

# House of Commons Environmental Audit Committee

# **Carbon budgets**

# Third Report of Session 2009–10

Volume II

Oral and written evidence

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# The Environmental Audit Committee

The Environmental Audit Committee is appointed by the House of Commons to consider to what extent the policies and programmes of government departments and non-departmental public bodies contribute to environmental protection and sustainable development; to audit their performance against such targets as may be set for them by Her Majesty's Ministers; and to report thereon to the House.

# **Current membership**

Mr Tim Yeo MP (Conservative, South Suffolk) (Chairman) Gregory Barker MP (Conservative, Bexhill and Battle) Mr Martin Caton MP (Labour, Gower) Colin Challen MP (Labour, Morley and Rothwell) Mr David Chaytor MP (Labour, Bury North) Martin Horwood MP (Liberal Democrat, Cheltenham) Mr Nick Hurd MP (Conservative, Ruislip Northwood) Rt Hon Jane Kennedy MP (Labour, Liverpool Wavertree) Mark Lazarowicz MP (Labour/Co-operative, Edinburgh North and Leith) Mr Ian Liddell-Grainger MP (Conservative, Bridgewater) Mr Shahid Malik MP (Labour, Dewsbury) Mrs Linda Riordan MP (Labour, Halifax) Mr Graham Stuart MP (Conservative, Beverley & Holderness) Jo Swinson MP (Liberal Democrat, East Dunbartonshire) Dr Desmond Turner MP (Labour, Brighton, Kempton) Joan Walley MP (Labour, Stoke-on-Trent North)

# Powers

The constitution and powers are set out in House of Commons Standing Orders, principally Standing Order No. 152A. These are available on the Internet via www.parliament.uk

# Publication

The Reports and evidence of the Committee are published by The Stationery Office by Order of the House. All publications of the Committee (including substantive press notices) are on the Internet at: www.parliament.uk/eacom/

A list of Reports of the Committee from the current Parliament is at the back of this volume.

### **Committee staff**

The current staff of the Committee are: Gordon Clarke (Clerk), Simon Fiander (Second Clerk), Tim Bryant (Committee Specialist), Edward White (Committee Specialist), James Bowman (Senior Committee Assistant), Susan Ramsay (Committee Assistant) and Steven Everett (Sandwich Student).

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The following memorandum has been reported to the House, but to save printing costs it has not been printed and copies have been placed in the House of Commons Library, where they may be inspected by Members. Other copies are in the Parliamentary Archives, and are available to the public for inspection. Requests for inspection should be addressed to The Parliamentary Archives, Houses of Parliament, London SW1A 0PW (tel. 020 7219 3074). Opening hours are from 9.30 am to 5.00 pm on Mondays to Fridays.

Further memorandum from Aubrey Meyer, The Global Commons Institute

# **Oral evidence**

# Taken before the Environmental Audit Committee

# on Tuesday 9 June 2009

Members present

Mr Tim Yeo, in the Chair

Mr Martin Caton Colin Challen Mark Lazarowicz Dr Desmond Turner Joan Walley

*Witnesses:* **Professor Sir Brian Hoskins**, Member, and **Mr David Kennedy**, Chief Executive, Committee on Climate Change, gave evidence.

**Q1 Chairman:** Good morning, and thank you very much for coming in. We are very grateful for your time. Just so that we can try and pace this, we have quite a lot we would like to talk to you about and we have about an hour and a quarter as we have another witness, so we will proceed as briskly as we can, dealing with the issues in a thorough way. Could I start by asking if you feel that the budgets and targets which the Government now has, whether they are actually consistent with the aim of avoiding dangerous climate change.

Mr Kennedy: Perhaps we can answer that in two stages. First of all, we recommended targets which, we thought, were consistent with avoiding dangerous climate change, and that is the 80% in 2050 of all greenhouse gases, including aviation and shipping, and we recommended, what we called, an "interim target" of 34% emissions reductions in 2020 rising to 42% if there is a global deal, as being consistent with that 80% longer-term goal, so that is what, we thought, would make us avoid the risk of dangerous climate change. The Government has accepted all of those recommendations, so, as you know, the 80% is already in the Climate Change Act and the 34% which, we said, should go into the legislation prior to a global deal has been accepted in DECC, and Ed Miliband announced that and it is going through the House at the moment under the affirmative resolution procedure. The other thing that we recommended as well was that the 34% should be achieved through domestic emissions reductions, not the purchase of credits, and again the advice has been accepted there. The last thing is that, if you look at the narrative to the secondary legislation, we have recommended a set of options for reducing emissions to meet the budgets, whether that is energy efficiency improvements, electric cars or renewables in the power sector, and the narrative in there very much reflects what, we suggested, are the appropriate set of measures to reduce emissions. Sir Brian Hoskins: If I could come in on the first part of that, there is a lot of discussion of what "dangerous climate change" is and, if you are in an island in the Indian Ocean, I suspect it is pretty dangerous already, so we looked at this. There is this EU target of two degrees and some people take that as very robust as if 1.9 is all right and 2.1 is just over the top, and there may be thresholds in the system somewhere near there, but we certainly do not know they are at exactly 2.0, so we took the attitude that we wanted, in probability terms, to keep the 50-50 point as close to two degrees as we could. We also then looked at something else, the chance of reaching four degrees above pre-industrial levels, and I think sometimes, when we speak about four degrees, we think, "Oh well, everywhere could manage four degrees", but it really becomes an index of how far we have gone along the road. If you think about the regional changes and perhaps even global changes that would correspond to that four degrees, there is no doubt that that would be a world where life, as we know it, could not be pursued. We wanted the chances of going there to be of the order of 1%or less, so we wanted the 50-50 point to be two degrees and, if it could have been less, we would have said "Fine", but we did not think pragmatically that that was possible at this stage, so those are the two criteria, the 50-50 point close to two degrees and then a very, very low chance of getting to that fourdegree world. This led us to the sort of idea then that the global emissions should peak before 2020 preferably, but certainly by 2020 and drop around 4% per annum after that, that is for global emissions, and down to about a 50% global cut by 2050 and, then going from that global cut of 50% by 2050, we had to say, "What does that mean for the UK?" and we said that the only way you can envisage that is that this is a per capita emission allowance at that stage of something over two tonnes of CO<sub>2</sub> per person and that means an 80% cut for the UK. The way we decided is that that was the 2050 point, but then, on the way to that, we took account of the EU targets of approaching 2050 consistent with this global emission curve and what was actually technically possible, and we came up with the earlier targets, so we believe what we have is consistent with keeping climate change within bounds that are pragmatically possible and as least dangerous as we think can be done at this time.

**Q2 Chairman:** That is interesting. If we are saying that already there is a 50-50 chance of an increase of more than two degrees, we are saying it is quite possible that the world could become a dangerous

#### 9 June 2009 Professor Sir Brian Hoskins and Mr David Kennedy

place even if the current targets are achieved, which at the present time some of us might think is also quite an optimistic assumption, but let us leave that at the moment. Even if we do what we are planning to do and what you have set out as a Committee, there is still a significant risk that we are going to be in very dangerous territory.

Sir Brian Hoskins: I do not think we can be complacent about a world where the globally average temperature rises above two degrees. There is no doubt there will be huge adaptation that is required to face that and the question is whether that is possible and whether that is possible in most countries, particularly in the poorer countries of the world. I do not think we would say it is necessarily going to be easy and, if one had gone back to 1850 and made choices, perhaps one would not decide to be here, but it will require major adaptation around the world to face that sort of climate change. The chances of crossing major thresholds, perhaps at this time we do not know we will cross those, and sealevel rise for 1,000 years is possible to levels which maybe we can cope with in time, but we certainly could not if they happened rather quickly.

**Q3 Chairman:** Is there a risk that, if we start to think about adaptation measures on the basis of a rise in temperature of significantly more than two degrees, (a) that kind of admits we are not going to achieve the two degrees, and (b) it may even weaken the pressure to do so and if we are in a world which has a three- or four-degree rise?

*Mr Kennedy:* This is something we are thinking about at the moment because, as you know, we have just established an Adaptation Sub-Committee which Lord Krebs is the Chair of. We are aware of Bob Watson, who is the Chief Scientist at Defra, saying, "Let's aim for two, but plan for four", and we want to explore that idea. Do we really want to aim for two and plan for four? I am not sure that those two things fit together and we want to articulate what you actually aim for and adapt to, we have only just started, so we are not sure how we are going to bring those two together at the moment, but that is clearly an issue that we need to tackle.

*Sir Brian Hoskins:* If I can add to that, you drive a car in the manner of not having an accident, but you still take insurance, and I would view the adapting to a higher level as an insurance against the possibilities of that sort of thing happening.

**Q4 Dr Turner:** The Report published a week or so ago suggested that 300,000 people globally have already died each year because of climate change, and I do not know if you accept that or not, but, if we are talking about being a global leader tackling climate change and that amounts to a 50-50 chance, is that an acceptable level of risk? If somebody gave you a gun not with one bullet in it, but three, with every other chamber free, you would not accept that kind of Russian roulette, so why should we claim that we are doing the right thing? *Sir Brian Hoskins:* This is a very interesting position for me. I have never been attacked from this side before in a parliamentary committee and it has always been the other way.

Colin Challen: It is friendly fire!

#### Q5 Dr Turner: That is the worst kind!

Sir Brian Hoskins: I agree, and in the summer of 2003, for instance, in Europe there were many deaths associated with that and there clearly will be major events which almost definitely can be related to climate change. It is always difficult with individual events to relate them, and in terms of health then relating the actual increase in the number of deaths to climate change is always a problem, but I am sure there will be events. If we manage to limit climate change to two degrees, there still will be events that will be extremely serious ones, it will happen, and I think that, if we could see a realistic scenario where we went below that, we would be recommending that. I think where we are at this time, if I thought the world could keep to the sort of emissions scenario we were proposing in our Report, I would be fantastically pleased. We would hope for more perhaps, but that is going to be incredibly difficult to keep to what we are saying, and I think what we have is a compromise between what is possible, just possible if we really work at it, and what we would like in a perfect world.

Mr Kennedy: Let us say, we are very confident in saying that the 50% global cut should be a minimum and the 80% cut for the UK should also be the minimum. As Brian says, in order to recommend more than a 50% global cut, you have got to have a sense of what it is you are going to do to bring your emissions down below 50% of current levels and how much it is going to cost and what the impact of that is going to be of taking you away from this two to three degrees band of temperature change, so you get into a grey area where it is not clear how much it will cost and it is not clear what it will achieve, so we did not feel confident in saying that more than a 50% cut is what we should aim for. We are certainly open to people coming to us and saying, "We have got a plausible scenario for a bigger than 50% cut. This is what it involves and this is what it will achieve", and then a more ambitious target may be appropriate.

**Q6 Colin Challen:** We are basically saying to ourselves and to developing countries that we will only go so far as we feel we can afford and we may afford a bit more if other people can reach an agreement. Is that really sending out the right signals about the level of risk we are expecting other people to accept?

*Sir Brian Hoskins:* I have just been to India and given a public climate change talk and I put in the targets that the UK is specifying in its legal framework and they were incredibly impressed that the UK, after all this talk in the developed world, someone is actually putting this in as legal targets to meet, and I think the crucial thing at the moment is that the world emissions peak, and start to go down before 2020 and that we head on in that direction. There is a lot of work that suggests that it is the

cumulative carbon dioxide that we emit that is the real problem, so what we have got to do is to start limiting that as soon as possible, but there is no doubt that we will continue to monitor the science and, if there are real indications that things are even worse than we took into account in our Report, then we can do that adjustment to reduce that cumulative carbon emission later on. I think that to agonise too much at this time whether the 2050 target should be just a little bit lower or not, the crucial thing is that we start on that trajectory going down at that sort of rate and we can do some adjustments afterwards, and I suspect the science has always, over the last 20 years, tended to suggest that things are worse than we thought they were before, so it would not be at all surprising if we are turning the screw further later on, but at this time, if we can really head in the direction we are proposing, then that is a marker to the world actually of what we are intending to do.

**Q7 Colin Challen:** If you say that we can turn the screw a bit tighter later on, that is a licence to politicians, as it were, to print credits for themselves until the cows come home. It is giving them a green signal to say, "Okay, the big effort comes a bit later". *Sir Brian Hoskins:* No, I think we have given them a very hard signal now and it could be made ever harder.

*Mr Kennedy:* We have given them a hard signal and there is a gap in our work, so the gap is that we have got the path to 2023 and we have got the target in 2050, but we have not got the path yet defined from 2023 to 2050, so it is something we come back to in the Climate Change Act and we fill in the gaps over the next years on that path, and we will be recommending the fourth budget which applies to the end of the 2020s next year.

**Q8 Chairman:** But the crucial thing, even if you have a pathway beyond the 2020s, is to make sure that enough happens before 2020 to get that peak.

Sir Brian Hoskins: Absolutely.

*Mr Kennedy:* Very much so, and that is our focus in the Report we will give to Parliament either in September or October this year when we will set out our vision in detail of what has to happen to meet the carbon budgets.

**Q9 Mark Lazarowicz:** Just to be clear, Mr Kennedy, I thought you said that could not come up with a plausible scenario to go beyond 50%.

*Mr Kennedy:* I said that, in principle, somebody could come up with a scenario. We have not come up with one, the IEA has not come up with one or Nicholas Stern or anybody else out there. If there were to be one, we would consider it, and I come back to the point that our recommendations are a minimum.

**Q10 Mark Lazarowicz:** So you have the expertise to be able to give us a range of scenarios if you were asked to do that?

*Mr Kennedy:* We have given a range of scenarios for meeting the very ambitious targets that we have proposed. We have not found any scenarios to go beyond, to get more than a 50% global cut.

**Q11 Mark Lazarowicz:** On the point of the importance of cumulative emissions, does that not underline your argument that we should really be working towards the intended budget rather than the interim budget in the planning? That is obviously again a matter for the Government and Parliament, but does that not underline your argument that the more ambition at the early stage that we can put in, the better?

*Sir Brian Hoskins:* The very term we used was "intended" and that is certainly what we thought would happen, given the global agreement, and, if it is possible to go towards that target, then that would be more consistent with the cumulative carbon emissions globally, and the more every country can do, that will help.

*Mr Kennedy:* We are hoping to have the intended budget in place in the next two years. If we did not have it in place for 10 years because there was a problem with the global deal, and we hope that does not happen, but, if there were not a global deal and we are stuck with the interim budget, obviously then there will be more to do in the 2020s, but we hope we do not get into that situation.

**Q12 Mark Lazarowicz:** Again, I appreciate that the decisions of what percentage to have to go for is a combination of the scientific projections combined with the pragmatic realities of politics, but, from what you are saying, I get the impression that certainly the European 20% cut is very much a pragmatic political one rather than a scientific one and that is basically what is behind it, is it not?

*Sir Brian Hoskins:* The target we have set is consistent with the European 20% and 30% for the 2020 period and the UK has to do more as its share of that.

**Q13 Mark Lazarowicz:** But that is not only the scientific basis for the 20%, is it, it is the basis of the horse-trading at the European level, is it not?

*Sir Brian Hoskins:* I think they were actually designed with something in mind, though I am not sure how definite that was, of actually contributing to this notional trajectory towards 2050 and what the European contribution could be, but I am sure the hope again was that it would be the 30% one they would be going for, but that will be part of the negotiations in Copenhagen.

**Q14 Mark Lazarowicz:** But the intended budget was for a low-carbon pathway and should we just not domestically be going on that pathway because it makes sense to do so for all sorts of reasons?

*Mr Kennedy:* Well, what influenced our thinking was that to be on the intended path in the first budget period would involve us, for example, purchasing credits in addition to the domestic emissions cuts through energy efficiency and whatever else we are doing. We asked ourselves, "Is it worth the UK

purchasing credits when nobody else is stimulating the global market at the moment?" and we did not think there was a strong rationale for that. We think there is a strong rationale for the UK being a participant in the global market when everybody else is and building this market up and achieving a bigger global emissions cut.

**Q15 Dr Turner:** How content is your Committee with the way in which the Government has implemented your recommendations so far and, if you have got any areas of concern, can you tell us about them?

*Mr Kennedy:* I think we have said that the Government has accepted our recommendations, I think that is a first step, and we have talked about the importance of actually meeting the budgets, achieving the emissions cuts; I think that is where the hard work starts.

**Q16 Dr Turner:** There is a lot of difference between accepting a recommendation and implementing it. That is the area I am asking you to comment on.

Mr Kennedy: I do not think it has been implemented at the moment, so we have got the targets and they will be in the legislation. We have a whole set of policies from the Climate Change Programme to the Energy White Paper, but do those separate policies together add up to a coherent, strategic approach to meeting carbon budgets? I think our sense is no and, as we said in our Report in December last year, we do need a strengthening of the policy framework in certain areas. For example, we talked about the supplier obligation going forward and we are not sure that that will deliver, unless it is radically reformed. We talked about the need for a set of policies to support renewables, to support nuclear, policies that need to be in place for coal-fired power generation, a strategic approach to developing electric cars in the UK. We are looking to the summer strategy which DECC will produce in the next month or so to give us that vision, the set of policies which will deliver the emissions reductions, and we will provide a view on that summer strategy in the narrative in our Report to Parliament in September/October, which will be our vision and our strategic approach to meeting the carbon budgets.

**Q17 Dr Turner:** That is about as much as an answer to that question as I can reasonably expect to hear, I guess.

*Sir Brian Hoskins:* Perhaps I can add to that that the Committee is an independent one and, there is no doubt, we will be monitoring and monitoring very hard what those policies are and whether they are likely to do it, and we are eagerly waiting to do that.

**Q18 Dr Turner:** And you must tell us what you think, with no reservations.

Sir Brian Hoskins: We certainly will.

*Mr Kennedy:* There is a specific response actually, so we raised the point about whether we could allow investment in conventional coal-fired power generation over the next 10 years with a view to retrofitting that, and we set our position out very

clearly. It could be allowed if it was on the full expectation of a retrofit and, if CCS is not retrofitted to conventional coal plant, then conventional coal will not generate in the 2020s and there should be a regulation to say that. Now, the Government has responded with its three-pillar policy which is any new plant has to have some CCS, CCS would have to be retrofitted, and they are talking about whether, if it were not to be retrofitted, you would then say that a coal plant cannot generate. That is something where we will be working with them, we will be following their proposals as they develop and they are going to have a consultation in the next couple of weeks on that.

**Q19 Dr Turner:** Do you think there is a risk with budgets that they could end up deferring action if it looks as if enough has been done to meet a particular budget, so a country could just say, "We don't need to do anything for another couple of years, chaps, desirable though it might be because we've met the budget"? Do you think there is a risk of that?

Mr Kennedy: Yes, I think there is a very specific risk over the next five years. We have got a recession at the moment and the recession will reduce emissions, and it will reduce emissions to the point that, in principle, you could meet the budget which is in the legislation without doing much. That, for us, is a very dangerous situation because we need to start improving energy efficiency and we need to start investing in renewable electricity and the whole range of measures. If we do not start those things now, we are not on the track to our 2020 goal or our 2050 goal, so the way round that for us is not just to look at emissions reductions and whether the policies are on track for the budget, but to look a level lower and to say that it is not just the level of emissions, it is a whole set of things which have to happen underneath that, whether it is investment in renewables or lofts being insulated or electric cars on the roads, so we will have a very comprehensive framework that looks at all of these things.

**Q20 Dr Turner:** Can you give us comfort and assurance that there is no question of your recommendations being tailored to what you know the Government might accept?

*Sir Brian Hoskins:* Can I, as an independent member of the Committee, say absolutely no chance. **Dr Turner:** That is very important.

**Q21 Colin Challen:** The Tyndall Centre was discussed at your meeting on 20 March and clear differences emerged, and I think the main one was their recommendation that we should aim for the stabilisation of 450 parts per million as soon as possible, whereas your Committee seems to suggest that we should keep the 500 and then try and retrieve the situation to get back down to 450 parts per million. What do you think is wrong with the Tyndall Centre's approach?

*Sir Brian Hoskins:* The Tyndall Centre has an alternative approach, but let me say what we have done and contrast it with what they have done. We have said that the target is a temperature target, that

is what we are interested in, and we then have looked at the problem as a transient one, as one that develops in time, and we have gone for emissions trajectories which may actually slightly overshoot in the level of carbon dioxide in the atmosphere and then fall afterwards, whereas the Tyndall Centre did not do any calculations. We did lots of calculations and the Tyndall was based on some calculations in a paper two years previously by someone else and what that was was actually looking at an equilibrium level of carbon dioxide of 450 and, when you start to think of that equilibrium, the scientific uncertainty is far higher and it is including all sorts of slow processes which might occur in 1,000 years' time which we cannot have confidence in, so what we have gone for is actually the transient one where we are actually going for a trajectory and we looked at various trajectories which, in the carbon dioxide level, would slightly overshoot to maybe near 500, but then decrease afterwards, so we are not thinking about an equilibrium. In a sense, if we think about an equilibrium, we want to return to the preindustrial eventually, so we do not want an equilibrium at 500/450, but we want to actually go back to a lower level than now so that this is a transient pulse of climate change that we are giving the world. We have gone for doing calculations using the latest models and we have done lots of those, and they used previous calculations and only a few of those. They went for this equilibrium level out there, whereas we looked at the dynamic problem and also we included all the greenhouse gases considered separately in the calculation. In the calculation they took account of, it was only carbon dioxide and they tried to fold the others in, so it was not nearly such a sophisticated calculation that they were using.

*Mr Kennedy:* If we come back to your point, you have talked about the 50-50 above two degrees or below two degrees, and actually, if you look at the temperature distribution in the Tyndall Centre analysis, they have the same probabilities of being above and below two degrees as we do pretty much, so they end up in the same place, but they get there a different way.

**Q22 Colin Challen:** The models that you are using, do they fully incorporate possible feedback effects such as ocean acidification, deforestation and so on, and how actually do you assess those things when they are very indeterminate?

Sir Brian Hoskins: Do they include them fully? I cannot answer honestly yes. We do not know what we do not know. However, the climate change models at the moment, the fully-fledged climate change models, try to include all the processes you have mentioned, the Arctic sea ice melting, for instance, which changes the reflection of solar radiation, the change of the Amazon forest which would have impacts on the climate, the fact that the soils, as the climate gets warmer, may not absorb as much carbon dioxide. We took all those sorts of things into account according to the current knowledge, so we took a range of the parameters associated with all those feedbacks and that gives the sort of probability distribution that we came up

with, so we are taking those into account at the best that current knowledge is. One of the advantages for the Climate Change Committee is that it was all done essentially almost in six months before the Report was produced, so we were able to use all the science that was around up to this time last year and nothing has really come since which says that we did something wrong, so the feedbacks are in those calculations as best we know them at this time.

**Q23 Mr Caton:** In written evidence to this inquiry, the Institute of Mechanical Engineers has criticised your Committee for not carrying out a rigorous and detailed analysis of the feasibility of achieving the targets. What analysis did the Committee make of the feasibility in terms of policy, engineering capability, industrial capacity or the skills base available or likely to be available in the engineering community?

Mr Kennedy: Certainly we differentiated between what we call "technical" emissions reductions and feasible emissions reductions in the first three budget periods. We showed that, in our view, what is feasibly achievable is enough to meet the carbon budgets. To give the example of energy efficiency improvements, we know that there is a lot of opportunity and that we have not taken that opportunity in the past. We considered the state of the industry for energy efficiency improvement, we considered the social research evidence base, why it is that people are not acting in the way that we might think they should act, and we brought those things together and gave an assessment of what we realistically think that we can achieve. In terms of the specifics of the engineering side of things, it is very important to consider have we got an engineering capability to deliver, for example, offshore wind, and investments are going to be very important in the next 15 years, have we got the capability to deliver nuclear investments again and CCS; there is a whole range of things where we will need some engineering expertise. I think we did not go into detail on that in the December Report, but it is something we are thinking about as part of our roadmap and vision for what has to happen to meet the carbon budgets and it will form part of our Report to Parliament in October.

Sir Brian Hoskins: Clearly, we had a limited period in which we could put our Report together, but I think what we produced has then stimulated activity, for instance, at Imperial College, where I am. There are 600 energy engineers and there is now a programme looking at how we get to that, essentially, zero-carbon electricity supply by 2050, and that involves the technology, the grid, the policies and the people to do it, and it is a huge task to see what is there, but I think we have stimulated that and we will certainly take on board what these sorts of groups come out with, but it is a major challenge. We could not look at the whole feasibility, but we did an overview of it and there are people working in greater detail on that and that will affect the policies which we will be recommending or looking at and seeing whether what the Government is doing is sufficient.

#### 9 June 2009 Professor Sir Brian Hoskins and Mr David Kennedy

*Mr Kennedy:* We should add that we have got an engineer on our Committee, Julia King, who is very aware of these kinds of issues and brings them up regularly at committee meetings, and that is why we are focusing on them going forward.

**Q24 Mr Caton:** The current annual percentage reduction in emissions is around 2%. What is the annual percentage reduction in emissions implicit in the budgets recommended by your Committee and accepted by the Government?

*Sir Brian Hoskins:* Well, we are looking at 80% over the 70-year period, so essentially, if we are around that over the whole period, then we must be going at something like the 1 or 2% per annum level, something in that range. Clearly, at times it is much more difficult to squeeze out than at other times and, where one can make the greater reduction, then clearly we will.

*Mr Kennedy:* The average annual emissions reduction under the intended budget is about 2.8% and, if you draw a curve that goes from now to 2050, you can see that that 2.8% is on the path to an equal annual percentage emissions reduction up to 2050 which we think is probably an appropriate path towards 2050.

*Sir Brian Hoskins:* I did the wrong analysis, sorry, it is double what I said.

#### **Q25 Mr Caton:** Is that 2.8% achievable?

Mr Kennedy: Well, we think it is and we have set out how we think it can be achieved through a range of measures in buildings, in the power sector, in transport and also in agriculture, which we should not forget because that is an important area which we brought into focus in this debate. Will we achieve it? If we think we will not achieve it, we have to do something differently, and we have not achieved those kinds of emissions reductions in the past. What is it that we have to do to achieve it? We have hinted in the December Report and we will put our views in full in the September Report and we hope they will be consistent with the Government's summer strategy which needs to, as I have said, give this vision, this strategic direction and a detailed set of policy prescriptions on how we are going to achieve our policies to achieve the cuts.

**Q26 Mr Caton:** What reductions do you think we are going to see comparatively in the immediate future, in the next couple of years or the next few years anyway?

*Mr Kennedy:* In the next couple of years, well, we will see emissions reductions through energy efficiency improvements, and we have CERTs which is the energy company-led policy of insulating lofts and cavity walls and sending you compact fluorescent lightbulbs through the post. That has to change going forward, we think, and the supplier obligation has to be much more whole house and neighbourhood based, but, as I say, we will talk in detail about our views there. Energy efficiency improvement is one and emissions reductions from transport, we will see some efficiency improvement over the next years with conventional combustion

engines, we will see some investment in renewable electricity and over the next five or 10 years we need to make massive cuts through all of these measures, we need to make some progress on electric cars and probably we need to feel confident that nuclear is coming into the mix, and CCS by 2050, we want to know whether that is going to be a big part of our story or not.

**Q27 Chairman:** David, when you came to us in February, we asked about contraction and convergence and you said that equal per capita emissions by 2050 seemed "reasonable". Nick Stern has suggested that close to equal per capita emissions in 2050 would not really be fair because that does not take enough account of the responsibility of the developed countries for the problems that exist. Do you think that there is an argument for saying that the scale of the contribution which developed countries should make should actually be even greater and, therefore, the targets and budgets that we are looking at will need to be made even more demanding?

*Mr Kennedy:* I think this is really beyond our scope as an organisation to take a view on. What we have said was that it is very hard to imagine a situation where the UK is above the global average, and the UK could be below, but whether it is below is a matter of judgment and negotiation that we have not wanted to get into, so we are aware that there are different ways of attributing responsibilities, whether it is historic or differentiated paths to contract and converge or whatever. As I say, that is really beyond our scope and it needs the kinds of judgments that we do not feel we can make as a committee.

#### Q28 Chairman: I cannot tempt you?

Sir Brian Hoskins: There are clearly various arguments there and I could be persuaded by one or the other. I think I view this again as the danger of arguing on the head of a pin the 2050 target. The immediate thing is that we have got to turn over these global emissions and head down that direction and it could well be that the UK, if we really do manage to get a zero-carbon electricity supply by 2050, a fantastic target and, I think, an amazing opportunity if we can develop the technologies to do that sort of thing, maybe we will say, "Yes, we can do that", and a lot of the residual that we were saying is going to be associated with things like agriculture at that stage, the greenhouse gases associated with agriculture, and really we are in only the early stages of seeing what could be got out of agriculture, so it could well be that the UK could decide to go below that level at that time. However, I think that, if we spend too much time at this stage arguing about whether it is there or there, if it is compared with where we are now, it is down there and I suspect that, if we really are in that direction, we might be able to do more and in helping others, but by that stage, if we are really able to help others in the zero-carbon electricity supply, maybe they will not need more either.

Q29 Colin Challen: I recognise it is not really your job to enter into the political domain, but you are, by the very nature of this task, in the political domain and that does mean talking about burden-sharing and it does mean talking about global agreements and our contribution now with either intended budgets or other kinds of budgets. With that guided philosophy of contract and converge, as Lord Turner calls it, or contraction and convergence, how would it affect your budget-setting process if the Waxman-Markey Bill with its fairly low interim budgets, how would that affect our share of the burden? Would you be happy to continue with the prognosis that you have delivered about the next three budgets and so on if the Waxman-Markey Bill were the basis of a global agreement?

*Mr Kennedy:* I do not think we are in a position to say that at the moment in the sense that we will have the negotiations at the end of the year and we will see where we are in the States. Will the 30% target be triggered? That is the first question for us and, if it were to be triggered at the EU level, then that would trigger our intended budget. If it were not to be triggered and there were to be an in-between outcome which could result because of Waxman-Markey not being ambitious enough in the eyes of Europe, would we then suggest that our intended budget is too ambitious as a contribution to a lower overall European effort? We have not considered that and I do not think we can give an answer without having a full consideration of it.

**Q30** Colin Challen: Is burden-sharing something which the Committee needs to spend some more time having a look at? It spends a lot of time on the science and at the economics and not the burden-sharing, yet the burden-sharing aspect is an essential part of this stool and it will not stand up without that third leg.

*Mr Kennedy:* Very much so, and I think we were careful to say that the 2050 target is not contract and converge, it is equal per capita emissions in 2050, and contract and converge is about the path to the data in which you get convergence as well, so we do need to think about the burden-sharing methodologies and we have the opportunity to think about them. That is when we look at the fourth budget period which we will start to look at immediately after we give our Report to Parliament in September or October. I do not think we can define the appropriate UK contribution and path through the 2020s without thinking about the different burden-sharing methodologies, so we will give it our full consideration at that time.

**Q31 Dr Turner:** Given the enormous reliance which the Government and your Committee place on the EU ETS as a policy instrument for delivering  $CO_2$ reductions, there seem to be some very big questions around it, notably, for instance, the proposed cap in Phase III is supposed to deliver a cut of 21% emissions in the European power and manufacturing sector, but if, on the other hand, the full quota of project credits is used, the reduction of

emissions within the EU could shrink to just 7%. Does this not weaken the advice which you are giving to the Government on budgets and is it consistent with the whole carbon budgeting process? Mr Kennedy: I think we should differentiate ourselves there. You have characterised it, firstly, that the Government has set a lot of store by the EU ETS and I think the Government, although I cannot speak for them, I think they do set a lot of store by the EU ETS, and we have questioned the role of the EU ETS. We have said it is a useful tool to have there alongside a range of other tools and what has happened since we reported in December is that the carbon price obviously has gone very low as a result of the recession. We are carrying out our analysis at the moment of whether we think the carbon price is going to bounce back and, if it does not bounce back, that is a real problem for us because we are relying on the carbon price to drive a lot of lowcarbon investment, particularly in the power sector. There is a real question: will the carbon price play its role? Adair Turner has hinted at this before the Energy and Climate Change Select Committee where he said that he thinks that it makes a lot of sense to seriously consider underpinning the carbon price, and what we are looking at is possibly underpinning the carbon price, but a whole range of electricity market interventions that are mainly required to support power sector decarbonisation, so it is an open question for us, is the carbon market going to play its role or not, and we are moving, I think, in the direction, without saying what we are going to say in September/October, where a range of interventions needs to be seriously considered if we are not confident in the carbon price.

Q32 Dr Turner: But the carbon price is a very significant element and underpinning it in some ways is an issue which is increasingly discussed, but it is kind of separate from the implication of, for instance, banking allowances and using credits in Phase III. Just how do you take that into account with national carbon budgets? There seems to be such a level of unpredictability there that it potentially makes a nonsense of the whole structure. Mr Kennedy: I think there are two things. One, I think you are hinting that possibly at the European level maybe we do not need to reduce emissions because there will be so many credits in the system. We do not think that will be the case and we think there will be emissions reductions needed in Europe and within the UK energy-intensive sectors. Another way of coming at that, and maybe this is what you mean, from an accounting perspective is how do we factor in the emissions reductions that are from purchased credits rather than domestic emissions reductions and, in that sense, we have the traded sector budget, which we set out in our recommendations last December, and what we look at there are the net emissions from the traded sector and those net emissions are the emissions minus any EUAs that are purchased by the UK and any CDMs that are purchased.

**Q33 Dr Turner:** Has the Committee considered taking a position on the use of credits? I notice that the Government has limited the use of offset credits for the non-traded sector to zero, but only for the first budget period. Do you think we ought to introduce more certainty in the whole process by yourselves making some serious recommendations to control or to limit the use of offset credits?

*Mr Kennedy:* Are you saying that we should then change the primary legislation? I think it is the primary legislation that requires the limit on credits to be set only one budget ahead, so, within the parameters of the primary legislation, they have done as much as they can. We have said that we do not think we should use the purchase of credits to meet the second or third budgets, except in a world where we have got the intended target in 2020, so, if you could design the legislation in a way to accommodate that, then our recommendation could be fully implemented. At the moment, it cannot be.

**Q34 Dr Turner:** But, looking at it from a slightly broader perspective, ultimately most of the 80% cut by 2050 will have to come from domestic efforts, otherwise it is just not going to be meaningful, so would it not make sense to drastically limit the reliance on offset credits and allowances now so that we stimulate more domestic action more urgently and achieve a better result faster?

*Mr Kennedy:* I agree in the sense that we recommended that the 34% cut in 2020, which is the basis of the interim budget, should be achieved through domestic emissions reductions and not the purchase of credits.

**Q35 Dr Turner:** So you are on the side of the angels then.

*Mr Kennedy:* But, as I say, within the current legislation, there is not a lever to actually write that down as a formal commitment of the Government.

**Q36 Dr Turner:** I think we can agree that you have identified a grey area with all sorts of serious implications that need to be addressed.

*Mr Kennedy:* Whether they need to be addressed, it is certainly something we will be very focused on. We have to monitor the Government's progress in reducing emissions next year and, as part of that monitoring, we will be saying, "Is the bulk of the emissions reduction being achieved through domestic emissions cuts?" and we will be looking at the complementary purchase of credits and saying, "Is that appropriate or is it too much, and is the Government shying away from the difficult political choices to get domestic emissions cuts?" That will be central to our narrative over the next years.

**Q37 Mark Lazarowicz:** Have you any view on the way that the Government has indicated that it intends to approach the issue of purchased credits or maybe the Government is not putting it yet? What is your initial feeling about the way the Government has said that it intends to approach these credits?

*Mr Kennedy:* They have said that they do not intend to purchase any credits for the first budget period and they have not really said anything about their intentions for the second and third budget periods.

**Q38 Mark Lazarowicz:** Is there a case for a different approach for EUA credits or CDM credits because the EUA ones obviously are a scheme which is the cap and with the CDM ones there are more question marks, so is there a case for having an approach between the two of them?

*Mr Kennedy:* In principle, it would have been an issue, but, in practice, they cannot purchase EUAs to meet the non-traded sector budget and they cannot do that because of the way that the European Framework was designed, so I do not think it is an issue for us in practice.

**Q39 Colin Challen:** We know that the IPCC reports, when they are published, are already a few years out of date because of the necessary peer review process and so on, and it does rather beg the question of how often the Committee should review the science and what might constitute a significant enough development of the science for it to initiate an immediate review?

Sir Brian Hoskins: I was very involved in the last IPCC and I was involved in a meeting a couple of months ago to think about the next one in terms of the science. We have our finger on the science that is occurring through my role and through generally the Committee having a contact there, and we certainly are keeping an eye on any new developments in the science and we will continue to do so. If those are suggesting in any way that we should revise our proposed targets or our advice, then we will certainly take that on board, and we have this continuing process which allows us to do that and I think that is extremely important, so I agree with you, the IPCC is assessing and it then has a tremendous robustness because of the whole process, but the penalty you pay is that it tends to be a little dated when it comes out, so we are keeping our eye on the science and we have very close relationships with the Hadley Centre here and the other global climate centres around the world, I have personal contacts with all of them, and we will be taking it on board, I assure you.

**Q40 Colin Challen:** And that could lead to recasting the budgets then?

*Sir Brian Hoskins:* If we found that the science was telling us something new and we needed to recast them, then we should do that.

**Q41 Colin Challen:** Well, some people argue that actually there has been a lot that is new since the IPCC Report was published, particularly on the feedback cycles.

*Sir Brian Hoskins:* Well, I think this is where, as I said before, our work was really done this time last year and the IPCC Report then was 2007 and, as you say, most of the work that was published was in 2006, so we were really able to take on board two more years of science which had occurred. If you

look at our Report and see the things we mentioned, I do not think there is anything that really has come to the top of the agenda that we did not mention there, so the melting of the summer Arctic sea ice, yes, there is a problem and it is at the higher end of any of the modelling, but we took that on board in our Report, so we were cognisant of the things that have happened since the IPCC Report and we have recognised them and that is why we made our targets as stringent as we did, and the modelling that we did took those on board as well.

**Q42 Colin Challen:** If there were changes in the UNFCCC methodology and the way that they calculate historic datasets at all, would that lead to your having to revise the carbon budgets, do you think?

Sir Brian Hoskins: The historical datasets?

#### Q43 Colin Challen: Yes.

Sir Brian Hoskins: I thought you were going to be referring to the other greenhouse gases because, if I can just mention that, one of the problems is how you actually consider the range of greenhouse gases. We talk as if they are all carbon dioxide and we talk in terms of the carbon dioxide equivalent, which is how we have tended to put the final bit of our budget, but the other greenhouse gases do behave in a different manner and they affect the climate in a slightly different manner as well, so the Kyoto "basket" is one way of tackling those, but we would certainly recognise in the modelling that we do that we have to consider them in different ways, and it may be actually that thinking about those in different ways in the UK might turn out to be a good thing to do. In terms of the historical, I think we are aware of the CO<sub>2</sub> levels in the atmosphere now and of methane and nitrous oxide, et cetera, so we can measure those, and I do not think we are in for any shocks in terms of measuring what we have done to the climate system so far in terms of the actual gases in the atmosphere. In terms of the impact on the climate system, of course we may find that there are problems.

**Q44 Mark Lazarowicz:** How worried are you, or how worried should we all be, of the fact that every climate model seems to underestimate the situation when we look at it again a few months or years later? Clearly, we cannot predict what is unpredictable, but how far should this always push us towards a precautionary approach and going for the tougher end of emissions reductions rather than the weaker end?

Sir Brian Hoskins: Again, I am on a different line here. Usually, I give a talk and say that we should be aware of all these possible dangers. If there is one criticism of climate models I have, if you double carbon dioxide, you get this and, if you quadruple carbon dioxide, you get this, and it is all too smooth, whereas most complex, dynamical systems like the climate system tend to behave more in terms of plateauing and then more abrupt changes, so yes, I think things have tended to be moved towards the more constraining end all the time and I think that,

in going for a two-degree target or trying to keep as close to that as possible, one is recognising that more and more of these things are liable to kick in beyond there, and there may indeed be surprises which are going to push us to say that we are not going far enough. If I can mention the summer of 2003 again, that should not have happened yet. The climate models were giving it as routine by the middle of the century, but at the moment it occurred, it occurred partly because of the particular weather pattern and we do not know at the moment whether that weather pattern is liable to occur more frequently in the future, so yes, there is a possibility that, with more understanding of the science, we are going to be pushed to the more constraining end and, if and when we see that, then we will take that on board in our targets. I think that, given the direction we have started on, it would be easy enough, and it will always be difficult, but we could adjust to the new information and, given that we have set out on this new direction for the UK, it would be possible to take that on board.

**Q45 Mark Lazarowicz:** How far is your modelling and your policy work generally taking account, as far as it can, of the possibility of these types of changes in the science, requiring greater constraining? How far are you trying to take it on board in what you are doing?

Sir Brian Hoskins: Well, I am on the Climate Change Committee, so I suppose that is a recognition. Weather and climate is my thing, so that is a recognition from Adair Turner and the organising of the Committee that they needed someone on board who is up to what is happening on the scene. I am there at every meeting, or try to be, and, if I find something new, you can believe that I will be bringing that forward to the Committee, so we have the information coming to our regular monthly meeting and, if there is something new, then I will be bringing that to the table or else the secretariat will have found it and will be discussing it, so I believe we are on board and we can very actively discuss it if there is new information which suddenly says that we have got to do more.

*Mr Kennedy:* In terms of a concrete opportunity, I have said that we will be looking at the fourth budget period next year and, as part of that, we will take a look again at the science. If the science tells us that we need to be more ambitious, we will reflect that in our advice for the fourth budget, but, if we are more ambitious in the fourth budget, we would have to ask the question: does that mean we have to be more ambitious in the first, second and third budgets to be consistent with that? We will be asking ourselves those questions next year.

**Q46 Mr Caton:** Continuing on the problems of climate models, has any work been done recently to reduce uncertainties in projections, to correct against over-optimism and ensure better peer review of the model?

*Sir Brian Hoskins:* There is. There is a lot of work going on the whole time, I assure you, to actually evaluate how models are performing compared with

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the real world, compared with each other, to look at any new observations that come in, to see whether the models are consistent with those new observations or whether it means one should refine something or change something. This is a living process that is going on. The models have a firmer basis on equations of physics, Newton's laws of motion, et cetera, so there is a very firm foundation there, but then, when you start putting in another process like clouds, of course there are all sorts of different ways that can be done and all the time you could say that weather techniques are being tried. For weather forecasting all the time in seasonal behaviour, there is an experiment going on in the system the whole time and this is used to confront models and say, "Are you still doing the right thing or should we adjust the way we are doing it?" so this is a living process which I, with other hats on, am very involved with and it is certainly happening. I think that, when we talk about the uncertainty, the uncertainty is much wider if you go to this equilibrium situation that Tyndall was talking about before and, when one talks about this transient behaviour over this century and sort of thinking about the carbon dioxide in the atmosphere peaking and then perhaps coming down afterwards, the uncertainty is rather less than that partly because it involves less understanding of how heat is diffused through the deep ocean and things like that, so there is major uncertainty. I think that uncertainty is much higher when you consider the regional manifestations of what a two-degree or four-degree rise would mean, so, if you ask me, the Indian monsoon is amazing for its lack of variation. Plus 10% and people are flooded out, minus 10% and they cannot grow their crops. Is that going to stay the same in a four-degree rising temperature? Probably not, but we cannot tell you at the moment where that would go, so I think the uncertainty comes much more in saying, "What would that mean if I lived in India or I lived wherever?" rather than in the globally averaged temperature context.

**Q47** Mr Caton: Recognising that there is uncertainty, as you do, is that addressed in the policy framework at this stage or can it be addressed in the policy framework?

*Sir Brian Hoskins:* It is extremely difficult to do so, but I suppose that comes in in our twin targets of trying to keep the 50-50 level near two degrees and saying that the four-degree world is one where we believe many of those things, such as the Indian monsoon or whatever, might make life untenable in certain regions of this earth, so it is taken on board when we set the criteria we set, and that is very much guided by people like me, saying, when I look at the climate system, that I can see that there are going to be real fault lines in that system as we get into that sort of world.

**Q48 Mr Caton:** To what extent is your Committee dependent on emissions projections from the Department for Energy and Climate Change model

in delivering your advice on carbon budgets and on the balance to be achieved between the traded and non-traded sectors?

Mr Kennedy: Certainly we draw on their model, so in the December Report we had, what we call, a "referenced" emissions projection and then we had the budget and the difference between those two was the emissions reductions we need to achieve. It was not the only thing we used. We did two things. First of all, it was a bit of a black box, the DECC energy model, so we brought in some consultants, Oxford Economics, to review that model and they said that it is largely fit for purpose, but they recommended a few changes and those changes were implemented. We also hired some consultants to develop alternative emissions projections for us which we could use as a benchmark against which to compare the DECC model, and that was a Cambridge Econometrics' set of projections that we used. They are reasonably close. The Cambridge Econometrics' projections are a bit higher than the DECC emissions projections, so, if you believe them, there is more emissions reduction required to get to the budgets that we have proposed. There is a great deal of uncertainty in emissions projections modelling, as you know.

**Q49 Colin Challen:** How confident are you with the integrity of our carbon accounting systems? It seems that much of this is just based on estimates, for example, the input of fossil fuels rather than a measured output from a chimney stack or the problem that aviation presents relating to pulsing. There is a whole range of things here, so is carbon accounting sufficiently accurate for us to actually make sensible decisions?

Mr Kennedy: I think we are reasonably confident for things like power generation and the way that we measure those emissions for our inventory. I think where we raised the question in the December Report was in the non-CO<sub>2</sub> emissions where we are lot less certain, for example, about methane emissions in agriculture and it may turn out to be the case that some of the non-CO2 emissions are lower or higher than we currently think and, if that were the case, then either we would have to reduce emissions more than we currently think or less, depending on whether they were higher or lower. If you look at the range of uncertainty there, we do have estimates of the range of uncertainty and our view was that it is manageable, so, if there were to be a revision of the way we count these non-CO<sub>2</sub> gases, then we could accommodate that within the budget framework.

Sir Brian Hoskins: Can I just pick up on aviation, which you mentioned. It is very difficult to count, at the moment, in a single number, what is the impact of aviation. You have the carbon dioxide that is going to perturb the carbon in the atmosphere for the next few hundred years and you have a contrail that may live for an hour, and actually putting those two together is really stretching the science in terms of actually finding metrics to really understand what that behaviour is. Indeed, there is still no understanding—or the understanding is at a very low level—of what the impact of aviation is on the cloud in the upper atmosphere—so not the contrails themselves but the cirrus cloud impact of aviation. So this is a very live issue. The actual metric for something like aviation—you know how much aviation fuel is used but then getting a metric for the other impacts is the subject of current research.

*Mr Kennedy:* That is something we are going to come back to in the report that we do on aviation in December. So we will ask the question: if you think the radiating force factor is one for aviation, would it be sensible to add the incremented capacity at Heathrow; if you believe it is two, would you still want to add that? So we will set the range of scenarios across the estimates of what people think the forcing factor might be.

**Q50** Colin Challen: The net carbon account. What would you think would be the width of the error band deviated from the central case? Is it 5%, 10% in either direction—15, 20? Could you put a figure on it? This is a very serious question.

*Mr Kennedy:* It is a serious question. The Clerk of the Committee said, actually, we are allowed to come back after the event with answers to very difficult technical questions, and I think I would place that one in that category, and one we can come back to you with a band of uncertainty.

*Sir Brian Hoskins:* Could I say, globally, I think, the gleam in the eye is that within a few years, perhaps, from satellite measurements, from in-situ measurements and from modelling, one may be able to invert and actually find out remotely what are the emissions from each country. In the end, that sort of policing might be required for a global view.

**Q51** Colin Challen: This line of questioning, obviously, would lead to the validity and the equivalence of offsets and carbon credits, if they are sought from countries which do not have the level of technical expertise that we do. Do you discount at all any of those credits for that reason in the calculations that you make?

Mr Kennedy: Our position on credits was-let us turn it round; because in 2050 we have to reduce emissions domestically then our budgets are dominated by domestic emissions reductions. We did not see an issue in complementing those emissions reductions with the purchase of EUAs. We did not see a problem with, at the margins, the purchase of CDM. We know there are debates about the certainty of credits where you do not have a cap against which you can issue those. It is not something we have really got into and I think our view is that, probably, there may be a need to strengthen the framework for issuing CDM, and as far as we understand the UN is working on developing that kind of framework and it is something for the Copenhagen discussions, I think, to develop project-based type mechanisms.

**Q52 Joan Walley:** Can I pick up on what Colin Challen raised in respect of carbon accounting. In view of what you said, Sir Brian, about aviation and about looking at new ways of being able to assess from satellites and so on, can I just ask you how the policy of the Climate Change Committee then gets translated into policy on the ground in respect of infrastructure projects? If there is so much uncertainty or still so much knowledge that we do not yet have to translate into the accounting of the budgets, how do you then, from the Climate Change Committee, advise governments about the factors which need to be taken into account when government is appraising, using Treasury rules etc, the long-term climate impact of, for example, expansion at Heathrow? How do you translate that into policy on the ground?

*Sir Brian Hoskins:* Let me start then with the Heathrow link. We are looking at aviation and we will be reporting in December in terms of keeping the UK aviation emissions or impact on climate at, certainly, not higher levels than currently. I think we can act as a conduit for the best current scientific knowledge to say how one should assess something like aviation, and then we can look at the implications of that assessment on the budgets. I do not know if you would like to take it from there.

*Mr Kennedy:* In referring to the kind of rules for appraisal of projects you are talking about the social cost of carbon that they use—

**Q53 Joan Walley:** And, also, about the basis on which planning decisions are being made right now, not having that clear, long-term information. Could what you do lead to changes in assumptions that would lead to a policy change on the ground?

*Sir Brian Hoskins:* We would hope so, yes. When we have come to a clear view of aviation, for instance, that should have an impact on policy and what happens on the ground.

**Q54 Joan Walley:** With due respect, is that not going to be too late for decisions about Heathrow at the moment?

Mr Kennedy: There is that specific point. Our view of what has to happen (and this will be investments across all of the sectors) we will publish in-I keep saying "September or October" but the law says we have to do it in September, but we cannot give a report to Parliament when you are not here, so it may be when you come back on 12 October)-and that will have a detailed set of investments, and it is not too late to lay those out in October with a view to those being taken forward over the next five and 10 years. On the specifics of Heathrow, first of all, we do not know what we are going to say about Heathrow; we are now in the middle of doing analysis. Is it too late for what we say to feed into the discussion in December? I would not have thought so, but there is a lot of politics involved, which is, again, not for us.

**Q55 Mr Caton:** To calculate progress on meeting UK carbon budgets, the Government intends simply to count the trading sectors' allocation of allowances rather than its actual emissions. This has been criticised by environmental groups because it provides no incentives for driving emissions below the cap given within the ETS. Do you have a view on that?

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Mr Kennedy: We do, and I think we were very clear in December in saying that we cannot just say: "This is a black box we have got to cap and so we do not care what happens in the energy-intensive sectors and, in particular, in the power sector," What we said is a certain set of things have to happen to make us confident we are on track to decarbonising the economy on the path to 2050. Going forward, we will not just look at the ETS path and say: "Well, actually we cannot ever miss the budget for the traded sector", because by definition it is a cap set so we will be looking a lot deeper than that; we will be saying: "Is there enough renewables stuff being proposed into the planning process? Is it coming out on time? Is construction starting? Are the renewables coming on the system? Are the investments going into transmission? What is happening with nuclear? What is happening with CCS?" So our focus will be all of the things that drive the emissions reductions, which I think the critics of this way of accounting are very interested in seeing happen.

**Q56 Mr Caton:** Would you like to see the Government shifting away from just using the allocation of allowances?

*Mr Kennedy:* It is not a key issue for us to have a discussion about the way of accounting; the key issue for us is that these things have to happen and that the monitoring framework has to include a very sharp focus on what is it that is happening on the ground in terms of investments. We will make sure that is part of the monitoring framework.

**Q57 Chairman:** Progress in Britain towards a 20% cut by 2010 has been disappointing. Are you pretty optimistic that we are going to do better by 2020? *Sir Brian Hoskins:* We have to remain optimistic. I would never have guessed a couple of years ago that the UK would have these targets—so fantastic. I remain optimistic that once we start thinking about those we will see the amazing opportunities that this new technology is going to get us and put the UK in the right position. So if we are always treating this as a: "God, we're being held down to this; this is too much", I think it really will be a struggle. If we could just turn the corner and see the opportunity, I think we might actually quite enjoy it.

*Mr Kennedy:* If you look at the social research, there are grounds for optimism in the sense that people understand that there is an issue with climate change and they would like to do something about it, but they do not really know what they can do. If you put that together with the fact that there is a range of

things that we can do over the next five, 10 and 15 years that are not bad, in terms of quality of life-so energy efficiency improvement saves you money and reduces emissions; a lot of people would not go and buy an electric car now but in five or 10 years' time it will be as good to drive an electric car as a conventional car. The power generation story. Again, if we are serious about this and if we get the policies in place this summer we can really make some progress on increasing renewable electricity. So I think there are grounds for optimism. It is going to take leadership from government, and it is a social transformation we need. We have been successful in social transformations in the past, whether it is attitudes to drink/driving or smoking in pubs; there are positive examples from the past and I think it is all to play for. The summer strategy is, for us, key and we will be looking at what are the range of measures in there?

Sir Brian Hoskins: I can look at two previous situations: the Clean Air Act, which was remarkable and a great turnaround, and it was not easy—we do not know what a fog is these days—and the Montreal Protocol; again, a superb example of where the problem emerged, the science said: "This is what the problem is", and because industry saw an opportunity—the substitutes for CFCs, there was a new market here and something new to do—it all fell into place. In fact, the Montreal Protocol has actually done more for helping the mitigation of climate change than Kyoto. So the Montreal Protocol was fantastic; we have done it before, it was easier but I think there are examples and this one we can do as well.

Q58 Chairman: Those are all very fair points, I think we would accept. We just felt that in the past the Government has not been very accurate in predicting the impact of its climate change policy and we have identified what we call "optimism bias" in some of their future projections. There we are. We have covered a lot of ground this morning and we are very grateful to you. We are running out of time, as we have another witness, but I am sure we will be wanting to talk to you again. I should have said at the beginning, incidentally, and I am sure it is the view of the whole Committee, that we are delighted that the Committee on Climate Change exists and are very encouraged by work you have done so far. I think the reports have been extremely helpful and to the point, and you have our complete support in all that, and we look forward to a continuing dialogue.

Sir Brian Hoskins: Thank you very much indeed.

### Supplementary memorandum submitted by the Committee on Climate Change

This letter responds to your questions on the use of offset credits and the scientific analysis underpinning the Committee's advice. I will also answer Colin Challen's question on measurement uncertainty.

#### THE USE OF OFFSET CREDITS IN EU ETS

The main scope for emissions reductions over the first three budget periods within EU ETS comes from the power sector. The Committee's position is that the use of offset credits in EU ETS should be complementary to decarbonisation of the power sector required to be on track to meeting longer-term emissions reduction goals.

In our December report, we questioned whether the EU ETS price would be sufficiently robust to support investment in low-carbon generation in the absence of other measures. We concluded that other levers would also be required to support investment in wind generation and CCS demonstration, with the possible need for intervention to support investment in nuclear new build.

In new modelling of future carbon prices that we have undertaken for our report to Parliament in October 2009 we reflect a number of changes that have ensued since our December report, including:

- Lower emissions from the energy intensive sectors as a result of the recession.
- Increased use of offset credits in the final agreed package in comparison with the EC's January proposals.
- Increased emissions reductions required as a result of moving from an all departing to an all departing/all arriving methodology for inclusion of aviation emissions in EU ETS.

The new modelling suggests that whilst the carbon price will still be determined by the cost of gas fired relative to coal fired generation, this will be lower than we had previously projected. It therefore makes our previous concerns about the level and volatility of the carbon price and its ability to incentivise low-carbon generation investment more pronounced.

We will set out the analysis in full in the report to Parliament, where we will also consider appropriate policy responses (eg tightening the EU ETS cap, limiting the use of offset credits within EU ETS, underpinning the carbon price, intervening in the power market, etc).

#### THE USE OF OFFSET CREDITS TO MEET ECONOMY WIDE EMISSIONS REDUCTION TARGETS

When we wrote that an EU reduction of 20% GHG in 2020 would be too low, but a 30% reduction would be adequate with commensurate commitments from other countries, we were referring to responsibility for emissions reductions (ie emissions reductions to be achieved domestically, or through the purchase of EUAs/ offset credits).

We will consider whether the 30% cut is in fact adequate given commitments from other countries when we give advice on the appropriate level of the Intended budget following a global deal [our recommendation in the December report was indicative, pending a global deal].

Our advice was that we should aim to meet the Interim budgets (ie corresponding to the EU's 20% target) through domestic emissions reductions, with possible purchase of offset credits to meet the non-traded sector Intended budget (ie corresponding to the EU's 30% target). We will set out our latest analysis of domestic emissions reduction potential in our October report drawing out any implications for the balance of effort between domestic emissions reductions and the purchase of offset credits to meet the Intended budget.

To the extent that purchase of offset credits may be appropriate to meet the Intended budget, we note proposals for strengthening existing mechanisms put forward in Mark Lazaarowics' recent report (eg sectoral trading and crediting, and strengthening CDM).

#### THE COMMITTEE'S APPROACH TO CLIMATE CHANGE SCIENCE

The scientific modelling upon which the Committee based its advice was consistent with the latest science (2 years beyond IPCC 2007) and accounted for all the climate processes which are currently understood and quantified.

The Committee used the MAGICC model to assess the climate impacts of alternative emissions trajectories. This is a "simple" coupled model—including an interactive carbon cycle—which has been used extensively by the IPCC to make global average climate projections (see IPCC WG1 AR4 Section 10.5.3).

We ran MAGICC hundreds of times for each emissions trajectory, sampling values for carbon cycle feedbacks and climate sensitivity from distributions covering the range in the C4MIP experiment, which is the most up to date and comprehensive comparison of the world's leading climate models (see Annex 1 of our December report for more details). Our analysis therefore incorporates all the major feedback processes that are currently included in the leading models.

The Committee's approach was to adopt a climate change objective based on assessment of damages at different temperature increases, and feasibility/cost of options for mitigation. It was not, as you suggest in your letter, to select a trajectory for feasible emissions reductions and use this to frame an objective. Our

climate objective was to keep the likely global mean temperature increase at or close to 2 degrees, and to keep the probability of dangerous climate change (ie more than 4 degrees) at very low levels (eg less than 1%). Consistent with the latest thinking, we also allowed a transient overshoot in atmospheric CO<sub>2</sub> levels rather than seeking to stabilise at a certain concentration.

Our analysis suggested that global emissions should peak before 2020 with a subsequent annual emissions reduction of at least 3/4% to achieve our climate objective. This path is similar to that set out in the Synthesis Report from the March 2009 science conference in Copenhagen.

The results reported in IPCC WG1 AR4 (Figure 10.21c) are generated from three simple coupled models (ie not models from the C<sup>4</sup>MIP comparison) which consider CO<sub>2</sub> only. This is in contrast to our modelling, which also accounted for non-CO<sub>2</sub> emissions including aerosols and other Kyoto gases in addition to CO<sub>2</sub>.

By inspection, for a 450ppm stabilisation scenario these models appear to suggest a range for global emissions reductions of 45-80% relative to peak year. The cut proposed by the Committee is around 65% when compared to the peak year, and is therefore within the range of cuts proposed by the three models.

The Committee's proposals do reflect a judgment, and a different judgment could be made, for example, if greater weight were to be attached to the probability of limiting temperature change below 2 degrees, or if there were new evidence on feasible abatement.

The Committee recognises uncertainty in the science and that new results will emerge, and has proposed that this be allowed for by periodic review of the scientific evidence base and adjustment of emissions reduction targets as appropriate; we will next review the science in the context of our advice on the fourth budget period (2023-2027), to be published at the end of 2010.

#### Emissions Measurement Uncertainty

We considered the issue of measurement uncertainty in the context of developing our advice over whether carbon budgets should relate only to CO<sub>2</sub> or cover all GHGs. In this context, we distinguished between level and trend uncertainty:

- There is much more uncertainty over the level of other GHG emissions (14%) than CO<sub>2</sub> emissions (2%). This reflects, for example, lack of precision measuring methane emissions in agriculture relative to carbon emissions through the burning of fossil fuels.
- There is less trend uncertainty, however, manifest in the convention that inventory revisions are typically applied consistently over time (ie historically and going forward). This would allow a measurement change to be accommodated by a technical adjustment to carbon budgets rather than any significant adjustment to climate change strategy.

Given significant benefits from inclusion of non- $CO_2$  gases (eg providing incentives for emissions reduction in agriculture), the Committee therefore recommended that carbon budgets should cover all GHGs. The Committee will continue to track any changes in the methodology (eg development of the smart inventory for agriculture) and related changes in measured emissions, drawing out implications for carbon budgets/carbon budget management.

24 August 2009

### Memorandum submitted by Global Commons Institute

1. SUMMARY

- 1. The UK budgets came from Contraction and Convergence via the Royal Commission on Environmental Pollution [RCEP] 2000 report "Energy—The Changing Climate". The report recommended C&C but applied it at rates that are too slow to keep within the 2° limit.
- 2. To keep within the 2 degrees Celsius temperature limit, the budgets need to be based on a global emissions contraction of 80% by 2050 and where the airborne fraction may still stay constant @ 50% giving a 450 ppmv outcome. But with sinks failing @ 0.5%/yr, the outcome may still be 450ppmv.
- 3. By not taking account of the "new" Coupled-Carbon-Cycle modelling in IPCC AR4 Chapter 10 [2007], the UK Climate Change Committee models and the assumptions used by the Committee on Climate Change are not valid in setting carbon budgets.
- 4. There is unanimous agreement among the coupled climate carbon cycle models driven by emission scenarios run so far that future climate change would reduce the efficiency of the Earth system (land and ocean) to absorb anthropogenic CO<sub>2</sub>. There is evidence that the CO<sub>2</sub> airborne fraction is increasing, so accelerating the rate of climate change.
- 5. Until about 1800 the overall climate system was at equilibrium. The very sudden rise of the atmospheric concentration of  $CO_2$  and CH4 since then shows that the system is no longer in conditions of homeorhesis, it is going out of control.

- 6. Joke Waller Hunter, Executive Secrearty of the UNFCCCCOP-9 in Milan in 2003 said, "Achieving the goal of the United Nations Framework Convention on Climate Change inevitably requires contraction and convergence."
- 7. The basis on which the UK Committee on Climate Change arrived at the UK's share of the global effort to cut emissions was the RCEP and their advocacy of Contraction and Convergence.
- 8. Convergence to equal per capita emissions entitlements globally for example by 2020, would reflect the C&C principle where, *"if contraction must be accelerated for reasons of urgency, convergence must be accelerated relative to that for reasons of equity."*
- 9. There appears to be an emerging consensus for Contraction and Convergence as the UNFCCCcompliant global framework for climate mitigation, as evidenced in the reference material attached to this memorandum.
- 10. There is real danger of not doing enough soon enough to avoid dangerous rates of climate change.
- 2. Question: Where did the UK budgets come from? Are they adequate to keep within the 2° limit?
  - 1. whether the UK's statutory targets for greenhouse gas emissions are consistent with the Government's objective of limiting global warming to no more than 2°C and whether they are enforceable;
  - 2. the extent to which the Committee on Climate Change's recommended budgets to 2020 are consistent with the UK's target for 2050.

Answer: They came from Contraction and Convergence [C&C], but applied at rates that are too slow to keep within 2° limit

- 1. But with sinks failing @ 0.5%/yr, the outcome may still be 450ppmv.
- 2. In concert with others, the UK Government's aim is to limit overal global temperature above preindustrial to no more than two degrees Celsius. Not exceeding 450 ppmv CO<sub>2</sub> in the atmosphere is considered a pre-requisite of keeping within that limit.
- 3. "Enforcing" the right target will be no harder than enforcing the wrong target.



# Chart 1

Presently the budgets are a function of a global emissions contraction of 50% by 2050 with convergence to equal per capita entitlements globally by 2050. The UK budget came from IPCC's "canon" of "uncoupled carbon-cycle models" assuming an airborne fraction of emissions constant @ 50% giving 500 ppmv. But with sinks failing @ an average of 0.5%/yr, the outcome will be 500 ppmv.

To keep within the 2 degrees Celsius temperature limit, the budgets need to be a function of "coupled modelling" with a global emissions contraction of 80% by 2050 and where the airborne fraction may still stay constant @ 50% giving a 450 ppmv outcome. But with sinks failing @ 0.5%/yr, the outcome may still be 450ppmv. Convergence to equal per capita emissions entitlements globally for example by 2020, would reflect the C&C principle where, if contraction must be accelerated for reasons of urgency, convergence must be accelerated relative to that for reasons of equity.



3. Question: Were the climate models and the assumptions used by the Committee on Climate Change valid

in setting carbon budgets?

The suitability of the climate models and the validity of the assumptions used by the Committee on Climate Change in setting carbon budgets

Answer: No. By not taking account of the Coupled-Carbon-Cycle modeling in IPCC AR4 Ch. 10 [2007], the Climate Change Committee was not up to date

- 1. Lord Adair Turner incorrectly told the EAC that "feedbacks" were in the climate models that his committee had relied on for their revision of the control figure for the UK.
- 2. He said, "I mean you're absolutely right to identify that one of the things that you have to be very aware of is the process of going to two degrees or three degrees in itself produces feedback loops that which increase the chance of going to a higher level, but those feedback loops should be in the scientific models to start with. Right, so that is precisely what the scientists are attempting to get to grips with. So when the scientists say this emissions trajectory, we believe, has a 99% chance of keeping us below 4 degrees, they have embedded their best judgment of the feedback loops within it. They haven't produced a model without feedback loops and then you have to add feedbacks loops as a separate thing; those feedback loops are in there already. I think what gets very complicated is whether there is anywhere you know what people call 'tipping points' or thresholds-does it become totally irreversible or do we simply have feedback loops without absolute irreversibility and I think the scientists vary on that. But we did highlight that it was possible that some of the feedback loops became very strongly reinforcing above a certain temperature and that there were some physical things which might be irreversible; you know the melting of the Greenland ice-sheets etc. So I think we have taken fairly rigorously those into account in the way that we did it, and that was... it was a sense of those feedback loops and that irreversibility that made us believe that the crucial thing is to limit the increase to two or slightly above two degrees and to make very likely that we don't go above three and almost certain that we don't go above four."

Chart 2



3. The underlined section above is significantly incorrect. Indeed the opposite is true with regard to the modelling of carbon cycle feedbacks. This is the omission of feedbacks that was finally addressed in IPCC AR4, the modelled images here are unpacked on pages 12 and 13 of this document.



Chart 3

- 4. It comes from Ch 10 WG1 IPCC AR4 [2007]:-http://ipccwg1.ucar.edu/wg1/Report/ AR4WG1\_Print\_Ch10.pdf
- 5. Lord Turner refers to the Hadley Centre models. It is the Hadley Centre coupled model in the image where the difference in the future weight of global carbon emissions between the "uncoupled" models ["b"—where feedbacks are largely omitted] and the "coupled models" ["c"—where feedbacks are considerably represented] is greatest [as shown in "d"—where the differences are weighed]. In a phrase, the contraction events are accelerated [or shrunk by more than 40%] when the carbon-cycle feedbacks are included. Lord Turner's committee appeared to be unaware of this.
- 6. In concert with others, the UK Government's aim is to limit overal global temperature above preindustrial to no more than 2 degrees Celsius. Not exceeding 450 ppmv CO<sub>2</sub> in the atmosphere is considered a pre-requisite of keeping within that limit. As things stand that we will fail in that aim.
- 7. The contraction events for 450 ppmv modeled in the image on the bottom of page seven were published for the first time by IPCC AR4 in 2007. They come from the Hadley Centre and are "uncoupled" [without feedbacks] compared with "coupled" [with feedbacks].
- 8. With the effect of "positive-feedbacks" now understood as an issue of urgency, the "coupled" emissions contraction event has been shrunk to only 60% of the earlier "uncoupled" event. In weight terms, 2000–2100, it is the difference between around 550 and 330 Gtc.
- 9. In percentage terms, this is the difference between the 50% and the 80% cut in emissions globally by 2050 shown. Note the 80% cut by 2050 was called for at WEF/DAVOS [p 24 point 1].
- 10. A *full-term* global emissions "contraction-and-convergence-event" at sufficient rates is the strategic necessity to keep within the 450 ppmv limit. With a global cut of emissions by 50% by 2050 and international convergence to equal per capita by that date, these rates of contraction & convergence [C&C] are the stated basis of the UK Climate Act as things stand. For reasons of urgency and equity, these must be accelerated to for example the rates in lower graphic page 6.
- C&C came from GCI via the Royal Commission on Environmental Pollution [RCEP] report 2000. C&C requires rates sufficient to solve the problem. RCEP accepted the principle that the rate of global convergence must be accelerated relative to the rate of contraction of greenhouse gas emissions required for to achieve the 550 ppmv they advocated 550 ppmv.
- 12. Lord Adair Turner, Chairman of the independent Committee on Climate Change, wrote to Ed Milliband, the Minister for Energy and Climate Change [07/10/08]. He confirmed acceptance of the original RCEP C&C target of a 60% cut in UK emissions by 2050, and justified its revision to the RCEP figure of an 80% cut by 2050 inside a 50% cut globally for 450 ppmv, on the grounds of urgency:—"the dangers of significant climate change are greater than previously assessed;"
- 13. Being, on the grounds of equity, equal per capita globally by 2050, telling an enquiry by the House of Commons Environmental Audit Committee (EAC);—"*The core [of the Act] is contract and converge. We cannot imagine a global deal which is both doable and fair which doesn't end up by midcentury with roughly equal rights per capita to emit and that is clearly said in the report. This is strong support for what Aubrey Meyer has been saying.*"
- 14. The House of Commons Energy and Climate Change Committee (ECCC) then told Lord Adair Turner that;—"[your] pragmatic support for Contraction and Convergence, on the record from a meeting with the EAC [04/02/09], is very welcome."
- 15. Then, referring to the call in January 2009 from World Economic Forum for an 80% cut globally by 2050 on grounds of increased urgency, [see pages 24/25] they asked him;—"Would you accept that as the speed of Contraction accelerates, the speed of the acceleration of Convergence will also have to pick up? There's always been a presumption at the International Climate Change negotiations that Developing Countries will be allowed to increase temporarily their emissions to help development. But that's going to be a concertina'd process—is that really how you'd see it?"
- 16. Lord Adair Turner replied;—"While this raises a complex issue of international negotiations, you are right."

IMPACT OF INDUSTRIAL EMISSIONS ON HOMEORHESIS ON CO2 & CH4 FROM LONG PAST

- 1. Noting the "heat-trapping" properties of carbon dioxide [CO<sub>2</sub>] and methane [CH4], they are known as "greenhouse gases" [ghgs].
- 2. The record of these ghgs in ice-core samples collected around the world, now extends to one million years before the present. Measurements have been made of flows between their sources and sinks.
- 3. The correlation between the varying temperature and atmospheric concentration of CO<sub>2</sub> and CH4 is apparent from the data charted opposite through four ice-ages over the last 450,000 years.
- 4. What is also observable is that the overall climate-system was at equilibrium. In conditions that were clearly "homeorhetic",—in other words, overall self-correcting—the correlation between the

varying temperature and atmospheric concentration of  $CO_2$  and CH4 was in "band-widths" of [a] 180–280 parts per million by volume [ppmv]  $CO_2$  [b] 300–700 parts per billion by volume [ppbv] CH4, with [c] Temperature varying between 5–15 degrees Celsius.

- 5. This is fundamental to understanding the circumstances we are now in. The very sudden rise of the atmospheric concentration of  $CO_2$  and CH4 since 1800, shows that while the correlation is still there, the system is no longer in conditions of homeorhesis, it is going out of control.
- 6. John Knaess who led the US delegation to the 2nd World Climate Conference in Geneva in November 1990, made the key points at a news conference receiving the IPCC First Assessment Report [FAR]. When he was asked if this "global warming stuff" was really happening, he said:— *"Its simple sophomore physics; the questions are only how much change and how soon?"*





OBSERVED CO2 IN TODAY'S ATMOSPHERE [MOUNA LOA; US GOVERNMENT]

- 1. Since 1974 and from Mauna Loa Observatory in Hawaii, the US Government has coordinated a world programme making direct measurements of rising atmospheric concentrations of CO<sub>2</sub> and other gases.
- 2. The wavy blue line is the aggregate of measurements, going up and down on a rising average, reflecting seasonal flux in the "carbon-cycle".
- 3. Compared with the straight line [the dotted line], the overall trend curvature [the solid as the average of the blue] shows "acceleration" in the rise of the concentrations of CO<sub>2</sub>.
- 4. This reflects the first and probably already as well, the second of two things:—[a] acceleration in the source-rise of human CO<sub>2</sub> emissions globally and [b] declining "sink-capacity" for these extra CO<sub>2</sub> emissions in the natural sinks of CO<sub>2</sub>.
- 5. In geological time, as shown by linking to the graphic above, this rise is very sudden. It is like "an explosion in slow motion" and represents a complete loss of "homeorhesis".

UNCOUPLED CLIMATE MODELS TO ASSESS FUTURES WITH SUDDEN LOSS OF HOMEORHESIS

- 1. Since the 1980s "climate models" have been developed to help predict the future atmospheric concentration of  $CO_2$  and CH4 under various forest and fossil-fuel burning "scenarios". With that, the implications of this array of potential "futures" on global temperature and climate change have been assessed.
- 2. A main focus of these has been on the "carbon-cycle" through the oceans, atmosphere and biosphere, but as influenced by the impact of the emissions of these gases from human sources as a result of the start of burning forests and fossil fuels [coal, oil, gas] with the onset of industrialisation.
- 3. The principal carbon cycle model used to help answer this question was the "Berne Model" and output from it was first published by the Intergovernmental Panel on Climate Change [IPCC] in 1994. Five "scenarios" were published; these were future carbon-emissions "contraction-events" or "budgets" for outcomes of 350, 450, 550, 650 and 750 ppmv atmospheric CO<sub>2</sub> concentration in the global atmosphere.



Chart 6

- 4. These reflected a judgment given in the IPCC's "First Assessment Report" [FAR] from 1990. In 1990 the atmospheric CO<sub>2</sub> concentration was 353 parts per million by volume [ppmv] or 25% above the pre-industrial maximum value of 280 ppmv. IPCC's judgment was that an immediate 60–80% cut in human emissions of CO<sub>2</sub> would be needed if the upward rise in the atmospheric concentration of CO<sub>2</sub> in that year were to be halted immediately. They didn't say it had to be done and they didn't say it didn't; but two things were crucial.
- 5. First: It was apparently not the 100% cessation of emissions that was required. Continuing with 40-20% of emissions was judged to be consistent with atmosphere CO<sub>2</sub> "stabilisation". This view came from observing human emissions and global concentrations of CO<sub>2</sub> since 1800. Measurements covering those 200 years showed [a] roughly half of any year's emissions from

human sources returned to the apparently enlarging natural "sinks" for  $CO_2$  and [b] the other half remained in the atmosphere—where a pattern seemed to have emerged of what became misleadingly known as the "Constant Airborne Fraction" [CAF].

- 6. Second: The "airborne fraction". Whether this fraction was in reality constant or not, it was cumulative because the human emissions that stayed in the atmosphere added up over time as a rising "stock". That explained the rise in ppmv of atmospheric concentrations of CO<sub>2</sub>. By June 1992 the UN had agreed a Climate Convention, the objective of which was to stabilise the rise of ghg in the global atmosphere below a value that was "dangerous". The probability of "positive-feedback" where natural "sinks" ceased to enlarge, shrank and even turned to sources, so accelerating the rates of climate change was largely ignored, as they were "speculative" and difficult to model.
- 7. Fossil fuel dependency had become fundamental to modern economic activity and the correlation of GDP to CO<sub>2</sub> from fossil fuel burning has been and remains at nearly 100%. The heat-trapping implications of rising CO<sub>2</sub> had serious implications for the future. The climate change questions "how much how soon" became "will the benefits of global growth gradually be outweighed by the damages caused by global climate changes".
- 8. All the questions about UK carbon budgets in the Climate Act asked by the EAC relate to that global question. In this "battle-of-the-rates" the C&C propositions offered by GCI for the last 15 years relate to feedbacks and fighting that battle by answering that question rationally.
- 9. With the 350 ppmv budget removed and one for 1,000 ppmv added due to pressure from industry lobbyists in Working Group Three of IPCC, the IPCC re-published these Berne-Model-type results from 1995 onwards. As is shown below, for the IPCC 1995 Second Assessment Report [SAR] the 2001 Third Assessment Report [TAR] and the 2007 Fourth Assessment Report [AR4], these scenarios were repeated and have remained the standard reference set for the "climate-policy" community for more than 10 years until the present time.
- 10. It is of note that over 300 years of future time with CO<sub>2</sub> concentrations theoretically stabilising "safely" at up to 1,000 ppmv, on the back of finding, extracting and combusting an inventory of up to two trillion tonnes of future fossil fuel resources, these scenarios all modelled contraction:concentration events that, ignoring the positive feedbacks not-too-mention the rapid depletion of reserves of oil and gas, *ludicrously* assumed the airborne fraction of emissions in these scenarios would all remain constant at around 50% right up to 1,000 ppmv.



Chart 7

COUPLED CLIMATE MODELS TO ASSESS FUTURES WITH SUDDEN LOSS OF HOMEORHESIS

- 1. However, in Chapter 10 of IPCC AR4 [2007] Working Group One [WG1] an important contribution from the "Models Inter-Comparison Group" was included which addressed this feedback issue openly for the first time. All the carbon-cycle emissions scenarios were revisited comparing the past "Uncoupled" model runs with the new "Coupled" model runs, with IPCC saying:
- 2. "There is unanimous agreement among the coupled climate carbon cycle models driven by emission scenarios run so far that future climate change would reduce the efficiency of the Earth system (land and ocean) to absorb anthropogenic CO<sub>2</sub>."
- 3. Published in a non-headline-grabbing manner with a complexity of graphic information that discouraged interpretation, the graphic [exactly as below] appeared on page 791 where:



- 7. Because of the density of this overlay, but especially because of the significance of the acknowledgement of the positive-feedback issue being modeled and published by IPCC for the first time, GCI wrote to the Technical Support Unit [TSU] of IPCC Working Group One [WG1] to get confirmation that the information as shown in the graphics on page 13 had correctly disentangled the IPCC graphic on page 12. With thanks, TSU confirmed this saying, "we wish out authors had been this clear."
- 8. The principal reason for this enquiry was the quite extraordinary discovery that in all the coupleduncoupled comparisons and unclearly shown in the images published in the AR4, two different paths for emissions globally were being shown prior to 2000, as is shown by following the dotted lines.
- 9. The reason for this was finally given by the Hadley Centre who said that when "coupling" to reflect feedbacks was calculated, the revision of source:sink relations in the carbon-cycle showed that sink-function in the models had certainly been over-estimated prospectively and retrospectively as well.
- 10. In other words, with the "weight-record" of concentrations and past fossil fuel emissions well documented, the modelers concluded that the recent historic emissions from deforestation had also been overestimated, throwing their estimates of the strength of sink-function into further doubt.

4. Question: What was the basis on which the Committee on Climate Change arrived at the UK's share of the global effort to cut emissions?

The basis on which the Committee on Climate Change arrived at the UK's share of the global effort to cut emissions.

Answer: The basis was the Royal Commission on Environmental Pollution [RCEP] and their advocacy of GCI's Contraction and Convergence [C&C] who made C&C a key recommendation of their report "Energy—the Changing Climate" [2000]

Key RCEP recommendations:

- The UK should continue to play a forceful leading role in international negotiations to combat climate change, both in its own right and through the European Union. The gov-ernment should press for further reductions in the greenhouse gas emissions of devel-oped nations after 2012, and controls on the emissions of developing nations (4.68).
- The government should press for a future global climate agreement based on the contraction and convergence approach, combined with international trading in emission permits. Together, these offer the best long-term prospect of securing equity, economy and international consensus (4.69).
- The government should now adopt a strategy which puts the UK on a path to reducing carbon dioxide emissions by some 60% from current levels by about 2050. This would be in line with a global agreement based on contraction and convergence which set an upper limit for the carbon dioxide concentration in the atmosphere of some 550 ppmv and a convergence date of 2050 (10.10).

"ENERGY—THE CHANGING CLIMATE RCEP" [2000] CHAPTER 4—PROSPECTS FOR AN EFFECTIVE INTERNATIONAL RESPONSE: CONTRACTION & CONVERGENCE

"The government should press for a future global climate agreement based on the Contraction & Convergence approach, combined with international trading in emission permits. Together, these offer the best long-term prospect of securing equity, economy and international consensus (4.69).

4.47 Continued, vigorous debate is needed, within and between nations, on the best basis for an agreement to follow the Kyoto Protocol. Our view is that an effective, enduring and equitable climate protocol will eventually require emission quotas to be allocated to nations on a simple and equal per capita basis. There will have to be a comprehensive system of monitoring emissions to ensure the quotas are complied with. Adjustment factors could be used to compensate for differences in nations' basic energy needs. Those countries which regularly experience very low or high temperatures might, for instance, be entitled to an extra allocation per capita for space heating or cooling.

4.48 A system of per capita quotas could not be expected to enter into force immediately. At the same time as entitling developing nations to use substantially more fossil fuels than at present (which they might not be able to afford), it would require developed nations to make drastic and immediate cuts in their use of fossil fuels, causing serious damage to their economies.

4.49 A combination of two approaches could avoid this politically and diplomatically unacceptable situation, while enabling a per capita basis to be adhered to. The first approach is to require nations emission quotas to follow a contraction and convergence trajectory. Over the coming decades each nation's allocation would gradually shift from its current level of emissions towards a level set on a uniform per capita basis.

By this means 'grandfather rights' would gradually be removed: the quotas of developed nations would fall, year by year, while those of the poorest developing nations would rise, until all nations had an entitlement to emit an equal quantity of greenhouse gases per head (convergence). From then on, the quotas of all nations would decline together at the same rate (contraction). The combined global total of emissions would follow a profile through the 21st and 22nd centuries that kept the atmospheric concentration of greenhouse gases below a specified limit.

4.50 The upper limit on the concentration of greenhouse gases would be determined by international negotiations, as would the date by which all nations would converge on a uniform per capita basis for their emission quotas, and the intermediate steps towards that. It would probably also be necessary to set a cut-off date for national populations: beyond that date, further changes in the size of a country's population would not lead to any increase or decrease in its emission quota.

ontraction and convergence: implications for UK carbon dioxide emissions							
maximum atmospheric concentration ppmv	permissible UK in 205 % of 1997	Cemissions 60 7 level	pern	nissible UK emissions in 2100 % of 1997 level			
450	21	[The 80% (	cut]	11			
550	42	[The 60%	cut]	23			
750	56			47			
1,000	58			61			

#### Chart 10

4.51 In table 4.1 we have applied 'Contraction & Convergence' approach to carbon dioxide emissions, and calculated what the UK's emissions quotas would be in 2050 and 2100 for four alternative upper limits on atmospheric concentration. We have assumed for this purpose that 2050 would be both the date by which nations would converge on a uniform per capita emissions figure and the cut-off date for national populations. If 550 ppmv is selected as the upper limit, UK carbon dioxide emissions would have to be reduced by almost 60% from their current level by mid-century, and by almost 80% by 2100. Even stabilisation at a very high level of 1,000 ppmv would require the UK to cut emissions by some 40% by 2050.

4.52 The UK-based Global Commons Institute has taken the lead in promoting 'Contraction & Convergence', and has developed a computer model that specifies emission allocations under a range of scenarios. The concept has been supported by several national governments and legislators. Some developed nations are very wary of it because it implies drastic reductions in their emissions, but at least one minister in a European government has supported it. Commentators on climate diplomacy have identified contraction & convergence as a leading contender among the various proposals for allocating emission quotas to nations in the long term.

4.53 The other ingredient that would make an agreement based on per capita allocations of quotas more feasible is flexibility of the kind already provided in outline in the Kyoto Protocol. Nations most anxious to emit greenhouse gases in excess of their allocation over a given period will be able and willing to purchase unused quota at prices that incline other countries to emit less than their quota, to the benefit of both parties. The clean development mechanism, which allows developed nations to claim emission reductions by sponsoring projects that reduce emissions in developing nations to levels lower than they would otherwise have been, can also be seen as a form of trading.

4.54 In the longer term trading by companies in emission permits, drawn from national emission quotas determined on the basis of a contraction and convergence agreement, could make a valuable contribution to reducing the global costs of stabilising greenhouse gas concentrations while transferring resources from wealthy nations to poorer ones. Trading needs to be transparent, monitored and regulated, and backed by penalties on nations that emit more than they are entitled to. If it became merely a means of enabling wealthy nations to buy up the emission entitlements of poor countries on the cheap, thereby evading taking any action at home, trading would not serve the cause of climate protection. Nor would it if developing countries that had sold quota heavily went on to emit in excess of their revised entitlements."

- 5. C&C METHODOLOGY FOR A FRAMEWORK-BASED MARKET—HOW IT CAME INTO RCEP
  - 1. From 1990 GCI argued for the notion of the future sharing of permits to emit ghg on an equal per capita basis globally. It was seen as a general expression of "global equity". When the results of the Berne Model were first published in 1994 GCI uniquely created the rational calculating model that we called "Contraction and Convergence" [C&C] that calculates any rate of achieving equal rights, subject to the limit that achieves the objective of the UNFCCC. Following the lead given by the Bern Model, *in this order* C&C calculates and integrates:—[a] any global path-integrals of future emissions [Contraction:Stable-Concentration-events] with [b] any rate of arriving at the globally/ internationally equal per capita sharing of such events [Contraction:Convergence] with linear convergence and an optional population base-year function.
  - 2. The model includes:—[c] historic data for emissions of all countries 1800–2000 [CDIAC] and [d] population projections for 50 years [UNSTAT] and the "base-year" function can be invoked for any one of those years as desired by users. As C&C is integrated in spread-sheet architecture, internationally comprehensive graphic output demonstrating different rates of C&C is quite easy to generate and the trend rates of growth for the economy, emissions, concentrations and the damages caused by climate changes can be compared to this, as follows for example:



3. The costs of continuing to cause the problem faster than we respond to avoid it are incalculable. The key is to calculate and demonstrate futures where we understand communicate and organise to solve the climate problem faster than we cause it. C&C is a tool for that purpose. The UK Climate Act is a globally defined, national response to what it now accepts is a C&C-based engagement with that international dilemma.

### Chart 11

4. GCI displayed large graphic output of C&C to the UN climate negotiations from 1996 onwards and C&C immediately became fundamental to the UNFCCC's equity-debate on QELROs [Quantified Emissions Reductions Limitations Options] and it came close to being adopted at COP-3 in Kyoto in 1997: http://www.gci.org.uk/temp/COP3\_Transcript.pdf [p 43].



- 5. In 1999, as a result of all this, the Royal Commission on Environmental Pollution [RCEP] requested GCI to provide Contraction and Convergence [C&C] input to the report they were preparing based on the Berne model. GCI presented them with material resembling the three scenarios along-side. GCI's "rule" was as shown; where contraction was accelerated, convergence was accelerated relative to that.
- 6. As shown on pages 14 and 15 of this document, in their report to Gov-ernment "Energy—the Changing Climate" [2000], the RCEP adopted C&C at rates for 550 ppmv with convergence to per

capita equality by 2050 and this gave the figure of a 60% cut in UK emissions by 2050. RCEP made C&C and minus 60% for the UK, a "key recommendation" to Government. While the Government wavered on the adoption of C&C, the figure of minus 60% for UK emissions by 2050 derived from it became the initial basis of the UK ghg control.

- 7. Keeping scenarios for 450 and 550 ppmv, RCEP incautiously replaced the scenario for 350 ppmv with ones for 750 and 1000 ppmv adding:
- 8. "Concentration of 550 ppmv represents approximately double the concentration of carbon dioxide in the atmosphere prior to industrialisation (2.7). Some environmental groups (including the Global Commons Institute, see 4.52) regard 550 ppmv as a dangerously high concentration which is incompatible with the aim of sustainable development.8 8. Global Commons Institute's website, http:/ www.gci.org.uk
- 9. The institute regards 450 ppmv as an upper limit."
- 6. NOTE ON THE METHODOLOGY AND POLITICS OF C&C AND POSITIVE FEEDBACKS
  - 1. From the outset GCI had been concerned about the really problematic nature of the "positive-feedback issue" because:—[a] the threat of climate change becoming "runaway" was a reality proportional to the extent the effects of warming started feeding off each other, generating a global fast-breeder reaction the possibility of which was hard to discount though [b] the difficulties of numerically "modeling" this were nearly insuperable.
  - 2. There was understandably fierce resistance to allowing the questions about "how much change, how soon?" and "at what rates will the benefits of economic growth be outweighed by the costs of the damages it causes?" to entertain the possibility that all our efforts to organise a global contraction-and-convergence equivalent event may just become too little too late and so ultimately futile.
  - 3. Moreover, by 1996 GCI had already generated a reputation for "radicalism" because of publicly fighting and also winning a battle against "the economics of genocide" in the preparation of the IPCC Second Assessment. [IPCC SAR WG3 Chapter 6].
  - 4. With the C&C model's introduction in 1996, the contraction:concentrations part of calculus simply mimicked the procedures of the Berne model. These, although modeled a different way, showed a relationship between emissions and concentrations that de facto equaled and extended an airborne fraction forward over time that remained roughly constant at 50%.
  - 5. Indeed, all the Berne-type emissions:concentration scenarios published by the IPCC 1994 to 2007, were for all practical purposes, expressions of an airborne fraction of emissions constant at 50% and these—dangerously—have held the status of "holy-writ" since 1994.
  - 6. GCI's method was to go from mimicking the contraction:concentrations relationship as modeled in the Berne model [and the other models that were gradually appearing], to a method of simple mathematical trend-projection. Unlike the so-called carbon-cycle models, which whether "coupled" or "uncoupled" were opaque, GCI's method was simple, precise and transparent. As the C&C model was designed to compute any rates of contraction with any rates of convergence, at first mimicking the convention of 450, 550 ppmv and so on, GCI computed with C&C: [a] a range of emissions contraction-events, with rates and dates and carbon weighed conventionally in gigatonnes of carbon [Gtc] as flows of carbon per unit time; but then:-[b] with 1 ppmv CO<sub>2</sub> equalling 2.13 Gigatonnes carbon, atmospheric concentrations of CO<sub>2</sub> were converted to weight, so accumulations [concentrations] were more easily computed as a fraction of emissions. The value of 280 ppmv in 1800 gave atmospheric stock of carbon in that year as 595 Gtc. and the rising atmospheric concentrations of CO<sub>2</sub> were then projected as an accumulation of various fractions of the emissions contraction-events i.e adding to the existing atmospheric stock at constant rates of of 50%, 75% and 100% airborne fractions. As the graphics opposite show, this procedure gives a frame of reference [yellow band] against which different rates of "sink-failure", eg at 0.5%/year, 1%/ year, 2%/year, can be projected for comparison.
  - 7. Presently the budgets are a function of a global emissions contraction of 50% by 2050 with convergence to equal per capita entitlements globally by 2050. The UK budget came from IPCC's "canon" of "uncoupled carbon-cycle models" assuming an airborne fraction of emissions constant (a) ~ 50% giving < 500 ppmv. But with sinks failing (a) an average of ~ 0.5%/yr, the outcome will be > 500 ppmv.
  - 8. To keep within the 2 degrees Celsius temperature limit, the budgets need to be a function of "coupled modelling" where a global emissions contraction of 80% by 2050 and where the airborne fraction may still stay constant @  $\sim$ 50% giving a 450 ppmv outcome. But with sinks failing @  $\sim 0.5\%$ /yr, the outcome may still be > 450ppmv.
  - 9. Convergence to equal per capita emissions entitlements globally for example by 2020 [as shown here], would apply the C&C principle where, if contraction must be accelerated for reasons of urgency, convergence should be accelerated relative to that for reasons of equity.

- 10. This rate-of-convergence of course is the principle means whereby correction of the past asymmetries of "Expansion and Divergence" can be negotiated.
- 11. As noted in the Garnaut Review [2007], "The contraction and convergence approach addresses the central international equity issue simply and transparently. Slower convergence (a later date at which per capita emissions entitlements are equalised) favours emitters that are above the global per capita average at the starting point. Faster convergence gives more emissions rights to low per capita emitters. The convergence date is the main equity lever in such a scheme."



#### Chart 13

7. IMPACT OF FEEDBACK ON "C&C PROPORTIONALITY-RULE" AND THE UK CLIMATE ACT

- 1. In a letter to the Secretary of State [07/10/08], Lord Adair Turner confirmed acceptance of RCEP's C&C-derived target of a 60% cut in UK emissions by 2050. He then, consistent with RCEP figures for [uncoupled] C&C, [see RCEP table 4.1 row 1, page 13 of this document] justified its revision to an 80% cut by 2050 on the grounds of urgency and equity telling the Environmental Audit Committee [EAC]:—"The core [of the Act] is contract and converge. We cannot imagine a global deal which is both doable and fair which doesn't end up by mid-century with roughly equal rights per capita to emit and that is clearly said in the report. This is strong support for what Aubrey Meyer has been saying."
- 2. The Energy & Climate Change Committee [ECCC] subsequently put to him that:—"[your] pragmatic support for Contraction and Convergence, on the record from a meeting with the EAC, is very welcome."
- 3. Then, referring to the call from WEF for an 80% cut globally by 2050, [pages 24 25] asked him:— "Would you accept that as the speed of Contraction accelerates, the speed of the acceleration of Convergence will also have to pick up? There's always been a presumption at the International Climate Change negotiations that Developing Countries will be allowed to increase temporarily their emissions to help development. But that's going to be a concertina'd process—is that really how you'd see it?"
- 4. Lord Adair Turner replied:—"While this raises a very complex issue of international negotiations, you are right."

- 8. THE EMERGING CONSENSUS FOR C&C
  - 1. Since 1992 and embracing the years of the so-called "Kyoto-Protocol" [1995-1997-2008], valuable time has been lost in negotiation of a genuinely UNFCCC-compliant global framework.
  - 2. At COP9, Milan, 4 December 2003, Joke Waller Hunter Executive Secretary of the UNFCCC said publicly:—"Achieving the goal of the climate treaty inevitably requires contraction and convergence."
  - 3. Lord Adair Turner's evidence to the EAC in Feb 2009 was encouraging and said:—"The core [of the Climate Act] is contract and converge. We cannot imagine a global deal which is both doable and fair which doesn't end up by mid-century with roughly equal rights per capita to emit and that is clearly said in the report. This is strong support for what Aubrey Meyer has been saying."
  - 4. After 20 years of campaigning for C&C, this was another notable example of feeding the the emerging consensus for C&C described by Kemal Dervis Chief Administrator of the UNDP. On 5 April 2008, the UK Government hosted an international Conference on "Progressive Governance" outside London. At this a paper by Lord Nicholas Stern (LSE) and Laurence Tubiana (Iddri/ SciencesPo) entitled "A Progressive global deal on climate change" was presented to the conference. It stated that:—"An international agreement is essential. It must be based on the criteria of effectiveness, efficiency and equity. Effectiveness demands a long-term global goal capping global emissions and providing a long-term trajectory for investment in low-carbon technologies. This should be at least a halving of global emissions by 2050. A pragmatic principle of equity would require an equalisation of per capita emissions by then."
  - 5. This was immediately then endorsed by the Head of UNDP, Kemal Dervis, who was present and welcomed it as part of what he called "the emerging consensus" which the UNDP had itself described as C&C in their Human Development report for 2007–08 "Fighting Climate Change; Human Solidarity in a Divided World" in the section "Contraction and Convergence; Sustainability with Equity" [see Section 10.9 of this document].
  - 6. Section 10 provides some of the evidence of this "emerging consensus for C&C". The eminent persons and institutions in this only partial list is long, but from it the names, Tony Blair, John Schelnhuber, Kemal Dervis, Nicholas Stern stand out because they have been conspicuously part of a version of "the emerging consensus for C&C" that advocated minus 50% globally by 2050 with equal per capita by then.
  - 7. The 50% cut by 2050 globally coincided with the equalization of per capita emissions globally by that date too, involving an 80% cut in the emissions of Developed Countries.
  - 8. In other words part of the C&C principle where, "for reasons of equity, convergence must be accelerated relative to the rate of contraction" was accepted in this "emerging consensus".
  - 9. Yet a year later these people signed the statement from the World Economic Forum in DAVOS [Jan 2009] which called for an 80% cut globally by 2050 [see Section 8.2 of this document].
  - 10. This new position of an 80% cut globally—ie by everyone—remarkably abandoning the equity part of the principle that convergence must be accelerated relative to the rate of contraction.
  - 11. For reasons of "urgency", the call for the cut of 80% by Developed Countries stood and was simply extended to everyone else in Developing Countries to do likewise.
  - 12. The UK Climate Act applies the equity aspect of the C&C principle that "convergence must be accelerated relative to the rate of contraction". However, it is at overall rates that are too slow to achieve the UK Government's target of 450 ppmv/2 degrees.
  - 13. The Stern et al WEF/DAVOS position correctly accelerates contraction for reasons of urgency to a rate that could keep us within that target, but abandons the aspect of the principle where convergence must be accelerated relative to that for reasons of equity.
  - 14. It is notable these people on the WEF/DAVOS list didn't pick up on the issue of feedbacks even with the arrival of the "coupled" modeling published in IPCC AR4 in 2007 and that only, finally with their publication of that WEF/DAVOS statement in 2009, would it appear that they did.
  - 15. However, to have abandoned "the emerging consensus for C&C" which they had become a significant part of generating, by failing to uphold the aspect that, if contraction must be accelerated for reasons of urgency, convergence must be accelerated relative to that for reasons of equity as well, *it was provocative and counter-productive*.
  - 16. In the Energy and Climate Change Committee, Colin Challen MP correctly emphasized what he called the dangers of Developing Countries being "concertina'd" as the rate of contraction inevitably "picked up" for reasons or urgency without the rate of convergence being accelerated relative to that for reasons of equity.
  - 17. He welcomed the acceptance by Adair Turner that the C&C principle was the core of the Climate Act. He then questioned him about the situation created by the WEF statement where accelerated contraction was called for asking that, "if contraction must be accelerated for reasons of urgency, convergence must be accelerated relative to that for reasons of equity."
- 18. Lord Turner took Colin Challen's point and responded by saying that he was right.
- 19. So the questions posed by EAC about the derivation of the carbon-budgets in the UK Climate Act are appropriate. The control figure as advocated and defended by Lord Adair Turner's Climate Change Committee is a result of being unaware of, or possibly just ignoring, the coupled modeling in the AR4, the "debut" of which was itself was years overdue.
- 9. RISK:—THE REAL DANGER OF NOT DOING ENOUGH SOON ENOUGH
  - 1. However, all this reveals another and more serious problem and it is in this risk-context that the emissions control paradigm outlined in the UK Climate Act needs to be understood. With sinks failing and feedbacks becoming more net positive as concentrations rise, a reality becomes more and not less likely that the higher concentrations are forced to go by unrestrained emissions or even by insufficiently restrained emissions, the faster the annual rate of sink failure will become.
  - 2. The models don't really tell us that on current trends of failure to control emissions and the momentum that is being generated by this, it is not implausible to foresee rates of net sink failure that can eventually become greater than 100% of emissions per annum. The interactive effect of positive feedbacks can accelerate and even totally overwhelm the declining of source:sink "balance" we still presently have.
  - 3. Runaway climate change can become unstoppable as we all go beyond a point of no-return, where all attempts of "emissions-control" become futile as we are overtaken by the damages from the momentum of what becomes increasingly catastrophic rates of global climate change.
  - 4. As the RCEP correctly recognised in 2000, a fully global solution is needed to this definitively global problem and that the global framework for organising the ghg emissions control to prevent this is Contraction and Convergence.
  - 5. The key is to bring C&C to bear as an organising principle and then apply it at rates that are fast enough to head off the threat of what the eminent Australian Government economist Prof. Ross Garnaut had already called in 2007, "the diabolical problem of climate change to which humanity may well lose." As with the UK RCEP his Climate Review for the Australian Government in 2007 was based on Contraction and Convergence, about which this year he wrote:—"Over the last 20 years, Aubrey Meyer's sustained work through the GCI with the 'Contraction and Convergence'or C&C—concept and campaign, has created a global standard that is now widely recognized as an outstanding and essential contribution to the global debate on what to do to avoid dangerous rates of climate change. This is remarkable and reflects the integrity of the argument where C&C is mathematically rooted in the science of climate change and marries the limit to future human emissions that avoids dangerous rates of climate change to the politically compelling requirement of equal shares in the use of the atmosphere subject to that limit. It embodies the economic political reality, that adjustment to equal per capita emissions entitlements will take time. It is a rational, flexible and transparent concept that holds out the best hope of all urgent proposals that might form a basis of an environmentally and economically rational global agreement on climate change mitigation. The contraction and convergence idea was at the core of the proposals for inter-national agreement that are part of the Garnaut Climate Change Review, commissioned by and presented to the Australian Prime Minister and all State Premiers (R. Garnaut, 2008, The Garnaut Climate Change Review, Cambridge University Press; www.garnautreview.org.au ). Support should be given to this campaign particularly at this time as this year—2009—leads to a UN event in Copenhagen in December at which it is intended that the global plan to avoid dangerous rates of climate change is agreed and established for the long-term."
- 10. Reference Materials Supporting the GCI Memorandum
- 1. Garnaut "Climate Change Review" June 2008 [p 23].
- 2. World Economic Forum 2008: "Shaping an Opportunity Out of Crisis—A message to participants in the World Economic Forum Annual Meeting 2009 from Members of the Global Agenda Council on Climate Change." [pp 24/5].
- 3. "Global Warming-The Complete Briefing" 3rd Edition 2004, Sir John Houghton. [pp 26/9].
- 4. "Avoiding Dangerous Climate Change" CUP 2006, edited by Schelnhuber, Cramer, Nakicenovic, Wigley, Yohe. [pp 30/1].
- 5. IPCC Third Assessment 2001: WGIII, Chapter 1, Page 90. [p 32].
- 6. IPCC Fourth Assessment 2007: WGIII, Chapter 3, Page 214. [p 33].
- 7. "Climate Protection Strategies for the 21st Century: Kyoto and beyond" 2003, German Advisory Council on Climate Change (WBGU). [p 34].
- 8. "The Economics of Climate Change—The Stern Review" 2006, CUP: Part I, Climate Change, 2A Ethical frameworks and inter-temporal equity, page 47. [p 35].
- 9. "Human Development Report 2007-08", UNDP, [pp 36/9].

- 10. "Breaking the Climate Deadlock—A Global Deal for our Low-Carbon Future" 2008, Tony Blair and The Climate Group. [p 40].
- 11. "Energy—The Changing Climate" 2000, RCEP 22nd Report. [pp 41/2].
- 12. Letter from Sir Tom Blundell to GCI, 2000. [p 43].
- 13. UK Government response to RCEP 2000, Recommendation 3, RCEP para 4.69. [p 44].
- 14. "The Scientific Case for Setting a Long Term Emission Reduction Target" 2003, DEFRA. [p 45].
- 15. "The International Challenge of Climate Change: UK Leadership in the G8 and EU" 2005, House of Commons Environmental Audit Committee, page 268. [p 46].
- 16. "Beyond Stern: From the Climate Change Programme Review to the Draft Climate Change Bill" 2007, House of Commons Environmental Audit Committee. [p 47].
- 17. Links to GCI materials and information. [p 48].
- 18. C&C At The Climax Of The Kyoto [Cop3] UN Climate Negotiation, 10-12-1997. [p 49].
- 19. "The Incontestable Truth" 2007—DVD commissioned by the UK All Party Parliamentary Group on Climate Change. [p 50].
- 20. "Carbon Countdown" 2008, Global Commons Institute, Section 10, C&C Support. [pp 51/62].
- 21. Tributes and awards to GCI Director Aubrey Meyer.
- 22. Insurance Industry views of Contraction and Convergence.

29 April 2009

*Witnesses:* Mr Aubrey Meyer, Co-founder, and Mr Terry O'Connell, Director of Corporate Relations, Global Commons Institute, gave evidence.

**Q59 Chairman:** You have heard the previous evidence and you may have some comments on that. We have got your memorandum which you sent us just over a month ago.<sup>1</sup> I think my colleagues have seen that. No doubt you will want to refer to it. Could I start by asking you whether you think that Contraction and Convergence will be explicitly recognised in Copenhagen at the end of the year? Do you think that it is sufficiently well understood, and widely understood, for that to happen?

Mr Meyer: The polite answer is two maybes—I put it like that. Let me try and answer you more constructively. One of the ex-directors of the Tyndall Centre, Mike Hulme, recently published a book called Why We Disagree about Climate Change, and in it there was a whole section on Contraction and Convergence, which, in fairness to him, said it was an elegant and logical principle with enormous appeal but said "it had nothing to do with the negotiations". The description then went on in what I would call a pretty messy way. I wrote to him about this and I said to him: "Why did you engage with Contraction and Convergence if you did not feel that it was really essential to the argument that you were making?" He did not answer that. So I then said: "Why did you make the point that it has nothing to do with the negotiations, when quite obviously many people over, now, 20 years" (by "people" I mean institutions and, clearly, in government) "specifically have engaged with it, in some instances, actually in formation?" I said to him: "Whether you answer or not, let me assure you of this: if the negotiations have got nothing to do with Contraction and Convergence then the negotiations have got nothing to do with achieving the objective

of the UNFCCC." You might think that is a pretty bold statement but I can tell you this (and this was not in the memo that I sent to you) that in 2003 the previous executive secretary of the UNFCCC, a Dutch lady called Joke-Waller Hunter, published a paper and a slideshow and went on to the stump with a campaign which included the remark (and I will quote it) "Achieving the goal of the United Nations Framework Convention on Climate Change inevitably requires Contraction and Convergence". I rang them and I said: "This is a turnaround" and they said "Yes," (it is a bit like this Committee) "we did not say how they had to do it, but just said it had to be done". So, in principle, in answer to your question: "Will, in Copenhagen, C&C be recognised or not?", some will recognise it and some will not. "Will the negotiations themselves be based on Contraction and Convergence?" Maybe you could answer in a teasing way like this: you have heard a fairly ambivalent reaction from the Members of this independent Climate Change Committee you have just spoken to as to whether between David Kennedy and Adair Turner the Climate Act is or is not an expression of Contraction and Convergence, but as far as Adair Turner was concerned, and it was under pressure from Joan (and I am very grateful that this pressure was brought to bear on Adair Turner) he conceded, actually, not only that it was but they could not conceive of any other way of actually framing a global proposition to get everybody in. The question then arises: will this time, unlike Kyoto, our government actually go to the negotiations saying: "We actually now have climate legislation in the UK" (which, as we are told, is an example of how the British really mean what they say when they are engaging in climate change) "which is explicitly based on Contraction and

Convergence and we are advocating this principle and this methodology to this negotiating process to do likewise-to come together in a process of "Contraction and Convergence". I grew up in South Africa (I was on the white side of the tracks, you can see that) and, believe me, I have been in the middle of rioting mobs with machetes and stones and guns; the dirty, nasty violent side of politics nearly destroyed that country—it did not—and the reason that it did not was because, ultimately, largely because of the genius of Mandela and the ANC at that stage, certainly, they engaged in a process which framed as was deliberately "truth and reconciliation", and that, to me, is Contraction and Convergence: the truth of the rate of Contraction that is necessary to save us from running out of control with runaway rates of climate change, and the explicit Convergence procedure and the constitutional methodology of saying: "Under that limit equal rights to everybody" as a way of bringing everybody in, is that reconciliation process. If somebody has got something better, please, for God's sake let's hear about it; please, for God's sake, even if you think that something better may vet appear but you do not know what it is, settle for this in the meantime. So my answer is actually, bloodymindedly, "Yes" and "Yes".

**Q60 Chairman:** Do you think that as the science is getting more compelling on the urgency and the scale of the response that is needed to address climate change in a way that limits the temperature rise to something short of dangerous levels—is the fact that that is going to start impacting on the emissions on developing countries (perhaps sooner than many of them would like) likely to provoke opposition to Contraction and Convergence from developing countries?

Mr Meyer: It is a fair question. An example of a bloody-minded reaction from the negotiations in this week gone by was from the Indians. They have clearly, yet again, come under pressure to get serious about climate change and to accept the need for emissions control and all of this. There was an editorial in an Indian broadsheet from a government spokesman which, literally, said: "We don't like this pressure; science does not trump equity". Think about it. They have been in a, frankly, chaotic way the front end of C&C advocacy for the last 20 years. My dissatisfaction with them is they have always used it as a sort of cover to carry on doing whatever they wanted to do, saying that because of poverty and historic emissions, and all of that, they had a blank cheque to do that, and the world was with them, so they were not susceptible to this kind of pressure. My problem with that was to say that if you argue purely defensively like that, you will never actually realise the opportunity that C&C creates for you within the negotiations. In other words, if you want to advocate this principle of equal per capita rights to the global commons under the limit that saves us, and all the rest of it, and C&C specifically is the methodology to actually count that out (and that is what I really want to talk about today), instead of getting into more and more complicated calculations about how historic responsibility can somehow be factored into everybody's special accounts and, therefore, delay the requirement for involvement by the Indians, the Chinese and all the rest, as Ross Garnaut clearly recognised in his report in Australia and as is stated in this memo, the primary equity lever on that issue of Contraction and Convergence is simply to "accelerate the rate of convergence relative to the rate of contraction". Now, to come back to your question about the science (and you have, very nicely, already dealt with this, not only in this Committee but, also, in the Energy and Climate Change Committee), if it turns out for reasons of urgency that the rate of contraction has to be accelerated then, obviously (and Adair Turner conceded this, thanks to a question from Colin), largely, the rate of convergence has to be accelerated relative to that. That is the only way that the Indians will get any claim on what is left that might satisfy their hunger for equity but devoid of the delusion that the equity trumps the science. The science, if you will, and the reality of climate change trumps absolutely everything and everybody, including us. There is no way out.

**Q61 Joan Walley:** I just, very quickly, wanted to come back to what you were just saying in reply to the question as to whether or not you are confident that Copenhagen will explicitly recognise Contraction and Convergence. Following on from your answer, do you feel that there is sufficient input from the Foreign and Commonwealth Office and the International Development Office into the momentum that is building up in terms of preparation for the case that the UK, through Europe, will be presenting in Copenhagen?

Mr Meyer: Joan, I wish I could give you a solid "Yes" three times over. I wish I could make believe that that was true. I do not know that it is true but I am pretty confident, even not knowing that it is true, that it is not true, and that is the real problem. That is a real opportunity for politicians in this very Parliament to address. Seriously, I beg you to think about this. There is a very clear precedent from Kyoto. Contraction and Convergence was launched on the negotiations formally in 1996-big images of all countries operating in this configuration were put up by the UN; everybody saw it. It absolutely hit the button because the big subject then was "Quelros" (Quantified Emissions Limitation Reduction Objectives)-how do you get everybody up to the same place under the limit that saved us? There was a fantastically strong response to it, including not only the Chinese, the Indians and the Africans but, also, from the US, under Clinton at that time. We were specifically asked to go and argue the case in Delhi, in Beijing and, crucially, in Washington. When we got to the end of the Kyoto negotiations (this was December 10, midnight; the clock stopped and they went into this final bit of the negotiations), there were two really contentious issues on the agenda, at that point. One was voluntary commitments from countries who might sort of feel the need to, at least, show willing, and the other was emissions trading

#### 9 June 2009 Mr Aubrey Meyer and Mr Terry O'Connell

and how you would actually quantify the emissions reductions limitations objectives that were necessary "not only to avoid dangerous climate change but, crucially, also, to enable trading to occur". If you have not capped you cannot trade is, crudely, what it comes down to; it is a very simple point to understand. This is the point: I went to the then chief adviser to the then UK Government (it was the beginning of the Blair Government), a bloke who vou may have heard from. I believe. James Cameron, who was in Robin Cook's Green Globe Taskforce. We had known each other for years, by that stage, and did not see eye to eye. I went to him and I said: "James, I beg you, when the Contraction and Convergence propositions are launched in that trade debate, and they will be in roughly an hourand-a-half's time, ask your colleagues on the UK Government delegation to support what happens." He looked at me and he said: "Yes, I know it's right but, I'm sorry, I just can't", and walked off. That is the only time I have ever directly exchanged words with that man. Sure enough, at around twenty-totwo, the subject of emissions trading came up, the Chinese said to the US: "We understand that you have made a requirement for trade, everybody being in, and we understand that you have made this a walk-out issue, and we understand the meaning of that." At this point, the US was tentatively in because Al Gore had said: "I am here; I will halve Europeans' emissions from 15 to merely 5 or 7%, and the US will come in on this". He did not have a bat's hope in hell unless he got the Chinese and the Indians in; the Senate was not going to talk to him, they were going to say: "Don't even bother to come home if you haven't got them in". The Chinese said to the US: "We don't understand emissions trading and therefore we don't trust it. We don't have confidence that you understand it, and therefore we don't understand your advocacy of it; however, if you are making this an absolute demand and a walkout issue if you don't get it, we are saying to you" (this was the 1997 regime—it has changed a bit since then) "it has to be equal per capita distribution to everybody on the planet, or it's no deal." The Indians immediately chimed in and said: "That is exactly the position we have argued since 1991", and the Africa group—16 Anglophone nations, led by Carlo Maseros of Zimbabwe, at the time-said to the Chairman, Estrada: "Yes, that is why we have all advocated Contraction and Convergence." So this was a very, very loaded moment in the drama of the politics. The US responded by saying: "We're interested in the proposals from India and others on the Contraction and Convergence arrangements because this is the kind of deal that we inevitably have to make". This, please now note, was the moment at which the UK was supposed to say: "And we support that". Did they? No. So we now come to Copenhagen and, essentially, exactly the same standoff only with more malice, deeper danger and all the rest of it-exactly the same dynamic at work all over again-and is our government being programmed properly through DfID and other agencies (FCO) to be ready to absorb the shock of that and deal with it constructively, as opposed to creating another faux arrangement where (as I know some of you argue, and I agree with this) a bad arrangement is worse than no arrangement? A bad arrangement that actually disguises the seriousness of what we are really dealing with is an undesirable outcome and should be discouraged. This clearly required outcome, the C&C methodology at the heart of the entire negotiations, needs desperately to be established. Our Government, especially, not only with this Act but because of this Act, and because of the way the Act has been methodologically constructed, can go in there and walk tall. They can actually have a really good time; they have got a lot of support around the world for precisely this way of trying to bring the global house to order on the same song sheet. So while I feel it has not happened I feel it ought to, and if you can think of any ways that we can work together to encourage that to happen, please let's talk about it.

**Chairman:** Can I just remind everyone, we are conducting an inquiry on carbon budgets and we have until ten-past twelve to get through this session.

**Q62** Colin Challen: You heard the evidence this morning from the Climate Change Committee. How would you characterise their approach to burden sharing, and do you think they are making recommendations which accurately say what our share ought to be?

Mr Meyer: No. That is the end of it. I have known Brian Hoskins over years and I actually like him very much and I would not want to say a word against him in any personal sense at all, but from where I am sitting he did not give you accurate information, exactly in the same way that Adair Turner did not, which is why I wrote you that memo<sup>2</sup> saying they had not included the issue of feedbacks and coupled modelling in this supposedly up-to-the-mark modelling on which the whole Climate Committee's work and the Climate Act, and all the rest of it, is actually claiming to be based. This is why it is important to me that all of you had copies of the evidence, because I really want to focus you on understanding this vitally important pointcontrary to the impression created here and all over the planet that climate change is a desperately complex issue that only men in white coats can understand and relay the results to ordinary people like us. On the contrary, in this particular instance, ironically, it is dead simple: the model of emissions to concentrations (in other words, sources to atmosphere and sinks) is just like a bath with a tap and a plughole. It literally is that simple. The bath, in the model, is the atmosphere, the tap, with water flowing into the bath, is our emissions, and the plughole is the sinks where some of those emissions drain away. The assumption has been, in that model, that the tap has been flowing at twice the rate of the plughole since industrialisation. So, crudely, the bath level was going up. In other words, the concentrations of CO<sub>2</sub> in the atmosphere were going up. That was introduced with this Berne model which I have actually laid out for you in the

<sup>&</sup>lt;sup>2</sup> Ev 14

evidence, on whatever page it is (in my book it is page  $10)^3$ . This was introduced in 1994 in a special IPCC report<sup>4</sup> where they said—if you see there is a range of concentration outcomes in the top right-hand corner—

Q63 Chairman: It is page 10 in our copy as well.

Mr Meyer: It has all the pictures of the IPCC report covers on it. The budgets and the concentration outcomes, where for 350ppmv (which is where we were in 1990 and we would have to return to it). 350. 450, 550, 650 and 750-in each case, on the left-hand side, you can see they published a larger, slower contraction, a heavier contraction, event. In other words, a carbon emissions contraction event which has a weight and, in that shape, it is a path which has a rate and a structure to it. Each contraction event is larger for each higher concentration outcome. We looked at this and we immediately had a kind of Brian Hoskins reaction: "Hang on, this is suspiciously smooth." When you have to put some numbers down you have to make some decisions and assumptions. The assumption here (and I actually finally had the model just mathematically worked out) has been from that date, in 1994, until AR4 published a year-and-a-half ago, that the airborne fraction of emissions (that the tap continues to flow at roughly half the rate of the plughole taking them away) is 50%. That is not complex, white coat modelling. They may have created that with incredibly complex GCCMs (Global Climate Circulation Models) which cost billions of dollars and sit in the Hadley Centre, and all the rest of it, but that, crudely, was the carbon cycle model on which all the climate models have depended from the word go-from that day to this. They have become a little more highly calibrated, the extent to which you can go into detail has increased, the attempts to include non-direct feedbacks in the carbon cycle-an example of which is you lose the reflectivity and you create an absorption factor. Reflective ice is no longer there as a mirror; the dark ocean or the land underneath that absorbs that heat. Those things are in the model, but in respect, crucially, of the carbon cycle feedbacks, which means, literally, how the carbon sinks are packing up, how this plughole draining away at 50% is not, crucially, draining away at 50%—how those things come into play—that was tucked away at the back of AR4 published by IPCC at the beginning of 2007, very heavily obscured in Chapter 10 and the complex graphics on that page in your booklets. It is really crucial that you do understand this stuff is formally on the record from the supposedly peerless source of all science on this matter on the planet. All of those contraction events, there—you have basically got four scenarios for 450, 550, 750 and 1000 ppmv between there and there *(indicating)*, three models for each one (the Hadley centre model is in there too)—were revised in the mandate called "Coupled" to reflect "feedbacks", where the simple maths of it is that where the airborne fraction for the uncoupled models have been 50% retention/50% returned, the airborne fraction here, crudely, maps out as 75% retained/25% returned. That is really significant, because then if vou come to the detail-back to where our Climate Bill and our supposedly up-to-the-mark experts have created this Act and have established the figure of an 80% cut by the UK by 2050, which is inside a global cut of 50% by that year, which brings us indeed to the per capita sharing of this budget by that year, regardless of, God help us, how we actually count it out to get there-what you are actually then seeing, if you look at the graphics at the bottom of this page, just looking at the Hadley Centre model for 450 ppmv coupled and uncoupled, this really comes very tightly into focus now, so you can get a sense of real realpolitik engagement on this. The "Uncoupled Hadley Model for 450 ppmv" is indeed a 50% cut by 2050. Going on down from there, the Coupled Model (in other words, with the feedbacks put in) is "an 80% cut by 2050", to get the same result for 450 ppmy, if we are lucky. That is presented as an "equilibrium model" that you can get there and stay there. Just to darken it for you, that, in no sense, means that you have reached a temperature equilibrium; it just theoretically means you have met a concentration, a parts-per-million, greenhouse gas equilibrium. Even, to be honest, I think that is reaching, but it is a darned sight more urgent than a 50% cut by 2050. Then the final point is Colin pressing Adair Turner on the need to accelerate contraction (and there is the example of it) would you not need to accelerate convergence? He, quite rightly, cited (and I do not know whether this ended up in your evidence or not) a statement made by 25 of our most luminous experts on this issue, from WEF Davos in January—there they are: Tony Blair, Joachim Schelnhuber, Nicholas Stern, the list is positively glowing with epaulettes-all saying, in that very statement: "Oh dear, we need an 80% cut by 2050, not, in fact, a 50% by 2050, for reasons of urgency." You might ask "Why did they say it and what were they referring to when they suddenly got this extra sense of urgency?" Whether they were specifically thinking about this or not I do not know-I very much suspect Schelnhuber would have been on this case, no question about it. They collectively said that from that platform, but the point then comes back to the Bill: if you then say we are all going to achieve equal per capita by 2050 inside an 80% cut globally, the idea that you are going to go back to the Indians and say: "Actually, it's more urgent; you must get involved; we're all going to get .2 of a tonne by 2050, and, effectively, go there linear, pro rate, Poll Tax rate, from where we are now", is going to get you a whole list of editorials in the broadsheets in India saying: "Get lost", just like the last 20 years. The point inexorably flows back to Mr Kennedy and his Committee and the people who enact the Act itself and all the rest of it. It was the question about the need to be really preparing for tough times and not sort of be ambivalent about the levels of risk here, and play games of probability density functions, and all of this; we are in real difficulty in respect of the overall

<sup>&</sup>lt;sup>3</sup> Ev 19–21

<sup>&</sup>lt;sup>4</sup> Climate Change 1994 Radiative Forcing of Climate Change and an evaluation of the IPCC 1592 Emissions Scenarios, IPCC 1995.

problem itself and, especially, still, also, in this ghastly unsolved political argument that gets rehearsed year after year at the UN—rehearsed and not resolved.

**Q64 Mr Caton:** Considering your failing plughole metaphor, can you tell us a bit more about the evidence for declining sink capacity and what this means, especially in terms of future carbon budget targets?

Mr Mever: I can tell you a couple of things but I am specifically not giving you that in the evidence because whatever the evidence is, it is coming from within the IPCC. My reading of it is a couple of mechanisms: for example, as more  $CO_2$  is actually dissolved in the oceans they become more acidic. The effect of that is to make the carbon eating organisms-the plankton-less able to thrive. So the oceanic carbon sink regresses. That is one mechanism. The oceans will absorb less carbon because of that. As they become warmer (we all know—it is dead simple physics—if you warm a pan of water on the stove it actually starts to bubble; cold water will absorb gas, warmer water will release it), the sink function in a warmer ocean is reduced. You come to the really contentious issue of deforestation and land use, and all of that. I want to make the obvious point, which is what everybody does accept. that as forests become drier they catch fire more easily. Sometimes it is deliberate, sometimes it is not, but they not only do not absorb CO<sub>2</sub> but they actually release it. You have seen for a couple of years in a row, in places like Indonesia, that the forest fires become so intense that the forest floor actually catches fire as well and then a lot of carbon in the soil is released as well. So purely on that  $CO_2$ cycling you are seeing a reduction of sink capacity, and the group who have published the coupled models put a consensus statement in, which IPCC published, which said: "There is unanimous agreement among the coupled climate carbon cycle models driven by emissions scenarios run so far that future climate change would reduce the efficiency of the earth's system (land and ocean) to absorb anthropogenic  $CO_2$ ... There is evidence that the CO<sub>2</sub> airborne fraction is increasing so accelerating the rate of climate change." So they, as a consensus, peer review group, and everything, through this dogfight process (I can tell you about that another time) got that through. That, basically, says that the sinks are starting to pack up. Permit me, if I may, because I have my eye on the clock here, the way that C&C has been perceived has largely been that it is a sort of lovely idea from a slightly nutty guy who thinks that fairness is going to save the world. So everybody converging to equal per capita is probably a dotty left-wing idea, but, hey, some people like it-some do not. Everything in Contraction and Convergence is contingent on the prior calculation which is called contraction and concentrations. So if you look at this page (you can see there are two graphics here), this is how simple it is—it is not complicated on this absolutely key point. This is the reason why the whole UN negotiation exists; it is why the IPCC exists; it is why the objective of the UN Treaty is not

to stabilise temperature (although a lot of people think that might be a good idea and it is nice to think there is a switch you could reach to-there is not one); the only thing that we can tentatively control is our emissions, and that is with an eve to controlling the concentration level of these gases in the atmosphere-in other words, that you stop this plughole blocking up and that you turn the tap off as soon as you can, so that the bath level does not continue to rise. That is the crude analogy. Now, if you look at these two graphics here, this is exactly what the model does. The right-hand side of each graphic is from 2000 forwards for 200 years. It will, literally, compute any contraction event that you ask it to. So in the graph above you are seeing the equivalent of the uncoupled run for 450 ppmv and, in the graph below that one, you are seeing the equivalent event of the coupled run. You are seeing, in each case, above that, a reference set of concentration rises. This is not modelling in the sense of operating some huge obscure box; this is simply running spreadsheets and saying: "How fast is this adding up in the atmosphere? Is it adding up at 50% of the contraction event? Is it adding up at 100% of the contraction event?" I do not know if your copy has got colour, but there is a little "@" where you have 50 and 100%, simply as a reference framework to say it will not be lower than this and, theoretically, it would not be higher than 100%would it? Then you run trend rates through that of sinks failing at half-a-per cent per annum, 1% per annum, 2% per annum—just to make the point that it could be faster than 100%. You can see those sink failure rates: half-a-per cent takes 200 years to reach 100%; it takes 100 years at 1% to reach crashing that barrier. God help us, it only takes 50 years to reach 100% and beyond if it is failing at 2%. What is the evidence on the rate of sink failure? It is pushing between 1 and 2. When Brian Hoskins says: "We can't know about the things we don't know about"-we can know about this, and we can do this very simple, straightforward and transparent analysis and say: "Which way do you think the risk lies in all of this? In our favour or not?" Then, critically, if you want to reduce the risk of the bath overflowing, of the system exceeding the runaway threshold, what is the one thing that we know we can do that we are all directly, as nations, through the UNFCCC, involved in controlling? It is emissions; it is the emissions that we cause. Nobody is really disputing that either. The only hideous dispute has been how on earth do you (to come back to Colin's question) get to this issue of so-called burden sharing? How do you appease the developing countries who feel that they have had this massive opportunity first dropped on them which says: "Development is over; if you're poor too bad"? Their attitude is: "Get lost. We will do what we want and see how you like that." It has been an appallingly childish debate for 20 years, and that somehow needs to be resonant with some basic organising principle that everybody can understand. Even if they do not like it, they can, at least, see the one, magic element of it is that everybody is on the same page for the same reason, which is not to get

rich now or later (maybe those things apply in the distance) but ensure that there is a place still here where people can get rich on. I had to write to Charles recently and say: "I agreed with you when you said that poverty comes second to climate change because you are right you do need to have a planet on which the poor will be saved, and so on". However, it does not take many years to realise—it takes about a nanosecond—that you have to reconcile the gap between over-consumption and

under-consumption within the limit that saves us for us all to have some chance of a coherent debate and, possibly, a future beyond that.

**Chairman:** Thank you very much. That is an interesting foil to the evidence we had earlier on. As you know, there is a lot of sympathy for your strong views around the Committee membership. So we will take account of what you said and the written memorandum when we produce our report. We are very grateful to you for coming in.

#### Supplementary memorandum submitted by Global Commons Institute

In the light of developments this week and heretofore that:

- 1. The Copenhagen Summit in December on Climate Change will not achieve a "Climate-Deal" with the global aim of keeping us within an overall maximum 2 degree Celsius temperature rise.
- 2. IMECHE Climate Change Report stating, "The [UK] Government's targets and budgets have been set using a top-down approach based on the principle of contraction and convergence" adding that "IMECHE supports the C&C Principle."
- 3. The Archbishop of Canterbury invited the TUC to support climate proposals for, "*Contraction and Convergence proposals [as] the best-known and most structurally simple of these, [saying] it would be a major step to hear some endorsement of them from a body such as this.*"
- 4. The CCC report and the Climate Act are based on GCI's Contraction and Convergence [C&C] proposal and are in the words of Lord Adair Turner, Chairman of the UK Climate Change Committee [CCC], "strong support for what Global Commons Institute [GCI] has been saying". [Evidence given by to the [EAC] in February this year] and that
- 5. For organising and sharing the full-term emissions-contraction-event needed to bring us to UNFCCC-compliance, "*Converging to equal per capita entitlements globally is the only option that is doable and fair*" and that,
- 6. "*if, for reasons of urgency the rate of global contraction has to be accelerated, then for reasons of equity the rate of international convergence has to be accelerated relative to that.*" [Response given by Lord Adair Turner, Chairman of the UK Climate Change Committee [CCC] to the [ECCC] in March this year]
- 7. Noting this further support and following these logical arguments and that the UKMO Hadley Centre has now confirmed in writing to GCI that [as shown in the images alongside] that:
  - [a] the CCC's odds are worse than 50:50 for keeping within the stated maximum of a 2 degrees overall temperature rise with their Contraction and Convergence [C&C] Scenario and that
  - [b] the odds are better than 50:50 for keeping within a maximum 2 degrees with GCI's accelerated Contraction and Convergence [C&C] Scenario.
- 8. Will the EAC seek Government agreement with positions taken now by the UKMO, Lord Adair Turner and the analysis that to keep within the 2 degrees overall temperature rise, the rate of contraction needs to be accelerated to something like an 80% cut in emissions globally for reasons of urgency and that therefore the rate of convergence needs to be accelerated relative to that to something like 2020 or 2030 for reasons of equity.



## RELAXED CONTRACTION FOR REASONS OF POLITICAL FEASIBILITY CONVERGENCE ACCELERATED RELATIVE TO THAT BUT STILL FOR REASONS OF EQUITY



The Hadley Centre has confirmed that the CCC Odds are Worse than 50:50 for a maximum 2 Degrees Scenario with this CCC C&C Scenario.

## **BETTER THAN 50:50 ODDS FOR 2 DEGREES**

## ACCELERATED CONTRACTION FOR REASONS OF EQUITY CONVERGENCE ACCELERATED RELATIVE TO THAT FOR REASONS OF EQUITY



The Hadley Centre has confirmed that the GCI Odds are Better than 50:50 for a maximum 2 Degrees Scenario with this GCI C&C Scenario.

November 2009

### Tuesday 23 June 2009

Members present Mr Tim Yeo, in the Chair

Mr Martin Caton Colin Challen Mr David Chaytor Joan Walley

Witness: Professor Kevin Anderson, Director, Tyndall Centre for Climate Change Research, gave evidence.

**Q65 Chairman:** Good morning and welcome back to the Committee; nice to see you again. *Professor Anderson:* Thank you very much.

**Q66 Chairman:** We are all familiar with your work and judgments. Can I kick off by asking why you think that the recommendations of the Committee on Climate Change, who have already given evidence to this inquiry, on targets and budgets are not consistent with the level of cuts needed to keep the rise in temperatures below 2°C?

**Professor Anderson:** The first point, which is not a point perhaps directly for the Committee, is that if we are to avoid dangerous climate change and if that is characterised as 2°C (and that is a social or a political decision), then to avoid something that is dangerous, would you think a 50:50 view of that is reasonable? For you to avoid a dangerous something, do you think a 50:50 chance is an appropriate percentage, which is broadly what the Committee used? I would suggest if it is a dangerous something that you are trying to avoid 5% is still too high and 1% might be about reasonable. That is, I think, a fundamental issue that the committee has to grapple with: why would it choose 50:50 to avoid something that is dangerous? There are some reasons, I think, why they might choose 50:50, because 1% gives you a much more demanding target so they choose an overshoot. There are other people later who can comment as to how viable they think that is. I think it is fair to say that the scientific understanding of "overshoot" is not as robust as it is if we do not go up and then drop to a ppmy. There are some uncertainties around what that might trigger and we have to be quite optimistic that that will not trigger unforeseen circumstances that we know are out there but we do not quite know where they are, and they hold that overshoot, which I think Brian Hoskins referred to as a slight overshoot. I think 50ppmv is quite a large overshoot, and for it to be held for, I cannot remember exactly what, but something bordering on a century seems quite a long time and to hope that you do not trigger something else. That seems, as I say, quite optimistic. My understanding is that they use a single climate sensitivity distribution. I do not know whether that is an appropriate route to go down but again the later witnesses can explain why they did that and whether they feel it is appropriate or not, but certainly some of the work that is out there tends to use a range of climate sensitivity distributions. I understand they use a single cumulative value. We have recently discussed it outside, actually. An important point is that if you look in IPCC AR4 they generally get a wide range of emission cumulative values, a fairly specific concentration, and they have 450 parts per million, arguably CO<sub>2</sub> but I think it is not unreasonable to think that it is also CO<sub>2</sub>e if you are going to link it to temperature. They have a big range of what the emissions are, how much we can dump into the atmosphere over 100 years. The bottom end of that range I understand came from the Hadley Centre, and they have robustly defended the bottom end of that range, being that their model embodied a lot of carbon cycle feedback, which is a better way than lots of other people's models, and that significantly reduced the total emissions by, I think, about 27%; yet the Committee on Climate Change's cumulative value is much higher. I think it is outside of the upper end of the AR4 values. You could make the argument that one is CO<sub>2</sub> and one is CO<sub>2</sub>e, and that is an issue that needs to be debated. I do not think there is a simple correct response to that, but certainly it seemed a very high value used and it was a single value and I would question why they would be using a single value. Why would you not use a range for that? Turning to deforestation and food, deforestation could be as high as 25% of total emissions. That was not taken into account by the committee as far as I am aware, which you could argue implicitly suggests that deforestation is the responsibility of the countries that deforest. Given that we have already deforested in Annex 1 nations, I think that is possibly not a fair allocation of those emissions, so I think for countries that do deforest (and that will undoubtedly go on) some of those emissions are the burden of Annex 1 nations and that significantly changes the budgets. They did not consider food emissions, and indeed many people have not considered food emissions, which are again very significant. Emissions from agriculture overall are a very significant proportion of emissions. They did not include aviation up to 2022 and then it was pretty much a fudge after 2022. If you add deforestation, food, aviation and shipping you significantly reduce the energy space, so when they talk about things like decarbonising by 2050, the electricity system, they are not clear as to whether the rest of the system is fully decarbonised or not. I would argue that you cannot wait that long if you factor in deforestation, food, aviation and shipping emissions. I think there is a large hole in that part of the analysis which needs tightening up. The peak year we again discussed briefly outside. If I asked you when you thought global emissions were going to peak I think it is very unlikely that any of you would choose 2016 or Stern's 2015 or Paul Bear's work, 2012-14. If the economy bounces back, as everyone apparently hopes it does, emissions will continue to rise and I think it is unrealistic, possibly naïvely optimistic, and misleading to do the analysis around 2016 as a peaking year. Many people do not think of that. They do not take account of the fact that the peaking is that early. Do we really think this country is going to peak in 2016? In the States Obama said they might get emissions down by 4% by 2020 compared with 1990; yet they might fail so they may get nowhere on that. Generally most people miss their targets. The Japanese have said something like 8%, so you would expect the non-Annex 1 countries' emissions to be going up well beyond 2020, and therefore I think a peak of 2020 is still highly optimistic and fundamentally changes the results for the political world in terms of the rates of reduction that are necessary. I think 2016 is a dangerously misleading peak. It would be lovely if we could achieve it. Remember that in the UK emissions are going up and are going up very significantly. They are not going up in terms of our immediate national budget, and that is because we are buying more goods from elsewhere. If you look at the consumer index budget for the UK, published by Defra, you will see that emissions in the UK are rising, and rising very rapidly indeed, whereby a lot of those emissions are effectively in the goods we buy from countries that do not have caps. For the UK, which is probably one of the leading countries in terms of climate change, our emissions are rapidly going up because we are consuming more and more goods, so the best example out there is still going up. The other part which is important in this is the CDM. They said in the evidence<sup>1</sup> (I looked through it briefly on the train this morning) that under the interim budget there is no CDM (Clean Development Mechanism). I do not think that is true because under the Emissions Trading Scheme there will be some CDM. If you look at the latest EU energy and climate change package and tally that with the Committee on Climate Change's report, under the interim budget 17% of emissions we have bought from Ghana, Nigeria and other countries that have no targets. Under the intended budget 27% of the UK's effort can be bought. If you add to that the rest of the EU ETS that we can buy, and everyone, of course, wants to buy out of the EU ETS, you effectively can buy out under the interim budget 67% of the UK's effort and 75% for the intended budget. To me that does not seem a responsible way to go for a country that is trying to lead on climate change, that ability to buy out significantly from other poorer parts of the world that have no caps, so there is no guarantee of any emission reductions there. In fact, you might get an emissions increase, and on top of that to be able to buy from the EU ETS I think is probably irresponsible. You can already see that with Geoff Hoon announcing the third runway, for instance, and saying that emissions in 2050 from aviation will be the same as they were in 2005. On the same day

his own department published a report saying there would be a 60% increase in emissions, and the smoke and mirrors that allows that to occur is the buying from the EU ETS. Everyone is doing that with their airports. Everyone is doing it with all of their expansion. Everyone expects to buy in the future to allow them to build high carbon infrastructure now. There is a range of things there. Is 50% fair and appropriate for something dangerous? Overshoot, I do not think is necessarily the most scientifically robust route to go down. Is the single climate sensitivity distribution correct? Is the single cumulative value correct? If it is, is the high one correct? Ignoring deforestation, food, aviation and shipping—is that appropriate? Then should we be allowed to buy either the small amount you have left to do from CDM and the Emissions Trading Scheme? If you put all of those together what tends to be the case is that in everything we do we try to choose the most optimistic end of the science or the policy. If, every time you go to the supermarket and they overcharge you, eventually you start to think there must be something systematic in the fact that they always overcharge and never undercharge. If, every time we choose a number that knocks the amount we have to do politically down, I start to wonder how close plausibility or practicality is sailing to political expediency, and I am uncertain as to how much the committee, and I have a lot of time for what they have done, have been driven by what they think the political orthodoxy is prepared to face. I do not think as an independent committee that is their responsibility.

**Q67 Chairman:** You have raised plenty of issues in that answer. Just picking out one or two things, first of all on the point about the 2°C, given all that you have said, what level of cuts would we require to make to keep the temperature rise to 2°C? *Professor Anderson:* For the UK or globally?

Q68 Chairman: The UK to start off with.

Professor Anderson: For the UK it would depend on how you apportioned emissions. At the event I was at last week with some of the facilitators from the less developed countries they suggested that we should have cut to zero emissions a few years ago because they would say there is a massive burden historically. We already have a debt to them of what we have emitted, so it depends enormously on what apportionment regime you go for. I know a lot of the LDCs are now saying that we should pay for historical emissions. If that is the case you will have to find some form of sequestration, or you buy enormous amounts of emissions from them at a very high carbon price, I would say, to make it fair. I do not think there is an easy answer to that. If you believe in historical emissions and our responsibility for those then we have to cut immediately to zero. If you think, "Let us forget historical emissions; that is the past", if you take from 1992, from Rio, we knew from there, or if you take from 2000, you can then do some apportionment regime, and, depending what apportionment regime you do, you will get different reduction rates. One of the papers we have produced

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would say 6–9% would be reasonable for the UK if we peaked in the next few years, say, 2012, 2014. Six to nine per cent per annum reductions from energy would be about right because remember we have to factor in food and you have to say what do we do about deforestation. I do not think the committee took those into account. They have 2.8% reduction, I believe. If they took deforestation and food into that and then said what is left for energy, even for them there would be a much tighter reduction rate than that.

**Q69 Chairman:** That would be quite challenging. Is there any point in our doing that unilaterally?

**Professor** Anderson: It depends on your moral framework, really. Do you want to show leadership or do you want to go down with the *Titanic*? That is purely a political decision. I know where my views on that are. I think the climate change community has not served the policy makers well, either in terms of demonstrating leadership or often in terms of directly giving their message to policy makers. I think it has often been softened, to be honest. I think we have all chosen to go down the route of least resistance and I think that if we are going to show leadership we have to move away from that, both in the scientific community and the political community. I see no evidence of that at the moment.

**Q70 Chairman:** The Committee on Climate Change has to operate in the real world, the political world and so on. Is it more realistic to talk in terms of trying to reduce the risk of a rise of temperature of  $4^{\circ}$ C to very low levels? Is that a more realistic and meaningful aim than for the Government to continue talking about keeping the rise to  $2^{\circ}$ C, which seems now very unlikely to be achieved?

**Professor Anderson:** I take the view, and I have done for several years, and I know that Bob Watson from Defra now takes this view, that we should all-out aim for 2°C in terms of mitigation but we should adapt for something considerably higher. At 4°C, as I understand it, and again some of the later witnesses are more expert on this than I am, you do not stabilise, so you have got to see ongoing increases from there. I do not think we can survive in any social form that we recognise globally at 4°C. A one metre sea level rise takes out about a third of Bangladesh; 35 million people live there. It takes out all of Orkney pretty much and lots of the low-lying parts of the world. We would all be impacted by that one way or another. I think if we go down the 4°C route it is completely morally irresponsible and I think we would rule the day but we would be able to do nothing about it because we will set that in train over the next few decades. That is why it is absolutely essential we make the right decisions now. I do not think 4°C is the right route to go down. However, I do think we have to do adaptation, particularly for poorer parts of the world, at 4°C. Do not build any city below a 10-metre sea level rise.

**Q71 Chairman:** We are happy to address adaptation issues in the autumn. Just finally on this section, you characterised a 50% likelihood of exceeding 2°C, if

we think that is dangerous, as a pretty hefty percentage. Do you therefore regard it as really necessary that we should aim for a much lower concentration of greenhouse gases in the atmosphere in order to reduce that 50% likelihood of exceeding 2°C?

**Professor Anderson:** Yes, I do. In the same way that the Committee looks at these things in a practical way as well, I see no evidence that we are prepared to make those changes to our lifestyles, but yes, I think we should be aiming for something much lower, and certainly 400 would be to me to be the upper end of what we should be aiming for, but that would mean absolutely fundamental changes to our lives this afternoon and we are not prepared to make any of those changes; I see no evidence of any of us doing that, so, yes, I do think 400 would be a far more appropriate target to aim for.

**Q72 Joan Walley:** You say you see no evidence of people making changes to their lives this afternoon. That really brings it home, does it not, and yet we are talking about a trajectory that is taking us with budgets up to 2022?

Professor Anderson: Yes.

**Q73 Joan Walley:** How would you reconcile this really complicated five-yearly budget set 15 years in advance between now and 2050 and the immediacy that we need to make changes this afternoon?

**Professor Anderson:** At the moment I do not think they can be reconciled. In terms of the budget approach, and again all credit to the Committee here and indeed to the whole parliamentary process, it has shifted away from the scientifically illiterate view of long-term targets to a scientifically robust view of cumulative emissions; at least it has significantly embraced that approach, not fully but significantly, and I think that is a real improvement, so the budgets are a real way forward. However, I do think that the policy framework, the social framework, to bring about what has been put into the budgets laid out by the committee is completely lacking. For instance, I was at the Climate Change Conference in Copenhagen this year where 2,500 of the world's scientists flew to Copenhagen to tell the rest of the world about how urgent climate change is. These are the people who are fully informed who are making no changes to their lives on average. In fact, I would think almost certainly their emissions will have gone up every year for the last 10 years. The people who know the most about it, with the most amount of information, somehow think they are the group that should not respond. The civil aviation industry thinks that, the shipping industry thinks that, the car industry thinks that. Every sector thinks it is the unique sector. Every individual thinks they are the unique individual that should be the exception and everyone else should make the changes. Whilst the budgets are there, there is no political structure to make those significant changes from all of us. We think that we are the reasonable person and everyone else is not.

**Q74 Joan Walley:** But we need to be confident that there is an agreed level of effort that fits into that public framework and into that social framework, and I do not see how we can be confident that that is going to be there to get us on to the emissions pathway, given the complete lack of interest and awareness that there is about this one core issue.

Professor Anderson: I would agree but do we despair or do we say—that is the reason we have meetings like this. That is the reason people are engaged in this process, trying to drive the whole process forward. It is not in my view going in the right direction in any way, shape or form yet, but there is a thin hope that we can get some conversion there. I think it will require really dramatic political leadership, way beyond what currently we have been discussing. It is all very well putting the budgets in place but the mechanisms to bring about those changes simply are not there. I do not think the public will is there either. Actually, I think the politicians are way ahead of the journalists and well ahead of the public on this, so I think some credit should be given to the politicians that have been engaged in all of this process, particularly for the UK here. However, still I see no real drive towards this. The only hope we have at the moment is that bankers have really screwed up our economy, because growth globally is now down 2.9% over this year. Emissions will have come down. The only time emissions come down is when you have a hit on growth, so after September 11 you saw emissions globally come down. Now you are about to see emissions come down. Until we are prepared to accept the fact that you cannot reconcile the rates of reduction we now require with economic growth in the short to medium term whilst you put lowcarbon supplies in place we will not get the rates down to levels that match the budgets that move us towards 2°C.

**Q75 Joan Walley:** And you are saying that we should have a continuous trajectory all the way up to 2050? *Professor Anderson:* Yes, but, obviously, the further out you go the more you hope to be able to understand. Yes, broadly the committee had that. They drew it out to 2022 and then they drew a vague dotted line out to some 80% reduction by 2050 and some sort of discussion about aviation and shipping. It was certainly a start but, as I say, it did not take account of food or deforestation. Those issues were not considered and aviation and shipping are a fudge at best. They have made a very good start but there is a long way to go to make that more robust. However, I still think it gives a really clear political signal about what we need to do now.

**Q76 Joan Walley:** You mentioned just now about the political orthodoxy of the Climate Change Committee. Do you feel that it is limiting its recommendations in terms of what will be accepted by governments or do you think that it is showing the leadership that it should be showing?

**Professor Anderson:** It is showing some really important leadership on the emissions issue. Moving away from long-term targets (at least to some extent) towards cumulative emissions is a big improvement,

but, reading through the evidence that was given here from the committee, the words "practical" and "plausible" kept coming up all the time. I get this everywhere I go-"That's politically unacceptable". My guess is that living under a metre sea level rise is politically unacceptable. There is an assumption that because the orthodoxy will not allow us to mitigate to a certain level so that is unacceptable then there is no cost to that. If we are not prepared to accept that we are inherently then accepting the high level adaptation or complete displacement of some economies. The future is unacceptable and there is no acceptable route out of that. In fact, if anything looks politically acceptable at the moment it is unlikely to work. One of the metrics of political unacceptability is a requirement of whatever future we go down, and we have got ourselves into that position. We are in 2009 and our emissions in the UK and globally continue to rise. We have known about this since 1992 at best. We have been talking about it ad infinitum since 2000 and we have done absolutely nothing. We have got ourselves into the position knowingly and now we are faced with really difficult choices because it is cumulative emissions approach, not a long-term target approach. We have no-one to blame but ourselves for this.

**Q77 Joan Walley:** Just finally from me in this series, do you believe that the work that the Climate Change Committee is doing in terms of that trajectory is now sufficiently factored into the work that is being done to overcome the difficulties because of the recession?

Professor Anderson: I think the answer to that is no. and I do not blame the committee or anyone else. We do not know how to bring these things together as vet but I think it is really important we start to link them together. I think there are some interesting lessons from what we call a recession. Unfortunately, I do not see how the Annex 1 countries can continue to see economic growth and reconcile that with the rates of reduction necessary for anything like 2°C. I think we have to learn lessons from how to distribute the pain and suffering of a recession more fairly because I think we have to go through that, particularly in the Annex 1 wealthy countries, in the interim period over the next 10 or 20 years for us to have any hope of the sorts of reduction rates that are necessary.

**Q78 Mr Caton:** You have already mentioned the Committee on Climate Change's interim budget which the Government has decided to follow until there is a global deal when the EU moves to a target of a 30% cut by 2020. What are the risks associated with following an interim pathway rather than the intended pathway?

**Professor Anderson:** Quantitatively, I think it is very difficult to work out exactly what that would mean because the risks relate to the global budget and that does not say anything necessarily about the global budget but I think there is a significant risk in terms of leadership. I did not quite understand the first response from David Kennedy on this. If you claim to have a view as to where we need to go for 2°C you

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cannot say that if the rest of the world does less we will do less as well. That is not coherent. If the rest of the world does less you have to do more to move you to towards  $2^{\circ}$ C, so they are not being driven by that; they are being driven by what they claim to be the political realities of the world around them. Therefore, there is a danger for the interim route. It is an easier route and again it sends a message to everyone that we are not prepared to demonstrate the leadership that the intended budget would have shown, so I think there is a risk there in that we should have shown that leadership, though I have to point out that a 27% buy-out for the CDM significantly reduces the benefit of having an intended pathway.

**Q79 Mr Caton:** If we end up keeping the interim budget right the way through to 2022 how much steeper will we have to cut UK emissions after that date?

**Professor Anderson:** The difference between the intended and the interim is very small. We produced a report which, if the Committee has not had it, I am happy to pass on to you, which shows that difference.<sup>2</sup> It plots the graphs out to 2050. The difference between the intended and the interim is not particularly large in terms of the cumulative emissions. It is a matter of just a few per cent difference, so it is not that significant.

**Q80 Mr Caton:** So we need a tougher budget than either the interim or the intended?

**Professor Anderson:** Oh. ves. I think the EU should be going for something like a 40% reduction by 2020, and I am not even sure whether we should take that on a consumer basis rather than a producer basis. If we keep exporting our emissions to China and elsewhere that have no caps I do not think that is necessarily appropriate so I think we should consider taking a consumer basis for our emissions from the OECD countries, from the EU, and we should look at a 40% real reduction by 2020. It will do two things. It will send a far clearer signal to the LDCs to sign up to something significant in Copenhagen, which they will not do unless the Annex 1 countries show real leadership, which we are not going to show, I think, so we would have to make those sorts of levels of reduction, and we cannot keep assuming that we only look at our immediate at-home emissions. We have to take account of the fact that a large proportion of our emissions come from other parts of the world.

**Q81 Colin Challen:** Can I come back to the question of aviation and shipping and ask whether there is a logic in including them in the targets but not in the budgets?

**Professor Anderson:** There is a logic to some extent with shipping. I do not think there is for aviation. We know everything we need to know about aviation in terms of CO<sub>2</sub> emissions. It is robustly quantified, we

know all of that data, we know where the airport is setting off. We have a reasonable way of apportioning emissions 50:50.

**Q82** Colin Challen: But there is no agreed way of apportioning emissions.

**Professor Anderson:** The UK broadly accepted that when it worked out its aviation emissions. It works them out. It already has ways of quantifying these numbers. The EU is very likely to accept exactly that particular route of 50:50. If you take all landings, all takings off or half of all return flights and add that cumulatively around the globe that works, it adds up to the full number, so we all accept that. There are big issues about uplifts, the other factors of aviation which we can come back to if you want to discuss that, but I think aviation could have been factored into the budgets from now, and I think should have been factored into the budgets.

**Q83 Colin Challen:** Has it been factored into the budgets?

Professor Anderson: Yes.

**Q84 Colin Challen:** What difference has it made? Is it significant?

Professor Anderson: For the UK aviation is just under 7% of UK emissions and growing. Aviation and shipping, if you add them together they have roughly the same emissions as private cars. It is like saying let us ignore private cars. I think most of us would suggest that that is not a reasonable approach when we look at CO<sub>2</sub> emissions, to ignore all cars. It is a very nice proportion for the UK, very different from the numbers globally. As I say, it is a little under 7%. Given that that is a sector that is growing very rapidly and, you could argue, is being promoted to grow by certain planning rules that allow expansion of airports and so forth, and given that the emissions from aviation are looking to grow significantly whilst at the same time we are supposedly going to reduce emissions from elsewhere, they very rapidly become an even more significant proportion of the emissions. I think to ignore aviation is again a dangerous omission that we knew about. We did not have to do that. Often people say aviation and shipping are the same thing. They are not. First, the shipping data is all over the place whereas the aviation data is not. Secondly, it is really hard to know how you apportion shipping emissions. If a ship brings apples from New Zealand to the UK but on the way runs off to Venezuela and picks up chickens to drop off in Holland, how do you apportion those emissions? These are things that are not well understood. Some of the emissions data estimates on shipping are twice some of the other estimates, so there is a huge discrepancy in shipping emissions and we do not know how to apportion routes that are not clear. Ships bunker fuel. They go to a particular port just to put on lots of fuel because it is cheaper and they can carry it round at no real energy penalty. Aviation cannot do that. Shipping is more complicated so we definitely should have

<sup>&</sup>lt;sup>2</sup> Note: www.foe.co.uk/resource/reports/tyndall\_climate report\_ccc2008

included aviation. I think it would be reasonable to make a fudged guess as to what shipping might be and have it there as a proxy number.

**Q85 Colin Challen:** How long do you expect it to be before the shipping problem has been resolved? Which carbon budget should we be aiming to include shipping in?

**Professor Anderson:** There is quite a lot of discussion about whether shipping should be a country in itself, and I think there is some logic to that, to say that it is such an awkward, difficult sector that perhaps it should just trade within its own boundaries. I would suggest, if we do that, that it is not allowed to buy emissions from anywhere else and we give it a very stringent emission reduction pathway. It will want to buy out from elsewhere; everyone wants to buy from elsewhere. I think there is some argument to be said for shipping being its own country and that it has to reduce its emissions at whatever, 6% per annum, and let it do it however it feels fit. Let the market for shipping determine how to do that, but I am very reluctant to say that it should be allowed to buy from other parts of the world or from other sectors.

**Q86 Joan Walley:** Given the importance that you are adding to shipping, have you engaged in discussion at all with the Chamber of Shipping or with Lloyd's List?

Professor Anderson: Yes.

**Q87 Joan Walley:** What response have you had?

Professor Anderson: I have had some engagement with them myself, not a lot. I should express an interest. I served my time as a marine engineer in the Merchant Navy so I am responsible for a lot of the emissions from these ships that bring our goods over here. One of my colleagues in particular has been discussing things with the various shipping organisations for quite some time. They are quite keen on the idea of there being a separate sectoral emissions budget for shipping. They want to be able to buy from elsewhere though. That is where we would probably to some extent differ from their view, but they think there is some merit to be had from being separate. I think at the moment we may broadly hold with that because it looks very difficult to know how you add it to a national emissions budget. Myself and my colleagues, who have been looking at shipping for some time now, would probably agree with their view but you cannot buy out from that cap.

**Q88 Joan Walley:** The reason for my question is that there has been some concern expressed within the shipping industry about a recent report of this Committee<sup>3</sup> and I just wonder where the informed debate is within the shipping community that could bring forward the leadership that is required at all kinds of different levels, including within the shipping sector.

**Professor Anderson:** I think it is still an uninformed debate at the moment across the board on shipping. We do not know the data. The raw data is missing. We have not as yet been able to track the routes particularly well. We know what happens in ports but we do not know the routes by which ships come here. We know that ships bunker fuel all over the place. We do not really understand that, so at the moment we do not have a lot of data, but I do think, as I said before, that we are in a position now where we could start to set up a mechanism for shipping to work within its own remits whilst we tighten up the data side.

**Q89 Joan Walley:** And that would include the IMO, would it?

Professor Anderson: Oh, yes.

**Q90 Colin Challen:** I have been listening to your evidence. It feels to me like, whilst you say you respect the Climate Change Committee and give it due credit, nevertheless what it is recommending is complacent, or is it worse than complacent?

**Professor Anderson:** As I said, I think they are being too much influenced by immediate plausibility and political realities.

**Q91 Colin Challen:** That is part of their remit, is it not?

**Professor Anderson:** It is, but it is also to be informed by the science. If immediate political realities cannot be reconciled with the science which side do you come down on? The role of the committee in my view is to be an independent committee that is significantly influenced by the science and less by the political realities. That is the role of politicians; that is what we appoint them for. If the committee ends up being another filter between the science and the politicians that is completely inappropriate because there are far too many filters between the science and the policy makers already. I think the role of the committee is principally to be driven by the science with some awareness of some of the broader political issues that are there. I personally would like to have seen the committee being a scientific committee. I wish it had not got any economists on it. I do not think that is the role of the committee; that is the role of economists and the Government, to deal with those issues. I think they should have been given as impartial summaries of the science as possible, and I do not feel that is what the committee has done. It has looked at what is politically acceptable. Maybe I am wrong on this but it does seem to me that every time they choose something that is at the much more optimistic end of science you add all these together and you come up with a result that says, "Hey, this is just about doable within the political orthodoxy, a bit challenging but we can do it". That just feels a little bit too convenient.

**Q92 Colin Challen:** So you are saying that the Tyndall Centre's approach and their approach are using the same figures but they are simply taking a more generous view of what those figures might permit?

<sup>&</sup>lt;sup>3</sup> EAC Fourth Report, *Reducing CO<sub>2</sub> and other emissions from Shipping*, HC 528, Session 2008–09, published 1 June 2009.

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Professor Anderson: Yes. Somebody might say we have taken the opposite end of the spectrum. I hope we have not, and I would be pleased if people could point out where we have. I hope what we have generally tried to do is take almost like the orthodoxy in terms of the science. For instance, we take no account of tipping point issues. We have not factored in aerosols. We have also not factored in uplift issues from aviation which would be very significant for the UK. We have taken almost the most conventional form of the science and the results are still politically very demanding. I do not think the rest of the nuanced issues around it are very important for the policy debate. I think we are very clear which route we should be going down, and yes, taking the sort of approach we have taken, taking the orthodox data that is out there across the full range and allying that with things that most people ignore, like deforestation, food, peaking after 2016, are absolutely central issues. You come up with very different results, but if the committee had done their analysis with a peaking of 2020 their results would not be hugely different from ours, I do not think. They would be very similar. That peaking date is absolutely essential to understand how important that is, and whether you think 2016 is an appropriate peaking date. The other bit they did not do any real work on, they say they did not even consider it particularly, I saw in the responses, is about apportionment. They must have used some form of apportionment of global emissions to the UK to develop any UK budgets but they certainly did not take account of any historical emissions in there, so that apportionment issue is another one that the committee have glossed over and it needs to be more thoroughly investigated.

**Q93 Colin Challen:** On that point they have said that they have used a C&C approach, sort of; they do not actually use contract and converge as contract and converge. This peaking date is clearly important for future emissions, say, after 2020, because it is bound to have a significant impact. What difference does it make to the post-2020 trajectory, having these different dates between 2015 and 2020 itself, and could you perhaps say something about the impact of the recession on the peaking date because I have read that the recession would have a 6% reduction impact on global emissions. Maybe that will impact on when we should have the peak year for emissions. Professor Anderson: I will comment on the last point first, the recession. I think it is very difficult to say. The estimate is now that growth will drop by 2.9%. You would expect emissions reduction to be a little bit less than that over a year, not more, but, of course, everyone is trying to push the economy back up. There is a bit of rhetoric about this, about some green growth, and particularly OECD countries, in terms of their reflation packages, are putting virtually nothing into green growth. The places that are leading on that are places like South Korea and China. They are putting about a third of their reflation packages into meaningful green growth. We are doing nothing, the rest of Europe is doing nothing and the States are doing nothing. It does

appear that everyone is trying to drive forward out of the recession as quickly as possible to get back to the old pathway, so, yes, this will be a step. You will go up, emissions will stabilise or maybe drop a little bit for a couple of years or so, and if we can actually drag ourselves out of recession, which is the goal of all these economic reflationary packages, we will go back on the old pathway as quickly as we possibly can and then we will start to think about climate change and the environment again, probably. Arguably, if we have a stabilisation of emissions for two years, we have reached the peak and then we go back up again, that will adjust when you might think that peak should be. I would still suggest that we should not move 2020 out to 2022. I still hold the view that we should go for 2014, we should go for this afternoon as the peak. The sooner the peak the easier it is for us to achieve. I just think it is unrealistic to keep doing the analysis on 2015 and 2016 when almost all of us accept that that is so unlikely to occur because 53 or 57% of global emissions come from the non-Annex 1 countries and those emissions, quite rightly, are going up very rapidly because that is a sign of their improved welfare and development. Our emissions are also going up, so everyone's emissions are going up. There is no sign of any sense of urgency towards 2016, so I think it is more realistic to choose 2020. I would not want to see that pushed back to 2022 because of the recession. I think 2020 is just about doable. I did not quite get your first point on that. You said if we peaked in 2020 what would be the emissions reductions afterwards.

**Q94 Colin Challen:** If we delay the peak it is bound to have an effect on the cumulative total in the atmosphere by that point. Therefore, we would have to have more severe reductions following 2020. It leads on to my next question, which is about our annual reductions pathway. If we peaked this afternoon at two o'clock what would be our annual reductions target, do you think, from such an early peak? If it were to be delayed until 2020, from that year on what impact would that have on the annual reductions that we would have to make, if you have done that calculation?

Professor Anderson: Not without a computer in front of me. If we could peak now or in the next few years the reduction rates are going to look not too dissimilar from the ones outlined by the committee, probably a bit steeper than that. This is looking at it from the UK perspective. If the whole globe peaked and you attributed the emissions to the UK in the way that the committee have done, then a 2 or 3%per annum reduction rate would not seem unreasonable, but remember that that is for all emissions. That includes food, if it is not taken out of it, and they have not included deforestation which I think should be factored in there. Therefore, on any view it would still be somewhat steeper than that. It is probably reasonable to say 3-5% for energy if we could peak now. If we go to 2020, and then if we take out food and deforestation out of 2020, basically the rate of reduction is double figures. You decarbonise almost immediately. The difference is an infinite

reduction rate pretty much after 2020 for energy, if you want to hold any reasonable chance of 2°C, because the rest of your emissions that you will be permitted after that would have to go into food and would be taken out also by deforestation. I think if we leave it to 2020, and we tried to show this with some energy curves in the paper, you would have to completely decarbonise the global system, even if you were really optimistic, by about 2035, 2045. That is assuming the upper end of the cumulative values for 2°C. If you think it is reasonable to assume that the non-Annex 1 countries would be allowed to use energy after us, fossil fuel based energy, and I think that was a reasonable assumption in the past, then we would have to decarbonise well in advance of 2035, so 2020, 2025. As I say, it is almost a vertical drop if we globally peak in 2020 for Annex 1 countries or you fail to meet 2°C or any reasonable chance of it, which I think is far more likely.

**Q95 Mr Chaytor:** The revised EU ETS Directive for Phase III weakens the cap quite significantly. I am interested in what you feel about the balance between allowing Member States to purchase allowances within the trading system as against the proportion of their reductions that could be achieved by purchasing offset credits using CDM. *Professor Anderson:* I think CDM should not be allowed. I completely disagree with any CDM.

#### Q96 Mr Chaytor: Why?

**Professor Anderson:** First, if the CDM countries have caps, that is fine and if it is a cap structure that is apportioned around the globe based on some underlying premise like a certain Community value for 2°C and you apportion that out in a way that everyone accepts, then fine, you can have CDM, but that is not what CDM is about. CDM is buying emissions from countries that have no caps.

**Q97 Mr Chaytor:** But, following Copenhagen, there may well be the possibility of some caps being agreed by non-Annex 1 countries. If there were a deal that led to that then that would change the situation over CDM.

Professor Anderson: Yes. There is a slightly more nuanced point in this, but if there were a deal that led to emissions caps for all nations around the globe, and if those emissions caps were all premised on the same underlying scientific approach and the same target, 2°C or whatever that target might be, then I think you could argue that CDM is a workable mechanism, because if we buy a tonne off them they cannot emit that tonne. However, if there is no cap and we buy a tonne off them the important thing to remember is that CO<sub>2</sub> is in the atmosphere for a long period of time. We keep hearing about this additionality thing, "We can guarantee the additionality". Over 100 years? That is how long the CO<sub>2</sub> is in the atmosphere for. You get these sorts of things, "We will put some wind turbines up and displace something else", but those wind turbines will give access to electricity that gives access to a television that gives access to adverts that sell small scooters and then some entrepreneur sets up a small

petrol depot for the small scooters and another entrepreneur buys some wagons instead of using oxen and the whole thing builds up over the next 20 or 30 years, so it is the same thing. The additionality test would be, if you can imagine Marconi and the Wright brothers getting together to discuss where they will be in 2009, easyJet and the internet will be facilitating each other through internet booking. That is the level of additionality you would certainty have to have over that period. You cannot have that. Society is inherently complex. The  $CO_2$  is there for that long, so additionality is a meaningless concept in a complex system, which society is over that sort of time frame, so CDM has no validity as a mechanism for reducing CO<sub>2</sub> emissions in the absence of caps. It may have validity as a mechanism for providing funding to other countries that deserve that funding, in my view as reparation because we have stopped them going down the fossil fuel route and we have also imposed very significant climate change impacts on them, so it is not aid; it is reparation, but if that is used as a way to allow us to do the things we want to carry on doing then that is completely inappropriate. That is why I am fundamentally opposed to CDM in the absence of caps. When it comes to the EU ETS, it is okay if you buy off that but you have to think that, if everyone is going to buy off it, like you are using the reason for why you build the third runway: you buy it off the EU ETS, and no doubt every other airport is doing the same thing, how viable is that as the caps tighten up in the future? Are we locking ourselves into high emission infrastructures we cannot get out of?

**Q98** Mr Chaytor: Is that not the purpose, to encourage more people to buy through the allowances so the price of allowances will go up, which is the biggest incentive for them to invest in low-carbon infrastructures?

Professor Anderson: Within the EU?

**Q99 Mr Chaytor:** Within the EU. *Professor Anderson:* Yes, the price will go up but—

Q100 Mr Chaytor: But the consequence of more people buying the allowances will drive the price up. Professor Anderson: You are quite right, so every nation invests in massive airports, buys all the new A380s and the new Dreamliners when they come out, and then turns round and says, "Actually, we have bought all of these things. We cannot fly them any more because we cannot, unfortunately, switch them over to hydrogen". There are biofuels but there are massive concerns about biofuels and they also wax at altitude so it is difficult to fly with biofuels, so we will have built all of this high carbon infrastructure and then somehow we are going to have a political system to say, "That is perfectly okay. We will just leave that to one side. We do not mind having spent all this money on it. We are not going to use it". As soon as we have built these things we will find every mechanism out there to allow ourselves to be able to use them and show no leadership. The idea that we are going to deliberately set up a high carbon infrastructure because we can

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buy out elsewhere and then in the future somehow we are going to make that redundant well within its lifetime is a complete waste of capital expense when we could be improving the tram systems and lots of other things in our countries that we are lacking. I think it is an irresponsible route to go down. I think Hoon's comment is a really good example of exactly what all the countries will be trying to do. They will be gaining the whole system to allow them to carry on doing what they historically have done. They appear in discussions about whether we can have power stations without CCFs, the idea that they might retrofit in the future. All of these sorts of things and the emissions that come from that allow us to buy out of the EU ETS. Germany and Poland will be saying that, everyone will be saying that, and all that will happen is that you will weaken the national allocation plans so the emissions will get weaker and weaker because every country will be arguing as to why they cannot make the changes.

**Q101 Mr Chaytor:** So you are not opposed to the trading scheme itself but should there be a cap on the amount that individual countries can buy through the trading scheme?

Professor Anderson: There is a cap now. Obviously, it is only the traded sector. I do not have a problem if the cap is tight and we had a very clear idea of where that cap is going, because then we would know, if we built these things, to some extent what the prices might be. We have no idea what the cap is because it is a horse trading process; we all know that. They are all horse traders, so the more high carbon infrastructure every country puts in there the more they are all horse trading, the weaker the caps will turn out to be and we will end up with the pretty meaningless system that we have got now. I like the EU ETS as a mechanism within the EU; I do not think it would work globally, but it is fundamentally flawed and it is far too weak. The other thing, and this is an important point that needs some more research, is that the assumption at the moment is that a tonne is a tonne is a tonne. I think buying a tonne from CDM is not a tonne at all; it is nothing to do with climate change, but buying a tonne from the ETS is still assumed to be, "We buy a tonne from there; it is the same as us emitting a tonne here". I do not think that necessarily holds. If the UK has a very strong view that 2°C has a certain probability as the way it should go and it works out its own pathways, the EU does not have that as its premise. At the moment it has a traded sector and some ad hoc policies for the non-traded sector, so the overarching structure of the science and the regime within the EU is not as robust as that for the UK. For a robust regime to go to a non-robust regime and claim that a tonne is a tonne seems to me not appropriate. If you imagine a country that really believed in 2°C and another country that really believed in a 6°C future, is it appropriate for the 2°C country to buy a tonne out of the 6°C country? They are not the same thing. This country would have to make no changes. I think that if the UK wants to show some leadership, which it claims it does and I would argue it is doing, it should not buy it out of the EU ETS on a tonneby-tonne basis. There should be some proportionate cap so that every time we buy it there is only 0.8 of a tonne or 0.7 of a tonne.

**Q102** Mr Chaytor: Just on this method of accounting within the carbon budgets, what is the significance of us using the allowances as the means of accounting for progress rather than the actual emissions? Is there a significant difference between allowances and emissions?

**Professor Anderson:** I do not know the answer to that one. My view is that we should take the emissions as what we should be assessing our progress against, not just home emissions but emissions that relate to consumption as much as production, the emissions data Defra has had produced for itself already. It is public if you go and search for it but it does not make it openly public that UK emissions are basically doing that. It always tries and says they are going down a bit, so I think we should take the consumption emissions as well as production emissions but it should be the emissions that matter.

**Q103 Colin Challen:** Do you think there have been any major scientific developments which perhaps the Climate Change Committee has not taken into account? I am thinking particularly of the IARU Conference in Copenhagen in March and its conclusions which have just been published.

**Professor Anderson:** Undoubtedly the science is changing. Anyone who plots a learning curve, and we have all been plotting these things for years, would be able to tell you that whatever we think was fairly good before becomes bad now. The situation gets worse and worse. There is no learning curve, so what is coming out of Copenhagen is that it looks like the impacts for 2°C are probably at the worse end, and no doubt they will not be appropriate for 2°C; they will be appropriate for 1.5°C. We have not learned from this. All the time we underestimate the scale of the problem and the scale of the adaptation issue and the impacts and the scale of the mitigation issue, and we have no learning curves there at all. We get burned every time and we put our hand back in the fire again and we will no doubt do it again. What has happened is that the science has changed. The science says, yes, things look even more demanding than they were before. Originally people used to talk about 550 for 2°C and that has gradually moved towards 450 and some people talk about 400 now. You can almost plot that pathway and I think we should be aware of that. This is my concern with the Climate Change Committee. It errs on the side of optimism and yet the learning curves say you should err on the side of pessimism.

**Q104 Colin Challen:** Should it somehow be more flexible, able to respond more quickly, because I do not think they are going to publish another report on these initial conclusions for quite some time? As I say, they have done their main body of initial work which will carry us through politically for quite a

period of time. There seems to be a mismatch there in its ability to quickly update the Government on changes that might be necessary for budgets.

Professor Anderson: What it should have done in the first place was take more a pessimistic view than an optimistic view and then it should not have to revisit the science too often. The concern about revisiting the science is that science is inherently an iterative, uncertain process, and that is what is good about science; it is not a black and white view. Therefore, you have to be quite careful of any process that keeps coming back to revisit the latest science because the latest science is likely to be wrong or not quite as it seems in a couple of years' time. I would be a bit cautious about approaches that kept going back to the science and revisiting the budgets, but I think if we had started off in the first place by taking a far more practical view (and they would probably argue that politically it was not very practical), if we had taken a more negative end of the spectrum, I think that would have held us in good stead as the science changes out in the future and it is very likely to carry on down that learning curve as things are going to get worse and worse. If you had done that in the first place you would not have to keep revisiting the science, but it is really important that we do revisit the science. One of the big issues that came out, particularly in terms of the poorer parts of the world, was acidification, that at 400–450ppmvCO<sub>2</sub> you are going to see some very significant acidification issues. We do not know quite what will do to fisheries and things like that, but a lot of the poorer parts of the world are really dependent on things like their local fisheries and those sorts of impacts are potentially catastrophic for some of these economies and societies and I do not think they have been factored in sufficiently well. There are some really important issues we need to think through. For instance, DFID's role might be to think about those sets of issues to do with how the aid budgets reflect the change in acidification; are there issues that need to be thought through there, or the adaptation to the areas that rely very heavily on fishing to other forms of support for their economies? There are issues that come out of that that may affect other things than just mitigation. I think the committee should probably have taken a less optimistic view, possibly a more demanding view, than they did and therefore they would not have to keep revisiting the science so often.

**Q105 Colin Challen:** But that would require far more demanding budgets and some kind of crash programme of public works, et cetera?

**Professor Anderson:** It would, yes. We have no problem investing trillions in the banks. You must have heard this over and over again; people go on about this now. We have been arguing for a few billion pounds here, there and everywhere. There is never any money around. As soon as the banks go pear-shaped there is trillions that somebody found, so we can find trillions to deal with things but we cannot find a few measly millions or billions to deal with supposedly one of the greatest threats that we face, so, yes, I think there should be a massive

investment programme in all sorts of things to drive things in a different direction, but we have unfortunately spent the money on the banks.

**Q106 Mr Caton:** You accuse the Climate Change Committee of being over-optimistic. Recent history shows the Government has been even more over-optimistic in its forecasting. What are the main lessons that it needs to learn now for the future of the UK climate change programme, given the disappointing progress towards the 2010 target for a 20% cut in CO<sub>2</sub> emissions?

**Professor Anderson:** The lessons that we all know. Everyone is always so optimistic. They say it is just a learning curve. We can look at that learning curve. The committee has been far too optimistic, the Government has been far too optimistic, the globe has been far too optimistic. So many people will be relying on Copenhagen as if something worthwhile is going to come out of Copenhagen. I hope something worthwhile comes out of Copenhagen. It looks extremely unlikely that that is going to happen and very few people I know who are senior people involved in the negotiations there think anything significant is going to come out of it, so we need to be thinking a bit more realistically about where things are going, and if you do that you come out with the sorts of things that Colin is talking about here, almost like a Marshall Plan. That is the sort of shift that we are going to have to see but we are not going to do that. We are going to come up with as much optimism as possible that allows us to carry on with the orthodoxy, so until we are prepared to recognise that all we are doing at the moment is preparing to recover the deckchairs on the Titanic in preparation for moving them. We are not even at the moving the deckchairs stage, let alone pointing the ship in a different direction. We are so far removed from the scale of the problem and we are so reluctant, all of us, to address this because it affects us personally, it affects our economy, the way we live our lives, our attitude towards other people, that at every level we try to find anything we can to avoid that, whether scientifically or politically. I do think we are far removed from this, and this is almost an issue of culture and philosophy as much as it is now of science. In some respects the mitigation agenda is well understood from a science perspective. The science has got to tell us a lot more about the adaptation agenda as yet but I think for mitigation we know what we need to do. The problem is not lack of engineering, the problem is not lack of science; it is lack of will. I think it is far more of a cultural, political, philosophical issue now than it is one of science and engineering.

**Q107 Joan Walley:** You have said what is wrong with how we are going forward but, given the policy framework that we are currently operating in respect of the Climate Change Committee, what do you think the Government should be doing? How should it be addressing the need for a more consistent and regular approach towards evaluation? What would

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you put in place? What would you advocate? It is all very well to say what should happen but what would you do to evaluate our existing policies on that?

Professor Anderson: They are not going to point us in the right direction and that is principally because they are driven by the price mechanism. The price mechanism for dealing with climate change is just one of a suite of instruments it might use and it is being overly emphasised as to its importance. The price mechanism is a perfectly reasonable route to go down if you have marginal adjustments year-onyear. If you want to reduce emissions by 1% per year, yes, up the price of carbon, up the price of fossil fuels and you will gradually move in that direction. You will not deal with climate change but you can use the price mechanism. If you want to deal with climate change you are going to have to look at some reductions that are far greater and there are enormous equity implications from doing that, so I think you require far more of a regulatory framework. If Government is going to genuinely be committed to climate change it has no longer to be fearful of very stringent regulation and there should be no get-out clauses in this. For instance, in the legislation that is coming through on cars some time soon, I think, it is 130 grams per kilometre of CO<sub>2</sub>. That is a fleet average. If a car can be made at 130 grams per kilometre, and Audi made the A2, which is a four-seater, with 94 miles per gallon at 100 grams per kilometre about seven or eight years ago, you should be selling no car above 130 grams, not as the fleet average. The regulatory framework should be really clear on this, that in miles per gallon terms no car should be allowed to be sold on a forecourt next year that does less than 50 miles per gallon, and it will be improved at 5% every single year, year in, year out, to give a real clear market signal. That is no new technology; we do that already for some of our cars. That also affects the role model issue. The Top Gear end becomes about driving the more efficient car rather than the faster car. I think we need to have really clear regulations like that. I would have a moratorium on airport expansion, so no airport expansion until the improvement in efficiency from aviation can be matched to any growth rate. There should be no increase in emissions in aviation.

**Q108 Joan Walley:** You have just mentioned two things. You have mentioned greater emphasis on and use of regulation and you have mentioned the whole issue towards airports and airport capacity and airport policy, but, given that we have got the Climate Change Committee and we have got DECC, what you have just talked about in terms of trying to change the policy framework links to two different government departments, ie, BERR and the Department for Transport.

Professor Anderson: And Treasury.

**Q109 Joan Walley:** And Treasury. In terms of what you are saying, how would you reconcile these different government departments with the work of the Climate Change Committee and its policy framework?

**Professor Anderson:** I assumed that government was completely joined up nowadays so it would automatically transfer between these departments. That is what we have been told for a long time. In reality the Government is like every other part of our own lives-there are all these separate elements where there is no integrated thinking. There is lots of integrated rhetoric, and that is not just in government. I work in the university and the whole university spectrum is like that. It is set up in silos. Our own lives are like this where we do not behave rationally. It is a huge problem. I regard this not just as a government problem; it is a huge problem of our modern society-how do we integrate and think about these sets of issues and sustainability? We have to deal with that across the board of these remits. You have to have far more powerful ministries. At the moment they are little snapping dogs at the ankles of BERR and Transport and Treasury. That is not appropriate. What they are setting in train has to be fundamental in what the Treasury is thinking about and what BERR is thinking about and what Transport is thinking about, so they will have to meet with the goals that have been laid out by the Committee on Climate Change, or, I would suggest, more stringent goals. There is no sign of that occurring yet but there is if you look at places like the Welsh Assembly Government, and arguably it may be occurring in Scotland, where you see more integration. I think the UK Government is a peculiarly English government in that sense in that it maintains this level of fragmentation and hierarchy that is not immediately evident. If you talk to Jane Davidson in Wales, she is driving through all sorts of things in Wales with a peanut budget, and it also gets opposition within the Welsh Assembly Government, that we are just not prepared to do here. There are examples out there of governments even within our own boundaries that are demonstrating greater leadership on integration. I think the UK, as I say, almost a peculiarly English government, is not demonstrating that at the moment and that is another area of leadership where we should be showing that to the rest of the world, that we can actually do that, that Treasury will jump to the tune sometimes of DECC and Defra, which it certainly does not do at the moment.

**Q110 Joan Walley:** And in this joined-up world that we are talking about how would you make sure that all the changes and advances and greater understanding in respect of scientific awareness is then consistently and periodically factored into this non-silo operation of other government departments?

**Professor Anderson:** One thing that is happening at the moment, and this is my own experience; I have recently given a number of talks to DfID, is that there has been a whole range of seminars we have set up for DfID and they look to me to be really interesting dialogues. It is very much a two-way dialogue. As academics it is good for us to have some sense of what is going on in the political process. There was a two-day event and they have got some follow-ups to that. I have got some more seminars

coming up with DECC, so I think those standard mechanisms can allow us to get the message across to the policy makers, but we do not get asked to go to BERR, Transport or the Treasury. We are there at DECC and Defra. I do not think there is anything particularly difficult about getting the scientific message across; I think we know how to do that, and it is the Committee on Climate Change's responsibility to do that as well. It is the idea that, once you have got the message across, what powers are there to ensure that these ministries match the requirements of what the science has shown, interpreted through the committee and the way it does that?

**Q111 Joan Walley:** How much would you say that that links back to whether or not there is or is not a sufficiently broad skill-set amongst the professionals and the civil servants in each of the silo departments that you have just referred to?

**Professor Anderson:** I have met some very good civil servants and some very good MPs, but many of them, I think, still probably struggle with some of the science. I do not know if anyone has got the graphs on this, but my guess is that there are far more people trained in the classics than there are trained in science across the Civil Service and across Parliament, all of the MPs, and the Lords for that matter. I think that is probably not particularly healthy, and I think that is a long-term issue, how you overcome that. I do not think we are going to do that overnight.

**Q112 Chairman:** Thank you very much. We have covered quite a lot of ground. Your characteristic trenchant views are of interest to the committee and we will be discussing them further, I am sure.

**Professor Anderson:** I thought they were moderate views!

Chairman: Thank you very much for coming in.

#### Memorandum submitted by the Met Office

#### INTRODUCTION

1. Climate change is real and getting worse. The earth is already nearly 0.8C warmer than it was in around 1900. Without large and rapid global emissions reductions it is very likely that global warming will exceed  $2^{\circ}$ C over the coming decades.<sup>1</sup>

2. The present day concentration of the main man-made greenhouse gas,  $CO_2$ , is already around 380 ppm with other greenhouse gases adding an equivalent  $CO_2$  of around 70 ppm. Some estimates suggest that greenhouse gases would have to be stabilised at or below 500 ppm  $CO_2$ -eq to give a good chance of limiting eventual global temperature rises to between 2 and 3°C above pre-industrial levels. The Met Office Hadley Centre models warn that an even lower level of 450 ppm would most likely be required. Even if we can limit global warming to between 2 and 3°C, and local changes may be considerably larger over most of the globe, there will be significant changes in the world's climate, some of which may be irreversible.

3. Climate change is a global issue and the reduction of greenhouse gases therefore requires a concerted global effort. UK carbon budget targets must be aligned to global targets.

# The frequency with which targets and budgets should be reviewed and updated to take account of new scientific evidence

4. Currently, carbon budgets are specified in detail for three periods, 2008–12, 2013–17, and 2018–22, with additional discussion of the 2050 target. There may be some value in extending the detailed budgets further into the future based on existing knowledge. Later, the budgets should all be updated when new information on climate science or significantly different models becomes available. A pragmatic approach would be to link it to the IPCC reporting cycle (approximately five to six years). Additionally, if new technologies become available or costs of mitigation technology changes significantly it may be useful to update the budgets between IPCC reporting periods.

# The suitability of the climate models and the validity of the assumptions used by the Committee on Climate Change in setting carbon budgets

5. The Met Office Hadley Centre worked with the Committee on Climate Change to translate global multi-gas emissions scenarios into temperature projections. This was carried out using a simple climate model, set up to sample uncertainty in key climate parameters. The ability of this modelling system to reproduce more complex climate models was demonstrated during a study using scenarios with increasing greenhouse gas concentrations. This validation has since been extended to demonstrate that it also has skill in reproducing more complex Earth System Models for emissions scenarios with rapidly declining emissions.

6. The Committee on Climate Change's 2016:4% low scenario corresponds to a  $CO_2$  emission reduction of around 50% on 1990 levels by 2050. Using the Met Office Hadley Centre model, it corresponds to a median warming of a little over 2°C, with a probability of around 50% of exceeding 2°C.

<sup>&</sup>lt;sup>1</sup> Intergovernmental Panel on Climate Change Working Group 1 4th Assessment Report.

7. The Committee on Climate Change required probabilistic scenarios of temperature projections for a range of emissions scenarios. Doing this with the most complex three-dimensional earth system model would be computationally expensive. Variants of the simple model approach used for the Committee on Climate Change have been used in mitigation studies in the United States and the EU, and we believe this approach is suitable here.

8. However, we also recommend that in future a small number of further simulations be carried out with a complex three-dimensional Earth System Model. This would provide additional validation and make available regional scenarios for estimating the residual impacts after emissions reductions, which would be useful for adaptation planning.

9. Some of the validation data on the use of the simple model to give temperature projections, and the details of the 2016:4% low scenario results, are reported in the technical annex to the Committee on Climate Change's report. We would be pleased to supply copies of the key validation plots and to provide a longer submission or presentation on any aspects of our response.

#### Choice of climate sensitivity uncertainty distribution in Met Office models

10. In projecting the response to emissions reductions there are some important issues to consider, particularly in the uncertainty in one of the key climate parameters—climate sensitivity. Climate sensitivity can best be described as a measure of the eventual amount of global average warming for doubling of CO<sub>2</sub>.

11. The Met Office estimated the distribution of climate sensitivity uncertainty from a study by Murphy *et al.* This combined information on complex climate models with a wide range of climate observations.

12. Alternative distributions of uncertainty in this parameter do exist and a short set of test simulations using some of these reveals that the Murphy *et al* distribution tends to give a lower probability of staying under a  $2^{\circ}C$  global warming target. The implication is that, for the type of scenarios we consider here, we have taken a precautionary approach to estimating the risk of exceeding a given peak temperature level for a given evolution of greenhouse gas concentrations in the atmosphere.

13. However, we also note that while the probability of exceeding the 2°C level varies with the choice of distribution, the spread in the central (median) estimate of warming by 2100 using different climate sensitivity distributions for various mitigation scenarios (such as the 2016-4% low) tends to be much less than the difference between a business-as-usual (do nothing) scenario and the mitigation scenario.

14. We interpret this as there being a significant degree of robustness in the median warming presented by the Committee on Climate Change, whereas the estimate of the probability of staying below 2°C represents a more precautionary approach.

#### Other recent scenarios

15. Alternative mitigation scenarios have recently been published by Anderson and Bows, Meinshausen *et al*, Allen *et al*, and Parry *et al*.

(a) The Anderson and Bows simulations suggests that more rapid post peak reductions in emissions than that estimated by the Committee on Climate Change will be required to achieve similar temperature outcomes. We believe this is an artefact of their method, and that this method is not as suitable as that used by the Committee on Climate Change and Met Office Hadley Centre.

However, we plan to examine the Anderson and Bows scenarios in the modelling framework we applied to the Committee on Climate Change scenarios and would be pleased to update the Committee later.

- (b) The Meinshausen *et al* scenarios appear to give a median warming of around 1.8°C for a 50% emissions reduction by 2050, and estimates a lower probability of exceeding 2°C. This appears to be mainly a consequence of the climate sensitivity treatment—less weight is given to the Murphy *et al* distribution (see points 7 to 11).
- (c) The Allen *et al* scenarios treat only CO<sub>2</sub> but appear to be largely consistent with the Committee on Climate Change warming projections. This work also demonstrates why it is useful to have some consideration of the target emissions trajectory even beyond 2050.
- (d) The Parry *et al* scenarios use a similar approach to the Committee on Climate Change work and give a consistent result.

#### Future work

15. AVOID is a DECC/Defra funded research programme led by the Met Office in a consortium with the Walker Institute, Tyndall Centre and Grantham Institute. It was set up to provide UK stakeholders, especially those in Government, with the latest mitigation advice, tailored to their specific needs. AVOID will make the latest climate science accessible to decision makers, building a framework that will encourage integration between climate scientists, social scientists and economists to inform policy.

16. The Met Office Hadley Centre is currently extending the range of scenarios used by the Committee on Climate Change, and later this year we will provide a new estimate of global impacts and the costs of achieving mitigation policy. Early indications are that the AVOID scenarios are consistent with the Committee on Climate Change scenarios. We would be happy to provide further information from this programme to the Committee.

Further details about the AVOID programme can be found here Met Office: Avoiding dangerous climate change

#### The Met Office

17. The Met Office has a world-leading standing: because of its scientific excellence in both Numerical Weather Prediction and Climate Research and because—uniquely—both activities are carried out within one organisation using a single modelling suite. This combination of scientific expertise and operational capability means that the Met Office can provide "seamless" prediction—on timescales from an hour to 100 years.

18. The Met Office supports the UK's high profile policy role on climate change issues—scientists from the Met Office's Hadley Centre made a significant contribution to the Intergovernmental Panel on Climate Change (IPCC) assessment reports and to the internationally recognised UK Stern review on the economics of climate change. We are at the forefront of world leading climate research, funnelling data from diverse natural sciences into climate prediction models that will produce, for example, the UKCP09 projections.

21 May 2009

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*Witnesses:* **Professor John Mitchell OBE**, Director of Climate Science and **Dr Jason Lowe**, Head of Mitigation Advice, Met Office, gave evidence.

**Q113 Chairman:** Good morning. Thank you for coming in. Also, I think it is very helpful that you have heard the previous evidence as well. As we go through the points we want to discuss you may wish to comment on what Professor Anderson has said. Could I start with a general question? Do you think that the targets and budgets which the Government are now presenting are actually consistent with limiting the risk of dangerous climate change?

**Professor Mitchell:** If I can go back a bit, I think one of the big issues is uncertainty in climate sensitivity. One can specify what the emissions are and work out what the concentrations are, but the uncertainty comes when one tries to translate that into a temperature target, and I think, in taking the approach that we have recently, rather than having single values but trying to look at a probability distribution of what that sensitivity is, is a major step forward. It is the first attempt at this and the science may change, but I think it makes a lot more sense than what people have tried to do in the past, taking a single scenario.

#### Q114 Chairman: Using that approach.

*Professor Mitchell:* I certainly approve of a probabilistic approach.

**Q115 Chairman:** Let us try and look at that now. If we take the scenarios about a range of concentrations and what that means in terms of global average temperature rise, do you think at the moment, when we are talking about aiming for a 50% risk of exceeding two degrees centigrade, that is consistent with the level of concentrations we are likely to achieve given the emissions pathway?

**Professor Mitchell:** The whole point of having probability distribution is to allow you to look at risk, so it is more a policy issue what level of risk you take, but from the science point of view what we are trying to do is quantify that level of risk to the degree we can given our current understanding of climate, and I think we are satisfied, given the understanding we have at present, that we have specified those levels as well as we can.

**Dr Lowe:** I would like to add something to that. The risk estimate comes from our uncertainty in this particular quantity of climate sensitivity, but there are different estimates of the uncertainty, so, if you like, there is uncertainty on the uncertainty. What has been done in the Climate Change Committee work is that they have taken the 50:50 value from one particular climate sensitivity distribution and the particular distribution they have chosen is the higher distribution. So they have actually taken a

#### 23 June 2009 Professor John Mitchell OBE and Dr Jason Lowe

precautionary approach. I prefer to think of the 50:50 as choosing a value from the centre of the distribution, i.e. half the models are above it, half are below it. So it is operating in a region where we have more faith in those models but it has this precautionary point of view that we have taken, this particular estimate of uncertainty.

**Q116 Chairman:** We are getting into a lot of unknown unknowns! If we wanted to significantly reduce the risk of exceeding two degrees, which is said to be 50:50—that is the present level—does that imply aiming for a much lower concentration of greenhouse gas in the atmosphere?

**Professor Mitchell:** Yes, that is the whole ethos behind the approach, that it allows you to say, "Well, we are going to take a 50:50 chance", or, "We think, if we are going to take a precautionary principle, we are going to cover a much lower risk of exceeding that value.

**Q117 Chairman:** Okay. So that is the scientific, reasonably confident conclusion. Is it possible to quantify how much effort we are going to have to make if we want to get that 50% risk of exceeding two degrees to increase.

*Professor Mitchell:* To reduce the uncertain uncertainty?

**Q118 Chairman:** Well, yes. Suppose we were to say we only want 10% risk of exceeding two degrees? Can we then translate that into a scientific objective as well in terms of greenhouse gas concentration?

**Professor Mitchell:** I think, in general, as one goes to lower levels of risk, just from a statistical point of view, it becomes more difficult to pinpoint that accurately. I think we actually have looked at 1% risk, but the uncertainty in the tail of the distribution is much greater than in the centre, and that is one reason for emphasising the centre. In the same way, in the recent adaptation scenarios that have been released, we have not gone beyond 10%, because you are starting to get larger uncertainties once you get down to that level of risk.

**Q119 Chairman:** Looking at the issue of carbon budgeting, which is what is actually scheduled as the aim of this inquiry, we have got budgets set as far as 2022 now and in a couple of years' time the next period up to 2027 will also be set. That is 17, 18 years. Do we need to consider setting budgets any further in advance than that, or is that sufficient?

**Professor Mitchell:** I think, from a science point of view, if you know where you want to get to, then you probably want to look out further so that you can check that what you are doing in the short term is consistent with what you may need to do in the longer term. If you are just setting targets over the next 15 years but you are not sure where you are going after that, then I think you are leaving open the case where you may come into a situation where you cannot achieve your longer-term aim. The second comment I would make is that, of course, science does change, and one does need to be aware

of being able to update the science as appropriate, and I think that needs to be incorporated in whatever legislation you are putting in place.

**Dr** Lowe: It is probably worth adding there is a halfway house where, yes, it would be great to specify the entire trajectory of emissions, and that is what we do with the modelling work, but a halfway house is that you specify the emissions for some time into the future, perhaps up to 2030 or 2050, but with that you also have a cumulative total, so a much longer-term time horizon as well, because of the long response times in the system.

**Q120 Chairman:** One of the powerful points made earlier was that we are investing in infrastructure whose lifespan will go well beyond 2027. When we build a new aircraft now the expectation is that it will be used for probably 30 years. The same might be true of a power station when we have got no date for carbon capture and storage. So we are making decisions which will directly affect emissions well into the 2030s, which would seem to strengthen the case for having budgets which go with that.

**Professor Mitchell:** That is certainly the case for the longer-term infrastructure as well.

**Q121 Colin Challen:** I wonder if you have a view on what kinds of developments in the science might take place which would trigger, perhaps, a review of the budgets that the Climate Change Committee has set and whether there has been anything in recent months which, in your view, could actually count as such an important change: because, I think, correct me if I am wrong, we have been told that the Independent Climate Change Committee has based the bulk of its science on the IPCC Fourth Assessment of the science which is a few years old and has been through a peer review process, and so on.

Professor Mitchell: I think it could put things in perspective. I have been involved in this science for about 35 years and in 1978 one of the National Academy of Science committees came out with a range of about one and a half to four and a half degrees for doubling CO<sub>2</sub>, and that has not changed that much over that period. There has been a lot of oscillation within it. The second comment I would make is that science progresses regularly; so trying to predict surprises can be difficult. Having said that, I think the assessment made in 2007 was a good and solid assessment. I think the recent meeting in Copenhagen tended to emphasise some of the more speculative aspects of climate change, including the ice sheets and perhaps methane clathrates, and those probably are issues for the longer term and, of course, for mitigation in this committee, but I think one always has a problem as a scientist between giving what is the well-established view but being aware of possible surprises in the future. There were a couple of issues that came up in Copenhagen. One was the rate of rise of sea level-have we underestimated the rate of melting ice sheets-the other is probably what happens to methane which is

locked in the tundra, and, again, that is something which is not going to be an issue until you get to the larger increases in temperature.

Q122 Colin Challen: You heard the evidence from our previous witness (which, I have to say, I tend to agree with) that, like engineers, we should perhaps over engineer our structure. If we are going to build a bridge, you try and build it, these days, to withstand totally unlikely events so that it is going to last and do the job. Should not science also be doing that, given that we are discovering all the time and the discoveries tend to go in the wrong direction? I am thinking about things like ocean acidification, and so on, much better understood now than maybe a few years ago, but a lot more to learn, and that applies to a great many of these areas. So should we actually not just say we will fix ourselves on a central band or the more optimistic opinion but to over engineer?

**Professor Mitchell:** There is a cost that comes with that, and, I think, again coming back to looking at the more probability/risk-based approach, that is where the science is going. Take something like the Thames Barrier. You are between two extremes. You do not want to under engineer that and then have a catastrophic flooding event; on the other hand you do not want to over engineering it and spend a huge amount of money for a risk that is very small; and that will depend on the particular case that you are looking at. So the level of risk is different for different applications, and that is why we have taken a probabilistic approach. In terms of taking a precautionary principle, I think that is very much a political decision and the role as a scientist is to provide the evidence which supports that in the most faithful way possible.

**Q123 Colin Challen:** I was at the Copenhagen Conference earlier this year. The impression I got was that the error band, if you like, on the models has been consistently optimistic and that the empirical data that is now coming in, in droves, points to a worse picture. Do you think that the Climate Change Committee has the flexibility to handle this and to make recommendations in a timely fashion?

*Professor Mitchell:* Could I clarify what you mean by "optimistic"?

Q124 Colin Challen: In terms of? Professor Mitchell: The modelling.

**Q125 Colin Challen:** If we look at the ice sheet data that has been observed, the trend there has been significantly worse than was predicted. This is going back just a few years, but, all the same, you can see the trend is below the worst model, if you like. I am not a scientist; I am just trying to express the graphs that I have seen based on the empirical data versus the models.

**Professor Mitchell:** I think one has to be careful looking at observations, because they include both the longer-term trends due to greenhouse gases but

also short-term variability. In your example, I am not sure whether you are referring to land ice or sea ice.

#### Q126 Colin Challen: Sea ice.

**Professor Mitchell:** Certainly there has been a very marked decrease in sea ice. We know year to year and over a period of several years that can vary a lot, and we have to be careful we do not base policy on what turns out to be a short-term natural event which exaggerates the rate of climate change, but, similarly, not to underestimate the effects due to short-term effects which reduce it. So part of the science is to try and clarify whether that is due to natural variability, and that is one of the things that the probabilistic approach can take into account, because we can look at the observations, we can look at natural variability, we can factor that into the estimates that we make for the future. Again, I think it emphasises the importance of going from single model estimates to looking at what the range of variability is, what the sources of uncertainty are, and it also leads you then into how you much focus efforts to reduce those uncertainties.

Dr Lowe: Can I add to that? With sea ice in particular, yes, there has been a lot of attention as to whether the models can actually reproduce the recent rapid declines. What we found in a version of our own model is that, when you include natural variability and you put that on top of the climate signal, then you can get year to year variations as large as some of the recent ones we have seen. Can I just bring in land ice, because there was so much focus on that at Copenhagen? The emphasis there was on evidence that suggested further acceleration of the contribution of land ice to sea level rise, but emerging in the literature there are other counterarguments. For instance, there was a talk at the AGU late last year that presented evidence of a slow down of some of the outlet glaciers and some modelling work was published in Nature Geoscience on that. So, as part of taking a balanced view, we look at both the studies that are suggesting acceleration and the studies that suggest deceleration.

**Q127 Colin Challen:** Just to be clear, would you say that the evidence generally points to the models being pretty much correct within their range of uncertainties?

**Professor Mitchell:** I am not aware of anything which shows a large disagreement. The UKCP scenarios were produced taking a wide range of models but then looking at observational constraints, how well they simulated certain aspects of the present climate, how well they simulated recent trends, to weed out those models which were less credible than the others, and certainly the results we got from that are very consistent with IPCC 2007. There is a dilemma, in that do you, when some new science comes in, latch on to it immediately with meetings like Copenhagen, or do you allow a longer period to assess the science, to weed out things which have not been thought through properly? It is a real

dilemma. One of the issues with the IPCC is that it is such a long process that it can leave things out i.e. new results that have appeared in the last two or three years.

**Q128 Colin Challen:** Should the Climate Change Committee that we have set up (and I think the UK is recognised as being a leader in climate change science) have a shorter timescale for reviewing these things than relying on the IPCC's four-year timescale?

**Professor Mitchell:** I think, in terms of the Climate Change Committee, it is obviously sensible to take into account the latest information. I think they would need to do so in terms of the background of the IPCC assessments but looking carefully at any changes from that, perhaps investigating that and, coming back to Professor Anderson's comment, looking at the science and making sure actually it does stand up to scrutiny and it is not just a single paper which is based on perhaps some short-term evidence.

**Dr Lowe:** We also have a new project that is funded by DECC and Defra called AVOID. It used to be Avoiding Dangerous Climate Change but it has been shortened. The entire purpose of that project is to make sure that the mitigation science pulls through to government. So it is in the process of producing a set of scenarios that build on those of the Climate Change Committee, and it is not just a single institute study, it involves the Met Office, the Grantham Institute, the Tyndall Centre, the Walker Institute. So the idea is that we pull through this science on a more rapid basis, and we do have regular contact with staff from the Climate Change Committee.

Q129 Joan Walley: I am not a scientist, so I am getting a little bit confused with all of this modelling and the way in which the modelling is shaping the policy that comes out of it. Previously we had Lord Turner, in his evidence to the committee<sup>4</sup>, saying that climate models incorporate carbon cycle feedbacks, and then it turns out that there is a distinction between feedbacks. Then there is the concern about the Global Commons Institute saying that you have got coupled and uncoupled models. I am just wondering if you can explain to me, in layman's language, the way in which the Climate Change Committee has taken its evidence in this coupling. whether or not it has taken all the concerns on board that it should have done and whether or not there is not a sort of faster race where not the whole thing is based on what is actually happening.

**Professor Mitchell:** In terms of the modelling, I think the first thing to make clear is that it is based on physical, biological and chemical processes which we understand to a greater or lesser extent. So it is not like economic modelling, where you have various empirical models, it is actually based on the laws of physics. In terms of what you include in the model, the earlier models did not include the carbon cycle. Those processes have now been added, so that

the carbon concentration depends on how the biosphere changes, how the ocean carbon cycle changes in terms of temperature, circulation and so forth. In adding feedbacks, we do not explicitly add a feedback: we will add the processes that we understand to be important, and, when those work together, the feedback will come from that, so we do not prescribe feedbacks specifically. When we say things are coupled, it means that all those processes are combined together and work together, rather than running one model and then running another model. I am trying to remember the question.

**Q130 Joan Walley:** The concern that I have is that, in evidence that we have had from the Global Commons Institute from Aubrey Mayer, he has pointed out that the IPCC has specifically said the omission feedbacks from models was an issue and that the real question is whether or not you have coupled or uncoupled feedbacks. Is that something which you have taken into account?

**Professor Mitchell:** The models will take into account all the feedbacks we are aware of that we think are important, then we can quantify that we understand, and to that extent the Climate Change Committee has obviously done that. Science being science, we uncover new feedbacks and there is a delay in being able to incorporate those in the complex models. One can use simple models to get, if you like, a fast-track estimate of what the effect would be, but one would have to refer to the more complex models to make sure that when you add that additional feedback you are actually taking into account all the processes that are important.

**Q131 Joan Walley:** Two things on that. The first thing is that Aubrey Meyer said that the models used by the Committee on Climate Change were uncoupled. Therefore, his recommendation was that, because they were uncoupled, they were not suitable. Would you agree with that?

Dr Lowe: I am going to take that one. I had a look at the submission from the Global Commons Institute last night and the figure I think you refer to comes from IPCC in chapter 10 and, in this context, "uncoupled" refers to whether temperature feeds back onto the carbon cycle, so where the temperature and rainfall can affect how trees take up carbon, and it has a very particular meaning. For the curve in question, basically you run the model without this effect of climate feedback on to trees and the biosphere and you get one number, you run it again with this effect, the coupled version, you get a different number and, if you have got the same emissions going in, the coupled version leads to typically a higher concentration because you are increasing the emissions that come back from the biosphere. The runs that the Climate Change Committee used to include those feedbacks, so in that definition they were described as coupled. The precise values we use to work out the magnitude of the coupling comes from elsewhere in IPCC and from a study referred to as a C4MIP study, which to date is the most comprehensive analysis of that particular type of feedback onto the carbon cycle.

<sup>&</sup>lt;sup>4</sup> Carbon Budget: Minutes of Evidence, Tuesday 4 February 2009, HC 234, published 26 March 2009.

**Q132 Joan Walley:** In your written evidence that you have given to us<sup>5</sup> (and, as I say, I am not a scientist, so this is all very difficult for me) you say that the models that were used by the Committee on Climate Change were suitable, but you also go on to say that you would call for further simulations using the Earth System Model. Does that mean that you are not accepting that the data and the assumptions that were taken by the Climate Change Committee were adequate and sufficient, or are you saying that far more needs to be done on this modelling, taking into account coupled and uncoupled versions? If so, can you say why this is necessary, and what would be the costs of doing that and what would be the benefits of doing that work?

**Professor Mitchell:** I think one of the reasons is that the Earth System Models, which take into account all these feedbacks—they take into account the weather, the oceans, the forests, the effect of the carbon cycle on the oceans—are expensive to run. So what we do is take those models and we run them over a number of scenarios and then we can use that to produce simple models, much in the way that Professor Anderson has used—taking the global models and simplifying them. You can then do a lot of investigations very cheaply.

**Q133 Joan Walley:** I thought our earlier witness this morning, Professor Anderson, was warning us, that because, for example, food, deforestation, aviation and shipping had not been taken fully into account, that was going to open up massive short-comings in the way in which the whole premise of what was going forward was taking place.

**Professor Mitchell:** I think that refers to how you control emissions. In the modelling, we take the human induced emissions, and those are prescribed. So I think that was referring more to how you reduce emissions rather than, given an emissions scenario, how then you include that in the model.

**Q134 Joan Walley:** But the modelling has, somehow or another, to be connected to where the emissions are, does it not, at some stage?

**Professor Mitchell:** That is more the socio-economic modelling, which the Met Office is not involved with. We will start with a set of emissions which will be tied to some kind of socio-economic scenario, make certain assumptions about aviation, and so forth. As far as the atmosphere is concerned, it does not really matter where the carbon comes from, it gets well mixed, and hence it is not relevant to the science of working out what the climate impacts are given a set of emissions.

**Q135 Joan Walley:** So why is it necessary to do this Earth System Model?

**Professor Mitchell:** To know what the effect of carbon dioxide is on climate, taking into account all the different interactions between the atmosphere, the ocean, how the carbon cycle itself responds both to changes in climate and to changes in carbon dioxide, because it will respond to the induced

changes of carbon dioxide. So it is to make sure you have got a holistic picture of the whole system of climate and the carbon cycle. To do that properly you need a full three-dimensional model, and, as I say, that is too expensive to run a lot of scenarios.

**Q136 Joan Walley:** How do you mean too expensive?

**Professor Mitchell:** In terms of computer time. These things are enormously expensive in terms of computer time, and that is probably one of the main limitations.

**Q137 Joan Walley:** Are you saying there is not the capacity to actually do this work?

*Professor Mitchell:* There is not the capacity to do, in detail, all scenarios.

**Q138 Joan Walley:** If it is needed, why can we not be doing it?

**Professor Mitchell:** To a first approximation you can take the complex model and look at the results and simplify those to get broad relationships between emissions, temperature and carbon dioxide, and that is what we have done. When we look at those results, we will then come back and check any key results with the global model, but we cannot explore the whole range.

Dr Lowe: The type of models we have used, the simple models, they are simple Earth System Models and they are good at reproducing some of the features of the more complex three-dimensional models that John refers to. So they are good at producing global average temperature, and we have tested them by comparing them with the more complex models over a range of different scenarios. At the moment there are fewer simulations of the type of scenarios we are talking about here, with very strong mitigation. I think part of the suggestion is that it would be nice to do some further testing with this particular type of scenario. As it happens, we have now done some of that very recently and we find a simple model does have some skill even for that type of scenario. The second point, though, is that the complex models do give you something extra. They tell to you what is happening regionally so you can actually go down and look at the process within the model regionally and say, "Is that realistic?"; whereas with the simple global model you can only look on a global average; you are averaging out some of the information. Also, because the complex model it has this more elaborate way of representing processes, if there are any surprises within the system, any local more rapid changes. then you will see them within the three-dimensional model. So we would not run this more elaborate model for the 729 model variants that we ran for every scenario that was used in the Climate Change Committee, what we would suggest doing is maybe picking one, two or three of those across the temperature range, almost as a check, to see what is happening regionally.

**Q139 Joan Walley:** Is that something you are going to be doing automatically or is that something which somebody somewhere needs to be showing leadership on and pushing for?

*Dr Lowe:* That is something the AVOID project has in mind doing.

**Q140 Joan Walley:** So it is doing it anyway. *Dr Lowe:* We are doing it anyway.

**Q141 Joan Walley:** To the extent that you need it to be done. It is doing it fully, 100%?

*Dr Lowe:* It is doing a subset of three-dimensional model runs. I think it is a matter of trying to debate how many you would really want to do.

**Q142 Joan Walley:** How many would you really want? How many would it be nice to have and how many is it necessary to have?

**Professor Mitchell:** It depends on the degree to which you want to take out your results. The assumption is that the simple model does a reasonably good job, but, as Jason has alluded, there may be certain regimes where, either locally or even globally, you do see some marked responses, some extreme responses, which are unexpected. So it is a question of how certain you want to be of those results.

**Q143 Joan Walley:** So that I am clear, is that actually incorporated in this AVOID project that you referred to that, is it, Defra are doing? *Dr Lowe:* Defra and DECC are funding this.

**Q144 Joan Walley:** I just need to know, yes or no, are they covering it in full or does some pressure need to come from somewhere to make sure that it happens? *Dr Lowe:* Some of it has already happened (some of it has now been done); some more of it is planned on the work plan, on the timeline of AVOID already.

**Q145 Joan Walley:** Is that exactly what you want to happen, or are you asking for more than is currently funded or possible?

**Professor Mitchell:** I think there is always room for improvement. It is not just on the litigation side but also on the adaptation side. In terms of the, modelling, as Jason alluded to, changes regionally in the carbon cycle add up to the global total. Therefore, the more accurately you can do regional climate change, the more accurately you can look at the carbon budgets as well as the climate change to which we are adapting. One of the issues that we have had with the UKCP scenarios is that we are aware that, for example, the modelling of storm tracks, which are particularly important for climate, is poor in models. So one of the things we would like to do is to do that better. For that we need high resolution, for that we need more computing, and that is something that the Met Office is already engaged in working towards. The limitations, perhaps not so for mitigation, except in terms of the scope of things you can cover, but for adaptation being able to model in more detail is important.

**Q146 Mr Chaytor:** To what extent do you think the Committee on Climate Change has taken on board the scientific evidence and translated it directly into appropriate policy recommendations, or do you think the committee is being too pragmatic in terms of only recommending what it judges to be politically feasible?

**Professor Mitchell:** What we have done at the Climate Change Committee is they have said these are the scenarios we would like you to look at. We have run those scenarios to see what the effect on climate is and what the effect on the carbon cycle is. Jason probably has had more contact with that. That is work he has been involved in. I have also had contact on the adaptation side, where I have explained what we have done for the UKCP scenarios, so I know they are listening to what the science is and taking it into account. In terms of mitigation scenarios, you have had direct contact with the Climate Change Committee.

**Dr Lowe:** Yes. This has been quite a long process. We have had numerous discussions on the various uncertainties. So several of the topics like feedbacks that have come up today, there have been numerous discussions behind those. These, again, have not just involved one or two people, they have involved multiple experts coming in. In that way I think there has been a fairly good examination of the available science, that is the available science that is coming through AR4, but also the post AR4 science. For instance, there were staff from the committee at the Copenhagen Climate Change Conference to see what new was coming out of that. That seems pretty current in terms of pulling in new information.

**Q147 Mr Chaytor:** But in terms of the committee's reports, the committee's recommendations over targets and budgets, do you think that what we now have in respect of targets and budgets accurately reflects the significance of the scientific recommendations, or do you think there is some mediation and some compromise there?

*Dr Lowe:* When I look in a report I can see how the budget numbers trace through to the climate simulations that we ran. I am not sure if that answers your question directly.

Q148 Mr Chaytor: It answers it indirectly. You mentioned the uncertainties. There are uncertainties over CO<sub>2</sub> emissions but also uncertainties over non CO2 emissions. Could you say a bit more about that? Dr Lowe: Yes and no. No, in the sense that for us those emissions are the input, if you like, and then we combine the uncertainty on those scenarios with the climate modelling uncertainty. Yes, in the sense that in both the Climate Change Committee work, and now extending that in the on-going projects, we run a range of different scenarios. These have a range of different CO2 and non CO2 gases. One particular uncertainty, in the form of atmospheric aerosols, we have looked at in a lot of detail to see how that moves the temperature probability results around, for instance, so it is in there.

**Q149 Mr Chaytor:** In terms of what is missing, a lot of the science has progressed rapidly in recent years, and who knows what new insights are going to be developed shortly, but what are the most important missing areas of data now? What knowledge do you need most urgently to increase the level of certainty about your predictions?

Professor Mitchell: There is a lot of uncertainty but of the two main areas, one is probably cloud climate feedbacks. Clouds can either cool the climate, because they reflect the solar radiation back to space, but they also have a very strong greenhouse effect. So very small changes in cloudiness can have quite an effect on the earth's budget and, of course, with a warmer and moister atmosphere, it changes the distribution of clouds and models struggle to agree on what those changes are: so that is one of the biggest sources of uncertainty. We have been looking at different models to understand the key processes in determining that uncertainty, what observations we have to make to increase the physical reduce the understanding, to uncertainty. particularly through things like satellite, through aircraft measurements, and so forth. So that is the one big area. The other area is the carbon cycle, which is relatively new in terms of our system modelling. Jason mentioned the C4MIP, which is a carbon cycle climate change inter-comparison project. Again, looking at the models, trying to understand why they differ, then relating that to our understanding of the real system and making the measurements that we need to improve our modelling of it. In terms of the carbon cycle, because it is newer, I think in some ways there is more ground for progress. We know from weather-forecasting the problem of improving cloud simulations is very difficult, but, on the other hand, I have been involved in this 20 or 30 years and we have not reduced cloud uncertainty, but I think we are now getting to the stage where people really are concentrating on the processes rather than just running new simulations for scenarios, and I think there is a need for science to concentrate on that if we are not going to go on with this level of uncertainty.

**Q150 Mr Chaytor:** Are we dealing here with things on such a gigantic scale and over such a long timeframe that scientists really will have to accept that there will always be massive uncertainties? If we are trying to make scientific assessments to inform public policy in 50 years' time, has this ever been done before? Can you think of analogies of previous projections over such a long period of time?

**Professor Mitchell:** Not over that period of time, but I think you are right. What we tend to do is prioritise those things where we know we can make a difference quickly, but, on the other hand, if we do not start soon looking at some of these long-term uncertainties, we certainly will not reduce them. To some extent it is an act of faith. With science being science there are some things which we will be able to develop and some things which we will not, but we certainly need to maintain that effort, and I think there is a danger, if we do not do that, we could be five, 10 years down the road and find we actually

cannot say more than we can at present. So it is maintaining the longer-term research to reduce those uncertainties at the same time as making specific efforts to answer the sort of questions that you are asking today.

**Q151 Chairman:** Your memo to us<sup>6</sup> suggested that the estimate that the Committee on Climate Change have made on the probability of staying below two degrees centigrade represented a precautionary approach. Can you explain exactly what you mean by the phrase "precautionary approach" in this context?

Dr Lowe: That is a much easier one to do with a diagram actually, so we may need to supply that afterwards, but I will have a go first. It comes back to this point that one of the key uncertainties is climate sensitivity, and there are several different estimates of that measure of uncertainty. The Hadley Centre produces one, other climate institutes produce another. There are of the order of 15 of these now, but maybe more, because more are cropping up, and these uncertainty estimates are made in differing ways. If you were to sit down, the simplest thing would be to say, if we are interested in relating the stabilisation concentration of CO2 that gives a 50% chance of going over two degrees, we would come out with a different number for that CO2 concentration depending on which of those uncertainty distributions we go for, and what we find is that the Murphy et al distribution that we used in this work tends to give, if you like, the lower chance of staying below two, or it suggests that you need a lower concentration than some of the other versions. Again, this would be much easier with a diagram. I think perhaps a diagram with a couple of arrows may clear up the point very simply.

**Q152 Chairman:** In that case we will wait for the diagram. There is quite a significant difference between the Committee on Climate Change's work and the work done by Professor Anderson. How do you explain that?

Dr Lowe: Firstly, it is a very different method. We are starting with the emissions: from that we are working forward, calculating the concentration of greenhouse gases, and from that we are calculating the temperature rise. Professor Anderson is working the other way: he is looking at an existing model study that has levelled out CO<sub>2</sub> concentrations at 450 ppm, CO<sub>2</sub> only. That has given him, if you like, a lump of carbon in total. He has then said, okay, if this is our allowable lump that leads to 450, some of that is used up already with what has come to the present day, some of that will be used up with non CO<sub>2</sub> gases and what we have got left we will divide up over the years with a particular shape. So it is working backwards from the target. One thing it assumes is that you can take this lump of CO<sub>2</sub>, this cumulative CO<sub>2</sub> amount, and apply it as a cumulative CO<sub>2</sub> equivalent; so you can include the other gases in that. We are not as convinced that you can do it in that way, and so to test that Professor

#### 23 June 2009 Professor John Mitchell OBE and Dr Jason Lowe

Anderson has been kind enough to supply his emissions, and one thing we have been doing very recently is running them forward through the method we use. When we do that we find, if we take a particular case which peaked in 2015. I believe, and run that forward, because of our more precautionary climate sensitivity value, that gives a chance of exceeding two degrees of the order of 65% rather than the 50:50. So it is worse, because we are now running it with our precautionary estimate, but then, when we put in aerosols, we find that pulls the probability down again. So it pulls it down from 65% to a little under 40%. I think the main point there is that it is a different set of assumptions but it is moving the numbers around in terms of probability by several per cent. What I found looking at additional studies—because published recently there was also work by Meinshausen et al, by Miles Allen et al and by Martin Parry et al-is that the studies tend to become quite close in terms of the temperature level they approach within point two, point three degrees, but they disagree more on the probability numbers, and in some ways that suggests that the central estimate of the 50:50 temperature is actually a more robust measure to use when comparing different techniques. We would be more than happy to sit down and take the intercomparison with Professor Anderson further and really tease out what the difference is between the two studies.

**Q153 Chairman:** I am sure that will be interesting. Are there any other questions? No. Is there any other burning issue that we should have raised with you but we have failed to do so?

**Professor Mitchell:** No, I do not think so, thank you. **Chairman:** No. Then thank you very much for your time. We are grateful to you.

#### Supplementary memorandum submitted by the Met Office

During the oral evidence session on 23 June 2009, the Committee asked the Met Office to provide a supplementary diagram to demonstrate the Committee on Climate Change's (CCC) cautionary approach to climate sensitivity distribution. Also included in this note is clarification on the issue of the inclusion of coupled/non-coupled feedbacks in the models used by the CCC, and a short summary of what we have done and what we intend to do with respect to further use of a complex 3-dimensional earth system model and the benefits of further work.

Following the oral evidence session, Mr Aubrey Meyer wrote to Dr Jason Lowe at the Met Office requesting clarification on some of the evidence presented to the Committee. Mr Meyer copied his questions to the members of the EAC and we have, for completeness, included a summary of our response at Annex A.

#### SUMMARY OF KEY POINTS

The models used by the Committee on Climate Change did include the feedback of climate change on the carbon cycle—it was a coupled model as defined in section 10.4.1 of the IPCC AR4 study.

The CCC chose a particular climate sensitivity estimate when deciding on emissions targets. The climate sensitivity uncertainty estimate chosen was:

- (a) derived from a combination of the most sophisticated model available combined with a wide range of observations;
- (b) a precautionary choice in that it provides a lower probability of staying below 2C than other alternatives climate sensitivity uncertainty estimates.

Although the CCC climate change scenarios were produced using a simple earth system model its performance was validated against a more complex model.

Since these scenarios have been produced the simple model has been further evaluated against a more complex model and proven to skilful.

INTRODUCTION TO UNCERTAINTY AND RISK IN CLIMATE PROJECTIONS FOR THE CCC

Estimates of risk of exceeding a given temperature (eg 2°C), by a certain year, for a given emissions pathway, are a consequence of uncertainty in the climate projections.

The uncertainty in the simple earth system model used to generate the global climate projections for the CCC was expressed in turns of three key parameters. At present, we do not know the precise value of these parameters, but we do have information on their ranges:

*Climate sensitivity:* a measure of how much the average global temperature will eventually rise if atmospheric  $CO_2$  concentrations were to double.

*Ocean diffusivity:* a measure of how effectively heat is mixed between the upper ocean and the deep ocean. This has a significant impact in the rate of surface warming.

*Carbon cycle-climate feedback:* a measure of how much climate change can alter the natural flows of carbon between the atmosphere, the land and the ocean.

For a given stabilisation concentration of greenhouse gases in the atmosphere, the climate sensitivity determines the stabilisation temperature—although this temperature may take several decades or longer to be reached. Climate sensitivity and ocean diffusivity together determine how long it takes the temperature to reach stabilisation once the concentration of greenhouse gases and aerosols has stabilised. For a given pathway of future emissions, all three parameters determine the evolution of the greenhouse gas concentration over time.

The modeling approach used by CCC can be described as "coupled" in that it includes the feedback of climate change onto the carbon cycle.

This is the definition of "coupled" as used in section 10.4.1 of the IPCC AR4 WG1 and the C4MIP study.

#### CHOICE OF THE THREE KEY PARAMETERS

Figure 1 below presents the probability of the equilibrium warming exceeding 2°C (y-axis) for a range of stabilisation greenhouse gas concentrations expressed as equivalent carbon dioxide concentrations (x-axis). Each line on the plot is for a different estimate of the uncertainty in climate sensitivity. Eleven different estimates of climate sensitivity are shown, giving eleven different estimates of the risk of exceeding 2°C. Using any of the lines on this figure it is possible to quote the stabilization equivalent  $CO_2$  concentration that gives a 50/50 chance of exceeding 2°C. As each climate sensitivity uncertainty distribution leads to a different result, care must be taken when interpreting the CCC results in terms of probability.



Figure 1. The probability of eventually exceeding 2°C for a range of different climate sensitivity estimates. This figure is adapted from Fig 28.5 Meinshausen et al. 2006.<sup>2</sup> For clarity red squares have been superimposed on the Murphy et al<sup>3</sup> result.

The 50/50 result in the CCC simulations is obtained using the Murphy et al. climate sensitivity distribution. The Murphy et al. climate sensitivity uncertainty distribution was chosen for two reasons. First, it combines our most sophisticated type of model (complex 3-dimensional models) with a wide range of observations. Second, for stabilisation around 450ppm, it provides a lower probability of staying below 2°C than alternative estimates of climate sensitivity uncertainty, ie it is a precautionary choice. Above around 430ppm, it is clear that the Murphy et al. distribution gives the highest chance of exceeding the temperature target. Although this discussion is based on stabilisation temperature, a similar argument can be developed for the temperatures in the CCC scenarios at 2100.

Meinshausen, M et al. Multi-gas emissions pathways to meet climate target in Avoiding Dangerous Climate Chang, ch 28, edited by Schellnhuber, Cramer, Nakicenovic, Wigley & Yohe. Murphy, J M *et al.* Nature 430 768 – 772 (2004).

#### MODELING RECOMMENDATIONS FOR THE CCC SCENARIOS

#### What was done at the time of producing the CCC simulations?

A simple climate model (with coupled climate-carbon cycle feedback) was set up and demonstrated to reproduce the response of more complex earth system models for scenarios of increasing greenhouse gas concentration. Having demonstrated model skill, a range of simulations was made using the simple climate model. Several alternative sets of emissions scenarios were used and the results also contain information on uncertainty/risk.

#### What has been done since?

As part of the Met Office integrated climate programme (ICP), an idealised simulation with a complex three dimensional earth system model was carried out. This was idealised in the sense that emissions reductions were very fast and only carbon dioxide was treated. The simple climate model used in the CCC simulations was then compared against this new complex model simulation. The good agreement showed that the simple model has skill for scenarios in which emissions are reduced significantly (as well as that already demonstrated for cases when concentrations of greenhouse gases continue to rise rapidly). This increased our confidence in the suitability of the simple modeling approach.

#### What should still be done?

We recommend that a small number of simulations be set up of the CCC emission scenarios using the complex three-dimensional earth system model. This has several purposes. First, it provides a further check of the simple model for the precise multi-gas scenarios used in the CCC work. Second, it provides extra information on climate variability and any sudden surprises, for instance, changes in the ocean circulation. Third, it provides regional information, so that it is possible to understand which regions are warming most rapidly and to examine the local projected changes in carbon cycle feedback. As a by-product, this approach may produce information useful to the adaptation sub-committee of the CCC.

At present, we do not recommend repeating the entire simple model experiment set with complex threedimensional models to estimate the risk. Such a project would be comparable in scale to the recent UKCP09 analysis and is unlikely to provide significantly better global risk estimates. However, this position should be reviewed as climate science and/or model understanding develops, and if the requirement for global adaptation information increases.

Annex A

#### RESPONSE TO MR AUBREY MEYER'S QUESTIONS ON MET OFFICE EVIDENCE TO THE ORAL SESSION OF 23 JUNE 2009

Mr Meyer's questions centered on climate model results shown in the IPCC AR4 WG1 report. The specific questions and our responses are reproduced below and we have included some background information, also supplied to Mr Meyer, to facilitate a broader contextual understanding.

*Question One:* "As I pointed out in the written evidence from GCI that you said that you looked at, my reading of the figure from IPCC AR4 Chapter 10 is that with 'coupling' introduced, the image in fact shows the extent of the need to reduce the full-term emissions contraction-event associated with a given reference curve for concentrations. Can you confirm that that is your understanding please?".

*Met Office Response:* The graph taken from fig 10.21 of the IPCC AR4 WG1 report shows the results of three models. The Hadley Centre curve shows a simple model set up to replicate the more complex Hadley Centre model used in C4MIP. The simple model was then used to study the emissions that lead to a stabilisation level for  $CO_2$  of 450ppm for a single pathway. For this particular pathway, and only considering  $CO_2$ , the curve does show when coupling of climate to the carbon cycle is included, as it was by the CCC, emission levels would have to reduce further to achieve a given stabilisation level of  $CO_2$  concentrations. However, given that all the models in C4MIP and fig 10.21 are considered credible we believe the appropriate scientific approach is to include information from the full range of available models not just the results of a single (worst case) model. To that extent the Hadley SM curve on the graph is not, by itself, a good indication of the need to reduce emissions targets further than was indicated in the CCC simulations.

Question Two: "In the example graphic taken from the IPCC AR4 in what is tagged as the C4 MIP 'Hadley SM' model with runs for 450 ppmv it shows very clearly that what in the IPCC image is called:

"uncoupled" for 450 ppm requires a 50% cut in carbon emissions globally by 2050 and "coupled" for 450 ppmv requires an 80% cut in carbon emissions globally by 2050.

Can you confirm that that is your understanding of this image please?"

*Met Office Response:* As explained above, fig 10.21 does not show results from C<sup>4</sup>MIP, rather it shows outputs from three simpler climate models which also include interactions between the carbon cycle and climate. Furthermore, using the results of a single mode for a pathway of a particular shape and only considering CO<sub>2</sub> to make general conclusions about global emissions reduction targets for a single year,

2050, is not appropriate. It is also important when discussing percentage emission reductions by 2050 to state the year to which they are relative. The CCC expressed their recommendations for UK emissions relative to 1990.

*Question Three:* "You went on to say, "The precise values we use to work out the magnitude of the coupling comes from elsewhere in IPCC and from a study referred to as a C4MIP study, which to date is the most comprehensive analysis of that particular type of feedback onto the carbon cycle". The runs in question and highlighted in the attached graphic from the IPCC AR4 bear the tag "Hadley SM". Can you as a member of the UKMO Hadley Centre please explain to me what 'elsewhere in the IPCC' refers to?"

*Met Office Response:* Chapter 7 of the AR4 WG1 report summarises the results of the C4MIP project while table 7.4 presents the range of coupling factors for all 11 of the models used. C4MIP is mentioned extensively in section 10.4.1 of the IPCC AR4 WG1 report (the section from which you have taken fig 10.21).

#### BACKGROUND CONTEXT

The C4MIP project, summarised in Chapter 7 of the IPCC AR4 WG1 report, set out to understand the importance of coupling the carbon cycle to climate change and its impact on the evolution of atmospheric concentrations of CO<sub>2</sub>. Eleven models that explicitly represented the interaction between climate and the carbon cycle were used in the project.

Each model was driven by a single emissions scenario—SRES A2—and was run twice, once with climate coupled to the carbon cycle and once without. Each model simulation produced an evolving estimate of the total atmospheric concentration of CO<sub>2</sub>. By comparing the coupled to the uncoupled simulations, it was possible to gain an indication of the importance of feedback between climate and the carbon cycle.

All of the models run in C4MIP demonstrated that coupling the climate to the carbon cycle is important and that by 2100 climate change leads to the biosphere being less able to absorb CO<sub>2</sub>. A key result from the study was the significant variation across the models in the size of this effect, demonstrating significant uncertainty in representing the climate-carbon cycle feedback. Although C4MIP found the Hadley Centre model showed the strongest feedback effect, the other ten models are also credible and their results cannot therefore be ruled out.

This parity between the eleven models meant it was important, in the work carried out for the Committee on Climate Change, that the results from all C4MIP models were used to select the strength of interaction between the climate and carbon cycle. Several different future emissions scenarios were then run through a climate model (which has a treatment of the carbon cycle), in each case estimating uncertainty in temperature and greenhouse gas concentrations. The full uncertainty range was due in part to the range of climate-carbon cycle feedbacks in C4MIP. For each emissions scenario an output from the simulations was a probability distribution showing how likely different amounts of 21st century warming will be. The Committee on Climate Change then selected the emissions scenario that showed a 50% chance of limiting warming to approximately 2C above pre-industrial levels at 2100, as well as reducing the risk of a 4C rise to very low levels.

Before the simulations for the Committee on Climate Change, the Hadley Centre and two other modeling centres had already carried out studies specifically to evaluate the impact of climate change on carbon cycle feedbacks, and therefore the emissions required to reach atmospheric stabilisation at a number of concentration levels. These are shown in fig 10.21 in the IPCC AR4 WG1 report. Emissions pathways were based on  $CO_2$  only, unlike the more realistic Committee on Climate Change simulations that included aerosols and other Kyoto gases. Also relevant is that the Hadley simple model simulations in fig 10.21 were constrained so that atmospheric  $CO_2$  followed a particular pathway to 450ppm. In the Committee on Climate Change simulations, the atmospheric concentrations were not constrained in the same way. Instead, the emphasis was placed on the pathway of global temperature rise. It is important to recognise the limitation of the experiments reported in fig 10.21—which were largely to gain an understanding of the nature of the coupling between climate and carbon cycle rather than to provide definitive guidance on emissions reduction targets.

The models used by the Committee on Climate Change did include a coupling between climate and the carbon cycle and took full account of the 'coupled' model research presented in the AR4 WG1 report, the C4MIP study and related research.

July 2009

### Tuesday 14 July 2009

Members present Mr Tim Yeo, in the Chair

Mr Martin Caton Colin Challen Mr David Chaytor Dr Desmond Turner Joan Walley

*Witnesses:* **Professor Sir David King,** Director, **Dr Cameron Hepburn,** Senior Research Fellow, Smith School of Enterprise and the Environment, and **Dr Myles Allen,** Atmospheric Oceanic and Planetary Physics, Department of Physics, University of Oxford, gave evidence.

**Q154 Chairman:** Good morning and a very warm welcome to this session of the Committee's inquiry on Carbon Budgets. Could I ask, by way of kicking things off, about the Committee on Climate Change and their view that it is right to use a 50% chance of exceeding a 2°C rise in average global temperatures as the basis for their recommendations? Do you think that is a sensible approach?

Professor Sir David King: I think it is a very difficult question that you have started us off with. If you lay it out in scientific terms you would want to talk always in terms of a probability distribution function. A function that peaks at 2° with as much of the curve above as below would only be satisfactory if it were a rather narrow distribution. The problem is that the best science available would indicate that with a 50-50 chance of not exceeding 2°C you still have a relative high chance—I would say perhaps 20%-of exceeding 3.5°C. Exceeding  $3.5^{\circ}$ C would probably not be a wise thing to chance. However, at this point in time, it is probably as good as we can do. My colleague on my left, Myles Allen, is one of those scientists who are producing these sorts of figures so perhaps I could see if he would like to add to that.

Dr Allen: The crucial point is that if you are going to start off aiming for 2° then you are accepting the fact that you are going to have to modify what you do as you go along if you are going to have any chance of hitting it. Whatever policy we design now in the light of the knowledge we have today, one thing I can tell you with certainty is that it will not be correct because knowledge will evolve; we do not know the right answers now. You are going to have to design an adaptable policy and invest in technologies that will allow you to adapt in the future if we discover that we are overshooting. The other crucial point about this is that often people complain if you say "learn as you go" because it is sometimes interpreted as "let's do some more research, it is just an academic looking for more money". That is not what I am saying here. The only way of resolving some of the really fundamental uncertainties in how the climate system responds to increasing emissions is to reduce emissions. We have done one experiment so far; the next big experiment we have to do in order to find out how the climate system responds to changing levels of carbon dioxide is to change in the other direction. It is only when we have done that, some ten or 20 years later, after we have made substantial cuts in emissions, will we know where we are going. We just have to accept that. We cannot put off reducing emissions because of the uncertainty because we will only resolve the uncertainty by reducing emissions.

**Q155 Chairman:** Some people have suggested that the Committee on Climate Change and indeed the government have based their targets for reducing emissions and the carbon budgets themselves with too much regard to what is feasible in political terms rather than just focusing on the science.

**Professor Sir David King:** To a certain extent I think that is what Dr Allen has just been saying. If it were practical I am sure that the scientific advice would be to stop emissions today. The best advice I could give while I was in government was that we should reduce emissions as much as is feasible.

**Dr** Allen: Stopping emissions today would undoubtedly be painful and so inevitably the Committee on Climate Change has an eye to two considerations here. I do not think we should necessarily criticise them. They themselves acknowledged that they were making compromises on the environmental objectives, acknowledging the economic imperatives.

**Professor Sir David King:** Could I just add that of course your remit is to look at the UK situation but if the UK were to reduce its emissions overnight to zero and the rest of the world did not, this would not do very much for the problem. Part of this is what is also internationally negotiable.

**Q156 Chairman:** Those of us who have taken an interest in this for some time, looking back over the past 15 years the science has got consistently more robust throughout that period and there is inevitably a tendency for the government to be playing catch-up. They will be perhaps too optimistic in what they are hoping for and therefore underestimated the scale and the urgency of the challenge. Maybe sometimes the scientists themselves have been quite conservative in their presentation of what their conclusions are. Do you think we are in danger of falling into that trap again with the present set of government targets and budgets?

**Professor Sir David King:** My immediate response to that is to refer to inertia. There is inertia in our geological system which is roughly 20 to 30 years, in

other words the carbon dioxide or the greenhouse gases we have already put in the atmosphere will lead to a further temperature rise over the next 30 years whatever we do. The second inertia is the political system. I think that possibly more serious than the inertia in the UK is the inertia in the international global governance system. Kyoto was a long time ago now and progress has not been tremendous.

**Q157 Joan Walley:** When you had your position inside government, what advice did you give about overcoming this inertia? Surely that degree of inertia is not acceptable.

Professor Sir David King: I do not think that degree of inertia is acceptable and if we are going to get this problem under control we all know that it would be better to get it done quickly, rather than to leave it to future generations when it is going to be a little bit too late. What did I do? I think that I probably did more than anyone in any other country did in that time scale. I certainly raised the issue not only with the cabinet at the time but went on radio and television and made my position very clear. I do think that having a public voice on this made my actions speak louder within the cabinet. It was also, I would have to say, very important when the opposition took a strong position on this. Once both sides were almost competing with each other to take a stronger line, I felt that action became more certain.

**Q158 Chairman:** I am sure all that is true and certainly your own substantial contribution is recognised and respected. Even after all that, are we not in a position where today it could not be said that we are adopting a precautionary approach; there is still a considerable level of risk in the position that the government has now taken.

Professor Sir David King: Yes. My view is that on both sides of the House it may be easier to make speeches about climate change than to take action because action actually costs money. Whether the Treasury has taken this fully on board is the question I would ask. Very often policies would end up being massively softened. Take the stimulus funds for example. I do believe that the use of the stimulus funds to stimulate a move into a low-carbon economy was the intention when it was set up. What is the current estimate on how much of it would be used for stimulating the low-carbon economy as we emerge? Eight% of the total. I think that is quite a low figure. In South Korea, on the other hand, the figure is about 80% of the stimulus fund and in China it is about 50%. I think something goes wrong and I suppose I tend to point the finger at the Treasury.

**Dr** Hepburn: Obviously it is easier to make pronouncements and far harder to commit to them. I think a critical aspect of our climate change policy and the world's climate change policy is the credibility of the long run commitments that we make. You ask about allowing risk to remain in the system. I certainly do not disagree; there is considerable risk in the system. Equally the economics and the politics have to be considered

when we think about the credibility of the targets we are setting ourselves and I do not think there is a great deal of point in setting targets that we know almost for certain we are simply going to be unable to achieve because of political realities and economic costs. This is not a call for a weak approach to climate change; it is not a call to say that it is all too hard and too costly. However, it is a call to honestly face up to the costs, face up to the political difficulties, design policy that is credible in those contexts and which we can commit to and put the institutions in place to enhance that credibility. I might add that the Committee on Climate Change is welcome in this respect. Indeed, I called for something similar in 2003 in a paper with colleagues at Oxford. The institutional structure provides us with a greater credibility about the budgets and the targets.

**Q159 Chairman:** Do you think that the Committee's intended target, the more challenging one, is realistic? Could that be achieved?

**Dr Hepburn:** With a global deal on climate change, which is of course the condition that sits behind the intended target, reductions of 42% by 2020 are still incredibly challenging and they would be costly. However, I think they are achievable and I do not think it is economically irrational to seek to aim for that type of target.

**Q160 Colin Challen:** Sir David, you made quite a high profile visit to the States a few years ago to talk about climate change in a rather hostile environment.

Professor Sir David King: I do remember that.

**Q161 Colin Challen:** One might say that a ripple from that is the Waxman-Markey bill. Bearing in mind the last question and answer about our higher intended targets in a global deal, do you think that the Waxman-Markey bill provides us with enough incentive to go to a higher target? To me it seems lacking in ambition.

Professor Sir David King: What I see in the Waxman-Markey bill was, at the outset, the intention to produce something with real teeth, but as it progressed it got softened down. My own feeling is that the inertia that we were referring to earlier on within the political system is playing through in the United States. Despite the very clear intention of President Obama on this situation I do not think that that clarity has got through to the political system as a whole and I fear it will take four or five years before they have something that really does deliver what is necessary. The Waxman-Markey bill is, I believe, watered down, not to the point where it is not worth having-it is certainly worth havingand it is taking the United States quite a big step forward.

**Dr** Allen: On this point about inertia, one key development in the science over the past few years has been the recognition that essentially carbon dioxide is forever. If you emit carbon dioxide into the atmosphere its effects persist essentially indefinitely.

#### 14 July 2009 Professor Sir David King, Dr Cameron Hepburn and Dr Myles Allen

To some extent we need to start thinking about the cumulative impact of how carbon dioxide emissions add up over all time, not just emissions in any given year. That is what the science is pointing to; that is what the climate system responds to. On the whole recognising this point might actually help overcome a lot of the inertia in this, in that once people recognise that if you release carbon today it will not be available for you to emit in 20 years' time unless you somehow manage to develop the technology to take it back out of the atmosphere again, which nobody has at the moment. That does profoundly change the way you see the nature of the problem. One of the things I appreciated seeing in the UK Committee on Climate Change report was an acknowledgement that we are working within a cumulative budget for carbon dioxide and there is a limit to the total amount of carbon dioxide over all time that we can afford to dump into the atmosphere. The number they proposed essentially is equivalent to around a trillion tons of carbon; we have emitted about half a trillion so far so you could say we are about half way there. I should say that it took us 250 years to burn that first half trillion, with the present trajectory it will take us less than 40 years to burn the second. You should not use this as a reason for complacency but it is a very powerful way of framing the problem, certainly when you are thinking about the long-lived greenhouse gases.

**Q162** Mr Caton: Climate modelling means projecting what emissions are likely to be in the future. These projections are based on economic models. Are the models and the projections up to the job of predicting something in 2050?

*Dr Allen:* Which ones, the climate models or the economic models?

**Q163 Mr Caton:** The approach but particularly the climate models.

Dr Allen: I will speak to the climate models. I think the crucial point here is that we are no longer making a theoretical prediction based on physics alone. We are in effect simply extrapolating an observed trend. I hate to make my science sound so trivial. Of course we extrapolate it very cleverly but we are not working from theory alone; we are seeing the changes which were predicted and we are seeing more or less exactly the changes that were predicted back in 1990 by the IPCC. If you look at the IPCC's predictions from 1990 and what has happened since then they more or less hit it on the nail. As far as the global temperature projections in response to a given increase in carbon dioxide concentrations or greenhouse gas concentrations are concerned, there is an uncertainty in those but they are pretty robust. As far as how the carbon cycle responds to emissions, that is one step back. We are pretty confident about how the climate system responds on a 50 year timescale to a given concentration path. How emissions translate into a concentration path—in other words, how much extra carbon might come out of the biosphere as a result of warming temperatures, for example—that is much less certain. There are models which predict a massive die back of the Amazon in the mid-21st century which would release a huge amount of carbon into the atmosphere, irrespective of what human emissions are doing at that time, but other models do not do this. That is a much less certain part of the science. That is going back from concentrations to emissions. How policies will actually translate into emissions is the point where I hand over to Cameron. Dr Hepburn: The way to understand economic models is as tools to provide-hopefully-insight and understanding about the mechanics of the problem. You used the word prediction; I think that is a dangerous word. Clearly predictions are going to be wrong. Where they are helpful is in providing us with scenarios that help us to think through plausible futures. Sir David may wish to say something about the work at the Smith School or the work in government. What I would say about the economy models is that if you go back ten years, there were very few people predicting a recession. That is something you might put in a scenario. The original IPCC scenarios-the so-called SRES models-turned out to be wrong. The actual pathways followed involved much greater rates of growth of emissions than even the top level predicted because of the growth in global trade and China's role in that and the fact that China expanded its production on the back of coal fired power. These things you might think were predictable ex ante but in fact effectively were not. I think it is dangerous to describe the economic models as predictions. Where they are helpful is when they provide us with an understanding of the bits and pieces that make up plausible scenarios.

**Dr Allen:** In terms of setting a carbon budget, again bearing on what is predictable and what is not, we can predict the climate system's response to a cumulative injection of carbon dioxide with a fair amount of confidence. We can project the climate system's response to a specific emission path with much less confidence. That is one of the things which has come out of the science, that there are some things we know and other things we just cannot know given the current information. We will learn as the emissions trajectory changes but it is much harder.

**Professor Sir David King:** Your question is both broad and important. The science does not only rely on the modelling as indicated, but paleoclimatology is giving us a very clear indicator of the sort of behaviour of the planet's climate system in the past as a predictor of the kind of scenarios we can expect in the future. A very important part of climate science is studying the planet's previous climate behaviour. All of this is pointing in the same direction unfortunately.

**Dr Allen:** To add to that, one of the key messages that comes out paleoclimate research is that staying below 2° is a good idea. As soon as you go beyond 2° we start to get into territory where even predicting how the system will respond, how other sources of greenhouses gases may get released from the natural climate system and therefore exacerbate the anthropogenic injection becomes much harder. We
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can see in the distant past events of this nature and that is of course the kind of thing we need to worry about.

**Q164 Chairman:** When you say "go beyond" do you mean 3°?

**Dr** Allen: I would be much more cautious about claiming to be able to predict how the climate system would behave at  $3^{\circ}$  warmer than pre-industrial than  $2^{\circ}$ . It is the unknown unknowns if you like that worry me here.

**Professor Sir David King:** If I could just add one more thing about the economics, of course the geological availability of fossil fuels is a major factor in the economics and so having a very large remaining store of coal in countries like China, Australia and in the state of Virginia in America is a major factor in our ability to look at the high carbon scenario with a high probability.

*Dr Allen:* There is plenty of carbon down there to do a lot of damage.

**Q165 Dr Turner:** I seem to recall that the paleo record gives us more than pause for thought; it does not even bear thinking about. Some of the apocalyptic scenarios could well be true which makes it even more important that we try to succeed with our immediate moderate plans. We have not been too successful so far even in keeping on track with our climate change programme for 2010 let alone anything else. What lessons do you draw from that? What does the government have to do to up its game?

Professor Sir David King: I do not think there has yet been an understanding of what defossilising the economy actually means. I think if we looked at a defossilised economy in 2050 we would have to find an astonishing range of changes. Our entire mode of behaviour depends on the use of fossil fuels so whether we are looking at our mobile systems (I do not mean mobile phones), our systems of transporting people and goods around the planet, if you look at our built environment, those two together are about 80% of carbon dioxide and about 80% of our activity. If you look at every item of our behaviour—how does food end up on the table—we have to re-examine every aspect of what we do. In government what I saw was that this was originally seen as a problem for the energy section of the old DTI as if it had nothing to do with transport, as if it had nothing to do with all of the other bits of government. I do not think that we begin to tackle this problem until we understand that. Yes, I think pricing carbon dioxide is absolutely crucial but even in Europe today we are toying with pricing carbon dioxide-maybe "practising" would be a better phrase-but at 12 euros per ton, or whatever the price is today, we are not even close to the value I think we need to see. A hundred euros a ton would roughly cover the cost of carbon capture and storage of the top end of a coal fired power station and I would hope that the caps across European countries would be squeezed down until we got the price up to that sort of level. However, even with the price at

that level we will need to see all the levers of government-regulatory levers, obligatory leverspulled out in order to de-fossilise our economy. I have previously argued that the Committee on Climate Change should have been put in with the Bank of England because I do think that as we move forward we want to control both inflation and deflation of our finances, but we also want to control our movement to defossilise the economy. I am not joking: I think these two should be put together so that as we figure out how to manage our finances we are also figuring out how to lower carbon emissions. We are still a long way from understanding the depth of the change required. The science and technology are there (although we need more science) and the technology will come to the fore provided we get the right economic drivers playing through.

**Q166 Dr Turner:** One of the economic drivers—or rather economic brakes—is cost. Governments, not unnaturally, look to the cost of their policies and will look to policies that have the smallest price tag. If you look at it in terms of cost effectiveness, what do you think are the most cost effective policies that government could put in place as of now?

Professor Sir David King: I am going to have a shot at this and then turn to my young economic mentor in a moment. For me the most important thing, as we move into a decarbonised economy, is to avoid making investments in infrastructure and in longterm projects which are high in carbon of necessity. For example, whether or not British Airports Authority were to invest in a new runway or a new airport would come into that category because I would have imagined a future scenario in which fast rail overtakes the short-haul flights across Europe. That scenario is likely to mean that your investment in an expensive new airport system may not yield the return that you were hoping for. I am talking, as we move forward, about lowering the cost to our economy by avoiding stranded assets, by avoiding major infrastructure investments which are likely to have to be shut down because they are so heavily based on carbon. I would not myself have gone for four coal fired power stations with carbon capture and storage at this point in time because frankly carbon capture and storage is an unproven technology. It would seem that caution in investing in coal fired power stations ought to override that need. What I am talking about is for Britain to avoid companies like GM going bust, in other words if our major companies go bankrupt because they have been investing in the wrong sort of infrastructure-I am referring to the infrastructure required to build Humvees doing seven or eight miles per gallonthen we are going to find that it is an expensive transition. I think it would behave government to see that all the right regulatory behaviour is put in place to avoid investing in the wrong infrastructure. Now I will pass to Cameron if you do not mind.

**Dr Hepburn:** The point made about stranded assets has to be right. In response to the question about which technologies are more cost effective or least cost effective, there are three answers. The first is that

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we need to be very careful in assuming that we know. I am not saying that we do not need some planning but humility about how technologies will develop and about which rates of learning will proceed more rapidly and which different technologies are important. What that humility leads you to conclude is that in a way, like the Monetary Policy Committee of the Bank of England which does not interfere in every aspect of the economy, it sets one price and lets the rest of the economy sort it out. Similarly in climate policy, I am not saying there is no role for planning but getting the prices right is really a critical aspect of working out which technologies are cost effective. If you have your carbon prices sorted then you do not need vast teams of analysts trying to work out what your most cost effective response is. To that end the way our UK input into the European Emissions Trading Scheme prices and the prices we set here are very important. Let me just make one critical point about pricing and the political economy of pricing. First, we should be selling the allowances that we have available to the private sector and if we sell a large number of them up front with longer commitment periods, then what you create is an interest group owning carbon assets who want tighter targets in the future. At the moment in response to the question about political inertia we know that there is a vast amount of lobbying conducted by vested interests against change. Creating a balancing group that is pro-change-or at least pro-tighter targets-seems to me to be a rather important feature of speeding up the process of political change. A very powerful way of doing that is by allocating emissions allowances now so that the holders of those assets worth billions of pounds or euros want the trading scheme to continue and want prices to rise and hence want tighter caps. I think that political point about pricing is very helpful when we think about our humility in not trying to pick all of the technologies that are the least cost. The second point that is key here is recognising that we want to expose ourselves to upside and positive surprises and we do that when we invest in research and development in the lowcarbon arena. I think our levels of research and development in energy have been lamentable. It should be a relatively high priority to rectify those levels of research and development, given the scale of the challenge that Sir David has just outlined. Perhaps the Committee on Climate Change could have spent a little bit more time thinking about the role of low-carbon research and development and the role of the government, which is a very clear one, in supporting that. The third point is on the point that David made about stranded assets. Some degree of thinking ahead is helpful and planning is helpful. The reason is that market prices alone will not get your infrastructure sorted because they are effectively a marginal price and unless you have a very long term, very credible price that the financial sector can come in on the back of that and get the infrastructure in place (as I was mentioning earlier, political realities have to be addressed and I think it is unlikely to the case for some time) a level of clear planning about our low-carbon infrastructure ahead of time is required.

Professor Sir David King: Perhaps I could come back with one more point and then Dr Allen would also like to come in. Again your question was very broad. In setting up the Smith School of Enterprise and Environment we are bringing together top economists, top scientists, top lawyers-an interdisciplinary group—to help to advise governments and the private sector on this transition. When we are advising the private sector what we are talking about is persuading them that there is a massive opportunity for innovation within the private sector represented by this need to decarbonise our economy. When we look at the cost to the economy I would say, "Bring it on" because we have this enormously strong science base in the UK, second only to the United States in our total output, and we have this high density of small high tech companies in that magic triangle between Oxford, Cambridge and London, the highest density of small high tech companies in the world. In many ways we are poised to benefit from the innovation coming through to the private sector that lies ahead.

*Dr Allen:* On this issue of where should we be investing and what the most cost effective areas are, I want to take issue with something Sir David said. Can I use a visual aid?

**Q167 Chairman:** By all means, but we are not being televised.

**Dr Allen:** Sir David mentioned thinking about the amount of fossil carbon underground. This is a one in ten thousand trillion scale model of the problem; each of these is half a trillion tons of fossil carbon. We have used one and the second one will take us to around 2°; that is what the UK Committee on Climate Change says. The fundamental determinate of whether we are going to hit dangerous climate change is what we do with the rest of it.

**Q168 Chairman:** That is what we could use, is it? *Dr Allen:* This is basically what we could use.

**Q169 Chairman:** So we know for the record, how many pieces are there?

Dr Allen: There are ten.<sup>1</sup> Obviously, this is an estimate of the amount of fossil carbon that is economically recoverable. Therefore what you invest in (in terms of to what extent it determines the risk of dangerous climate change) ultimately depends on how it impacts on what happens to the rest of this carbon, which is why I would take issue with what Sir David said about carbon capture and storage. When we are looking at what is sitting down there there are essentially three things that might happen to the rest of that carbon. We could burn and dump it in the atmosphere with all the consequences we have been talking about; we can leave it down there as fossil carbon; or it could be used, if the technology evolves such that it allows it to do so, and the carbon dioxide sequestered back underground to

<sup>&</sup>lt;sup>1</sup> Note by Witness: There are ten pieces, representing what was there in 1750. We have already placed one in the atmosphere, and can only afford to place one more.

keep it out of the atmosphere. To my mind that is the determinant of success, whether or not we actually manage to come up with the technologies in time to avoid releasing the rest of that carbon into the atmosphere. That is why I would take issue with what was said about the investment about carbon capture and storage. From my perspective as a physicist looking at what matters for the problem, our investment in carbon capture and storage is orders of magnitude smaller than it ought to be given what is actually going to be required to avoid dangerous climate change.

**Q170 Chairman:** There are various ways of trying to drive all of this forward, one of which is the carbon price, but is there a role for an interventionist approach which might say that over a certain period we have to generate electricity only producing so many kilograms per kilowatt hour, so there is an actual arithmetical limit on the amount of emissions from each unit of electricity produced? Similarly, could you have something which related to people's movements as transport is such a big factor, so many grams of carbon emitted for so many passenger miles travelled? You could actually have a regulatory target as well to drive both research and drive investment. Would that be feasible?

Professor Sir David King: The example that I would give there that has been enormously successful is the car exhaust regulation target. Introduced in the 1970s, today it has reached a remarkable level. We have cleaned up all our cities around the world through progressive car exhaust regulation, stating in a given year that in three year's time what the requirement would be. I do think that is a very smart way forward. We know how to do it and if we could be tough with the car manufacturers then we should proceed. I say that because I have been very close to car exhaust regulation over the last 40 years and I do know that at every single step the manufacturers have complained and said that it was impossible. What we have to learn is to ignore what they say because their scientists and technologists will find the answer because they fear that if they do not then their competitors will and they will be wiped out. It is a very good way forward in my view.

**Q171 Dr Turner:** You have already spoken about the inertia of government but, with your experience within the system, have we got the ability within British government structures—either political or Civil Service—to make the smart decisions that are necessary?

**Professor Sir David King:** I would have to say that the level of expertise demanded within the advisorial system in government that you are referring to is not there at the moment. We have a system based on the generalist rather than the specialist and I think that that needs a radical change if we are really going to manage this problem.

**Q172 Mr Chaytor:** Sir David, in recent months you have expressed some growing scepticism about the costs both in the Stern Report and produced by the

Committee on Climate Change, the cost of meeting our targets and the cost of the damage that the Stern Report originally produced. Could you just say where you think we now are on costs? Is one% of GDP no longer accurate in your view?

Professor Sir David King: You may have asked a question which will now divide opinion between Dr Hepburn and myself because he has worked closely with Nick Stern. Basically my view is that the strength of the economic models used is limited. In other words, these economic models are really based on almost perfect decision making within the system. In other words, companies do not do what GM did; they behave as models companies and they know what legislation is likely to arise so they are going to invest in the right directions in the future. My belief is that we can only minimise the cost to our economy as we go forward if we act to see that information goes out to the private sector and that we have the right regulatory behaviour. No economist predicted the recent fiscal crisis. That fiscal crisis arises from strong negative feed-back terms in the economy related to confidence and other things. This is not included in these models. As physical scientists we tend to shudder when we see the models being used to predict the state of the economy. I then hesitate in criticising because I know that Dr Hepburn and his colleagues are fully aware of these limitations. Nick Stern is now saying two% of GPD. I am still a bit sceptical about whether it is minus one, two three; I do not know. Here is my scepticism in a nutshell. If we were to look at the cost of no action (in other words, to let the carbon dioxide run) what would the cost to our economy be? Stern has made an effort at calculating that. How do you include within that calculation the geopolitical destabilisation that might arise—and is likely in my view to arise-from an environmental global migration that is unprecedented? The Indian Government is now putting up a fence between India and Bangladesh supposedly to keep thieves out; one suspects it might have something to do with the fact that rising sea levels could well cause the people of Bangladesh to seek higher land and higher land is in India. I am just referring to the fact that by midcentury, if we have not grasped this problem, we will have massive negative feedback terms in the global geo-political economy that would be very difficult to calculate. Equally, I am saying that if we get it right and use our innovative capacity, we could move forward and actually grow our economy on the process of defossilising. Having said all of that, I pass over to Cameron.

**Dr Hepburn:** I think Sir David and I disagree less than he expects. There clearly is a large amount of debate about both sides of the equation on costs, both the mitigation side and the climate impact side. For the reasons I was setting out earlier, these things are incredibly difficult to measure and they are incredibly uncertain. Anyone who suggests otherwise is doing all of us a disservice because that uncertainty and indeed the unknown unknowns are relevant factors for us to consider when we think about how we ought to be responding to the problem. Let me focus on what is agreed amongst

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the economic profession because I think that is probably what is helpful. A lot of debate is of one or two%, it could be a bit more. Bear in mind that one or two% of global GDP are very large numbers; these are not necessarily small costs. Are the damages ten% or 20% under different scenarios? So there is debate. However, the point is that almost all sensible economists would agree that the damages from climate change-the climate impacts-exceed or far exceed the costs of doing something about it. That is one of the points that the debate between the American economists within American and between America and other countries following the Stern Review really brought out, that actually we do all agree that the economics of this problem suggest that we need to take action, we need to take action now and we need to start doing it in a very cost effective way. The next thing economists agree on is that we ideally would focus on two problems. The first is the carbon price and the absence of one; the second is the failure to capture research and development spillovers. In the context of a world where we do not get the carbon price right then you are looking at other policies like the ones that you suggested, emissions limits on power plants, limits on cars. These are second best policies but we do not live in a first best world.

**Q173 Mr Chaytor:** Has the recent economic crisis changed fundamentally any of the assumptions on which the original economic projections were made? If economic growth is not going to continue year on year at a steady two%, what are the implications of that?

**Dr** Hepburn: The financial crisis has really underscored the fact that humility is really the only response in the face of the economic uncertainty. In terms of what it does to emissions—the emission pathway—it does a little; reduce emissions and the reductions will be persistent for some time. It is not quite rounding error but it is almost rounding error. We will have booms and busts and I do not think that necessarily surprised anyone. I do not think it has led to a radical re-thinking of the future projections of growth in business as usual and hence the future of projection of emissions in business as usual and hence the scale of the problem.

**Dr** Allen: I think it is very dangerous that people often get the impression that economic crises are good for the planet because they reduce the emission rate but again, thinking back to this budget idea, it is not going to make any difference being poorer. Burning the carbon a little bit slower is not going to make any difference at all to what you do with the rest of it. Again it is a different way of framing the problem which avoids this misperception that somehow low growth is good for the planet.

**Q174 Mr Chaytor:** Is being poorer less likely to lead to scientific innovation?

*Dr Allen:* Precisely. The way you are going to solve this problem is by becoming rich enough to solve it in effect. Simply being poor will mean that you will emit the carbon slower over a long period but you

end up doing the same amount of damage to the planet. I think that is quite an important message to get across because there are advocates who say we should actually curtail growth in order to solve the problem of climate change and I would disagree with that.

**Professor Sir David King:** What I would say in the response to the fiscal crisis which is one that I supported very strongly last October was a stimulus budget. The stimulus budget put decision making in the hands of governments around the world on how that money should be spent. For example, the Department of Energy in the United States now has a very large R&D budget and that has come entirely through that stimulus funding. Governments can choose to invest this wisely into new low-carbon technologies which is precisely why Stephen Chu now has this enormous budget to spend on energy research. So I come back to what I said earlier about the stimulus fund as an opportunity to kick start a low-carbon economy.

**Q175 Mr Chaytor:** In terms of our government's response through the stimulus fund you drew the comparison with South Korea where 80% of their funds go into green growth. The UK Government's defence would be that we are probably further ahead than South Korea and therefore we do not need to allocate such a large share of our stimulus onto green growth.

**Professor Sir David King:** I put our government's figure at around eight%, as against South Korea's 80%.

**Q176 Mr Chaytor:** At Question Time last week the Minister said it was 20%.

*Professor Sir David King:* Did he? That is marvellous.

**Dr Hepburn:** I might just jump in and say that there are different ways of determining how you measure green. It is also rather important how you measure policies that had already been announced prior to the stimulus, whether you net them off or whether you count them as well. There is a certain art to the measurement of the greenness of a stimulus.

**Q177 Mr Chaytor:** Are there very specific areas of investment that you think should have been in the UK's stimulus package which were not? Had you been the chancellor where would you have allocated the money?

**Professor Sir David King:** I would certainly have looked at RDD&D all the way through to demonstration in low-carbon technologies. I am in favour of investment in carbon capture and storage; it is just the extent of that investment coupled with the number of power stations where we might disagree. Harking back to the time when a little white van visited every home in Britain to convert us from town gas to methane gas with North Sea gas coming through, I would have seen a little white van going to every home to improve energy efficiency within the home, loft insulation and so on. We have modern technology by which we can actually pick out exactly which houses in any village or town are poorly insulated so we could have targeted the construction industry where there are large numbers of unemployed people, by sending people around to do homes on a very widespread basis. There is an investment that would pay back in kind year on year because of lowering energy costs in running the houses, and would pay back in terms of emerging with a housing stock which is currently one of the least energy efficient in Europe into one of the most efficient in Europe. I would also have looked at fast rail. I would have looked at a whole range of projects where the investment would be an investment on behalf of those future generations from whom we are borrowing the money to dig us out of this fiscal crisis.

**Q178 Colin Challen:** The HSBC report in February is the one that is most popularly quoted analysing green stimulus packages across the world and that has the European Union overall green stimulus—the average across the EU—at 14%. So the elephant in the room is the 86% that is stimulating GDP growth, or trying to. How far do we need to shift from the current economic paradigm or do we need to shift at all? What is your take on this classic economic paradigm that we are trying to return to?

**Professor Sir David King:** I will have a shot to start with and then Cameron will come in. I do believe that this one number that we judge every country's health on—GPD growth—is a very misleading number and I do think we need to look at it again. My favourite number happens to be from Dasgupta where he looks at the wealth of a nation as its capital building infrastructure wealth, the human skills wealth, the environmental wealth and the cultural wealth of a nation. If you can put a figure to that—I do not see why you could not—then the growth in that wealth would be a much better measure than this simple number GPD that we are all so set upon as the only figure that matters for our economy.

Dr Hepburn: As I am sure we know here, GDP just measures busyness that is captured by a market; it does not measure output properly and it certainly does not measure welfare. We do not have a commonly accepted measure of welfare that we judge ourselves by and compare ourselves against one another with. I would echo David's comments there. As you probably know the Stiglitz Commission is working on a green measure. There are and have been several measures proposed in economics over the last few decades and I think it is high time we concorded on one and adopted it. It does not have to be perfect. GDP is far from perfect as a measure of output but we use it all the same, so I would echo the points there. As far as the question of whether we need to stop growing or slow growing, I do not disagree with what Myles said earlier. We have in any event population growth due to come and even if GDP per capita remains constant the earth's marketed output is going to grow so it is somewhat of hypothetical question to ask, whether we should stop or slow growth. I am not sure that answers the question. The question is how do we grow in a low-carbon and sustainable fashion. On the stimulus, I do think it was, at least in part, a missed opportunity here. We should definitely learn the lessons so the next time we have a crisis-and there will be one-we can get it right next time. I hear from my colleagues in China that the last bubble that burst, the Chinese officials said to the rail industry, "It is not your turn now, but next time there is a crisis be ready because the money is coming your way" and it did, billions of it, and they were ready; out they go with their rolling out of rail infrastructure. I do not think it is too much to ask that we can plan ahead ourselves for the next crisis-I hope it is not too much to ask—so that we do deploy in a more sensible and more low-carbon and effective way. In the interim the issue actually is the opposite. We have serious pressure on public balance sheets that is going to emerge. I do not think there are too many who would doubt that. In that context it is less about throwing money at the problem and more about thinking how the public balance sheet can be shored up by raising funds. The question here is: can we use that requirement of supporting a public balance sheet to shift to a greener tax base and to raise environmental taxes.

**Q179 Colin Challen:** Does the fact that the Treasury, being the only department in government that does not employ a chief scientist, have anything to do with its inability to assimilate these new ideas?

**Professor Sir David King:** I know exactly why you are asking me that question. I certainly did try to get a chief scientific advisor into every major government department and the Treasury was not very sympathetic to the idea. However, I think there is another issue with the Treasury that I could never get through on and this is the issue of not backing winners. There is a very deep belief in the Treasury that the market place is the only place where winners are determined. Using South Korea again as a good example, when a technologist invented broadband in South Korea the South Korean Government invested heavily in creating the infrastructure for broadband to spread in that country. If you look at the development of broadband it was quite extensive in South Korea before it ever went international. That was government investment in backing a winner. It was a risk investment but it turned out to be an enormous winner so companies like Samsung have massively benefited from that. I would say exactly the same with Silicon Valley. I do not think that Silicon Valley would have come into being without the DARPA funding that pulled the gismos through to the market place and created Silicon Valley. This is all anathema to the Treasury so the belief that we can pick winners which are low-carbon winners again does not match with the Treasury belief in the market system. Treasury will always look at market instruments as a means of tackling a problem and not investing risk money. For example, we have £150 billion a year fund for government procurement and I did try to see that a ring fence should be placed around 1% of that for risk procurement on gadgets being produced by our small high tech companies. I think that would have

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transformed our economy. Likewise here I would have liked to have seen government procurement funds being used to pull through low-carbon technology.

**Q180 Colin Challen:** In the context of this inquiry into carbon budgets do you think the Treasury has, as indicated by this absence of a chief scientist, a fear of science? In setting the remit for the Committee on Climate Change and our general political approach, the science is really something that interferes too much with their perceived wisdom which is why they do not want a chief scientist.

**Professor Sir David King:** No, I do not think that is right; it is much worse than that. One thing I will never accuse Cameron Hepburn of, is being one of those that I call suffering from economism, where you think that economics provides all of the answers. I do think you will find people who go rather close to my definition of economism within the Treasury. They feel they do not need the science base.

**Q181 Joan Walley:** Could I just come in and ask about the Green Book in the Treasury and how the Treasury should be revising the Green Book which determines the whole decision making basis and where money is actually spent. It seems to me that that failure to revise the Green Book in keeping with the pressure to decarbonise the economy is just something that has not been taken on board either by the Treasury or by Treasury ministers.

Dr Hepburn: I am obviously going to have a somewhat different emphasis than Sir David on these issues, particularly with regards to picking winners and the role of the Treasury. I had a role in the revisions that occurred earlier in the decade-2002 or 2003-and I think it is important that we look for consistency across different aspects of government spending. I am obviously personally very concerned with the environment and climate change but I do not think that environment and climate change issues should dominate health or education or other priorities. The role of the Treasury is to balance up those competing considerations, face up to trade offs and to do it in a way that promotes consistency. I did a survey for the OECD on policy appraisal a few years ago and the UK actually bears up rather well in comparison with other OECD countries. I say "rather" well but that actually means "exceptionally" well. This is not to say there is not a role for revisions of the Green Book to make it green in the environmental sense, but equally it is not intended to be and I do not think it should be a document that prioritises one specific area of public interest over others.

**Dr** Allen: I would just add one point to that. I think it would be helpful to simplify matters as far as possible. I do not know anything about our own

Treasury but other countries' treasuries are understandably concerned about the level of complexity of carbon regulation and the opportunities it appears to introduce to distract people from the business of making money, which is what the treasury wants them to do. For example, you could focus on the point, as Sir David made earlier, that if you are going to carry on using fossil energy in the second half of this century and avoid dangerous climate change then that fossil energy will carry a cost premium of 100 euros a ton minimum, that being the cost of disposing of the carbon dioxide within it. As far as the Treasury is concerned the case for changing our energy mix becomes a purely economic one; they do not need to worry about the environment any more because they simply need to add to their projections the fact that the cost of fossil energy is going to increase in this way in order to neutralise its environmental impact. Maybe one solution is to explain things to the Treasury in a very simple way.

**Q182 Chairman:** Leaving the Treasury at one side, are there other parts of the government which do understand the urgency of decarbonising the energy supply?

*Professor Sir David King:* Surely Ed Miliband gets it, does he not?

**Q183 Chairman:** Yes, I think he does. In the present Whitehall is that sufficient?

**Professor Sir David King:** As a matter of fact I would have to say that our foreign secretary also gets it. When he was in Defra as secretary of state I saw a secretary of state who really grasped the problem and I was very impressed on a recent trip to China to find that we have 28 people in the embassy staff who are working with the Chinese Government on metrics of carbon dioxide emissions. I think we are doing some things right but it has to be described as patchy.

**Q184 Chairman:** Do you think that the government is doing enough to overcome the planning difficulties which appear to be one of the obstacles to faster investment in low-carbon energy?

**Professor Sir David King:** No, not enough. More needs to be done. I think we are moving in the right direction. We all know about planning blockages—the vast number of wind farms that have never come into being because of planning blockages—and at the same time the inertia in moving that on seems to be causing a lot of drag.

**Chairman:** I am sorry we cannot continue because we are having an extremely interesting session, but time unfortunately has overtaken us. Thank you very much indeed for coming in and we will draw heavily on what you have said when we come to write our report.

#### Memorandum submitted by Professor Paul Ekins

This note gives preliminary answers to some of the questions posed by the EAC for this enquiry. Its purpose is to allow EAC Members to follow up orally those points on which they feel that further evidence is necessary.

The questions posed by the EAC, together with the responses, are as follows:

- 1. Whether the UK's statutory targets for greenhouse gas reductions are consistent with the Government's objective of limiting global warming to no more than 2°C and whether they are enforceable;.
- 2. The extent to which the Committee on Climate Change's recommended budgets to 2020 are consistent with the UK's target for 2050;
- 3. The suitability of the climate models and the validity of the assumptions used by the Committee on Climate Change in setting carbon budgets;
- 4. The basis on which the Committee on Climate Change arrived at the UK's share of the global effort to cut emissions; and
- 5. The frequency with which targets and budgets should be reviewed and updated to take account of new scientific evidence.

It will be very difficult to limit global average temperature rise to 2°C. The Hadley Centre model suggests that there is an 80% chance of this being exceeded at 450 ppm CO<sub>2</sub>e. Current (2007) levels are 396 CO<sub>2</sub>e (including aerosol cooling) or 463 ppm CO<sub>2</sub>e without such cooling, and are increasing at 2 ppm p.a. The science of climate change has several times revised upwards both its estimate of the extent of the temperature increase for a given increase in GHG concentrations, and the extent of the negative impacts for a given temperature increase. While considerable uncertainty on both these relationships persists, the trend is consistently and alarmingly in the wrong direction. The message from the science is therefore to reduce emissions as much as possible, with an emphasis on early action to reduce the cumulative emissions by any given date. The CCC's budgets are the minimum that would be consistent with an 80% UK (50% global) emissions reduction target by 2050, and this is the minimum that is consistent with any change of achieving a 2°C temperature increase target. It might also be argued that the budgets are the maximum consistent with policy possibility and credibility. Rather than tightening the targets (which could certainly be justified scientifically) the emphasis should now be on getting the UK on a trajectory to meet those that have been set.

On the enforceability of the targets, the means to do this are not at all evident. For the targets to be met, actions for the 2020 target will need to be taken now. It is not clear how the Government in 2020 can fairly be held accountable for the failure of the present and immediate future Government to introduce the necessary measures, should these continue not to be forthcoming. The targets rather seem to serve as a declaration of cross-party political intent, with arguably more credibility than they would have if they were entirely 'voluntary'. The political danger is that target-setting will be seen as an end in itself, rather than a preliminary to putting in place measures to meet the target:

6. The compatibility of current Government policies with achievement of the overall budget, how individual government departments can ensure policies are consistent with overall carbon budgets, and the potential role of departmental tradable carbon allowances;

The Government will miss its 20% domestic CO<sub>2</sub> reduction target for 2010, despite having been aided in this by the global recession. Policy-related emissions reductions since 1997 have clearly been difficult to achieve.

There is little evidence that current policies will bring forward the mix of demand reduction, efficiency increase and low-carbon supply that will be necessary to meet the targets in the 2020 budget. The government continues not to deploy in a systematic way the price mechanism, which is a key underpinning of all these sources of emissions reduction; there is little sign of saturation in energy demand in key sectors (eg transport); energy efficiency increases continue to be too slow practically everywhere (especially in buildings and transport); the Renewables Obligation has spectacularly failed so far to kick-start renewables deployment in the way seen in a number of other European countries; and there are continuing considerable uncertainties about whether and when new nuclear and CCS plant will come on stream and what it will cost, and, in the latter case, whether it will even work.

There are signs that the Government now recognises the scale of the challenge before it in respect of both its carbon emissions reduction targets and the EU renewables target in 2020. Its strategy due out this summer will contain its conclusions on a number of key proposals that have been floated in recent consultation papers, including feed-in tariffs, a Renewable Heat Incentive, and a new initiative for energy efficiency in buildings. Whether the targets are met will depend very largely on the level of ambition in the design of these and other instruments. If the emphasis is on limiting the costs, as in the past, then it is unlikely that they will be successful.

If departmental tradable carbon allowances' refers to the emissions of actual government departments, similar to the Landfill Allowance Trading Scheme for Local Authorities, then this could be set up quite quickly and might prove an instrument to accelerate the currently very slow (at best) pace of emissions reduction from the Government estate. If it refers to the sectoral emissions for which particular departments

may be deemed "responsible" (eg the Department for Transport for transport emissions), then this is a far more ambitious proposal. It could be worth investigation, and this could be explored at the EAC meeting if members wished:

7. The issues around using emissions trading (both credits from the EU Emissions Trading Scheme, and carbon offset credits) to meet UK carbon budgets, including the standards that should apply to such credits.

There are two priorities if dangerous anthropogenic climate change is to be avoided. Developed countries must pioneer a route to a low-carbon economy that is perceived by other countries to be attractive enough to follow. Developing countries must act to reduce their emissions below what they would otherwise be. To help them do this, they will need finance from developed countries.

The EU ETS, if the cap has been set low enough (itself a contentious question), will foster the first objective, and there is no reason why allowances should not freely tradable. Indeed, it would negate the purpose of the scheme if they were not.

Carbon offsets are a very different matter. At present, outside countries that have signed the Kyoto Protocol, they are not related to an emissions cap. There is no way that hypothetical baseline-related emissions reductions can be made robust. Rather, such offsets really only serve to transfer finance from developed to developing countries. In doing so, they serve to undermine the imperative of developed countries to move to low-carbon economies. Indeed, their very existence seems to acknowledge that such moves might be unacceptably costly.

For these reasons it would be highly desirable for the measures to meet the two priorities to be kept entirely separate. Developed countries should seek to meet their targets through their own efforts or through trading with other countries that have a robust cap. Finance for developing countries should be provided through other means that are more securely tied to strategic efforts at emissions reduction in developing countries.

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Witness: Professor Paul Ekins, Professor of Energy and Environment Policy, Kings College London, gave evidence.

**Q185 Chairman:** Welcome back to the Committee; we are very glad to see you again. We have about half an hour so we are going to pace our questions in a way which gives us a chance of finishing before 12 o'clock on this session. Can I ask first of all why you think we have not made as much progress as we would like to towards our 2010 target for a 20 per cent cut in  $CO_2$  emissions? We are not going to hit it, and given the rhetoric that has been around why do you think it is?

**Professor Ekins:** The policies that have been implemented have not been implemented strongly enough. There has been huge policy innovation over the last ten years. We have devised and put in place an extraordinary range of policies across all relevant sectors but they simply have not been strong enough. I would start by singling out the price mechanism. The Stern Review was absolutely clear; every economist is absolutely clear; every session such as this that I come to says that the carbon price is absolutely critical and unless we have a decent carbon price that is visible we will not be able to do it. However, we do not have a decent carbon price that is visible and until we do we will not manage to crack the problem.

**Q186 Chairman:** The recession obviously is going to help a bit. If emissions do fall in a recession is there something we can learn from that in terms of strengthening the other policies?

**Professor Ekins:** I think the main lessons to be learned from the fact that emissions will fall in the recession is that when the recession ends emissions will go up again. There is an absolutely ineluctable

link in all economies between incomes and energy use. This makes even more important the issue of carbon prices because unless carbon prices go up at the same time as incomes then inevitably economic growth will lead to greater carbon emissions. That is a lesson which we have yet to learn; it is a lesson that comes straight out of every single piece of energy economic analysis I know. If we are going to get richer we will use more energy unless that energy is also more expensive.

**Q187 Dr Turner:** Your evidence to us suggests that UK's 2020 targets need to be considerably toughened. What key policies do you think the government needs to implement to make this difference?

Professor Ekins: There is no magic bullet. We will need a range of policies across the sectors. However, they will need to be underpinned by a robust carbon price. That, to me, is a necessary but not sufficient condition for progress. The only way of introducing that in the absence of OPEC increasing prices (which is bad for everyone except OPEC; it is very bad for our economy certainly) is through a policy that I have spent an enormous amount of time researching called environmental tax reform whereby the government systematically increases carbon prices across the board-through the kind of escalator that we have seen now with the landfill tax, which we saw in the 1990s with the fuel duty escalator-and reduces other taxes to compensate so that the overall budget is not affected. People have more money in their pocket; businesses have more money because social security contributions and national insurance

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contributions go down; consumers have more money because income taxes go down or employees' national insurance contributions go down. If they then want to spend that money on high carbon goods and services then they pay significantly more than they are at the moment. Over time a five or six per cent escalator on the major carbon bearing energy uses supplemented by sensible regulation, supplemented by voluntary agreements of various kinds, supplemented by consumer information so that people became more aware when they were consuming carbon containing goods and services that would transform the economy by 2020 and I see no other way of reaching the 2020 targets which are right at the bottom of the Committee on Climate Change's recommendations; they are right at the bottom of where they need to be if we are to make the scientifically appropriate contribution.

**Q188 Dr Turner:** How much confidence do you place in the government's predictions of  $CO_2$  emission reductions by 2020? The government are saying 19 per cent; do you believe that?

Professor Ekins: I do not because I do not see the basic change in the policy approach and the policy profile which we need. What I see is a continuation of the policies that have, over time, been put in place since 1997—supplier obligations et cetera—which have certainly delivered something and it is certainly the case that emissions would be higher now than if those policies had not been implemented. However, they have not met the 2010 target and they will not meet the 2020 target unless we have a much higher underlying carbon price. In the previous evidence we heard that to motivate carbon capture and storage and make it economically viable we might need a carbon price of a hundred euros per ton of carbon dioxide; for me that is the absolute minimum towards which we should be aiming through a process of environmental tax reform by 2020. Not all at once, but a little bit every year. That would then start to make real inroads and the other measures that are being implemented would of course be motivated and stimulated to a greater extent. Innovators would have a greater incentive to invent low-carbon technologies; everyone would have a greater incentive to implement more efficient appliances and more efficient houses in energy terms. It would give an enormous extra stimulus to all the other things that have been implemented so far to rather weak effect.

**Q189 Dr Turner:** The Committee on Climate Change has recommended that the interim targets for 2020 ought to be achieved without the purchase of any offset credits. Do you think the government could however use offsets to make an additional effort to exceed those targets? What do you feel about the admissibility of credits in the system?

**Professor Ekins:** I think that using credits to achieve domestic targets confuses and undermines the purpose towards which we are directed. One of those purposes is to achieve a low-carbon economy in a developed country like the UK. Unless industrial countries like the UK achieve a low-carbon

economy developing countries are not going to begin to try to do anything on their own account because they will interpret moves towards lowcarbon economies as moves to stifle their development which they have made abundantly clear they are not prepared to consider. In a sense, by allowing people to purchase offset credits you are accepting that moves to a low-carbon economy might be unacceptably expensive. If they are going to be unacceptably expensive then people will not want to go there. What we have to prove is that we can do it and we have to use targets to stimulate the policy measures that will enable us to do it at home in our own economies. The second thing we need is the provision from developed countries to developing countries of finance to help them decarbonise their economies as they develop, which is a quite different purpose and should not be confused with the decarbonisation of our own economy. Unfortunately this business of offsets has been introduced in order to make it cheaper for us and therefore stop us moving as quickly as we might to a low-carbon economy, and in order to provide this finance. We would do much better to separate those two objectives, to provide the finance (which everybody agrees is going to be necessary for a global deal to be achievable) independently of our own targets to be met at home.

Q190 Dr Turner: So you would abolish offsets?

**Professor Ekins:** It seems to me that it is a very flawed mechanism. While we do not have another mechanism for providing the finance, there may be some political pragmatists who would say that in the absence of a kind of offsetting mechanism actually that finance would not materialise, then probably it is better to have offsetting credits than no finance. Then I think it would be very important for the targets that we set in our own country to be much tougher so that those targets themselves really did bring forward the kind of domestic effort that we need to show that decarbonising an economy like the UK is possible at acceptable costs.

**Q191 Dr Turner:** How would you envisage a financial support mechanism for developing countries actually working? How do you think we can get the developing world to cough up, instead of buying cheap credits?

**Professor Ekins:** There have been a lot of proposals of various kinds, some of them are more or less automatic like a global carbon tax. If you were to have a global carbon tax and rich countries were to contribute some proportion of the revenues from a global carbon tax into an international fund and the rest of the revenues from the global carbon tax could be used for an environmental tax reform of the type I was talking about earlier, that would be one possibility. Some people have suggested taxing international currency movements; some people have suggested using the Global Environment Facility of the World Bank and putting some proportion of GDP from each developed country into that to be used explicitly for low-carbon purposes. I do not think the problem is the lack of

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suggested financial mechanisms. I think the problem has so far been the unwillingness of the developed countries to follow through on any of those suggested mechanisms in order to implement them.

**Q192 Dr Turner:** There seems to be no actual move so far towards getting the international agreement that would be needed in order to establish such a mechanism.

**Professor Ekins:** We have the Road to Copenhagen document published by the government just recently where the prime minister does suggest a sum which developed countries should put on the table. This is clearly a crucial part of the bargaining that is going on in the run up to Copenhagen and no doubt it will continue right to the wire, probably until 11.59 on the final day when the final announcement is to be made as to exactly how much money is going to be there. My own feeling is that that is really not desirable and likely to be counter-productive. The only way we are going to counter this problem is through enormous innovation and low-carbon technologies, and if we achieve that innovation in our own country with our own technologies and with our own companies, then a lot of the money that goes in these kinds of funds will be used to deploy those technologies around the world and our own economies can benefit from that. We are used to that with trade and aid budgets in the past and this seems to me to be an extension of that. To have a low-carbon innovation fund at the global level funded by many hundreds of billions over a period of time is the minimum we will need, but it will ultimately benefit all countries, especially those countries that have taken the lead in developing the low-carbon technologies. At the moment it looks as if those countries are going to be largely constituted in Asia, places like South Korea which featured prominently in the previous evidence, and China and Japan because they are investing heavily in lowcarbon technologies. Unfortunately, we have yet to show that we take that form of investment seriously.

**Q193 Mr Chaytor:** Given your sweeping criticisms of the policies that this government and perhaps some other European countries have adopted as being inadequate, are you absolutely confident that the EU Trading Scheme as the central plank of the European Union's efforts to reduce its total emissions is the right policy for Europe? Or what changes to the EU Trading Scheme would you like to see in place to make it more effective and give it more teeth and more bite?

**Professor Ekins:** I think the EU Emissions Trading Scheme is an immensely important policy and I am amazed, to be honest, that the EU managed to put it in place in the relatively short time that it was negotiated. It does provide some kind of model for a global mechanism which we desperately need. I would have far preferred to have had a global carbon tax and most economists would agree with me that that would have been a far better way to have proceeded at this stage. We might then have moved towards a trading scheme in order to arrive at a more surety on the cap, but we failed to get a European

carbon energy tax in the early 1990s-which I remember very well-and it was clear that a global carbon tax was not going to be introduced. I think the European Emissions Trading Scheme was an essential second best, but very much a second best. In order to make it more effective there is only one thing you can do, which is to reduce the number of emissions that are allocated or sold through it. That is the way caps work; they work entirely according to the quantity of carbon that is allocated through them. If we have a very low-carbon price at the moment it is because there are too many allowances. These allowances are extraordinarily difficult to calculate; they are extraordinarily difficult to calculate even in the absence of lobbying because you never know what technologies will be brought forward as soon as you get a decent carbon price. Every single estimate of abatement technologies in practically any field has overestimated the cost that will be necessary to bring them forward when they become mandated. We have seen it with emissions regulations of all kinds and undoubtedly we are seeing it with carbon. There are many very low cost ways of abating carbon as the marginal abatement cost curves of McKenzie and others show in the Committee on Climate Change report. As those are mobilised by a carbon price of any size, the carbon price goes down. You have to be really tough on the cap in order to maintain the carbon price. Unfortunately, the political pressures brought to bear both at national level and at European level by those who want cheap carbon were very largely effective, in my view, even in the second phase. They were extremely effective in the first phase and very largely effective even in the second phase, meaning that we have too many emissions allowances in the system. I am afraid that in the third phase we are going to find very much the same thing happening. As soon as people believe there will be a carbon price above 20 euros per ton of carbon they will make the investments, that will bring forward limited innovation which will make the carbon price fall again. Unless we have a really tight cap so that people know that one is serious, perhaps a cap that suggests at the moment a carbon price of 200 euros per ton of carbon, then people would make the investments and that might come down then to 50 when we actually see the emissions trading. Politically that has not been proven possible to deliver.

**Q194 Mr Chaytor:** In terms of the use of offsets, you are utterly opposed to their use.

**Professor Ekins:** I am opposed to the use of offsets for meeting domestic targets. I think that the use of offsets may be a useful way for deciding which projects to invest in in developing countries but while developing countries do not have robust carbon caps—which they do not at the moment— then the absolute carbon emissions that are delivered by these offsets are extremely doubtful because you never know the robustness of the baseline against which they are being calculated. Undoubtedly many of these projects do save carbon but we do not know precisely how much and they simply serve to

undermine the robustness of the developed country targets which are supposed to be delivering against firm caps.

**Q195 Mr Chaytor:** Trading within the EU itself to meet our targets will be required to buy up to 25 million tons of EU allowances which presumably will be invested elsewhere in the European Union. *Professor Ekins:* Indeed. That is the whole purpose of the EU Emissions Trading Scheme.

**Q196 Mr Chaytor:** If the investment is elsewhere, particularly in countries that are heavily dependent on coal—Poland being the obvious one—is simply used to transfer from coal to gas, is that an effective outcome of the system because it is not dramatically reducing the amount of carbon consumed, is it? It is locking in Poland and other Eastern European countries to many more years of fossil fuel consumption.

Professor Ekins: The issue of carbon lock-in is very important and undoubtedly the best outcome would be to enable Poland and other countries to leapfrog from coal straight to renewables. It does not sound very good coming from someone in the UK because of course we have not leapfrogged from coal to renewables, we have gone very heavily from coal to gas so it might seem just a trifle rich for us to suggest that Poland did not do the same because our government has not been prepared to do that by paying what it would to exploit some of the best renewable resources in Europe. Obviously EU emissions trading schemes do tend to go for the next least expensive alternative once the cost of carbon goes up. To me the obvious answer to that is that if strategically we do not want people to go from coal to gas then the carbon price has to be sufficient for even gas fired power stations to be too expensive because of the carbon that they emit, so that renewables investments then do become economic throughout Europe. Again the UK would stand to benefit very greatly from that because our renewable resources are among the best in Europe and among the least exploited so far.

**Q197 Mr Chaytor:** If the cap is set too low because of political preferences and the lobbying of vested interests, does it mean that the trading system alone will be inadequate to deliver the kind of emissions cuts needed? I suppose my question is, is a carbon tax an inevitable supplement to the trading system because the trading system cannot deliver the depths of cuts in emissions that we will need?

**Professor Ekins:** Until the market becomes better established I think a carbon tax would be very helpful indeed. I have done quite a lot of work on how a carbon tax might be combined with the Emissions Trading Scheme at the European level and suffice to say it is perfectly feasible to do that. Until the carbon market settles down, until the costs of carbon abatement are reasonably well established, until one can see what sort of quantity of permits will deliver what sort of carbon price, then I think it would be very helpful to have a carbon tax which could be used to set a floor on the price of

carbon, which is what investors of low-carbon technologies tell us that they need above all. Indeed, when you look at those countries that have been successful in investing in low-carbon technologies, without exception it is because the investors have been able to calculate over a long period what the returns from their investment would be. That is not the case in the UK where we not only have the Emissions Trading Scheme which is very volatile but we have the Renewable Obligation Certificate Scheme which also produces very volatile prices for these ROCs so that it is not possible to make those bankable, take loans in the certainty of being able to pay off the loans and make a normal return for your shareholders. Until that kind of certainty is forthcoming through the system I am afraid that our investors will not make the investments in lowcarbon technologies that are necessary.

**O198 Mr Chavtor:** Your figure was 100 euros a ton as the absolute minimum, but with the current arrangements how many years will it be before the carbon price rises to, say, 60 euros a ton, which is where many people are saying is the cut-off point? Professor Ekins: It is very interesting because that depends entirely on innovation. It depends entirely on how the next generation of low-carbon technology develops and the extent to which, once we start rolling out these new designs of nuclear power stations and new designs of wind turbines, they become cheaper. The cost of photovoltaics is already coming down very fast, and if we were to make sizeable investments in sunny parts of Europe and North Africa which would provide large amounts of energy those costs might come down even faster. It may be that actually the backstop technology which appears in a lot of economic models-that technology at which very large quantities of low-carbon energy become availablewould emerge at 60 euros per ton of carbon dioxide. It is impossible really to predict what that is. What we know is that that would stimulate that development very quickly. If we were able to get to a price of 100 relatively quickly then the innovators would know that that gave a significant margin for the development of these technologies, and they could go forward in the confidence that they would make a return. It may then be that we would have a cost reduction and the price of carbon could come down, but that would be once we have gone over the hill of innovation and we have made those investments, we have deployed the technologies and we have started to reap the benefits of the economies of scale to the kind of sunlit uplands towards which low-carbon enthusiasts like myself look. However, it takes a long time to get to those sunlit uplands, as anyone who has been in mountains knows. That climb will not be easy and it will require high carbon prices and high carbon prices are politically difficult.

**Q199 Colin Challen:** The Climate Change Act sets the remit for the Committee on Climate Change and in that remit it has responsibility to take into account not only the climate science but fiscal circumstances, economic competitiveness and social circumstances

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amongst others. How well do you think it is balancing these things? How are the trade-offs working?

Professor Ekins: I think it is extremely difficult. The Committee on Climate Change is obviously a policy relevant body in the sense that it has to consider the policy implications of the targets that it suggests but it is not comprised of politicians and ultimately these decisions about balance between competing economic social and environmental considerations need to be taken by politicians. The scientific case for very strong carbon abatement is absolutely unassailable and the factor concerning which I am least optimistic, if you like, is that public awareness of what climate change means for this country and the world at the moment is nowhere near the scientific reality. People just do not seem to understand, appreciate or even be particularly interested in a change to human circumstances of absolutely extraordinary proportions that will dwarf anything that we experienced in the first 50 years of the last century when we had two world wars and Stalin purges. It is that kind of change that people need to realise is coming up the track in the second half of this century, which may seem a long time but of course it is well within the lifetime of probably most people who are currently living in this country at the moment. It is not far away and until we get that perception then I am rather afraid that the kinds of political changes and policies I have been talking about, as being necessary, will not be politically deliverable. I think politicians have a real responsibility to explain these things in ways that carry commitment, as do scientists and policy analysts like myself. At the moment the message has not got across with anything like the urgency that it needs to.

**Q200 Colin Challen:** Given that and given the remit of the Committee to consider all these other things which are not in themselves climate science related, do you think that the Committee has chosen the correct emissions reductions trajectory or should it have offered one or two other alternatives so that we can contrast what it has chosen with something which might have been more weighted to the science or perhaps a more generous trajectory which was more weighted to social implications?

**Professor Ekins:** I think the targets that we have are sufficiently challenging to serve their purpose. I think there is quite a strong chance that they will not achieve their objective even if they are part of a global effort of delivering us from dangerous and anthropogenic climate change. We know there is only a 50-50 chance of staying below the 2° with those targets. That 2° itself is not quite an arbitrary number but it was certainly chosen on the basis of certain political considerations. It is quite possible that 2° will turn out to be too much for a comfortable human existence of nine billion people on the planet, but it seems to me that the development we now need to see is to move from having set the target which, after all, is intended to be very much a first step in the process rather than the last one, to getting on a trajectory which will meet the targets with a certain

amount of comfort. In other words, we don't just put in place policies that we think, if everything goes absolutely according to plan, might just squeeze in under the 29 per cent carbon dioxide reduction, which has been the strategy for the 2010 targets. I have been monitoring the 2010 targets very closely ever since 1997 and every time the government has produced a new policy effort to meet the 2010 targets and has produced its calculations, it is just squeezing in below and of course the policies have not delivered to the extent that was anticipated and other things have blown the policies off course, so we have ended up missing them by rather a large margin. We simply cannot afford to do that in 2020 with these targets which are relatively robust and challenging and can be justified-kind of-with reference to scientific evidence. The overriding task now is to put in place the policies that can be seen will meet them with some assurance so that when things go wrong—as they undoubtedly will-and technologies do not quite deliver according to plan-as they inevitably will-and we have to spend more on carbon capture and storage than we thought we would and therefore we are able to implement less of it, or the first nuclear power stations do not go in quite as planned-as is happening in Finland-we do not then find ourselves many percentage points short of these targets which are already absolutely at the minimum of what is scientifically justifiable. We have to start upping the level of ambition of the policies that we put in place so that they will achieve these targets with some headroom for comfort, which is how government operates in many, many other areas. We need to introduce that into our climate change policy as well.

**Q201 Dr Turner:** You lead the energy systems and modelling research for the UK Energy Research Centre and your principal conclusion is that decarbonising electricity production should be our number one priority. Just how fast do you think this can be achieved and what should the government be doing to accelerate the process?

Professor Ekins: That conclusion arose out of modelling which indeed we did do. The decarbonisation of electricity is not something that can be done terribly quickly. There are three large possibilities for the decarbonising of electricity. They are: large scale offshore wind farms, new nuclear power stations and carbon capture and storage. All of those require very, very large investments which will take at least ten years to put in place. Between now and 2020 the contribution that is planned is that a lot of offshore wind will be in by 2020 (and it remains to be seen in the White Paper which will be published tomorrow the extent to which the government perceives that to be feasible) but I do not know anyone who suggests that there will be large numbers of carbon capture and storage plants or large numbers of new nuclear power stations up and running by 2020. Prior to 2020 we have to do what needs to be done largely through renewablesoffshore wind and biomass-and improvements in energy efficiency, in particular in relation to the existing housing stock. Those are the two really

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important efforts-increasing the energy efficiency of cars is another very important one—so that by the time we get to 2020 the overall size of the energy demand has been brought under control and we are clear about what sort of levels of the new decarbonised sources of electricity will be needed in order, eventually, to contribute to the decarbonisation not just of electricity itself but of household energy use which will increasingly rely on electricity and indeed vehicles and road transport which can increasingly use hybrid or electric vehicles. That time scale is between 2020 and 2040 really so that those big new investments in lowcarbon energy sources can roll out between 2020 and 2040, plus perhaps marine and wave power if that has been sufficiently developed by then.

**Q202 Dr Turner:** I was just going to ask you for a rough guesstimate of the possible contribution by 2020 of wave and tidal stream.

**Professor Ekins:** By 2020, very small; the first prototypes are barely in the sea and they are not delivering anything resembling large quantities of power. Wind technology is infinitely further advanced than marine renewables and we know what the challenges of rolling out large quantities of wind are going to be over the next ten years. The challenges in implementation terms will be just as great for marine; there will be large structures sitting in the sea having to deliver quantities of energy but at the moment we have no real idea what the design of the ultimate structures that will be the commercial models will be. That is very much a post-2020 technology so far as I am concerned.

**Q203 Chairman:** Thank you very much indeed. You have covered quite a bit of ground in a fairly short space of time so we are very grateful to you. *Professor Ekins:* Thank you.

#### Memorandum submitted by Professor David MacKay

#### SUMMARY

Is it technically possible to decarbonize Britain by 2050? Yes. But it is important to appreciate the scale of change and the scale of building that are required.

To illustrate the scale of the decarbonization challenge, I sketch a back-of-envelope energy plan that roughly adds up, and that is buildable by 2050 if we start now.

In this plan, we build almost every zero-carbon technology we possibly can, as fast as we possibly can, starting right away. The plan reduces energy consumption by between 30% and 50% (depending how the accounting is done) by adopting super-efficient technology for the two biggest consumers—transport and heating. The energy is produced by a diversity of sources, with roughly equal contributions from nuclear (increased 7-fold over 2008 levels) and renewables (increased 20-fold).

#### **OVERVIEW**

1.1 This plan starts in 2009 and aims to fully decarbonize Britain by 2050, and to keep the lights on along the way. I say 'fully decarbonize', but to be precise, there may be some industries that are impossible to decarbonize, for example, agriculture, steel, concrete, aviation, and international shipping; so what I really mean is that everything else is fully decarbonized. This plan focuses, for brevity, on the three biggest fish: transport, heating, and electricity.

1.2 I call this plan "Plan C" (to distinguish it from Plans D, L, N, G, E, and M, which appear in reference [1]). Plan C may be a possible starting point for constructive conversations aimed at developing a single consensus plan.

1.3 Like the six plans presented in the book, plan C has several components that may seem ridiculous or infeasible in today's political climate. Criticisms are welcome, but (in the interests of consensus-building) I suggest that they should be accompanied by a proposal for a replacement plan that adds up and that will have a better chance of achieving consensus.

#### UNITS AND OTHER ASSUMPTIONS

2.1 In this document I will describe both average powers and peak powers in gigawatts (GW). To convert these national units into personal units, it may be useful to note that a national (UK) power consumption or production of 1 GW is equivalent to a power consumption or production of 0.4 kWh per day per person in the UK. It is important to distinguish average power production and peak power production (or "capacity"). I'll measure both in GW, and will sometimes add a letter "p" to denote "peak". For example, speaking of John Hutton's wind aspiration (announced December 2007 [2]), we might say "33 GWp of wind power would deliver 10 GW on average".

2.2 The abbreviation "M" denotes one million.

#### 2.3 Build rates

For simplicity I will describe steady growth of all technologies. In reality of course most technologies will more naturally grow along an S-curve of some sort.

#### PLAN C, IN BRIEF

3.1 Britain's primary energy consumption today is about 300 GW, most of it fossil fuel. Roughly one third of energy consumption relates to transport and one third to heating. (This is a cartoon of Britain—inaccurate, but hopefully accurate enough to help discussions of the big picture.)

3.2 Plan C steadily reduces the energy demand of transport and heating by electrifying them and at the same time making them more efficient. By 2050, energy consumption for transport (excluding planes and shipping), heating (excluding industrial heating), and electricity is reduced to about 125 GW; almost all energy for heating and transport is supplied by electricity.

3.3 This plan supplies this energy consumption by growing a diverse spread of technologies; most technologies are grown at roughly the maximum rate I think is plausibly achievable. Renewables (domestic and imported) are increased roughly 20-fold, and nuclear power is increased 7-fold over 2008 levels. The electricity comes from the following sources. (The numbers given here are average outputs, not capacities.) Wind: 30 GW; tide: 8 GW; waste-to-energy: 2.5 GW; "clean coal" and biomass co-firing: 3.2 GW; nuclear: 70 GW; concentrating solar power in deserts: 10 GW; wave: 0.75 GW; photovoltaics: 0.75 GW. (That's a total of about 125 GW of electricity—nearly a three-fold increase in average electricity production.) Solar panels will provide 2.5 GW of hot water and heat pumps (should we want to count them as an energy source) will pump on average about 32 GW of low-grade heat into buildings. Sustainably-sourced wood will supply about 7.5 GW of heat.

#### SOME DETAILS

#### 4.1 Efficiency measures

Obviously, we take all the low-hanging fruit. We provide mandatory free building insulation for all old buildings. We install smart meters that engage and inform building users. We switch all building lighting to LEDs, or equally efficient alternatives, by 2050. We promote car clubs, public transport, cycling and walking. We promote "reduce, reuse, recycle" everywhere they make sense.

#### 4.2 Electric vehicles

4.2a. Electric vehicles will steadily replace fossil-fuel vehicles. 1.5 M new electric vehicles per year, each drawing an average power of 8 kWh per day, will increase electricity demand by 0.5 GW each year; vehicle-charging is a demand that is easily switch-off-and-onable. (These vehicles might initially be plug-in hybrids then in due course all-electric vehicles; the replacement rate, 1.5 M per year, is roughly today's replacement rate of fossil cars. By "plug-in hybrid", I mean a vehicle like the GM/Vauxhall Volt that runs entirely on electric power in everyday use, but has a small fossil-fuel engine to give it extended range.)

4.2b. All train lines will also be electrified over a period of 20 years. There will be an increase in rail freight. After 25 years the added electrical demand for electrified transport will amount to about 20 GW on average.

4.2c. One way of helping the growth of electric vehicles in cities will be to install power outlets for vehiclecharging in all lampposts that are near to parking places. Europe should agree on a standard for exchangeable batteries so that some high-use vehicles can refuel by battery exchange.

#### 4.3 Air-source heat pumps

Air-source heat pumps (high efficiency ones like the EcoCute from Japan, assumed to have average seasonal coefficient of performance better than 3.0) are installed in place of gas boilers and condensing gas boilers, which are phased out. These air-source heat pumps will eventually supply most building heating and water heating. The build rate will be 1 M units per year for a duration of 33 years. (This is roughly the rate at which fossil heating systems are currently being replaced.) Each unit will consume an average power of 1 kW in winter and 0.25 kW in summer. The additional new electricity demand thus created each year is 1 GW in winter and 0.25 GW in summer. For some buildings, ground-source heat pumps may also be viable, but such buildings will be a minority—air-source heat pumps are easier to retrofit to existing high-density buildings in suburbs. Where forests can be grown close to buildings, there will be some use of wood for heating also, but for the majority of buildings wood won't be available.

#### 4.4 Solar hot water panels

Solar hot water panels will be installed on buildings at a steady rate such that by 2050 2.5 GW of average power is delivered in the form of hot water. (More in summer, less in winter.) This plan assumes 16 million units, each 3 square metres in area, are installed.

#### 4.5 Wood

If we cover 15% of UK land with sustainable forests and willow and miscanthus plantations, 7.5 GW of heat can be supplied. (Today, Britain's consumption of heat is roughly 100 GW on average.) These plantations could be up and running within two decades.

#### 4.5 Tide

The Severn barrage is built and completed by 2022 (2 GW average output). Tidal lagoons are built in The Wash and off Blackpool, providing 1 GW of average output and some pumped storage capability, by 2020. A large investment ( $\pounds$ 20 billion of research and development) in tidal stream farms is made, with the goal of providing, by 2050, an average output of 5 GW. Assuming a lag of 10 years for development, most of this would be installed between 2020 and 2050.

#### 4.6 Waste-to-energy (municipal and agricultural).

The target would be to produce an average power of 2.5 GW from waste-to-energy plants. The capacity would be increased steadily at a rate of 0.5 GWp per year to 10 GWp, so these power stations would run at a load factor of 25%. The purpose of this low load factor would be to make a substantial contribution to daily load-balancing on the grid. This plan requires all municipal waste that is not recycled to be incinerated or pyrolysed, and an equal amount of agricultural waste too.

#### 4.7 Wave power

0.75 GW could be produced from wave farms in the Atlantic, facing West, 130 km long. Whether this investment would be economic is not clear.

#### 4.8 Solar photovoltaic panels

In 2006, PV produced 0.00075 GW, on average, in the UK. So if we assume that solar photovoltaic panels are increased one-thousand-fold, they would deliver 0.75 GW. Whether this investment would be economic is not clear. It is to be hoped that the cost of PV will come down. One potential benefit of decentralized power generation is the engagement and energy awareness it causes.

#### 4.9 Wind farms

Wind farms are built at a rate of 2.5 GWp per year, stopping once 100 GWp is reached. (British wind farm capacity was about 2.7 GWp in 2008.) 100 GWp will produce 30 GW on average. This amount of wind power would be roughly a 35-fold increase over 2009 levels. The land area occupied by wind farms would be roughly 5% of the country, or roughly half the area of Wales. The wind farms can be located onshore or offshore. Offshore wind farms would be significantly more expensive. Building wind farms offshore will require investment in jack-up barges: perhaps ten barges, costing £60 M each.

#### 4.10 Pumped storage

Alongside the growing wind farms, five new pumped storage facilities would be created—perhaps one in Wales (new build, like Dinorwig, which stores 10 GWh of energy and has a peak power of nearly 2 GW) and four in Scotland (by conversion of existing hydro facilities, like Cruachan and Foyers). Each would be similar in scale to Dinorwig with a peak output of 2 GW, and preferably storing a bit more energy than Dinorwig, say 40 GWh each. This 10 GW rapidly-adjustable source, along with the rapidly-adjustable demand of the half-charged electric vehicles that are connected at any time (amounting to an easily-switch-off-and-on-able demand of 10 or 20 GW), and the rapidly-adjustable demand of heat-pumps for making hot water and heat pumps for winter-building-heating, will allow the balancing of fluctuating demand and intermittent renewables.

#### 4.11 Interconnectors

Additional virtual pumped storage can be obtained from connections to countries with hydroelectricity. We build 5 GW of interconnectors between Britain and Norway (with cables from both Scotland and England); perhaps 1 GW to Denmark; and perhaps a 1 GW interconnector to Iceland, assuming that Iceland would increase its hydroelectric capacity. We also build 0.25 GW per year of new interconnector to France, so that by 2050 the connection to France is increased from 2 GW to 12 GW.

#### 4.12 Coal and gas with carbon capture and storage

8 GWp of "clean coal" power stations will be built at a rate of 1 GWp per year, providing an average output of 3 GW (more in winter, less in summer). This will require the import of roughly 11 GW of coal (assuming the power stations are 40% efficient and that capture and storage requires 25% of the power). For comparison, in 2006, the UK imported 70 GW of coal.

The coal stations will also co-fire biomass, thus capturing some carbon dioxide and genuinely neutralizing the emissions associated with some continued fossil fuel use by air travel, industry, and international shipping. Market forces may lead to the building of gas power stations with carbon capture and storage, but I won't assume that these exist in 2050, since who knows where the price of gas is going. I think it safest to assume that cheap gas will be all gone by 2050. Plan C has no micro-generation combined-heat-and-power on the assumption that heat pumps are better, and allow decarbonization.

#### 4.13 Nuclear power

New stations are built at a rate of 2.2 GW per year, the first stations coming on line in 2018. By 2050 Britain would have 70 GW of nuclear power—roughly what France has today. This sustained build rate (2.1 GW per year) is similar to the historical build rate in France (3 GW per year).

#### 4.14 Imported renewable power from other countries

Through international agreement and cooperation, concentrating solar power stations are built in Mediterranean and North African deserts at an appropriate rate such that the power bought by Britain increases at a rate of 0.25 GW per year. By 2050, the power would be 10 GW. New power lines across Spain, Italy, and France would be required. These power lines would be part of a European super-grid, useful for power-balancing across Europe and North Africa.

#### 4.15 Fluctuations of renewables and of demand; smart grids and storage

Both wind power and nuclear power have difficulties tracking demand. (Modern nuclear power stations can be turned down, but they give the best economic return on investment if they are left on all the time.) It is therefore essential to implement smart demand management or storage or both, on a very large scale. The two main forms of demand that will be easily switch-off-and-on-able will be electric vehicle charging and electric heat-pumping. Wherever possible, buildings should have heat stores—the bigger the better—to help provide demand that can be moved in time by hours, days, or even months. Storage technologies deserve strong investment, because cheap storage will help any decarbonized energy plan, whatever its mix.

Without smart demand management, the expansion of wind and nuclear will not work.

#### FURTHER DETAILS, OPTIONS, RISKS AND UNCERTAINTIES

#### 5.1 Population

This plan has made no allowance for population change.

#### 5.2 Wind/nuclear mix

Plan C gets the lion's share of its 2050 power from wind and nuclear. The mix could be adjusted in response to economic or political preferences: the exchange rate to be aware of is that each Sizewell-B is equivalent (on average) to 2000 (2 MW) turbines, which would make up windfarms occupying an area of roughly 2000 square kilometres.

#### 5.3 Electric vehicles

There are significant questions about batteries. Will it be possible to make batteries cheaper and lighter? Will it be easy to recycle old batteries into new batteries with only a small energy cost? Are there resource constraints that would make it difficult to deploy millions of electric vehicles? Plan C assumes that technical progress will resolve all these questions. There do seem to be promising signs of progress.

#### 5.4 The "Vehicle-to-Grid" option

Plan C assumes that the charging of half-charged vehicles will be a big chunk of easily-switch-off-and-onable demand. We could imagine going further, using electric vehicles not only as adjustable demand, but as occasional energy-sources too: using them as batteries for the benefit of the grid. This option is called "vehicle to grid" (V2G). Plan C did not assume this use of electric vehicles; it is possible that vehicle-to-grid might make economic sense.

#### 5.5 Hydrogen

Plan C makes negligible use of hydrogen for transport because hydrogen vehicles use about four times more energy than electric vehicles. We can't afford the energy! Plan C is already very close to the buffers of plausible power production.

#### 5.6 Biofuels

Plan C makes negligible use of biofuels for transport. Domestic production of biofuels at any useful scale would require too much land area, and it is not clear that environmentally-sound biofuels will ever be importable at significant scale from overseas. If biofuels are produced, their main use in a decarbonized-Britain plan should probably be in agricultural machinery, aviation, shipping, plug-in hybrids, and long-distance road freight.

#### 5.7 Waste-to-energy

In a decarbonized world, there is eventually going to be a shortage of chemical feedstocks for manufacturing useful stuff. It will therefore be important to reuse and recycle stuff, especially carboncontaining stuff, rather than simply setting fire to it. At present we send roughly 1 kg per day per person of stuff to landfill. This will end. Plan C assumes that this waste stuff, and an equal amount of agricultural waste, is used in waste-to-energy facilities. The ideal waste-to-energy facilities are waste-to-chemicals facilities that preserve as much as possible of the carbon (and other useful lego bricks) in a form useful to the chemical and manufacturing industry. This means that the energy derived from waste may become smaller than plan C shows. National Grid have published ambitious plans for the turning of waste into methane gas for distribution to houses for use in heating and cooking. Perhaps a partial implementation of that idea would make sense, but I believe that society will come to think of methane as a resource that is too valuable to simply burn for domestic heating. We need a Chemical Feedstocks Plan for the post-fossil-fuel era.

#### 5.8 "Clean coal" with carbon capture and storage [CCS]

"Clean coal" is as yet an unproven low-carbon technology, with several uncertainties, therefore Plan C features only 8 GW of prototypes. If, by 2020, CCS is not proven to work, the coal in this plan could be replaced by additional nuclear build. If CCS works and if economics favours CCS over nuclear then the plan could be tilted in that direction.

#### 5.9 Hydroelectricity

In Plan C, there is no increase in hydroelectricity. Hydroelectricity continues to produce 0.5 GW on average, as it does today.

#### 5.10 International shipping

International shipping is quite an efficient user of fossil fuels, but perhaps we should plan to defossilize it too. (In 2002, Britain's share of international shipping used a power of 10 GW; that corresponds to a significant fraction of the UK's carbon budget for 2050.) In plan C, Britain restarts President Dwight D. Eisenhower's "Atoms for Peace" initiative, building and maintaining a new fleet of nuclear-powered container ships and passenger ships.

#### References

1. David J C MacKay (2008). "Sustainable Energy—without the hot air" UIT. This book contains further exposition, and sources and explanations for most of the numbers and estimates given above.

2. "Wind 'could power all UK homes". http://news.bbc.co.uk/1/hi/uk\_politics/7135930.stm

#### 9 July 2009

Witness: Professor David MacKay, Professor of Natural Philosophy, University of Cambridge, gave evidence.

**Q204 Chairman:** Good morning and welcome to the Committee. Can I thank you for giving us all a copy of your book which we have been given this morning?<sup>2</sup> I will start by asking you if you think that the way in which we talk about emissions targets and carbon budgets is meaningful to the people who need to understand the importance of them.

**Professor MacKay:** You are thinking of the British public I assume? Is that who you are referring to?

**Q205 Chairman:** I was not just thinking of the British public really, I was thinking of the decision makers as well.

Professor MacKay: I do think it is important to understand the scale of our energy consumption and the scale of what we are talking about when we name these targets. We have been hearing from the previous witnesses about the prices of carbon and the technologies and innovations that are expected, but at the end of the day, if we carry on living the way we currently live or with a similar lifestyle we will have to build a lot of new stuff. We will still be living energy intensive lifestyles at home and on the roads and the devices we will be using need to be built. We need better insulated houses; we need new heat sources that do not need natural gas; we need vehicles that do not run on petrol. We need this power to be coming from somewhere. Maybe clean coal can play some part in that but mainly we need to be looking at renewables and nuclear in our country or possibly in other people's countries if we do not want to use our own countryside as a place to get the power from. I think it is important that the public discussion of the carbon targets includes an understanding of the scale of what is required. I think the government is going in the right direction with many of its policies that we are hearing about (renewables, nuclear and home insulation) but the rate of progress in those directions is not sufficient at the moment and maybe people are not yet visualising the end point of what 2050 needs to look like if we are going to meet these climate targets.

**Q206 Chairman:** How can we express these things in ways that might be more meaningful so that people do understand what the scale of the progress needed actually is?

**Professor MacKay:** I suppose there are two ways of visualising the scale of these things. One is to talk per person what needs to be put up: how many square metres of solar hot water panels we should be thinking of (square metre per person might make sense); how many square metres of photovoltaic panels, if they become affordable and if you really want a big contribution from photovoltaic panels we need to be talking about not just covering all south facing roofs but substantial chunks of countryside as well. How large would the wind farms be per person? We need to be talking about many hundreds of square metres per person of wind farms. The personal scale is one way of visualising. Talking about taking a home and insulating it and putting 20

centimetres of polystyrene or some sort of good insulation on the outside of every home and every office building, at least all the old ones that are not up to Swedish building standards. So there is the personal visualisation and then there is the nationscale visualisation of what that means in terms of land areas that need to be occupied by some of these new facilities. If we want to reach the 2050 targets the sorts of things we need to be visualising, in addition to all the efficiency measures (where we make transport more efficient by electrifying most of it and we make heating more efficient by switching over to heat pumps perhaps), the power sources we need to be imagining involve something like a seven-fold increase in nuclear power so that would require building nuclear power stations not just on existing sites but probably on some new sites as well, and a 30-fold increase in wind farms in the country. That would be one example of a mix that would supply enough electricity to cover not only today's electricity but also electrified transport and electrified heating systems. A 30-fold increase in wind farms really would start intruding into the countryside; we do need to imagine perhaps coving five% of the country with wind farms. If that is viewed as politically unacceptable people need to understand the exchange rates. We need a plan that adds up. We cannot say no to everything. If we do not want 2000 more wind turbines we could replace those 2000 new wind turbines by an extra Sizewell B nuclear power station. That is the exchange rate and so we need to be talking about 70 Sizewell Bs or, if we do not like 70 Sizewell Bs then 70 times 2000 wind turbines would provide the same amount of power and would cover most of the countryside.

**Q207 Chairman:** We have been quite proud of our progress, relatively speaking, since 1990. We have some progress towards emissions targets, but that has been achieved at least in part by the fact that we have exported a lot of our heavier industries. Do you think it is important that we should measure emissions on a consumption basis as well as a production basis?

**Professor MacKay:** You are certainly right that we have exported a lot of our energy intensive activities overseas which are now out of control with the growth in emissions. We certainly need to understand that. I think we could reach our 2050 targets without explicitly accounting for what is going on in other countries as long as we trust them to be doing a similar accounting exercise and decarbonising their economies as well.

**Q208 Chairman:** Would that not allow them to argue that in effect we are riding on their back? We are pointing to a reduction in emissions in the UK simply because we are now buying steel or whatever from some other part of the world.

**Professor MacKay:** Maybe the point you are making is that attributing allowances to people on a per capita basis is perhaps not the most rational way to do things. If we do end up with some countries that are the energy intensive countries that manufacture

<sup>&</sup>lt;sup>2</sup> Sustainable Energy—without the hot air, David J C MacKay, 2009

all the stuff for everyone else, they could make a strong case that they ought to have a larger allowance and that perhaps would favour a system based more on carbon taxes, that wherever the fossil fuels are getting burned we will make sure we tax them appropriately heavily. This is really getting out of my territory; it is not my specialism.

**Q209** Colin Challen: The Committee on Climate Change has suggested that we should almost entirely decarbonise our electricity generation by 2030. Do you think that is attainable?

**Professor MacKay:** Is it possible to decarbonise by 2030? Yes, it is. The rate of building of clean electricity systems needs to be much bigger than what it is today. At the moment we have about three gigawatts of wind capacity that produces on average about one gigawatt of output. I think the right sort of build rate to aim for would be that every year from now until 2020 we need to put up that much again, three gigawatts of capacity every year. Similarly the nuclear build rate that people are talking about at the moment, I get the impression that people are imagining that there might be ten gigawatts built not by 2020 but maybe another decade after that or possibly as much as 30 gigawatts. Again that is not the right sort of build rate for meeting the target of complete decarbonisation of electricity, especially if we are moving to electrifying transport and electrifying building heating using heat pumps which would be a sensible policy. Then the actual amount of electricity required will have to actually increase and eventually maybe even double or triple.

**Q210 Colin Challen:** What is the simplest thing to do to head towards that 2030 ambition? What would be your view on the technology required?

**Professor MacKay:** I think we need to build pretty much everything that makes sense at pretty much the maximum rate imaginable. France built nuclear power stations at a rate of roughly three gigawatts per year and I think a possible plan that would add up for Britain would be to aspire to that sort of rate of building of nuclear power stations, roughly two gigawatts a year and similarly, as I said earlier, a build rate of wind farms of about 3 gigawatts per year. We need to pull out the stops on those two technologies which are the biggest options for electricity in Britain. In addition there are some other important options. I support a big investment in tidal stream research and development and maybe eventually tidal stream could be on a similar sort of scale as wind is today. I would also emphasise waste to energy plant. I think we should imagine building, for every town, a waste energy facility that would be taking waste that currently goes to landfill and causes all sorts of problems, using it as a resource, as a source of electricity and a source of feed stock for chemical processes which currently use fossil fuels as their feed stock.

**Q211 Colin Challen:** I have not yet had the chance to read your book but is it really looking at Britain as a sort of energy island or to what extent do you think that things like the super grid can make a contribution by 2030?

**Professor MacKay:** I think the super grid concept is essential for the future of humanity. In the long term, where is humanity going to get its energy from once the fossil fuels are not being used any more? Solar power in deserts has to be one of the major sources for humanity. I think it would make sense for Britain to join in building a super grid with a strong emphasis on solar power in deserts in Libya, in Algeria. Supporting the development of that infrastructure and technology I think would make a lot of sense. By 2030 could that be making a strong contribution? I think it is not impossible to imagine that by 2030 we could build solar power stations in deserts that have an area similar to the area of London and that we could have power lines crossing Europe carrying a power similar to Britain's electricity consumption today. I think this is possible. In the news in the last week we have heard that German countries are proposing to invest 600 billion euros or dollars in exactly that project. I think it would make sense for Britain to become part of that too. Britain could be self-sufficient in terms of its own renewable and its own nuclear power, but I think it would make sense for us to be supporting the development of solar in deserts which would lead to us then being energy importers. We are already energy importers obviously in terms of gas and coal so it would not be a radical change to have a dependence on Algeria and Libya for electricity.

**Q212 Colin Challen:** Even 2030 is quite a long way off given that the IPCC say we should start reducing our emissions by 2015. Putting to one side the fact that tomorrow we will have a renewable energy strategy published, if you had to look at the very short term—what needs to happen in the next two or three years, the first budget period of the Climate Change Act—what would you say we had to do immediately to head towards these longer-term targets?

Professor MacKay: I do not think the climate scientists care very much when the carbon gets emitted so I think emphasising urgent actions that have to be done in two or three years is probably not consistent with the science that says that the carbon goes upstairs and hangs around there for hundreds of years. I think what is urgent is to think about the long view and figure out a road map to 2050 and work out what the priorities are for investment to ensure that we do reach the 2030 and 2050 targets. The government has been emphasising electric vehicles; I think that is definitely a good part of the solution. Transport is roughly one third of our emissions at the moment, almost all using fossil fuels, and if we were to electrify transport it would not only defossilise the transport it would make it much more efficient because electric vehicles are more efficient.

#### 14 July 2009 Professor David MacKay

**Q213 Colin Challen:** You started that statement by saying that we should urgently look at the long term but does climate change science not say that if we are going to go for 80% a fall at the end of that period we should aim for a sharp fall in emissions at the beginning of the period because there is that big block of emissions that is the problem and if you have got to 80% cuts in the last five years before 2050 there is hardly any point in doing it.

Professor MacKay: I am sorry, I was not meaning to say that we could delay our reduction of emissions; it is the total that matters. I do not think it is essential to meet a particular budget in two years as long as the total remains the required total. My reason for saying that is that I am worried about locking. We could say that may be a good way to reach our shortterm targets is to have more use of gas which happens to be a fossil fuel and we could build a whole load of new technology that uses gas and reduce our coal power stations. I think this is what the market is about to do, we will have more gas power stations. People also talk about microcombined heat and power, perhaps a power station in every home. Again this would be using gas and it might be 7% more efficient than the way we currently use gas for home heating, but it is only 7% more efficient. It might help us achieve a short-term target but then it might be locking us into a technology that would prevent us from easily reaching the longterm targets.

**Q214 Colin Challen:** Should efficiency savings in fossil fuel based generation be excluded from any accounting we do moving towards the green economy? Some people have argued under various cap and trade schemes that a more efficient gas plant, or even coal with carbon capture and storage, should almost be counted as equivalent to savings from renewable energy.

**Professor MacKay:** I am not sure what the best way to do the accounting and setting up targets is. I would say that we need to make sure that the policies we come up with are consistent not only with the short term but with the long-term targets on the totals.

**Q215 Dr Turner:** We have obviously got to get off fossil fuels as fast as possible. How would you prioritise the actions that the government needs to take to expedite this process?

**Professor MacKay:** As I said earlier, I think we need to do almost everything as fast as possible so I would not want to set one priority against another priority really. You have heard from earlier witnesses that having a strong carbon price would really help, a strong price that is predictable for the future also. I would encourage a policy of having a floor on the carbon price so that if the Emissions Trading Scheme is not taking the price up to 60 euros a ton or 100 euros a ton then we could round it up. We could say there is an additional tax such that the price will be 100 euros per ton whatever happens in the market. That would then support the development of many

renewable technologies and other clean forms of energy and give people confidence that their investment is going to pay off in those technologies.

**Q216 Dr Turner:** Would you do this by way of regulation, for instance by putting stringent emission limits—grams of CO<sub>2</sub> per kilowatt—on electricity production?

**Professor MacKay:** That is a possibility, to have additional legislation that stipulates the required efficiency for particular technologies. This could be done for vehicles, for example, and there have been moves in Europe for emissions limits on vehicles in terms of grams per kilometre. You could have the same for electricity also and there could be explicit targets for buildings. We have building codes and we could have new targets that say, "Okay, all old building stock by 2020 has to be insulated to this standard". There are already grants that help reduce the leakiness of your house by 25% or so, but we need grants to support much more radical retrofitting of good insulation technology into existing buildings.

**Q217 Mr Chaytor:** The model of electricity generation that you propose would involve a huge expansion of infrastructure but is still a very centralised model. You are saying nuclear and vast wind farms will feed energy into the grid and simply replacing coal and gas. Do you give any credibility at all to the concept of de-centralised energy systems and micro-generation?

Professor MacKay: What I care about are the numbers and some forms of de-centralisation definitely work. Solar hot water panels on roofs are a de-centralised energy technology that works and might even pay for itself. I would strongly encourage support for hot water panels on every home. Another de-centralised technology that works and delivers energy locally is a heat pump. A heat pump is a back to front refrigerator that moves heat from your garden into your building. It is de-centralised; it is using a small amount of electricity that comes from the grid to move a lot of heat from your garden into your building. That is de-centralised and it works. I am not against de-centralisation; it is a question of whether the numbers actually stack up. The wind does not have to be organised into mega wind farms; it could be that it could be done on a community basis. A community of 2000 people could say, "We want to power our electricity with a one two-megawatt turbine" and they could get together. There is one successful example of this in Britain, a community that got themselves a small wind farm. That is roughly the scale, 2000 people buying a two megawatt turbine. That would then fit in with the picture I was sketching earlier of the scale of wind that is required. You could view that as decentralised. I think it is better for them to buy together one big, tall, two megawatt turbine rather than for them all to buy small roof-mounted wind turbines which are useless and never pay for themselves, unless they are in exceptional locations.

**Q218 Mr Chaytor:** What assumptions do you make about the rate of growth in energy efficiency both in terms of generation and consumption through appliances?

**Professor MacKay:** Heating systems today take high grade energy and turn it directly into heat, so a condensing boiler is about 90% efficient at turning high grade chemicals into heat by setting fire to them; electrical heaters of the standard sort are 100% efficient at turning high grade electricity into heat. That is very inefficient according to thermal-dynamics; you can do much better and that is what a heat pump allows. A heat pump can be perhaps 300% or 400% efficient. If you take one unit of electricity you end up with four units of heat in your house because what it is doing is pumping heat, moving heat from your garden into your house.

**Q219 Mr Chaytor:** Is the heat pump the most effective form of electricity generation for heating purposes?

**Professor MacKay:** A heat pump is not generating electricity, it is actually generating heat in your house and it is using a bit of electricity from the grid. That is four times more efficient than a standard resistance heater and in my view it is also four times better than setting fire to fossil fuels.

**Q220 Mr Chaytor:** Why are you not arguing then for a heat pump in every home? *Professor MacKay:* I certainly am.

**Q221 Mr Chaytor:** Is infrastructure and use of space the ultimate solution?

**Professor MacKay:** I think that is part of a sensible road map. People also talk about wood burning stoves but there is not enough land area in Britain for everyone to have a wood burning stove. I think heat pumps and solar hot water panels would play a crucial role in a decarbonised heating system. You were asking about efficiency options and the efficiency assumptions I am making. I am assuming a vast roll out of heat pumps and the Committee on Climate Change also assumed this in their model. That gives you a big efficiency savings. I am also assuming that we do have a big insulation programme, insulating old buildings as well as possible which is another of the most important things to do in terms of efficiency. On the transport side of things, electrifying transport can make it perhaps four times as efficient as it is at the moment. Making vehicles smaller, lighter and more fishshaped can also make them more efficient. I am assuming, in the sketches in my book and in the evidence that I gave to the Committee, transport does become more efficient but then there is the miracle of growth which undoes some of those options. In my sketch I assumed that overall there was a 50% net saving in energy consumption for transport when we moved to these electrified vehicles and a greater use of public transport and car sharing as well.

**Q222 Chairman:** I think we are now unfortunately losing our quorum so thank you very much indeed for coming in. We will study your book with great interest. It is a very good time to give MPs a book, just at the start of the summer recess, so there is a reasonable chance of it being read.

Professor MacKay: Thank you very much.

#### **Tuesday 27 October 2009**

Members present Mr Tim Yeo, in the Chair

Mr Martin Caton Mr David Chaytor Martin Horwood Mark Lazarowicz Jo Swinson Dr Desmond Turner

*Witnesses:* Lord Turner of Ecchinswell, a Member of the House of Lords, Chairman, and Mr David Kennedy, Chief Executive, Committee on Climate Change, gave evidence.

**Q223 Chairman:** Good morning and welcome to the Committee. Can I begin by thanking you for changing your plans to fit in with this date; we were having some difficulty, I know, and we much appreciate the fact that you put yourselves out in order to talk to us today. Can I start by saying how much I welcome the work your Committee has done since it was established. I think it has made a tremendously valuable contribution to the debate; and, in particular, I warmly welcome the report that was published two weeks ago as a very important report in its own right and also, I hope, an indicator of the future series that is coming. Could I start by asking what you think the Government will do in response to this report?

Lord Turner of Ecchinswell: We hope that the Government will reinforce its determination to do some of the things that it was doing in any case. We talked in this latest report, the first progress report to Parliament, about the need for a step change in the pace of reduction; that we had entered the first budget period running at about reductions of 0.5% per annum and we now need to go at about 2-3% per annum. We identified some of the aspects of policy which we think need to be reinforced or changed to be on that more aggressive path. It is true, several of those are in the Government's Low Carbon Transition Plan, so they were not things we had completely independently thought out. We had been continually interfacing with the Department and understanding the plans that they had in any case. There are some aspects of what needs to change which I think are underway already: for instance, a significant intensification of the approach in energy efficiency in the home; the need to move beyond the existing supplier obligation area. There are others where we believe there is a need for action, and I think it is now for the Government to respond and say what it plans to do there. For instance, we talked about looking at some stage-once we are beyond Copenhagen—at the whole operation of the electricity market, and whether that operates in a way which is conducive to the investment that we need in a decarbonised electricity system. Finally, if I could flag one thing in the area of transport, we flag the need for some pump-priming support to electric cars now. There is already money in budgets as that relates to that; I think it was £250 million committed; we flagged that there may need to be more than that to get us beyond this chicken and egg problem in electric cars. I think across the range of policies the key thing we have been saying is the need for a step change. Several of the aspects of that step change are already there and planned in the Low Carbon Transition Plan; and the key thing we would like to see in a response is working through the different areas where we have identified that need for a step change, and making sure that the policies are in place to deliver that.

*Mr Kennedy:* There are four specific things we will look at, and so over the next months we will be very focussed on the heat and energy saving strategy, so we have got a draft strategy that will come out in final form. We have set out our position on clean coal; and the Government will announce its framework for clean coal I think in December; so again we will be looking at what they say there. Another key area is renewable heat; and there is a proposal for a renewable heat incentive that is due over the next months; that will be key. Then there is a formal response required under the Climate Change Act by the Government to our report I think in January next year.

**Q224 Chairman:** We will return to some of those points in a moment. One of the things you said was the UK should now aim to over-achieve emissions reductions. Do you think the Government are going to agree to that?

Lord Turner of Ecchinswell: I do not know, but I think it is something for Government to debate and also for Opposition parties in Parliament to debate whether they are happy to accept that commitment. The background, of course, is the impact of the recession on emissions. Now it is not absolutely clear how big that will be. We have obviously focussed a lot of attention on it: we have used various different models to try and get a grip on it; but we think the recession in itself may take out somewhere between 40 and 70 million tonnes out of the first budget period which is, as it were, a reduction in our carbon emissions because factories are running less than they were before et cetera. It is very important that we do not allow that reduction-for reasons of economic recession-to fool ourselves that we are on an underlying path; and that is why we have not argued that Parliament should, as it were, go through the formal process of changing the first budget—we do not think that is required—but we do think there should be an objective aiming to outperform the first budget. We have also said that if we manage to outperform the first budget we should not *bank* that saving to allow us to underperform the second budget. That is the logic. I do not know what the Government are going to say on that, but I think it is an important issue for the Government and the Opposition (since we are in a pre-election period and therefore do not know what the Government will next be) all to decide what their attitude to that is.

*Mr Kennedy:* I think it will be hard for them to credibly not agree to out-perform. There are things we have to do in the first budget period to be ontrack to meeting the second and third budgets. The Government is committed to doing those things, and if they achieve what they are committed to then they will out-perform.

**Q225 Chairman:** You have mentioned some of the aspects of the Low Carbon Transition Plan: do you think, taken as a whole, that Plan will ensure that we actually deliver the sort of step change that your progress report believes is necessary?

Mr Kennedy: The Plan is certainly a move forward, in the sense that it is a set of commitments from the different areas of Government that—if they could be delivered-will meet the carbon budgets. There is a question: can they be delivered? What we have said in our report is, we have good foundations in terms of the existing policy framework but it needs tightening in the various areas. If you think about houses: are we going to achieve carbon budgets with the step change we need under the current framework? We have said: no, we do not think the energy supply-led approach will deliver. We need a different approach around a national programme. Are we going to achieve the transport emissions reductions we need under the current framework? Again, we need some policy strengthening. The same applies for renewable electricity and renewable heat.

**Q226 Chairman:** Some of the observers still think there is a bit of a gap between the vision and the delivery at the moment. We hear evidence from a variety of people—academics, NGOs and so on—who would say that. The figures that you have published in the report show very vividly that extrapolating what has been achieved in the past leaves us a long way short of a big and growing gap. Is it not clear that, if we allow that gap to open up at all, the task for the back end of the period to 2022 becomes even more challenging and difficult?

Lord Turner of Ecchinswell: Yes, that would obviously be the case. If we continue to run for several more years at the 0.5% reduction we would have a problem. We are unlikely to do that in 2008 and 2009 simply because the very preliminary figures—we do not even have the full figures for 2008 yet—clearly do show some significant reductions, but we think that has got a lot to do with the onset of recession. If we are not making underlying progress over the next five years we will then be piling up a need for catch-up subsequently. I think our overall attitude to the Low Carbon Transition Plan is that it is recognition by Government of what we have flagged; that the pace at which we have been making progress is not adequate and that we do need this step change. As David has said, it has identified a set of policies which, if they are delivered, are capable of getting us on the path that is required; but there is still some more flesh on the bones required to actually deliver that. For instance, in the whole area of home energy efficiency, I think there is already an emerging consensus that we need to move beyond the existing energy supply company-led supplier obligation approach—of a set of specific initiatives where they earn points for specific measures that they have taken—to a much more Government-led and required whole house approach; but there is still a lot of work to be done to put the flesh on the bones of what that is actually going to mean and how it is actually going to be delivered.

**Q227 Chairman:** Would it be fair to say that because the figures are a bit massaged by the recession at the moment nevertheless the actions that are taken in the next couple of years are absolutely crucial to the achievement of the 2022 target; because if we do not take the right actions—notwithstanding the flattering effect of the recession on the figures—there is going to be a real difficulty in the back end of the period?

Lord Turner of Ecchinswell: That is right-across all the different areas. For instance, if we look at the electricity decarbonisation process-which we believe is fundamental not only to take carbon out of electricity production but to prepare us for what we need to achieve in the 2020s, where we probably will apply electricity to a wider set of areas-if we are to hit the targets in 2020, for instance on wind generation, there have to be a number of projects going into planning in 2010, in 2011, going into construction in 2012, in 2013. One of the things we set out in the progress report was those sorts of forward indicators. Rather than simply tracking, when we actually get to the emissions results, are we on track, we will be tracking in 2012, are there enough wind projects going into planning that you can see them coming out of planning and out of construction because otherwise there is a danger that if you simply get to 2015, you physically cannot catch up in terms of the planning cycle periods, the construction cycle periods et cetera. It is very important that we make progress over the next three or four years.

*Mr Kennedy:* Just to drive all those things as well the policies we have talked about, whether it is the power market, the clean coal or the approach to houses—our indicator framework does include timelines for when the policy decisions need to be made in order that these things can happen over time. Those things have to happen this year and next year; so it is not the case that we can wait five years, for example, for the electricity market review; we have said that should be after Copenhagen, probably towards the end of 2010. We have not got time to sit back and not achieve.

**Q228 Dr Turner:** You have made it very clear that the Committee's target of a 2° rise in temperature is something of a matter of judgment in terms of practicality and a whole range of issues. Do you

think you could tell us something about the issues that have led you to the recommendations that are made?

Lord Turner of Ecchinswell: This was of course something which we did not cover in the latest progress report; we covered this in the December report last year where we were asked then to recommend on the target for 2050 and what that implied for the budgets to 2020. As you know, we ended up suggesting a global path which would take the whole world to a level of something like 20-24Gt of C0<sub>2</sub> equivalent emissions in 2050. Our reasonable share of that would imply something like an 80% cut below our 1990 level, and therefore we recommended 80% rather than the 60%, which was initially in the legislation; then we set out the intermediate path for 2020 consistent with getting there. The key question therefore is: where did 20-24Gt come from? That is where one goes back to the science. We are not a scientific commission: we have a small scientific resource to help us and we have a number of very good scientists on the Commission, but we do not do independent science research ourselves; that is not something we are geared up to do. We rely on understanding the consensus of the international scientific community, as expressed by the IPCC reports, and using the Hadley Centre in particular as a resource to run scenarios for us. We were trying to understand some of the uncertainties of the science; and the uncertainties in the science are considerable; and all that the science can give us is probability distributions of future results- not definitive results. In terms of what path of emissions leads to what temperature increase, we described it at considerable length and we went through it and challenged the scientists, et cetera but ultimately it comes off things like the Hadley model and the IPCC. The question then is: how did we decide what the objective is? We looked at the work of the IPCC Working Group III on the impact of adverse climate change and came to the conclusion that what that suggests is, first, that an element of climate change is unstoppable. Even if we literally cut all emissions to almost zero today, given what has occurred over the last 200 years we are probably on par for something like  $\frac{3}{4}^{\circ}$  or even a degree above pre-industrial levels; that is cooked into the system already; so that is point one. Secondly, the impact analysis does not show any magic point where you say, "Up to  $1\frac{1}{2}$ " or up to 2° is absolutely fine; beyond that it's disaster". What it shows is an accelerating and increasing set of harms, and it in particular shows that that harm tends to increase very significantly as you go from 2° to  $3^{\circ}$  to  $4^{\circ}$ . Thirdly, there is some evidence in the science that at some level these effects become really catastrophic and you get self-reinforcing cycles. There is some level at which the world really has to make sure that it definitely does not go aheadabove-under any circumstances; because then we really are into completely uncharted territory, first of all, in terms of the feedback loops within the science and, secondly, in terms of the increased impact on human welfare. It is a judgmental process but looking at that-and also looking at what is doable starting from where we are—we ended up believing

that a reasonable way forward was to say: first, in an ideal world the world would not go above 2°C above pre-industrial levels, point one. Secondly, it is actually very difficult to do that with a high certainty. If you were to set the target as being you want a 99% certainty of not going above 2°C we would have to start dramatically de-industrialising today. To get that probability down to the 1% or 2% level is a huge challenge which we might not meet. Thirdly, we therefore said: the challenge is to make sure that any overshoot above 2° is as small as possible. Fourthly, we said: we have to have some sort of rule out there that says we are keeping to very, very low levels the danger of catastrophic change. We defined that as, we want to be on a path where the best scientific analysis would now tell us that the chance of going above 4°C is below 1%. You would have that as a decision rule which you are continually refreshing. If in ten years' time they said, "The scientific understanding has changed; we used to think that this path got us to a chance of less than 1% of going above 4°. We now think that has gone up to 2%". Then you have to reinforce your policy and accelerate at that stage. We ended up with a decision rule which says, "We want a path where we are trying to limit to as small as possible the overshoot above 2°, indeed we are trying to have a 50:50 chance of not going above 2° at all". There is no particular science. Why would one care whether that chance is 52 or 48? It gives one, though, some sort of anchor. The crucial thing is limiting the extent to which we go above 2° and keeping very small the amount to which we go above 4°. That was the decision rule we set ourselves, and that decision rule sort of ends up with an 80% cut. It, first of all, ends up with a global target of getting down to something like 20-24Gt by 2050 and, by the way, going on down to 8-10Gt by the end of the century, so that is not the end of it. That is the process that we used. It is an inherently judgmental process given, first of all, the uncertainties of the scientific understanding of the relationship between emissions and temperature and, secondly, the uncertainties of the scientific and economic understanding of the relationship between temperature increase and impact on human welfare.

Q229 Dr Turner: Of course, the relationship between CO<sub>2</sub> equivalents and temperature is a very broad one and a most uncertain one. I entirely sympathise with your difficulties-we all share them-but a 50:50 probability is a very high probability. Certainly if the world's luck is anything like my own personal luck then it is absolutely certain that the world temperature rise would exceed 2°. First of all, would vou wish to set lower targets in order to try and minimise that possibility? If not, why not? Secondly, are you happy that the public and governments appreciate that the 2° that is generally talked about is not something you can rely on with any confidence, that it is just a probability and there is at least a 50:50 chance of it being exceeded and things being much worse even than is predicted?

*Lord Turner of Ecchinswell:* I think you are rightly illustrating that there has been a bit of a disconnect between true scientific understanding which has to

be based on probability distributions of the results, and the way that this phrase "2" has entered the media and public imagination as if it could be an absolute figure. We do not think there is any particular magic about a 50:50 chance as against a 55:45 chance of going above 2°; i.e. if you said, "At the moment I think the chances of going above 2° is 45%", and then two years later, "The scientists now tell me that it is 55%", there is nothing which would suddenly say, "Oh, that's a disaster for the world". What I think would be a much more worrying feature is if the science began to tell us, "Ah, we were previously telling you that there was a 15% chance of going above 3° and that's now become a 35% chance of going above 3°". That is, I think, where you want to concentrate. You want to concentrate on how the probability assessments of going above  $2\frac{1}{2}$ , 3,  $3\frac{1}{2}$  and 4 are increasing. Are those going up from very low levels, particularly at 4°, to higher levels? That would be the red flag where we have really got to start doing something because, as I say, we feel that the analysis suggests that it is between 2° and 4° that the world goes from a challenge which, although it will produce some detriment to human welfare at 2°, the world is probably capable of adapting to, and with some positives as well as negatives. So by the time you get to 3° and 4° there are very, very significant negatives and potentially irreversible effects; so that is the way we think about it. Should we worry that that is not well understood externally? I do not know. We have got our own way of thinking about this. We think it gives a fairly coherent basis for public policy. It does create a somewhat confused debate externally, because people do occasionally say, "Well, you're giving me a 50:50 chance of going above 2°. Have things slipped?" but that was always there. I do think people need to understand that if they wanted to get the chance of going above 2° down to, say, 20% or 10%, we have not run the figures but I think you would be on a dramatically faster path of reduction than anybody is talking at Copenhagen negotiation levels at the moment; that would be an enormous chance. What all this illustrates is, that alongside the mitigation plan that gets us down to approaching 20Gt by 2050, below 10Gt by 2100, if that is our path we have to accept that that is a path which will still, in all likelihood, have significant global warming effects. Therefore there is a very important adaptation agenda, particularly in the areas of the world most affected by climate change and most vulnerable to climate change; that is why there needs to be an adaptation agenda as well as a mitigation agenda.

**Q230 Mark Lazarowicz:** One of the issues which you have raised in the report is the issue of the carbon price and how this drives investment in low-carbon and renewable power generation. You identify a number of actions the Government need to take to address these, but what is your view as to how the Government should prioritise these objectives?

*Lord Turner of Ecchinswell:* We set out a menu of things that need to be considered. I do not think we are wedded particularly to one or the other because there are different ways of approaching it and some

of them depend on what might be feasible in European negotiations and things like that. Just to describe: in the electricity market in the past at the UK and European level we have placed a very strong reliance on the European Emissions Trading Scheme and the carbon price to pull through the investment in low-carbon which is required. That has reflected an economic theory that says if you combine that price instrument with our liberalised electricity market people will make the logical decisions to respond to that carbon price. What we have increasingly realised and what we flag in the report is that there is a problem here of cumulative uncertainty in investment decisions, and that cumulative uncertainty derives from an oscillating fossil fuel price, an oscillating carbon price and an oscillating electricity price, which depends on all the decisions that everybody else makes on the investments they are going to make. When you realise that, you increasingly realise that the existing structure of policies is not fit for purpose for the world into which we are heading. For instance, in the electricity market domain we have a system of incentivising electricity investments where people make investments and they are compensated by the electricity that they will sell at some future period where their electricity price in the wholesale market is highly variable and is very high at some times of the day and year, and zero indeed for most of the rest of the time, overnight, and on sunny days, and windy days in summer. When you step back and think about it, you realise that this is a system which is increasingly untenable as more and more of your capacity takes the form of things where you invest and then thereafter you have a zero or very low marginal cost. Those are the characteristics of both wind power and, indeed, of nuclear power. Indeed, it is very obvious when you think about it that if you had an electricity generating system which was entirely made up of things which had no marginal cost of production, i.e. it was all nuclear and wind, you could not possibly incentivise investment with the current electricity market system. We devised the electricity market system to achieve specific objectives back in the 1990s, and it made sense for a market where you could assume that the vast majority of generation had a marginal cost of production because it was using gas or coal; it will not make sense so much in future. We are worried that the combination of facing an oscillating fossil fuel price, facing an oscillating carbon price, and with the current electricity arrangements, we will not pull through the low-carbon investment that we need; or, if we do, we will pull it through at a higher cost to society than is otherwise required through, for instance, a higher level of ROC multiples than would otherwise be required. We are flagging that we now need to take a step back and think about a set of other policies that might be required. One of those which we undoubtedly think would be attractive, not just in the electricity sector but across the economy, is an underpin for the carbon price. What has happened, particularly with the recession, is a very significant fall in the carbon price below what we had anticipated; our latest forecast suggests that

the carbon price will stay below what we had previously anticipated out to 2020. We had previously thought the carbon price might go to, what,  $\notin$ 50 by 2020—

*Mr Kennedy:*—and now we think  $\in 20 - \in 30$  is probably the range, which is too low to support the investments we need in the power sector.

Lord Turner of Ecchinswell: Therefore we are flagging the issue and we see very considerable merit, not just in the power sector, but in other sectors, of having an underpin to the carbon price within EU ETS which would basically make the EU ETS a hybrid of a carbon trading system and a tax system. Indeed, it is quite interesting if you go back to the basic theory, for instance, which is discussed in the Stern Review of whether it is best to proceed when vou use price instruments with a carbon trading system, where you set the quantity but the price is a variable, or a tax system where you set the price but the quantity is a variable, a lot of economists would always have said that the best combination is a hybrid which has a quantitative cap and a fluctuating price but an underpin within that. There are then some issues as to whether we could or should go that alone, but certainly it is the case that if we could get European agreement to a carbon price underpin, so that it could not fall below a certain level within the EU ETS, that is something which we think has a lot of attraction. We also think that the time has come to take a complete look at the structure of the UK, the way that the UK electricity market works, and to consider whether it needs fundamental change or whether the existing arrangements need to be added to with combinations of feed-in tariffs or what are called "capacity credits", other ways of directly incentivising investment in low-carbon generation; rather than requiring the low-carbon generators to make their investment on the basis of a calculation of what they think the electricity price at the peak periods and the carbon price and the fossil fuel prices will be 15 years hence. We think there is a problem of cumulative uncertainty in the current arrangements. Mr Kennedy: I think it is very difficult to say in advance of Copenhagen what the appropriate way forward is. Ideally, we will have an ambitious global agreement and a tight EU ETS cap and a robust price; but let us see if that happens. If it does not then we are going to have to ask the question: do we need a domestic instrument on the carbon price? Even if we have a robust carbon price the question about the electricity market does not go away. Still we think a review will be needed whatever happens with the carbon price.

**Q231 Mark Lazarowicz:** Many things will arise from that. I can see some point in what you are saying, but how would you respond to the point that what you are suggesting is really a major change away from the policy design to produce a carbon price and produce a cap on carbon emissions from what has been built up in the last ten years and so on? How would you avoid causing uncertainty for the future as to the long-term stability of the system? Because if you start turning over a system which has been stable for

ten or 15 years then the confidence that the new system or the hybrid system will also be long-term will surely be undermined.

Lord Turner of Ecchinswell: We think you would create more certainty not less certainty. You would not be saying that you are getting rid of the EU ETS. You would be creating a price underpin within the EU ETS. I think that could be clearly understood and it could be clearly communicated that that is the policy design you are doing. After all, you have to realise that the EU ETS has not managed to create certainty out of its present way of arranging. In the phase one period, if you remember, the price effectively collapsed to zero for the last year of phase one trading because the allowances were set too generously. In phase two the price has moved in ways which almost nobody anticipated. People did not in the forecasts last year anticipate that we would now be facing a carbon price of, what, 13 or 14 at the moment, something like that, per tonne. We have a system which-because the levels are subject to political negotiation; because there is always uncertainty of what the next stage will be: because there is uncertainty about how tight they are given whether the economy is going to be growing rapidly or in recession; because there is uncertainty about whether people really do anticipate the future in the way that economic theory would suggest, or whether the price today balances supply and demand today rather than supply and demand over all the time periods within phase two and phase three-because of all that uncertainty we have an imperfect system at the moment, and we think that by introducing an underpin we will increase certainty. We think for the investors in low-carbon technology the fact that we and others a year ago were saying, "We think the carbon price in 2020 might be about €50 per tonne; our best shot now is about €25 per tonne in 2020", that is a huge degree of uncertainty in their investment decisions. We think we can adjust this in a way which creates a certainty of an underpin without getting rid of the structure of the way the market works.

**Q232 Mark Lazarowicz:** A last question if I may, but it is quite important. Could you just tell us: first, how would you envisage the underpinning system working; how would the underpinning actually happen? Secondly, who would pay for the underpinning and, thirdly, what kind of sums are we talking about being required to bring about the forward price?

Lord Turner of Ecchinswell: The key thing is that an underpin becomes much easier to do as you move towards 100% auctioning because it is simply a reserve price within the auction. Therefore people who are buying at auction—and we ought to be heading to everybody buying at auction—have to pay that price. It essentially becomes a tax mechanism through that. It is more complicated when we do not head towards auctioning. What you would probably do is simply introduce it as a minimum price within the auctions; to begin with it would be an imperfect underpin because auctioning would only apply to a subset of it, and then it would become a more effective underpin as we headed more towards 100% auctioning. That is the way you would probably do it; rather than a central bank trying to intervene in the way that central banks occasionally try to do to manage the exchange rate, which of course can get quite expensive. Structured that way round it actually increases Government revenue, because it increases the revenue to Treasury and it also provides greater certainty to Treasury of future auction revenues, rather than Treasury being faced with uncertainty of future auction revenues.

**Q233 Martin Horwood:** Could I join the Chairman in welcoming this report; I think it is a phenomenally important contribution to the whole debate. In your work on coal-fired power generation, you seem to be having a vision where, by the 2020s, we will be generating power from coal with carbon captured storage or not at all. Is that broadly right?

*Lord Turner of Ecchinswell:* That is the essence of it. I think one cannot exclude the possibility that if you had unabated coal at that time you might allow some of it to run on a very small number of hours per year and it would simply be used to make up peak capacity in winter. Certainly you would be in an environment where we do not see a role for unabated non-CCS coal as a base load bit of the system from beyond the early 2020s; that is incompatible with the reductions in g/kWh that we think we have got to achieve.

*Mr Kennedy:* We see a big role for clean coal through the 2020s and from the early 2020s if we put the foundations in place now.

**Q234 Martin Horwood:** In terms of how those foundations are being laid at the moment, you have welcomed the Government's CCS competition and the revisions to it, but in the report you seem to cast doubt on whether the signals are strong enough. You say that for any plant not fitted with CCS there will be little or no role further into the 2020s, and that is a concern that has been raised in Parliament as well; that in effect there is quite a large loophole in the current competition arrangements that would allow a plant built now to continue beyond the 2020s without clean coal. Is that right?

*Mr Kennedy:* I think what the Government said in its draft proposals was there could be a possible limit, and it was very tentative, on generation from unabated coal through the 2020s. We are very clear, this should be a firm limit and that should be agreed in advance and be very clear to anybody who is thinking of investing in coal-fired generation.

**Q235 Martin Horwood:** You are confident enough in the technology to be able to say that that should be a firm planning assumption?

*Mr Kennedy:* You can look at it in two ways: we are confident there is not a role for unabated coal in the 2020s; so whether CCS comes through or not there is not a role for unabated coal. It looks like clean coal, certainly from a technical perspective, is doable. What we want to find out more about is the

economics, and that is why we need to move forward with the demonstrations and we need to move forward with those quickly.

**Q236 Martin Horwood:** Looking at one of the scenarios the report paints, how likely do you think it is that the UK will have the sort of tripartite progress: 23gW of new wind; four CCS demonstration plants, both by 2020; and, the one I am personally less happy about obviously but is within the realms of Government policy, three new nuclear power plants by 2022? How likely are each of those to actually come to fruition, do you think? *Lord Turner of Ecchinswell:* We think each of those is doable; they are completely doable on the 23gW.

#### Q237 Martin Horwood: How likely?

Lord Turner of Ecchinswell: I think they are reasonably likely. I am an optimist. We have set out the pace at which we have to build new wind, both onshore and offshore, and it is absolutely not an impossible pace. It is not out of line with what the Germans have done over the last 15 years, or the Spanish have been doing; it is not an absurd rate. It does need appropriate incentives but we think it is completely doable and therefore should be achieved. It is certainly possible for us to build three nuclear power stations; you may not like them but it is possible to do that from starting now and to have those operating by 2020; and we can certainly have the four CCS demonstration projects. None of it relies on gleams of technology in the lab where somebody says, "I'm going to develop this" but they haven't been developed yet. These are all things which work. In the case of CCS they work at a certain scale, but it is a matter of taking it to full engineering scale: but the chemistry of it and the physics of it are known. Nuclear power plants exist; windmills exist; these are completely achievable targets, we believe.

*Mr Kennedy:* There are some very clear things we set out in the report that have to happen to make this a reality. I think in the case of onshore wind the key issue is going to be planning: can we get enough of this stuff through planning and approved? I think on clean coal are we going to get the funding for the demonstrations? Are we going to have a plan for continuity—so an early review of the next phase in 2015—which is really accelerating the proposal from the Government? I think on nuclear the key issue is to move forward with the planning framework, with the national policy statement, with the work of the infrastructure planning commission, with the regulatory approval of the new designs of nuclear reactors. If we can progress on all of those fronts then this does become very doable.

**Q238 Martin Horwood:** The biggest increase in capacity on wind is likely to be offshore, not onshore, is it not?

Mr Kennedy: About 50:50.

**Q239 Martin Horwood:** The infrastructure, for instance, in terms of the national grid and so on, is that progressing fast enough at the moment?

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Mr Kennedy: In terms of the timelines there, there are two things that we have said have to happen on the national grid. First of all, there is a set of what are called "least regrets investments" that have been identified: those need to proceed, and we understand they will proceed in the next year depending on agreement between Ofgem and National Grid. So that is something we will be focussed on going forward; but they do need to proceed based on agreement next year. The second thing is, we need some new rules for accessing the grid, so that you have got wind generation and you can actually transport it to where the demand is; and again we have said we need a new set of rules to be agreed by next year at the latest. If we can move forward according to that schedule, again it does become very doable.

Lord Turner of Ecchinswell: I think those issues of both the policy framework for grid access and the infrastructure investment by National Grid to support offshore are absolutely examples of things that have to happen over the next year/two years and get on with it, in order to make possible everything else; because unless those are in place, obviously an offshore wind investor is going to say, "No, I've got to delay it because I can't have certainty that those are in place"; so they fall into the category of things that are key priorities over the next couple of years.

Q240 Chairman: They do raise a new set of issues. To get the capacity from the offshore wind that will be available on the east coast, National Grid are now proposing to erect a series of pylons over an Area of Outstanding Natural Beauty in my constituency; that is not an uncontroversial proposal and is likely to be fought tooth and nail by all political parties. So there are some practical difficulties. Just on the planning point, which is very important, a common thread running through a lot of this dialogue is that decisions taken in the next year or two are absolutely critical to the achievement of what we want to do in ten years' time. Should the IPC be required to base its decisions on achieving at least the intended budget so that all planning decisions which have an effect on this outcome would have that as a sort of dimension they had to take into account?

Lord Turner of Ecchinswell: I do not think we have thought of that. Can we take that away and think about whether we need to shift around the . . . ? It is a matter of the balance of presumption in the inquiries. What has been already achieved is the idea that when you have either a wind development or a nuclear development you cannot fight it by going back to the basics of, "Do we need this for climate change?", et cetera. That, I think, is a major step forward; it says that the opposition to these developments has to be on the basis that there are some extreme local effects which knock it out. I think there has been a sensible shift to preventing the ability every time when there is a windmill, or every time there is a nuclear power plant, to go back to the basics of "Why do you need to do this at all? Is there climate change?", et cetera. That is in itself a shift in the balance of presumption and the balance of allowable debate. I think that is something we should probably track over the years—whether the changes that have already been made are adequate or whether at some stage one should consider shifting the presumption even more so, so that there is a very strong presumption that if it contributes to the achievement of climate change there need to be very extreme circumstances that go against it. Can we take that as an issue for further discussion?

*Mr Kennedy:* We are required to look at the national policy statements, for example, on nuclear and whatever, and they do feed into the infrastructure planning process, and they should be consistent with meeting the carbon budgets. That is something we will be looking about going forward.

**Q241 Mr Chaytor:** Can I ask about the costs of meeting targets and budgets. Obviously you have revised conventional economic theory about major markets very considerably in this report. In your opening remarks you talked about the importance of new investment in transport, domestic energy, efficiency and renewable heat. What sums of money are we talking about and where is it going to come from?

Lord Turner of Ecchinswell: Back in the December report when we looked at the cost in terms of GDP foregone from hitting either the 2050 target or the 2020 budget, we ended up with figures which were absolutely within the range of what Nick Stern had suggested: sort of,  $1\frac{1}{2}$ -2% of GDP sacrificed in 2050 to hit these targets, and figures for 2020 which were less than 1% of GDP. Those figures of course you cannot translate into, as it were, what does it cost in investment terms? They are basically saying that if you do this the GDP per capita, the income per capita, in 2020 will be, say, 0.5 % lower than it would otherwise be. I simply suggest one point of how to think about that. I think increasingly we actually know in the economic theory of welfare that these increments in GDP per capita do not necessarily convert through to human welfare and happiness to anything like the way we used to believe they did. Therefore, certainly if the impact is that an economy would previously grow at 2% per capita per annum and now it will grow at 1.9% per capita per annum, when you get to the end of that it is extremely unlikely that people will feel, "Ah, there's something gone wrong". What people will concentrate on are the specific things which make a difference to them. That is why when one thinks about the cost, one then needs to think about: what does it require to do to the cost of electricity; what does it have to do to the cost of motoring; and that we did set out in the December report, because we will have, both through the support which is needed for renewable energy, some significant increases in electricity and gas prices; they will in different ways come through to a higher price of electricity and gas. I cannot remember exactly the figures. David, can you auote those?

*Mr Kennedy:* We had a figure of a 25% increase in the price of electricity and the price for heating, and that is the price as distinct from the bill. We have also said energy efficiency improvement, depending on what kind of a house you live in, could reduce your

consumption by 50%. Certainly in some cases you could more than offset the price impact. Where that plays out, there is probably a bit of cost on average involved for households.

**Q242 Mr Chaytor:** Lord Turner, in your response there are two separate issues you are rolling up together here: one is the whole issue of GDP and how accurate it is as a measure of outcomes for human welfare. Leaving aside how accurately economists can predict into the future what the share of GDP will be, the other issue is: what is the impact in terms of prices, and in terms of Government spending in the first three budget periods? Because your point about electric cars, for example, assumes a considerable increase in direct Government subsidy to make the price affordable. Do we have some ballpark figures?

Lord Turner of Ecchinswell: That is not something we went through in detail in this report, but back in the December report we did have a chapterchapter 11-on economic costs and fiscal implications; because of course for Government there are both expenditures in some cases, but there are also revenue streams. In particular, one of the most important revenue streams is the revenue stream from the auctioning of carbon permits which, by the end of this period if I remember rightly, could be in the region of £9 billion per year, or could indeed be higher if the electricity price is higher. Many of the costs do not fall directly on Government. If we increase the electricity price that falls on individuals, then the issue, as David has outlined, is how far they can avoid that by improving energy efficiency. Some do fall on Government and, for instance, I think within what we have been suggesting two particular categories could fall on Government: first, specific support for technology like electric cars, to get them through this sort of chicken and egg problem of, "I'm not going to buy an electric car until there are charging points. I'm not going to put charging points in until there's an electric car". There is a role for Government in getting us through that. Secondly, support for energy efficiency in the home. Those are the two key areas where there is potential expenditure for Government. On the first one, Government has already allocated £250 million to support, and we have flagged that the figure could be of the region of £1-2 billion.

*Mr Kennedy:* It could be  $\pounds$ 1-2 billion which would support the purchase of the cars; the installation of a national network of charging points to support up to two million electric cars on the road by the end of the third budget period.

**Q243 Mr Chaytor:** In terms of domestic energy efficiency?

*Mr Kennedy:* The question there is not one of who bears the cost in the sense that this is a cost-saving thing so there is money to save. It is a question of who finances the upfront investment, for example, in loft insulation. Is it the household; is it the Government; or is it local authorities or energy

companies who borrow on behalf of consumers? There we have not been definitive about what the appropriate solution is.

Lord Turner of Ecchinswell: It may be there that the role is loans rather than grants. The essential problem is that there are many people who have a home and if they spend £10,000 on it they would get a return of reduced energy bills in future which would be perfectly reasonable and be as good as putting your money in the bank, as it were; but that is not how they will think about it. They will think about it as "£10,000 that I haven't got today". So there is a crucial issue there as to the role which the Government could play either directly or in a facilitative fashion, essentially in creating financing packages. We have not gone to that level of detail or precisely what the alternative options are for Government in that area. Those are the two key areas of potential expenditure: electric car support and energy efficiency improvement in the home.

Q244 Mr Chaytor: Yesterday the report of Professor Ekins—

Lord Turner of Ecchinswell: Yes, Paul Ekins.

**Q245** Mr Chaytor:—of the Green Fiscal Commission suggests, from my recollection, that the current proportion of revenue from green taxes, which is 7%, should be doubled by 2020. Would that be a figure that you could identify with?

Lord Turner of Ecchinswell: It is quite useful for you to mention that report because I can perhaps usefully put right a false impression over the weekend where it was reported that *I* was presenting this report, and it got somewhat mixed up with the Climate Change Committee. This is a very good report by the Green Fiscal Commission and I was one of four people who welcomed it last night and commented on it, the other three being one each from the Labour Party, the Liberal Democrats and the Conservatives.

**Q246** Mr Chaytor: Not the Editor of the *Daily Express*?

Lord Turner of Ecchinswell: Yes, they did not welcome it. What that is, that Green Fiscal Commission Report, and I think it is a very useful thing to do, is to deliberately be radical, and to say, "What would a radical rebalancing towards environmental taxes look like as a contribution to the debate?" They have taken a scenario which would take environmental taxes, taxes on some category of environmental harm particularly to do with climate change, from 7% today-but their forecast suggests that under the existing tax regime that would in any case fall to 5% of our tax revenues by 2020—and to make it 15%. It is 7% which would fall to 5%, becoming 15%, which then of course enables you on a revenue neutral basis very significantly to cut Income Tax and Employers' National Insurance. I think what they have done is illustrate what that could look like; illustrate that that would play a very major role, as it would, in reducing carbon emissions, and run through what the distributional consequences of that would be. I

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do not think the Commission is suggesting that the specific scenarios they have suggested are, "Yes, you've got to do that", but I think we would see it as a very useful challenge of: should we be thinking about a quite radical shift in the basis of taxation? The thing which is particularly attractive about that is, we have often talked in the past about shifting from a taxation of good things, like employmentemployment is undoubtedly a good thing; everything we know about human welfare says that unemployment is one of the worst possible things, so employment is a good thing-to taxation of bad things, like pollution. At various stages Government have said, "Well, we're going to do this and the good news is it's going to be revenue neutral because we're going to have a tax on landfill sites and your National Insurance has been cut". Of course, the trouble is two years later the National Insurance has gone up and they have said, "No, it's still been cut relative to what it would have been". The trouble is, when you try and do this balance in small amounts you do not generate the confidence that the offset is really there: my taxes went up on this side and they weren't cut on this side. I think what the Green Fiscal Commission has done is to suggest that maybe the way round this, to make it really believable to people, is to do it on a large enough scale where the increases in environmental taxes and the reductions in Income Tax or National Insurance are so big that they are visible; they do not get lost in the year by year movements, and therefore you get round the problem that I think we have faced in the past of a cynicism about this idea of offsets. I think this is an inherent problem for all governments. As long as you try and do these offsets in relatively small amounts at the margin you will find it very difficult to convince people that the offset was really there. That is what they are trying to do. We will certainly look at those ideas and put them into our thinking going forward. I do not think we would agree with every one of the ideas there. For instance, there is an approach to car purchase tax which does not involve differentiation according to energy efficiency and we certainly think if we are going to go down the route of car purchase tax or initial Vehicle Excise Duty Tax, as we are already, we should have strong differentiation between gas-guzzlers and energy efficients, and they have not gone down that route. There are some things we would not tend to agree with, but it is certainly an incredibly useful challenge.

**Chairman:** The Secretary of State is waiting just outside, but could we have just one final two minutes on energy efficiency?

**Q247 Jo Swinson:** Although the Government will point to all of the things—the £2.2 billion for energy efficiency, smart metres and so on that it is doing on housing—you have been very clear that they still need to have a step change and what is planned is not enough. Can you tell us what in the approach needs to change? When asked about the costs you said you do not have the details. Are you planning to work out a more detailed plan on how that can be done, or are you expecting DECC to do that?

Lord Turner of Ecchinswell: I think across all areas of policy the role of the Committee is to flag the need for policy enforcement, but we are not the detailed designer of policy and were never intended to be. I think the essence of what we need to do on energy home improvement is partly about cost and financing packages, but it is also fundamentally about creating one-stop shops. I think the biggest barrier to people seizing the opportunities in their homes-and I suspect many of us will know this individually-is we know there are things that we can do, if tomorrow somebody would walk through my door and for £500 write me the report on my house which says, "This is what you should do", tell me how much it would cost and then tell me, as a one-stop package, "These are the guys who are going to come and do it, and they're all going to do it in a two-week period", so you do not have two months of people doing this and people doing that, I would sign the cheque tomorrow without support. Other people with lower income may want financial support as well, but there are many people who would do it without financial support and what that says is, one of the biggest barriers here is overcoming this information and organisation challenge. There are lots and lots of people knowing that they could do cavity wall insulation; they could do loft insulation; they know they would get a payback for it; they know they could improve their doors, their windows. It is the hassle factor of: where do you go for one person who is going to make it all happen, et cetera? This is probably one of the most important things that Government has to focus on. Can they play a catalytic role in bringing into being one-stop shop providers where you can go, find out what you can do for your home, get told the price, get told a financial support package and get it all done? I think that is one of the biggest barriers we face in this, rather than necessarily the cost itself.

*Mr Kennedy:* We have been very clear, it is a national programme that takes away the hassle from energy efficiency improvement. Who should lead that? Is it the energy companies? We have said, "No, it shouldn't be the energy companies. It is a job for Government".

**Q248** Jo Swinson: Do you see the energy companies having a role?

*Mr Kennedy:* A delivery role in terms of getting people excited, getting people motivated and thinking this is not going to be a hassle for them, trusting whoever it is that knocks on the door, that is for the Government, not the energy companies. In terms of contracting the work, maybe the energy companies could have a role there.

*Lord Turner of Ecchinswell:* There is a problem of course that energy companies are the energy supply companies not the distribution companies. They do not necessarily have a continuous relationship with that house. There is quite a lot of churn in the electricity market as people go for new deals for electricity supply. I think this is an inherent problem and we have realised that it is more of an inherent problem, it is going to be even more of a problem as we deal with issues like smart metering and who

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owns the meter and getting that in. We need to create a mechanism which does not rely to the extent that we have relied on the energy companies which, as I say, do not necessarily have an ongoing continuous relationship with that household and that house. That is what we need to put in place. **Q249 Chairman:** Thank you very much indeed. It was a very, very useful session from our point of view and we look forward to continuing to have a dialogue with you.

Lord Turner of Ecchinswell: Thank you. Mr Kennedy: Thank you.

#### Supplementary memorandum submitted by the Committee on Climate Change

1. The graphs in your progress report show a gap between the "required path" for emissions and "extrapolation" emissions projections out to 2022. Your report acknowledges that you are only in the second year of the first budget period. What is the range of the extrapolated projected emissions in Figure 1 (page 14) for 2022? (What, for example, is the range of projected emissions lying within a 95% confidence interval around your central 2022 projection?)

There is no range for the extrapolation: this simply takes the previous five years' performance and projects forward at the same rate of progress. The point we were trying to make was that, based on past experience and our analysis of current incentives, there is a significant risk of policy failure. An alternative approach is to set out a range of emissions projections based on varying assumptions about fossil fuel prices, GDP growth, policy delivery (eg as in the Low carbon transition plan or our December 2008, report *Building a Low Carbon Economy: the UK's Contribution to Climate Change*). However, this approach masks the need for a step change given that it assumes policy is successful at unlocking emissions-reduction potential.

## 2. What assessment have you made of the feasibility of achieving the emissions reduction targets in terms of engineering capacity, industrial capacity or the skills base available or likely to be available in the engineering community?

Our focus has been the need to put in place a framework to improve the low-carbon investment climate. Our assumption has been that given such a framework, the supply chain will adjust, possibly aided by an active industrial policy (eg to address any skills shortages). Going forward, we will monitor supply chain capability in our annual reports to Parliament. In our October 2009 progress report (ie Meeting Carbon Budgets: the Need for a Step Change), we highlighted a particular need to focus on monitoring of supply chain capability in wind and nuclear power generation and solid wall insulation, and the need to set out an ultra low-carbon vehicle industrial strategy if the UK is to become a major producer in this market.

# 3. In its Progress Report, the Committee on Climate Change's scenarios include a 35% reduction in emissions in residential buildings by 2022 compared to 2007 figures. What assessment of costs have you made of your recommendations on whole-house and street-by-street approaches? To what extent are these approaches different to what the Government set out in its Low Carbon Transition Plan?

The assessment of costs for improving energy efficiency of the residential stock is set out in our 2008 report and a supporting technical paper available on the CCC website (Energy End Use Technical Annex). Updated estimates of the cost associated with solid wall insulation are set out in our 2009 report. This report includes a range for annual investment costs for residential energy efficiency improvement. Our analysis suggests that the range of energy efficiency measures together save costs (ie energy bill reductions more than outweigh up-front investment costs. See, for example, chapter 12 of our 2008 report).

### 4. In your progress report, you present projected emissions which you compare with reductions needed to meet the carbon budgets. To what extent do the figures you report take account of offset credits?

Projected emissions are compared with the Interim/Intended budget trajectories in the case of GHGs, and Extended/Stretch Ambition scenarios in all other cases. The Interim budget is to be achieved through domestic emissions reductions. The Extended Ambition scenarios are consistent with meeting the Interim budget through domestic action. Intended budgets could be achieved either through implementation of measures in the Stretch Ambition scenario or purchase of credits.

# 5. Have you done any research into the extent to which price support subsidies for electric cars might simply be absorbed in the profit margins of the car-makers, who perhaps then would not try as hard to deliver new lower-cost technologies (like batteries)?

Our assumption is that there are a sufficient number of electric car models due to come to market in the UK and elsewhere that competitive pressure will drive battery innovation/cost reduction. We will monitor closely battery costs in our annual reports to Parliament.

6. The Low Carbon Transition Plan includes "departmental carbon budget" (p218), which include relatively small budgets for the Treasury and HM Revenue & Customs. To what extent do you think these Departments should shoulder a greater share of the departmental carbon budgets, in view of their ability to influence emissions performance across Whitehall through spending and tax policies? How, if at all, would you like to see these Departments have greater accountability for Government-wide emissions performance?

We have not been asked to consider the governance framework for budget delivery. We would be happy to consider departmental budgets if requested via the process set out in our Framework Document (ie governance agreement signed with the UK Government and devolved administration governments).

7. In your Progress Report, you set out a new ambition to track policy implementation and Government progress against key milestones. Do you have the capacity and resources to do this tracking work? To what extent will you be dependent on external sources for data and analysis?

We currently have the resources to undertake required monitoring together with other tasks requested by the UK Government and the devolved administration governments. We have a very challenging work programme over the next year (as set out at the back of the 2009 report—this will be our busiest year yet) and would struggle to deliver this with a lower level of resourcing.

8. What in the Committee's view should the Infrastructure Planning Commission do to ensure that National Policy Statements reflect current overall UK emissions reductions targets? To what extent should NPSs address the need to deliver prospective new targets post-Copenhagen or other potentially required emissions reductions goals in the future?

The Committee has not considered National Policy Statements. With this caveat, our analysis suggests that the investment profile is very similar to meet both Interim and Intended budgets (eg the path towards power sector decarbonisation is the same in either case). It is not clear, therefore, that National Policy Statements should include a post-Copenhagen contingency.

4 November 2009

#### Memorandum submitted by the Department of Energy and Climate Change (DECC)

#### SUMMARY

The 2020 and 2050 emissions reduction targets under the Climate Change Act are legally binding and Government is fully committed to meeting them. The Government considers the targets to be broadly in line with contributing to the objective of limiting global warming to 2°C.

The Government considers that its proposed budgets are consistent with the 2050 target. The third carbon budget is consistent with achieving a 34% reduction in greenhouse gas (GHG) emissions by 2020, with the aim being to meet this through domestic reductions only in the non-traded sector; the CCC advises that this approach is consistent with the path to meeting the 2050 target.

The models used by the CCC are valid and fit for purpose, though Government agrees that more work is needed to determine whether simple climate models are sufficiently reliable, and is carrying out work to investigate the sensitivity of climate outcomes to emissions pathways and model parameters.

The Government agrees with the CCC conclusion that 80% is an appropriate 2050 emissions reduction target for the UK, and supports the CCC's approach of using a broad range of methodologies to reach it.

The reporting provisions in the Climate Change Act are sufficient to keep the targets and budgets in the Act under review.

The latest emissions projections show that the UK is broadly on track to meet carbon budgets to 2022. The Government will report to Parliament on its proposals and policies to meet the carbon budgets in the summer, as part of a wider energy and climate change strategy.

The Government is committed to using emissions trading as a key driver in reducing emissions and ultimately wants to see a global carbon market. The EU Emissions Trading System will deliver a 21% reduction in emissions on 2005 levels from heavy industry across Europe by 2020 and play an important role in decarbonising the UK economy. Our commitment to aim to meet carbon budgets through domestic emissions reductions alone in the non-traded sector and the EU restrictions on international credits in the traded sector, underlines how serious we are about decarbonising the UK economy.

#### DETAIL

Whether the UK's statutory targets for greenhouse gas reductions are consistent with the Government's objective of limiting global warming to no more than  $2^{\circ}C$  and whether they are enforceable

1. The UK's targets under the Climate Change Act 2008, are to reduce GHG emissions by at least 34% by 2020 (pending Parliamentary approval) and at least 80% by 2050, relative to 1990 levels. We consider these statutory targets to be broadly in line with the Government's objective of limiting global warming to  $2^{\circ}$ C. Our assessment is based primarily on the consistency of the targets with the conclusion of the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report that developed countries (Annex 1 countries under the United Nations Framework Convention on Climate Change) need to reduce their emissions by between 25% and 40% by 2020, and by between 80% and 95% by 2050 (relative to 1990 levels), in order to stabilise atmospheric greenhouse gas concentrations at 450 ppm CO<sub>2</sub>–equivalent. This gives an approximately 50/50 chance, taking account uncertainties in the response of the climate system to greenhouse gasses, that temperature increases will stabilise below 2°C.

2. The EU has also recognised the IPCC figures as being appropriate to meet its 2°C stabilisation target. We note, however, that achieving an emission pathway consistent with the 2°C stabilisation limit depends on other developed countries taking commensurate action, as well as developing countries eventually reducing their emissions below the baseline. In general, if emissions are reduced by more than the minimum levels as defined by the IPCC then the risk of exceeding 2°C is reduced and flexibility for subsequent action is increased.

3. The targets and budgets under the Climate Change Act are legally binding; the Government is fully committed to meeting them. The provision to allow carbon "credits", representing emissions reductions overseas brought into the UK, to be counted against carbon budgets, means that carbon credits can be bought to meet budgets if they are not met through reductions in domestic emissions.<sup>1</sup> If a carbon budget is exceeded, even taking into account of any credits, section 19 of the Climate Change Act requires that the Secretary of State must lay before Parliament a report setting out proposals and policies to compensate in future periods for the excess emissions.

### The extent to which the Committee on Climate Change's recommended budgets to 2020 are consistent with the UK's target for 2050

4. The Committee on Climate Change proposed two sets of budgets for the period 2008 to 2022, the "intended" budgets that would apply after a global deal on climate change, and "interim" budgets in the meantime. Both budgets are the same for the period 2008–12, but the intended budget requires a reduction of 42% in GHG by 2020 relative to 1990, and the interim budget a reduction of 34%, both relative to 1990. The same analysis was used to derive the target for 2050 so they are consistent with the underlying scenarios. They are also consistent with the IPCC reduction estimates mentioned above.

5. The Government agrees with the Committee on Climate Change's approach and announced alongside Budget 2009 that it intended to set carbon budgets now for the period 2008 to 2022 that are based on the CCC's "interim" budgets, and would amend the budgets following a global deal and once proposals are agreed on the sharing out of the EU target. In producing its advice, which was published on 1 December 2008, the CCC had to make certain assumptions about the shape of the final EU climate and energy package, which sets the EU policy framework. Under the package that was finally agreed in Europe in December 2008, the UK will have a slightly smaller share of the EU ETS cap from 2013 than the CCC assumed. As a result, the Government's proposed carbon budgets are slightly tighter than those recommended by the CCC—26 million tonnes of carbon dioxide equivalent (MtCO<sub>2</sub>e) lower in the third carbon budget.

6. The Climate Change Act requires the carbon budgets to be set with a view to meeting both the 2020 and 2050 targets. The Government has committed to aim to meet its proposed carbon budgets for the period 2008–22 through domestic emissions reductions only, without purchase of international credits in respect of the non-traded sector. This approach prepares the UK for a move to a tighter 2020 target and budgets in the future, and the Committee on Climate Change advised that this approach is consistent with being on the appropriate path to meeting the 2050 target.

### The suitability of the climate models and the validity of the assumptions used by the Committee on Climate Change in setting carbon budgets

7. The Committee used a simple climate model, "MAGICC 4.1", to calculate the climate response to greenhouse gas emissions. Such models have been used in most studies that seek to determine the relationship between emissions and long-term temperature goals. Whilst it would be more robust to use the much more complex general circulation models (GCMs), it is impractical to explore the wide range of emission scenarios necessary with such computer-intensive models. Given this, we consider the model used

<sup>&</sup>lt;sup>1</sup> Note that, as discussed further below, the Government will aim to meet the first three carbon budgets announced alongside Budget 2009 without the use of credits in the non-traded sector.

by the Committee to be fit for purpose because it accounts for key uncertainties in the climate system and uses a range of parameters that are derived from GCMs used by the IPCC. The simple models are able to closely simulate the global temperature response of general circulation models to baseline emissions scenarios. Having said this, we agree with the Committee that more work is needed to determine whether MAGICC (as well as other simple climate models) is able to reliably emulate the response of general circulation models to significant emissions reductions.

8. In considering the emission reductions required to be made by the UK, the CCC has had to make assumptions about global emission scenarios and the way in which emissions are shared between countries. It also defines the goal as keeping the central expectation (ie 50/50 chance) of temperature rise in 2100 to  $2^{\circ}$ C, or as close as possible, rather than  $2^{\circ}$ C as a long-term stabilisation goal. In general we consider the assumptions used to construct emissions scenarios to be defensible. However, some of them are based on expert judgements (such as how long it will take for emissions to decrease after a global deal is agreed and how quickly emissions will fall after peaking), and we feel that different emissions pathways could also be justified. For this reason, we feel that it is important to consider a wide range of emissions scenarios when assessing the possible climate implications of emission reduction targets in specific years. As the Committee's recommended targets are broadly consistent with other studies (as described in their report and summarised in point 1 of our response), we have confidence in their validity, given the general level of scientific uncertainty. Work being carried out under the DECC/Defra-funded 'AVOID' Programme will provide further insight into the sensitivity of climate outcomes to variations in both emissions pathways and climate model parameters.

### The basis on which the Committee on Climate Change arrived at the UK's share of the global effort to cut emissions

9. On 16 October 2008, during the passage of the Climate Change Bill through Parliament, the Government accepted the recommendation of the CCC (operating in shadow form before the Act received Royal Assent) that the UK's 2050 target should be increased from at least a 60% reduction in  $CO_2$  emissions to at least an 80% reduction in greenhouse gas emissions The Bill was amended accordingly, and this target is now set in law through the Climate Change Act.

10. The Government considers that the approach used by the CCC in arriving at the UK's 2050 target as its contribution to global effort to cut emissions is both a reasonable and pragmatic way to deal with a complex economic, ethical and political judgement.

11. The global target to reduce emissions must be informed by the science and economics of climate change. The determination of the UK's contribution however requires certain assumptions to be made about the amount of effort that other countries commit to, to ensure that the overall reduction is sufficient to avoid dangerous climate change. There are various theoretical methods that can be employed to share out the burden but, as the CCC point out, the 'correct' one is fundamentally an ethical judgement and will only be one part of the large array of considerations for individual countries when they determine their targets.

12. We therefore recognise that a range of conceivable outcomes may exist and support the CCC approach, which examined a range of burden sharing methodologies and concluded that, in most cases, 80% appeared reasonable. On this of all the above, we accept the CCC conclusion that 80% is an appropriate target for the UK.

### The frequency with which targets and budgets should be reviewed and updated to take account of new scientific evidence

13. We agree with the CCC that the targets for emissions reductions may need to be revised as more scientific evidence becomes available, but we also recognise the need to provide sufficient constancy in the targets to allow businesses and others to plan ahead. It also needs to take into account the time taken to review commitments under the UNFCCC.

14. The Climate Change Act requires the CCC to make annual reports on progress towards meeting carbon budgets to Parliament, and the Government must respond to these reports, also before Parliament. We are satisfied that these and other reporting provisions in the Act will be sufficient to keep the targets and budgets under review, including determining whether any additional specific review might be required.

15. We note that the recommendations in the Committee's 1 December 2008 report were based on the evidence summarised in the IPCC's Fourth Assessment Report (AR4), as well as scientific literature published after the AR4. A large volume of scientific research has been emerging since the AR4 and there have been further developments in our understanding of climate change since the Committee's report was published. The IPCC will publish its 5th Assessment Report (AR5) in 2013/4 and this will provide solid

background to the next main review of the targets. At the same time it will be important to keep a watch on emerging science in case this warrants an accelerated review process. In the meantime, however, this new scientific evidence only strengthens the case for strong and early action.

# The compatibility of current Government policies with achievement of the overall budget, how individual government department can ensure policies are consistent with overall carbon budgets, and the potential role of departmental tradable carbon allowances

16. The Government's report on "Building a low carbon economy: implementing the Climate Change Act 2008",<sup>2</sup> published alongside Budget 2009, summarises the main elements of the Government's approach to ensure that the framework established by the Act drives the transformation to a low-carbon economy required by the targets and carbon budgets. The report is based on the latest Government projections of future greenhouse gas emissions, which indicate that the UK is broadly on track to meet carbon budgets through domestic action. In the central scenario, emissions are projected to be slightly higher than the proposed carbon budgets in the third budgetary period. Combined with the associated uncertainties, this suggested that new measures are likely to be required to deliver additional carbon savings.

17. The Act requires the Government to report to Parliament on its policies and proposals for meeting the carbon budgets. This summer, the Government will publish an energy and climate change strategy, which will provide full details of the policies and proposals, including new measures to drive further domestic reductions. The strategy will draw on a number of recent and current public consultations, and will put our carbon reduction strategy in the context of our overall programme for delivering secure low-carbon energy, transport and housing, in a way which benefits the UK economy into the future.

18. Ensuring that the carbon budgets are met will require careful monitoring of progress, to ensure that the policies and proposals introduced by the Government are delivering the intended reductions. Working within the budgets reinforces the need to ensure that the effects of any new policies that could increase emissions are carefully considered, and corresponding reductions found elsewhere so that overall, balancing the effects of different policies and any external factors, we stay on track to meet the budget. A number of processes are already in place to help ensure that this is done systematically, in particular through the requirement for an assessment of the carbon impact of all new policies within the overall Impact Assessment. There will also be a need for a strong internal mechanism within Government to ensure that every department has a clear responsibility to play its part. The Government intends to set out more about how this will work in its Strategy this summer.

19. There are currently no plans for a system of tradable allowances between departments, other than trading in relation to emissions from the public sector estate that are covered by the Carbon Reduction Commitment. We currently believe that the usual processes of Cabinet government are the best way to ensure that Government policy as a whole delivers the net reductions needed to meet the carbon budgets, rather than creating a discreet system of tradable allowances for policy sponsorship of emitting sectors. If, as we develop our experience of managing the carbon budgets, it appears that some further form of internal trading would be useful, this option could be examined further.

### The issues around using emissions trading (both credits from the EU Emission Trading Scheme, and carbon offset credits) to meet carbon budgets, including the standards that should apply to such credits

20. The Government has consistently supported the principle of emissions trading and it remains our ultimate objective to achieve a global carbon market. However, we are not complacent about decarbonising the UK economy itself. At the same time as announcing its proposed carbon budget levels, Government also committed to aim to ensure that the budgets will be met through domestic emissions reductions only in the non-traded sector, without use of international credits. This commitment is supported by the Government's proposal to set through secondary legislation as required by the Climate Change Act, a zero limit on the use of credits in the non-traded sector for the first budget period.<sup>3</sup>

21. The UK believes that the EU Emissions Trading System (EU ETS) remains the best way to guarantee emissions reductions within the EU. The Government's proposed carbon accounting regulations will count the net amount of credits used by EU ETS operators against carbon budgets, whether this represents a net credit or a debit. There is a limit on the use of credits by companies subject to the EU ETS across 2008–20, which guarantees at least 50% of the emissions reductions will take place in Europe. In their report, the CCC advised that these limits were appropriate and that further restrictions for carbon budgets purposes were unnecessary.

22. An efficient and credible global policy response to climate change must allow for reductions to happen where they are most cost-effective across the world. An effective carbon market must also generate financial flows that provide for action not only in developed countries, but also in developing countries. The Government would therefore expect purchase of credits to form part of the additional effort needed to meet

<sup>&</sup>lt;sup>2</sup> http://www.hm-treasury.gov.uk/bud\_bud09\_carbon.htm

The non-traded sector refers to sources of emissions that are not covered by the EU emissions trading system, and it does not therefore include emissions from the large electricity producers and energy intensive industry. The zero limit proposed for the first budget period does not apply to credits and debits as a result of the EU ETS, and EUAs used by participants in the Carbon Reduction Commitment.

the tighter carbon budgets to be set following a global agreement for reducing emissions in the period after 2012, as recognised by the CCC. This commitment to planned credit purchases will contribute to the Government's efforts to secure a global climate deal and position the UK to influence development and reform of the international carbon market.

27 April 2009

#### Further memorandum submitted by the Department of Energy and Climate Change (DECC)

INTRODUCTION

This update to DECC's original memorandum of evidence to the Environmental Audit Committee (EAC) Carbon Budgets Inquiry was requested by the Committee. While the original memorandum remains entirely valid, significant progress has been made in relation to carbon budgets since April. There have also been several oral evidence sessions where further specific questions have been discussed. This should therefore be seen as an addition, but not a replacement, to the original, responding to these developments.

#### GENERAL UPDATE

In May the following Statutory Instruments were debated and approved by both Houses of Parliament:

- Carbon Budgets Order 2009 (SI No. 1259), which set the level of the first three carbon budgets.
- Climate Change Act 2008 (2020 target, credit limit and definitions) Order 2009 (SI No. 1258), which amended the level of the 2020 target in the Act, set the limit on international credits in the first budget period, and defined international aviation and international shipping for reporting purposes under the Climate Change Act.
- Carbon Accounting Regulations 2009 (SI No. 1257), which set out the rules to be followed for determining compliance with carbon budgets.

Following Parliamentary approval, the SIs came into force, and therefore the carbon budgets became law, on 31 May.

In July the Government published a White Paper—The UK Low Carbon Transition Plan—alongside the Renewable Energy Strategy, the UK Low Carbon Industrial Strategy and a Low Carbon Transport Strategy. The Transition Plan shows how we will meet the first three carbon budgets through action in all sectors of the economy. It sets out the steps for making a permanent shift to low carbon, while maximising economic opportunities, growth and jobs. By 2020, this should mean that:

- 40% of UK electricity will be from low-carbon sources—renewables, nuclear and clean coal;
- 7 million homes will enjoy pay-as-you-save home energy refurbishments, and more than 1.5 million households will be supported to produce their own clean energy;
- The UK will be importing 20-30% less gas than we otherwise would;
- The average new car will emit 40% less carbon than now; and
- More than 1.2 million people will be in green jobs.

The Transition Plan also sets out our proposals for how we will manage carbon budgets in Government, with every major department allocated their own share of the budget. The Plan is the most systematic response to climate change of any major developed economy and demonstrates our commitment in the lead up to global climate talks in Copenhagen in December. As already announced, the Government will tighten the carbon budgets in the light of a credible global agreement being reached at Copenhagen, and once proposals on sharing out the new EU target are agreed.

There are a number of forthcoming milestones relating to carbon budgets. In October the Committee on Climate Change will publish its first annual progress report to Parliament; the Government must respond by 15 January 2010. By next spring, the Government will publish a roadmap setting out the path to 2050 in the energy sector; and individual Departments will publish their carbon reduction delivery plans showing how they will meet their share of the carbon budgets.

#### Additions and Updates to Answers in Original Memorandum

### Whether the UK's statutory targets for greenhouse gas reductions are consistent with the Government's objective of limiting global warming to no more than $2^{\circ}C$ and whether they are enforceable

As stated in the original memorandum, the UK's statutory targets are consistent with the conclusion of the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report, and therefore with a 50% chance of limiting the temperature rise to 2°C up to 2100. This estimate is also consistent with recent results from the DECC and Defra-funded research programme called "AVOID" (see below).
The Government considers that the Committee on Climate Change (CCC) has given full weight to the science in advising on carbon budgets and targets, while recognising that achievement of a stabilisation goal is not something that the UK can deliver on its own and that an international agreement is required. It will also be necessary to keep under review the developments in scientific understanding to inform the scale of domestic and international mitigation action.

The original memorandum also notes that the targets and budgets under the Climate Change Act are legally binding and that the Government is fully committed to meeting them. The provision to allow "credits", representing emissions reductions overseas brought into the UK, to be counted against carbon budgets, means that credits can be bought to meet budgets if they are not met through reductions in domestic emissions.<sup>4</sup> If a carbon budget is exceeded, even taking into account of any credits, section 19 of the Climate Change Act requires the Secretary of State to lay before Parliament a report setting out proposals and policies to compensate in future periods for the excess emissions.

# The extent to which the Committee on Climate Change's recommended budgets to 2020 are consistent with the UK's target for 2050

As already announced—and in line with the CCC's advice—the Government will tighten the carbon budgets in the light of a credible global agreement being reached at Copenhagen. The CCC has made clear, in evidence to the EAC and elsewhere, that the 'intended' budget levels they recommended in their December 2008 report were indicative, pending a global deal.

As the UK negotiates internationally on climate change as part of the EU, the Government expects to agree the UK's emissions reductions targets under any future international agreement at European level. The CCC will therefore be asked to reconsider its advice on the level of 'Intended' budgets after a global agreement and once proposals on sharing out of the EU target are agreed. Government will then take this advice into account in amending the budget levels.

# The suitability of the climate models and the validity of the assumptions used by the Committee on Climate Change in setting carbon budgets

As stated in DECC's original memorandum, the simple model used by the CCC, "MAGICC 4.1", incorporates all climate feedbacks that have been identified from the more detailed general circulation models (GCMs). The simple models are able to closely simulate the global temperature response of GCMs for baseline emissions scenarios, and the GCMs themselves have been found to reproduce the observed climate within the expected range of variability.

A major research programme, AVOID ("Avoiding dangerous climate change"), jointly funded by DECC and Defra, has built on the CCC approach to provide a more detailed analysis of the sensitivity of climate outcomes to variations in both emissions pathways and climate model parameters.<sup>5</sup> The latest results from AVOID show, in agreement with the CCC's report, that in order to limit warming to 2°C in 2100 with a greater than 50% chance of remaining below this in 2100, early action should be taken so that global emissions peak in the next few years and very significant annual reductions are achieved thereafter. Our aim in international negotiations is to secure a global agreement that will deliver this.

Attention has been drawn to differences in the targets suggested by the CCC and those published by the Tyndall centre. These were primarily due to practical differences in scientific method and assumptions between the studies. It should be noted that there is a level of uncertainty inherent in such analysis that is being explored more fully in the AVOID project.

The Committee has asked in an oral evidence session about the integrity of our carbon accounting systems. The system used for carbon budgets, which measures emissions by way of our greenhouse gas inventory, reflects the agreed international approach to measuring emissions of greenhouse gases. It is important that the UK follows agreed international practice, as consistency with this is essential if we are to successfully negotiate global emissions reductions with other countries. Whilst it is also correct to state that the underlying calculations rely to some extent on estimates of activity data and emissions factors, we believe that in the long run this approach will give the most accurate results, and is preferable to an alternative approach which might, for example, measure emissions at a location close to their source.

# The basis on which the Committee on Climate Change arrived at the UK's share of the global effort to cut emissions

With regard to international burden sharing, the Government is working closely with EU partners and other countries to secure an ambitious, effective and fair agreement at the UNFCCC meeting in Copenhagen in December. We are seeking a comprehensive agreement that includes a clear long-term vision for global emissions reductions that is compatible with our 2°C goal. This would include: ambitious and comparable

<sup>&</sup>lt;sup>4</sup> As described below Government aims to meet the current carbon budgets without purchasing credits, and this represents an "insurance option" to be used only in the last resort.

<sup>&</sup>lt;sup>5</sup> www.avoid.uk.net

mid-term targets for developed countries; adequate contributions by developing countries according to their responsibilities and respective capabilities; and international architecture and mechanisms adequate to the task of meeting our mitigation objectives in the most cost effective manner.

The Global Commons Institute's Contraction and Convergence model was discussed in some detail during the Committee's recent oral evidence sessions. We recognise that there are some who regard this methodology as both effective and fair, given its focus on equal emissions rights and the establishment of a framework that would see all major countries participate from the outset.

The EU's March Environment Council noted that, based on elements such as current population projections, global emissions per capita should be reduced to around two tonnes CO<sub>2</sub> equivalent by 2050, and that, in the long term, gradual convergence of national per capita emissions between developed and developing countries would be necessary taking into account national circumstances.

In the current international negotiations, countries are strongly protective of their right to act in accordance with their national circumstances. Methodologies such as contraction and convergence that focus on one particular indicator—in this case per capita emissions—encounter strong resistance, not least because they do not appear to give sufficient weight to other important national indicators, such as mitigation potential, economic capacity to act or human development status.

The compatibility of current Government policies with achievement of the overall budget, how individual government departments can ensure policies are consistent with overall carbon budgets, and the potential role of departmental tradable carbon allowances

The Low Carbon Transition Plan sets out the proposals and policies that will enable the UK to meet its first three carbon budgets, fulfilling a requirement in the Climate Change Act. An annex to the Plan lists all the different policies, sector by sector, and the emissions reductions they are expected to generate in each year between 2008 and 2022, and over each of the three budget periods.

The policies in the Transition Plan are reflected in the latest emissions projections, published at the same time. However, emissions projections can never fully guarantee that the budgets will be met, as there will always be uncertainty about future emissions. While some policies, like the EU Emissions Trading System, guarantee that net emissions will be no higher than the limit or "cap" that is set, in other areas there is uncertainty about the level of emissions reductions that will be delivered by policies and whether other factors, such as faster than expected economic growth, will drive up emissions.

To mitigate this uncertainty, the Transition Plan provides an additional contingency margin. On the basis of the central scenario for emissions projections, the policies in the Plan will over-deliver against the carbon budgets by a margin of 39 million tonnes  $CO_2$  equivalent in the third budget period and by 147 million tonnes across all three periods. Uncertainty has also been reduced by improving the accuracy of the latest emissions projections, for example by removing any double counting of carbon savings by policies. The Government will also continue to explore new cost-effective policy options to reduce emissions in the UK, for example new ways to help small businesses to save carbon.

As well as proposals and policies across all sectors, the Transition Plan sets out the Government's plans to introduce a system of departmental carbon budgets, initially on a pilot basis to be reviewed ahead of the second budget period (2013–17). Their purpose is to ensure that every part of Government is held accountable for delivery of the UK's carbon budgets. Each major government department has been allocated its own carbon budget, made up of two elements. The first reflects a share in each of the major sectors of the economy, representing an approximation of its relative degree of influence on reducing emissions in each sector; and the second reflects emissions from the part of the public sector it has responsibility for.

Sectoral shares have been calculated considering departments' policy levers, policy responsibility for activities increasing emissions, and general responsibility and influence on economic sectors. They cannot be a precise measure of departments' contributions, but will give departments a stake in reducing emissions from a given sector, and a pressure to work with other departments involved in that sector in order to deliver their budgets.

As a first step, the public sector element of the departmental carbon budgets includes emissions from central government departments, based on the existing SOGE framework, and from departments' own administrative transport. They require a 30% reduction in these two elements by 2020, against baselines of 1999–2000 and 2005–06 respectively. The remainder of public sector emissions are included in DECC's budget, given its policy responsibility for the Carbon Reduction Commitment. But the intention is to include emissions from schools, further and higher education, and the NHS in the relevant department's carbon budgets by April 2010, and over time to include emissions from the wider public sector in the budgets of the departments with responsibilities.

# The issues around using emissions trading (both credits from the EU Emission Trading Scheme, and carbon offset credits) to meet carbon budgets, including the standards that should apply to such credits

The Government has already said, on the basis of the current 34% target for 2020, that it does not plan to buy international offset credits in any of the three budget periods, and will meet the budgets through domestic action alone. This applies outside the EU Emissions Trading System, where businesses can buy offsets within limits set at EU level. The UK Low Carbon Transition Plan shows how it will be achieved in practice, by setting out the policies that will reduce domestic emissions to the level necessary across all three budget periods. Government has only actually set a legal limit for the first period because this is what the Climate Change Act requires.

Carbon budgets introduce a new imperative: they are legally binding and must be met. The use of credits must therefore remain as an "insurance option" to meet the current carbon budgets, in the event that expected emissions reductions are not delivered. However, it is not part of the Transition Plan and should be seen as a risk management tool that would only be used as a last resort. The chances of this last resort being needed are low, due to the efforts to reduce uncertainty described above. Furthermore, any need to buy credits would come at a cost which effectively imposes a cash penalty on Government for failing to deliver the policies in the Transition Plan.

When tighter budgets are set, following a global deal, the Government will consider whether the extra emissions reductions required should be delivered at home or through buying offset credits that will deliver emissions reductions in developing countries. In doing so, the Government will be guided by the most cost effective path towards the 2020 and 2050 targets.

Under the carbon accounting regulations for carbon budgets, the contribution to carbon budgets of the sectors of the economy covered by the EU ETS (the "traded sector") is equal to the level of the UK cap (with units credited or debited to reflect the difference between the cap and actual emissions). The Government considers that it would be misleading to use actual UK emissions in the traded sector to count towards our carbon budgets, rather than the UK's allocation under the EU ETS; for example, although we might report reduced emissions in the UK, these might actually be displaced by increased emissions elsewhere in the EU, or vice versa.

It is also important to note that there will be a significant reduction in the access to credits in the third phase of the EU ETS (2013–20), compared to the second (2008–12). In addition, the Transition Plan shows that we expect that the UK will vary over the three budget periods between being net sellers (actual emissions lower than the cap) and net purchasers (actual emissions higher than the cap) of carbon units from abroad. This is contrary to the expectations of some observers that the UK is most likely to be a net purchaser over the period.

September 2009

*Witnesses:* **Rt Hon Edward Miliband MP**, Secretary of State, for Energy and Climate Change, and **Mr James Hughes**, Head of Carbon Budgets Team, Department of Energy and Climate Change, gave evidence.

**Q250 Chairman:** Good morning and welcome. Thank you very much for coming in. I rather felt in the light of the lead article in *The Times* that I should start with a sound engineer's question about asking what you had for breakfast this morning. You are not a meat eater at breakfast time?

*Edward Miliband:* I had some fruit but not as a matter of policy is the way I would put it!

**Q251 Chairman:** Do you want to introduce your colleague?

*Edward Miliband:* Yes, I do. Thank you very much, Chairman. It is a pleasure to be here. I have with me James Hughes, who is the Head of our Carbon Budgets Team. It is great pleasure to be before your excellent Committee.

**Q252 Chairman:** Thank you. We are appreciative of your coming in. We have got a lot of ground to try and cover. We just had Adair Turner and David Kennedy from the Committee on Climate Change before us, of course talking about their Progress

Report that was published two weeks ago. Do you think that the Low Carbon Transition Plan can deliver the step change that report is calling for?

Edward Miliband: Yes, I do and I want to be very clear that I agree with them, that we do need to step up the pace. I have been very clear about that. The reason for the setting up of the new Department of Energy and Climate change was a recognition that we needed to go further and faster on this lowcarbon transition. I think what is important about the Transition Plan—everyone knows the Government are good at having targets—is what this tries to give a sense of is, sector by sector, how we are going to achieve the targets. Some of the areas are more difficult than others, but it is a clear analysis, if you like, of how each area can contribute to meeting our carbon budgets. I think it is worth saying that, partly helped by this Committee, this is a world first to have carbon budgets legislated for and is part of the architecture of what we do. Also, and James may want to say something about this, having carbon budgets for each department is very important because the truth is the thing I have learnt about Government, Chairman, and I am sure

#### 27 October 2009 Rt Hon Edward Miliband MP and Mr James Hughes

something you have found is that if everyone is responsible for something, then sometimes nobody can be responsible for it, if you see what I mean. By allocating out responsibility, and that was a hard process, and we may get into some of the detail of that, every department has a direct interest in meeting what we are doing. I think both the approach and, I hope, some of the substantive policies contained in the Low Carbon Transition Plan will mean that we will be on track to meet the ambitious targets that we have.

Mr Hughes: Not to go into too much of the detail because you may want to ask some further questions later on, what we have done in the Transition Plan is set out, as we are required to do under the Act, both the proposals and policies for how we are going to meet the budgets that were set at the end of May. We have done that, I think, for the first time ever, quite comprehensively. We have had a number of publications in the past from Climate Change Programmes and Energy White Papers which have set out some of the new policies, but here for the first time we have set out all of the policies that are going to help us to meet those budgets. As the Secretary of State was saying, I think what we have also got there is, for the first time, this sharing out of responsibility between departments, for the small departments just in terms of their own operations and estates but for the larger departments the sharing out the sectoral emissions between them. We are currently working with those departments in drawing up what are going to be their carbon reduction delivery plans which will be published in the spring.

**Q253 Chairman:** Will the Committee on Climate Change's Progress Report now involve making any change or review of the plans in the budgets in the Low Carbon Transition Plan?

Edward Miliband: Of the actual level of the budgets?

#### Q254 Chairman: Yes.

*Edward Miliband:* No. We are going to do a formal response to them in January as required under the Act, so I do not anticipate that, but I do not think they are recommending changes in the actual level of the budgets, unless you heard differently from Lord Turner. They have specific recommendations which, of course, we will look at on the question of banking of any overachievement, if you like, in the first budget period or in subsequent budget periods but my understanding is they are not proposing changes to the actual level of the budgets.

**Q255 Chairman:** No, but they are saying that the UK explicitly should aim now to overachieve emission reductions.

*Edward Miliband:* Yes, although we did not make a huge deal of this at the time, it is worth saying that on our plans that we set out in each of the budget periods we do exceed by some margin what is required. I think it is 44 million tonnes in the first budget period, so in that sense we are on course to overachieve. I think there are a couple of things to say about that. One is that there is always a margin for uncertainty with these things. One of the reasons

why the figures have moved in a more positive direction, according to the Committee on Climate Change, is to do with the recession which is undoubtedly true. It could move back in the other direction with higher economic growth. There is a whole range of other uncertainties. We are on course for overachievement. I think that is the right place to be.

Secondly, it is worth saying also that we have taken a pretty tough line, as the Committee recommended, on the question of offsets and buying in offsets from abroad by setting a zero credit limit in the first budget period. We have set ourselves a pretty testing task. As I say, we will respond formally to them on the question of banking of any unused allowances in January.

**Q256 Chairman:** You would accept their recommendations about how the impact of the recession should be taken into account?

Edward Miliband: I think James may say something about this. There is a sort of disagreement about the precise detail of what the precise recession effect is, but there is no question that there is a bigger effect. To put this in a global context, it is worth saying that, according to the IEA, as a whole, the world will be emitting 2 Gw/t less in 2020 as a result of the recession. I think that is on a business as usual scenario, something like between 50 and 60Gt. There is no doubt that there is a recession effect. Do you want to say anything about the detail of that? Mr Hughes: Just a couple of things. One is that the Transition Plan published in the summer includes within the figures there our own assessment of what we think the impact of the recession is, so that has been taken into account in the Transition Plan. The figure that we came up with in terms of the impact of the recession was not as large as the one the Committee has suggested in its report. That is partly because the Committee and ourselves have used different analyses which has included a different approach in terms of looking at what the impact of the recession might be. That said, I think the decision on what the real impact of the recession is on the first carbon budget and what the implications might be in relation to the question of whether to bank or not may need to wait until towards the end of the first budget period when we can assess what the actual impact has been.

**Q257 Jo Swinson:** We hear about this 2° rise figure. It is always mentioned in media interviews and at the despatch box. Do you think people would be surprised to know that even if the Government meet their plans and targets, there is still a 50% chance we will go over that 2° rise? Is that not an unacceptably high risk, given the consequences that more than a 2° rise could have?

*Edward Miliband:* I think that the science is incredibly challenging and the truth is, globally and domestically, politics has a job keeping up with the science. It is important because I know your Committee has talked a lot about these 2° to various of its witnesses, including I think Brian Hoskins and also Lord Turner this morning. My understanding of

this is that we have already got 1.4°C in the bank, if you like, that is going to happen anyway. The prospects of keeping to under 2° are very, very challenging and in a sense that is the implication that I take from the Committee's recommendations and the recommendations that we adopted. I think they are right to say that the effects become more severe as we head towards 3°. In other words, that is the importance of 2°, as you head towards 3° and 4°, the weather effects become much more severe and they wanted to minimise those chances of ending up in that position. I think it is something like a 10%chance of 3° and a 1% chance of 4°, more or less, that is implicit in their figures. In a sense, I think that part of the challenge we face in public debate, to be completely honest, is to get across to people the pace of change and what is already inevitable in this. I suppose my job domestically and internationally is to try and go as far and as fast as we can and be as ambitious as we can.

**Q258 Jo Swinson:** I quite agree with you, politics does struggle to keep up with the science and that is challenging. What do you think the main barriers are to being bolder and taking a more precautionary approach, given even 10% of a 3° rise and what we know about what that would mean for the world? Are those barriers cost and affordability, technical feasibility or mainly political?

Edward Miliband: That is a really good question. I think it is a combination of things. If I think about this globally, there is a perception barrier that we face and, to be completely honest, I do not think we-and I use this collectively-the people who are the advocates for tackling climate change have been good enough at saving there is avoiding the nightmare and there is putting forward the positive vision. If you think about the debate in the United States, for example, that debate is sort of where we were some years ago in terms of coming to grips with: "Is this a real problem? Is the science real? How are we going to tackle it? Is it going to involve a lot of cost? What are the costs of acting?" In a sense, I think part of our challenge globally and domestically is frankly to put forward more clearly the potential prosperity benefits of acting, the energy security benefits of acting, showing we can deal with the fairness aspects of transition. In a sense, gloomladen warnings have their role-do not get me wrong, I can do those with the best of them-but I also think we have got to do a far better job of presenting the positive. In a sense, that is what is going to persuade people. A Labour Party member said to me, "Martin Luther King did not say, 'I have a nightmare', he said, 'I have a dream'". In a sense, I think we need to do a better job of that.

There is one final point I would make, Jo, which is about the global context of this, which is if out of Copenhagen we can show that we can have global emissions falling, not rising, by 2020, that would be a major success because once that starts to happen, ie emissions start to fall, people will think, "Actually it wasn't as difficult as we feared it would be and it didn't have as profound a problematic impact as we feared". **Q259 Mr Lazarowicz:** On the question of Copenhagen, I know you have been travelling around quite a few places and consulting with many governments about the Copenhagen negotiations. Can you give us your current thinking on the prospects for a deal in Copenhagen?

Edward Miliband: I think maybe it is sort of intrinsic to doing this kind of job that you swing between despair and hope in these things. I feel more hopeful than I did. I feel like it seems to me that the debate in America has taken a more positive turn. There are signs of a more bipartisan, not consensus but bipartisan support led by Senator Kerry and others. I think that is a positive. Overall, while this remains extremely difficult to do because it is doing what has never been done before, ie turning around global emissions is a big ask and it involves developed and developing countries, I think there are reasons to be optimistic in the sense that lots and lots of countries have responded to this deadline. The President of China went to the UN and announced a change in his policy and said, "We are going to target carbon intensity and have substantial reductions". Japan announced reductions in its emissions-a new Government-25% by 2020 below 1990 levels. The new Indian environment minister said, "Look, India can't just talk about the per capita approach, but has to say we are going to take real domestic action on climate change". In a sense what is tantalising about this is lots of the jigsaw pieces are on the board for a decent agreement. The question is whether we have the political skill, imagination and globally the collective, not just will, but method to put it together.

**Q260** Mr Lazarowicz: Can you also give us an assessment of the position of the European Union because, again, there have been some mixed messages? On the one hand, a reduction of a 95% on target was obviously a positive move. There were also some press reports yesterday about some Member States balking at the contribution required to the adaptation mitigation fund. Can you give us an update of the position with regard to the EU in the last couple of days?

Edward Miliband: We have the heads of Government meeting at the European Council at the end of this week and that is a very important milestone. The Prime Minister will be going and arguing strongly for Europe setting out as clear a position as it can, including on finance, and his proposal on finance in June, \$100 billion a year of public and private finance by 2020, I think has been an important milestone and benchmark in the debate. There are tough negotiations in this because it is a hard time for developed countries to be making additional financial contributions to developing countries or, indeed, to anything. There are some Member States who feel that this is going to be hard for them to do, so I think it is sort of inevitable in this that there are hard discussions and they are going on. Europe has shown leadership in this issue by saying, "We will do 20% unilaterally by 2020 and 30% as part of a global deal". That needs to be matched with a finance offer. I am hopeful but not certain that is something that will come out of the European Council this weekend. It is very important for Europe to set a clear benchmark. Why is this finance so important? Because we know we cannot tackle this global problem without developing countries being on board and we know that developed countries bear a very important historical responsibility. Quite apart from anything else, the poverty issues in developing countries, the problems that already have been created, the 1.4°C, if you like, that temperature rise is going to happen. Part of showing our sense of responsibility for that is by helping developing countries both to adapt to climate change and to get onto the low-carbon path, in a sense to do not as we did but to do as we say.

**Q261 Chairman:** Do you think that the principle of contraction and convergence is likely to be discussed much at Copenhagen?

Edward Miliband: I think probably not is the answer. I do not think that will form the basis of an agreement. I think that there is a sort of attractive justice element to the contraction and convergence idea. The complexity of it, though, is what is the point at which convergence takes place and what do we say about different countries' levels of growth at that point, GDP, how should we adjust for different weather conditions and all that? I think as a way of thinking about the problem and how you share out the problem, it is quite a good way of thinking about it. If you think about the US, they may be at 24 tonnes per capita at the moment but by talking about an 80% reduction, they are getting quite a long way down, not quite towards 2 tonnes per capita but towards a pretty low level of emissions. I do not think it will form the basis of this agreement, but it is an important thing in the background to be thinking about when we think about what different countries need to do.

**Q262 Dr Turner:** Ed, it is very heart-warming to hear that you have taken on board the principle of overachieving and built it into carbon budgets—the next carbon budget and sector budgets. That is very good, but I would like to ask how confident are you about succeeding in that, given the fact that we are certainly going to fail to achieve our current target of a 20% reduction by 2010?

Edward Miliband: Let me say something about this because this was a unilateral position that the UK took on. I think sometimes that the very brave and ambitious proposal we made obscures the massive progress that has been made for a variety of reasons. However, it is worth saying that the provisional numbers of greenhouse gas emissions show in 2008 20% below 1990 levels in the UK without trading and 22.5% below with trading; CO<sub>2</sub> 10% without trading, 13.6% with trading. The 20% was always very stretching. I would have preferred that we were on course to achieve it, but I think it is important to say, and you get this internationally, what people say to me internationally is, "Actually you are one of the few countries to have exceeded your Kyoto target". Therefore, there is respect for what we have done in this country. As to the future, I will be honest with you, Des, I am confident that we have the right plans in place, but I am absolutely clear about the scale of the delivery challenge we face. We face a massive delivery challenge in the energy sector where, for example, we have got to have 10,000 wind turbines on and offshore in the next ten years, quite apart from nuclear and clean coal. We have a massive delivery challenge in the household sector where we will have 80% of houses that are already built still standing by 2050 and that is why we have proposed big plans for pay as you save energy efficiency and insulation, but that requires a big communication with the consumer about the benefits to them of doing that and we face a big challenge in transport as well. I think the challenge is big. We have some very serious plans in place on the household sector, on energy and driving forward nuclear renewables, clean coal through planning reform, the levy on coal, all kinds of other things but it is a big challenge.

**Q263 Mr Caton:** Ed, you said in reply to the Chairman at the beginning that the Government do not intend to use offset credits to meet the carbon budgets. However, the carbon budgets order allows the use of EU ETS credits to meet the budgets and they contain a portion of offset credits. Are you concerned about the use of offset credits within the EU ETS and do you think it undermines efforts to reduce emissions domestically?

Edward Miliband: The way I would put it is that domestic action needs to be the backbone of what we do because we know that by 2050 if the world as a whole, including leading developing countries, has targets for reductions there will be much less available in terms of offsets. So domestic action is very, very important in this. People talk about the 20% target for the EU and how much of it is domestic and how much can be done by offsets. It is worth saying that our calculations suggest that about 16% of that 20% represents commitments the EU has made on renewable energy, efficiency energy, et cetera, so there may be a rule that up to 50% of it can be met by offsets, but it is also worth saying that there are additional domestic European commitments as part of the 2020 package which take you towards the lion's share of 20%.

On the specific question about the use of offsets, having said that domestic action is the backbone, I do not think it is wrong to use offsets, no, because I think the whole principle of cap and trade is that you can make abatement happen in the places where it is least costly. Frankly, and it goes back to my earlier answer to Mark, we are trying to get to a situation where we have significant sums flowing to developing countries. One of the ways, but absolutely not the only way because you need public finance as well, in which those funds can flow is through the carbon market and to offset some part of that. I do not think it is wrong in principle, I think that the use needs to be constrained and there needs to be proper domestic action if we are going to be on a path to the kind of reductions that all countries need to make.

**Q264 Mr Caton:** I guess the concern, and this is certainly what we have picked up from witnesses over the last couple of years, is that allowing offsets reduces the imperative to move to a low-carbon economy in developed countries.

Edward Miliband: It should not do that. I have a half-sympathy with what you say, but I think it should not do that. Let me give a specific example. I had the chance to go to India. They have 450 million people not connected to the electricity grid and they were telling me about their plans for 20 million people to get lighting through solar energy. As part of the abatement that we need in terms of carbon emissions in relation to India preventing a very steep growth in its carbon emissions, as part of a carbon market or sort of offsets regime, if we enable more people in India to have solar lighting and avoid those people going down the high-carbon electricity road, I think that is a good thing not a bad thing, so it must not be an excuse for not taking domestic action. That is where I agree with you, but I do not agree with people who say-and I am not saying you are saying this-that all offsets are bad and we should not be engaging in this.

**Q265 Mr Caton:** I think certainly one witness I can remember did not argue against putting resources into the developing world to allow them to do this sort of thing, they just argued that offsets have this negative impact in the developing world. Could I ask another supplementary? The Government count allocations rather than actual EU ETS emissions. Should they not be counting actual emissions, especially given that there is no direct national allocation of emissions beyond 2012? Will it make more sense to move to counting actual emissions now?

*Mr Hughes:* First of all, fundamentally we believe in the EU ETS and see it as an important part of our strategy for reducing emissions and we are looking to link that scheme up with trading schemes elsewhere in the world. We see that as the way forward in terms of reducing emissions worldwide at least cost. The good thing about the EU ETS is obviously it places a cap on emissions and we know what our limit is, certainly within the current Phase 2 of EU ETS. For Phase 3, it is true that because it is EU-wide it is a little bit more difficult to work out exactly what the UK share of that is, but we believe we can work out to a fairly high degree what the UK share of the EU ETS will be. We will be able to use that in terms of monitoring how we are achieving reductions in relation to the cap. But, that is only one part of the strategy; the other part is decarbonisation of energy within the UK, particularly electricity. That fits in with the plan to see more low-carbon electricity being used for heating homes and for transport. We see those two things complementing each other. If you look at the Transition Plan, it shows there is a great deal of decarbonisation which will go on in relation to the UK energy supply, to the extent that under the EU ETS, certainly for part of the period over the three carbon budgets, we are quite likely to be selling allowances to Member States rather than buying them.

Mr Caton: Thank you.

**Q266** Martin Horwood: Can I ask one supplementary to Martin's questions on that before moving on to the vexed subject of coal? One of the other issues which have been raised about the ETS, and BIS particularly raised in the National Audit Office Report, which we have highlighted on this Committee, is the use of carry forwards and how those are threatening to undermine even the achievement of the targets in Phase 3.

*Edward Miliband:* This is a really important point. The potential of banking of unallocated allowances, both in Europe and internationally, is a potential issue. It does need to be addressed as part of the Copenhagen Agreement and that is what we are working on.

**Q267 Martin Horwood:** That is very good news. The issue of coal: the Committee on Climate Change in its report has identified the risk that market investment is still pouring into fossil fuel fired power generation. Do you accept that point is right and, therefore, the market for power generation in this country needs to change in quite a fundamental way going forward? If so, what are your expectations, hopes or even plans for making that happen?

Edward Miliband: The way I would put it is this, markets on their own will go for the least cost option, in a sense that is what they are good at. The least cost option at the moment is gas. That is why we need to build in a series of interventions-this is what I call "strategic government"-to make sure that what I think of as the "trinity of low-carbon". which is renewables, nuclear and clean fossil fuels, are part of our energy future. On renewables, we have the Renewables Obligation. On nuclear, through planning reform and other things we are providing support to make nuclear happen. On clean coal, frankly, which I think is fantastically important-indeed. I think your Committee wrote a very good report on this, which I think the previous Department disagreed with and I agreed with, and said so in my response—at least, I hope that was clear. This is a technology which has been around for a long time but has never got to the scale it needs to get to. That is why we have proposed a levy to make carbon capture and storage happen and drive it forward. In short, I recognise what the Committee on Climate Change says, that we need to make the right interventions in the energy market to ensure we do not end up with high carbon lock-in and high carbon solutions, but we end up going down the lowcarbon route and that is what we are trying to do.

**Q268** Martin Horwood: One of the clear interventions the Committee has recommended and where it thinks there is—if I can paraphrase them slightly—a loophole in the current arrangements for carbon capture and storage, is that you have not yet sent a clear enough signal that by the 2020s essentially unabated coal will play little or no role in energy power generation. The loophole which is in there at the moment is that it is providing the technology is viable, but Lord Turner in his evidence

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earlier on today made the point that it is not really about the technology, it is about the simple fact that unabated coal cannot form a part of our energy generation in the 2020s on any significant scale if we are to meet the 80% target.

Edward Miliband: I agree with Lord Turner on this. Let me try and explain where I see this as a background. We had a policy which was for building unabated coal fired power stations. The establishment of DECC led to a different policy. which has basically got three components. This was our proposal, which we are still consulting on. First of all, any new coal fired power station has to demonstrate CCS on a substantial proportion of the plant. Secondly, by 2020 we should take a view about whether CCS is proven and then if it is proven, these new plants should have 100% CCS. Thirdly, if it is not proven, and we have asked this question, what do we do then? We have said in our initial set of proposals that we should have a presumption there would have to be some kind of restrictions in order precisely to meet the problem you are raising. If I can put it this way, I think the dilemma or the needle we have to thread in this is we have got to find a way in which companies will build, in my view, so that we can test carbon capture and storage, and not just test it but make it work. If we do not make it work, we will be failing Britain and we will be failing the world and we have got to avoid high carbon lock-in. What we are trying to do with our three conditions is find a way of threading that needle alongside the levy.

**Q269 Martin Horwood:** Is not the crux of it that an energy company needs to understand right now that if they are building an unabated coal fired power station, come the 2020s the likelihood is they will have to close it down if they have not got CCS and that signal has not been given yet?

*Edward Miliband:* I would disagree with that. Under our proposals they cannot build an unabated coal fired power station because we have said we have got to have abatement on a substantial proportion of it under our conditions. That is the policy we changed. That is the first point.

**Q270 Martin Horwood:** That was providing the technology was economically viable.

*Edward Miliband:* No. To be clear about this, we have said that on any new coal fired power station a substantial proportion of it must have carbon capture and storage fitted. We have said 400MW (gross). That is absolutely clear. We have said no more unabated coal fired power stations. You are looking quizzical.

**Q271 Martin Horwood:** That is not quite what was in the Government's statement. It is interesting that the Committee reported only two weeks ago that that clearer signal has not been given.

*Edward Miliband:* The question they are raising is the question of full carbon capture and storage fitting on any new plant. It is worth saying this, just to be clear: I changed that previous policy, this was an announcement we made in April, followed up in June with a consultation and these are the three conditions we have set out for consultation.

**Q272 Martin Horwood:** That is a clear statement of it now. The cut of 2% of emissions on 2008 levels by 2020 by the power and heavy industry sector— *Edward Miliband:* Did you say 2%?

**Q273 Martin Horwood:** Yes, 2% of emissions by 2020, which is on 2008 levels. Do you think that is consistent with the Committee on Climate Change's vision for almost complete decarbonisation of power generation by 2030?

*Edward Miliband:* I do not recognise the figure of 2%. We have said a lot on the Transition Plan that we are going to go to about 40% low-carbon generation of electricity by 2020 which compares with something like less than 10% at the moment. We are talking about a big change in low-carbon generation. I do not recognise the figure you were mentioning.

**Q274 Martin Horwood:** I do not have my source immediately handy. Can you tell me what role you might envisage for emissions performance standards, which seems to be potentially a very important lever, one which is not used at the moment and could make a huge difference?

*Edward Miliband:* We think they do have a role. Going back to this coal consultation we are in the midst of, we have said that if CCS is not proven, we think the EPS could have a role. We also said it could have a role in giving expression to the conditions we have laid out. I think the EPS could have a potential role in relation to coal, but potentially more widely also in the 2020s.

**Q275 Chairman:** On this point about the new coal powered stations: as you say, your very much improved response to our report, for which we are grateful, if I can just quote from it—we have not really discussed it this morning—"In summary, the consultation is proposing that any new coal powered station in England and Wales should demonstrate CCS from day one on a defined part of its capacity". 'Defined part' means what sort of proportion?

*Edward Miliband:* We are saying at least 400MW (gross) of CCS on any new plant. It depends on the size of the plant basically.

**Q276 Chairman:** That 400 might be a very substantial proportion on the capacity or it might not be.

*Edward Miliband:* It is probably right to say it is at least 25% because you could be talking about a 1.6GW plant. There is an important issue which you may not want me to get into on this, Chairman, where some people say, "Why not do 100% from day one?" The reason for not doing 100% from day one is we are testing a new technology which has only been demonstrated at a much smaller scale previously and we are also going to be charging consumers for this. Therefore, I think it is right that we drive forward

CCS as far and as fast as we can, but we do so in a way which is fair to consumers as well as the environment.

**Q277 Martin Horwood:** I do not think the Committee was highlighting what you have to do on day one, what it was saying was the signal you give to the industry, that by 2020 something like 75% of the power stations' emissions being unabated is simply not going to form part of our energy policy. Therefore, if that is the case, it will have to close down.

Edward Miliband: That is not the signal we are giving them because we are giving them a very clear signal about driving forward CCS, about demonstrating CCS and about saying it will have to be 100% if it is technologically and economically proven. Also, we are saying, if CCS does not work our presumption would be there would be restrictions on it. The argument some people would make is if you were to say, "We're going to close down the plant in 2020", then people are not going to build the plant. That is the point people would make to you. People are not going to build a new coal fired power station for five years, so we have to find a way in which we send a very clear message about decarbonisation and about CCS, but we also have to do it in a way which gets the CCS demonstrated.

**Q278 Martin Horwood:** Surely that is the nub of it then. If you are scared about them not building the plant, surely that is exactly what the Committee on Climate Change is saying. It says: "Whether or not CCS can be deemed economically viable, any conventional coal plant still operating unabated or even in large part unabated"—you can read—"beyond the early 2020s would only generate for a very limited number of hours".

*Edward Miliband:* Our proposals are exactly in line with the Committee on Climate Change.

**Q279 Martin Horwood:** It does not think they are. If you read page 134 of its report, it thinks a stronger signal has not been sent.

*Edward Miliband:* I do not know whether you asked Adair Turner and David Kennedy, but I had a discussion with them this morning about this and they think our coal policy is in line with their recommendations because we have said, as the third condition, if CCS is not proven there will be limits on what can be done.

**Martin Horwood:** It may get down to exactly what the limits and how big the loopholes are, I guess.

**Q280 Chairman:** You just mentioned consumers, which obviously are of great concern to your Department. However, if we are going to have a higher proportion of green secure energy, it is unavoidable that the price is going to go up for consumers.

Edward Miliband: Yes.

**Q281 Chairman:** Protecting consumers cannot be a driver of our response to climate change. It may be a driver of social policy in order to minimise the impact of fuel poverty, but we cannot allow a concern about price to restrict what we are doing to reduce the emissions.

Edward Miliband: I do agree, except in this respect: we always have to be aware that we have to try and make low-carbon transmission happen at the least cost which is feasible. I have been very clear, Chairman, and I said this when we published the Low Carbon Transition Plan, prices are going to go up. Our estimates are that the climate change impact of what is in the Transition Plan is 6% by 2020 on energy bills and 8% if you include previously announced measures. I was very clear about that because I think we need to level with people about this. Also, it is important to say-and this is important for the people who believe in this-there is no low-cost, high-carbon future. In other words, simply going for high-carbon, relying on fossil fuels, opening ourselves up to increased demand from China and India, driving prices up, that is also not going to produce a low-cost outcome. That is a very important point to make to people.

**Q282 Chairman:** One of the common threads in our earlier session was that the actions taken in the next two or three years are going to be critically important in achieving the 2020 targets and the budget cuts to 2022. If there appear still to be obstacles in the planning process, would you consider building into the remit of the IPC a requirement to have a strong presumption in favour of any proposals which appear to be necessary to achieve our climate change commitments?

Edward Miliband: That is an interesting point and when we publish our national policy statements in the next few weeks, I hope you will engage with them. We need to send a very clear message in our national policy statements about the need, not just for security of supply reasons, but low-carbon security of supply reasons to make this energy infrastructure happen. The thing I have learned in this is there is a planning process aspect to it, but, frankly, there is also a big public persuasion aspect. Persuading people about renewables, which are not popular, persuading people about nuclear-I am sorry to say that in front of some Members of this Committee-which is not popular, persuading people in relation to clean coal, which is not necessarily popular, I think the planning is important. I would be interested to have your comments on our national policy statements when they come out, but I think the persuasion part is equally important.

**Q283 Dr Turner:** The Committee on Climate Change suggests that the Government are relying on markets to drive the transition to a low-carbon economy and that any such confidence in markets to do this is misplaced. How do you respond to that?

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Edward Miliband: I think you need both. You need markets because, frankly, we have got some £100 billion or more of investment that we need to make this low-carbon energy happen and it is not going to come from Government. A lot of it is going to have to come from the private sector and that is going to come from markets, but you need a very strategic role for Government. Frankly, I think the idea of a markets-only energy policy is not going to work. I have tried to say that very consistently since I got this job. I do not mean this in a party political way at all, but Lord Lawson gave an important speech in the 1980s about his approach to energy policy, which was essentially talking about the way in which markets can deliver. However, we know that whether it is security of supply and the mix of gas and other fuels, low-carbon or price, markets on their own do not necessarily deliver on any of those, that is why you need a strategic role for Government, so I agree.

**Q284 Dr Turner:** Quite. There are limits to the signals or market drivers which are in place at the moment. Carbon price is very weak and the ROC system has limited effects. What thoughts do you have about putting market drivers in place through Government policy which can direct the investment into low-carbon technologies?

Edward Miliband: The most important thing we can do for a robust carbon price, and I agree that we need a more robust carbon price than we have, is to get an agreement at Copenhagen. If the EU can move from 20% to 30%, we will have a more restrictive ETS regime and, therefore, a higher carbon price. I do try and say this to people. There is a very strong economic case for Copenhagen, as well as the environmental case. If we are to give business the certainty it needs in terms of investment, we need a higher carbon price than we have at the moment and Copenhagen needs to make that happen. To be honest, that is where our focus is. It is also worth saying this, and this came through in the Committee on Climate Change report and Lord Stern's report: in the foreseeable future the carbon price on its own, even at significantly higher levels, is not going to be enough to stimulate the development of some technologies. If you think about carbon capture and storage or marine technologies, for example, which I know you take a close interest in, both of those are going to need specific Government support over and above what the carbon price on its own can provide. The only other thing I would say is I slightly think the ROC system gets a bad name in the sense that we have made a number of changes over time to adapt it. There was a 67% increase in offshore wind last year in the UK and I think something like a 30% increase in onshore wind. There are lots of forecasts in terms of what is going to happen in the wind industry here which are very positive now. We are now starting to accelerate deployment at quite a significant rate. I do not want to declare victory, absolutely not, but it is something like 9GW which has got planning permission and is awaiting construction.<sup>1</sup> We are already at 4, heading

<sup>1</sup> *Note by witness:* 6GW, rather than 9GW, has got planning permission and is awaiting construction.

towards 5 of the 6GW, so we are moving on this and banding the ROC has helped. In that sense, I think we should put some faith into the ROC system now and it is starting to work. I do not think now is the time to get rid of it.

**Q285 Dr Turner:** The Committee on Climate Change favours unilateral UK action to underpin the carbon price, almost irrespective of the outcome of Copenhagen. What is your view? Do you think it would help, and are you prepared to contemplate it? *Edward Miliband:* My preference is for Copenhagen to succeed. That is better and is going to be a more effective way to do it. There is an open question about whether unilateral action is possible. My focus is on Copenhagen and on plan A, which is that Copenhagen succeeds and drives up the carbon price. That is a better way forward.

**Q286 Mr Chaytor:** Secretary of State, there is still a series of interventions which you think are necessary. To what extent has Government's capacity to intervene in a market failure of energy policy been limited by the excessive intervention which has been necessary in the other market failure in the financial services industry? The money has been spent in propping up the banks and there is not going to be much more left to develop electric cars or whole-house domestic energy efficiency policy on a national scale, is there?

*Edward Miliband:* You are asking a very important question. It would be wrong for me to pretend that the economic situation somehow means it is as easy to get money for spending on climate change issues as it would otherwise be. It is very positive that, despite the difficult times, the Chancellor found £400 million of public finance in the Budget to help us develop our offshore wind industry, our marine industry, various other aspects, and also through the ROC, money to support offshore wind in particular. We have also got a huge amount of money in the system for ROCs. We have got the levy to support clean coal, which is important. In a sense, it is clearly unarguable that more difficult fiscal times make it more difficult.

The only other thing I would add about this is in the last year or two the debate about the environment has changed in a very positive way in the sense that people now see green jobs as part of our future economy and I do not think they did two years ago in the same way. Part of our job and task as politicians is to articulate better what it means in practice to get the green jobs to come here, but I think there is an opportunity in thinking about the future of our economy and an active industrial policy that we need to make sure we have lowcarbon jobs here. Overall, it makes life tough, but I think there are some opportunities.

**Q287 Dr Turner:** The Committee on Climate Change's progress report says that currently we have been improving energy efficiency at 0.5% per annum and suggests that we need to move that up to 2% or 3% per annum. That is a huge increase in the first three carbon budget periods. To what extent do you

think direct Government investment is going to be necessary to bring about that six-fold increase in energy efficiency?

Edward Miliband: Direct Government investment can always play a role in these things, although here is a real answer in relation to energy efficiency, which I think you, as someone who is an expert on this subject, will know. The truth about energy efficiency is it pays to do it, but the problem is the upfront costs. The task is to spread those costs over time, not over the time that someone lives in a house because that might be eight or nine years and is probably not enough time, but to spread it over a longer period so the repayment is connected to the house, not the person. Also, it is to find ways in which I think the private sector and others, local councils maybethat is part of our proposals-can come in and provide some of that up-front finance. Given the scale of the challenge, it is going to be very difficult for Government to provide all that up-front finance. Of course there are things we do through Warm Front, through, for example, the CERT obligation and, as part of our home energy efficiency plan, we are looking at what role the CERT obligation might play in the future and how that could help finance some of these changes we need to see. Essentially, you do need to make this a viable private sector business if you are going to get the kind of stepchange we need as well as Government playing their role.

**Q288 Dr Turner:** On the question of up-front finance for domestic energy efficiency, given that the state now owns wholly or partly an enormous proportion of our banking industry, why are the publicly owned banks not selling green mortgages?

Edward Miliband: I think green mortgages, dependent on what way you want to put it, 'pay as you save', can be part of the answer. I have to say, because I have looked at this, the experience with green mortgages so far has not been successful in the sense that I think the Co-op—which I think is a great organisation, there is no disrespect to the Co-ophave had a green mortgage which has had an extremely low take-up. There are bigger barriers that we face candidly in this. There is a direct financial barrier we face: I have tried to explain how I think we need to get over that, and that is going to need some changes in the way we think about this in terms of this longer time period of payback; that is important. There is a change aversion which people understand—I am sure we would have it about our own houses—about the kind of change that is going to be required, which we need to work out how we overcome. You are right that the banks can play an important role, I think they will have to play an important role, but it goes beyond that in terms of the scale of the challenge.

**Q289 Dr Turner:** Finally, on electric cars. Who should pay for the infrastructure?

*Mr Hughes:* What the Government are doing at the moment is putting down some seed corn money to get cities and regions to look at trialling some infrastructure. The Government have found about

£30 million, which was announced recently under the Plugged in Places programme. Before the end of the year there will be an announcement on where that money is going to go and where that infrastructure is going to be built.

**Q290 Dr Turner:** It would be geographically located, individual towns and cities will have their own local infrastructure.

*Mr Hughes:* We are looking at about three to six cities. That will be the start and we will see how it goes after that.

**Q291 Chairman:** Can we move on to the management of carbon budgets. Is the Treasury going to have a role here?

*Edward Miliband:* Absolutely. Nothing ever happens in Government without Treasury co-operation. It is an enthusiast for the system, not least because it sees that on the issue of the Government Estate there are big potential savings to be made. It is going to play a very important role in the system. The way we see it working is as part of spending reviews—the spending reviews take place probably every three years and this will be a very important part of that process—and monitoring, obviously monitoring of how people are performing in their carbon budgets will take place on a continuing basis. The Treasury and DECC will play a very important dual role in this process.

**Q292 Chairman:** If they are doing that together, will they be sharing some responsibility for delivering the reductions, and can we expect to see their tax policies targeted more accurately towards encouraging the necessary steps?

*Edward Miliband:* I feel I will get vaporised if I comment on Treasury tax policy! The Chancellor has to maintain his discretion on this, but I have talked to him a lot about the system of carbon budgets. He is very personally committed and the Treasury institutionally understands the importance of meeting these carbon budgets. Obviously taxation is one of the instruments it has to meet it. Its centrality in this is very important. Again, it goes back to what I said at the opening, the fact that we now have—the first country in the world—financial budgets, departments have financial budgets but they also have carbon budgets, I think is part of the culture change we need in Whitehall and elsewhere.

**Q293 Chairman:** Are sufficiently senior people in each department going to be held responsible for delivering individual departmental carbon budgets and their plans?

*Edward Miliband:* Mr Hughes, do you want to comment on the seniority or otherwise of your equivalents?

*Mr Hughes:* First of all, I should say within DECC we have set up a team that is going to be taking forward the management of the carbon budgets. We have specific individuals who are account managers who work closely with the main departments and working with them in terms of helping with capacity building, but also helping them with the

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development of their own carbon reduction delivery plans. Also, we have written around to all departments and asked them to nominate a senior responsible officer—that is quite often at board or Director level—who will be responsible for making sure the delivery of those departmental carbon budgets is seen through. We are going to be taking that forward, certainly through the National Directorate General within DECC, which covers delivery of domestic carbon emissions and meeting with opposite numbers to make sure they are all helping to deliver on this agenda. So far everything is on track for delivery of plans in the Spring.

Edward Miliband: One thing to add, Chairman, is I do not want to pretend that this is a system which will not undergo a sense of trial and error. We have devised a set of carbon budgets with other departments on the basis of direct policy influence, but then you have got to have the questions on indirect influence. BIS, for example, does not necessarily have direct control over everything business does, but in the carbon budget regime takes a significant share of emissions from business and the workplace. The Department for Transport has an important role, but obviously that is shared by the NHS, which is important because people travelling to hospital is a big issue, schools, et cetera. We have had to factor all that in to the process of devising and allocating these budgets. Experimental sounds a bit unfortunate, but it is a pilot, not in the sense that we are going to abandon it but in the sense that we are going to have to learn as we go along as to how this system works. There is also the question of the impact the department's performance has on the judgments that are made and if you have to buy offsets, where do they come from? If you have to buy credits, who pays for them, and all that?

Mr Hughes: One of the things this Committee will be very concerned about is obviously how effectively we are monitoring progress. This is something which has come up in the context of the report the Committee on Climate Change provided as well. What it has done in the context of its report is to set out what the indicators are and the milestones against which it will look to see how the UK is making progress; in the same way within the Department's Carbon Reduction Delivery Plans, it will be looking to agree indicators and milestones in that context as well. We will be looking at what the Committee on Climate Change has suggested are going to be its way of measuring things. It will need to be a much more rigorous process going forward to make sure we really do remain to be on track to meet our carbon budgets, not just in relation to what do the actual emissions reductions tell us, because they are a year or two behind, depending on whether we are talking about provision or actual-but do we look as if we are on course? Are we making the right decisions at the right time?

**Chairman:** Our experience in looking at the Greening Government Agenda is there was an enormous variation in the performance of different departments. A lot of that reflects the priority which individuals within those departments attach to these particular goals.

**Q294 Dr Turner:** I was going to ask whether your own appreciation of the gravity of climate change and the urgency of emissions reductions was shared across all Whitehall departments. *Edward Miliband:* To a man and woman, Des!

**Eurouru** Mandulau. 10 a man and woman, De

Q295 Dr Turner: I do not believe that!

Edward Miliband: The whole of Whitehall and the whole of politics have been undergoing a cultural change. Take an example, Peter Mandelson, rather unfairly in my view, got splattered with green custard. He has been one of the strongest advocates for low-carbon as an economic route forward for Britain. He has been championing discussions with the wind industry about what it can do here, obviously the nuclear supply chain and Rolls-Royce, with whom we are working on low-carbon in aerospace. I think there is a sense in which part of the task is to demonstrate that low-carbon and climate change is not just about the environment and is not just for environmental departments, important though that is, but it is part of our economic future, our transport future and all that. In a sense, that is what the culture of carbon budgets and the Transition Plan is trying to do. There is very wide sign-up to this in Government.

**Dr Turner:** I will not press you any further on the Treasury.

**Q296 Chairman:** Is there any particular action you think is called for on the Government's part in response to the Committee on Climate Change's progress report?

*Edward Miliband:* To be fair to it, and maybe to us, we need to study it properly and come back on that. I will say, I do think the Committee on Climate Change is not always necessarily comfortable for Government but, as you and I have discussed on other occasions, it does play a very important role in holding Government to account. I welcome the characteristically wide remit it has taken up.

**Chairman:** We have managed to dig up the reference in the Low Carbon Transition Plan— page 52—to the 2% cut in emissions, but we will write to you about that point. I would like to establish that we did find the reference in your own document, so it is there.<sup>2</sup> Can I say thank you very much indeed for coming in? It has been a very useful session and we look forward to a continued dialogue.

<sup>&</sup>lt;sup>2</sup> This was a typographical error in an early print run of the Low Carbon Transition Plan. The figure was corrected to 22% in later print runs. See Supplementary memorandum submitted by the Department of Energy and Climate Change, Ev 117.

## Supplementary memorandum submitted by the Department of Energy and Climate Change (DECC)

## DECC RESPONSE TO EAC QUESTIONS ON THE LOW CARBON TRANSITION PLAN<sup>6</sup>

# 1. Why is the carbon budget for 2008–12 of 3018 MtCO2e (Table 1, p39) higher than the "emissions before policies" baseline of 2964 MtCO2e for the period 2018–22 (Chart 3, p43)?

The "emissions before policies" baseline does not represent business as usual. It reflects a projection of UK emissions before any estimated emission savings from Low Carbon Transition Plan policies, but does include emission savings from previously existing firm and funded policies—such as those in the 2006 Climate Change Programme (see Tables A1 and A5). Due to these pre-existing measures, UK emissions are projected to be falling across the carbon budget periods in the baseline, albeit at a much lower rate than when the Transition Plan policies are included, and so "emissions before policies" are lower in 2018–22 than our carbon budget for 2008–12. Chart 1 (p6) allows a comparison of both baseline (top line, before sectoral reductions) and Transition Plan (bottom line, after sectoral reductions) emissions projections.

# 2. How can the 248 MtCO2e total emissions savings for the traded sector (EUETS) in 2018–22 reported in Table A4 (p202) be reconciled with the data in Tables A5 and A6?

Table A4 presents the projected emission savings from policies in the Transition Plan by carbon budget period on a net UK carbon account basis. The total savings in the sectors covered by the EU ETS (the traded sector) are reported to be 248 MtCO2e in 2018–22—based on the UK's share of the EU ETS cap given compliance with the EU ETS ensures that this is equal to the level of UK domestic emissions net of any sales and purchases of carbon units.

Table A6 lists the UK domestic emissions savings from Transition Plan policies in the traded sector, disaggregated by the economic sector in which the measures are implemented. The total traded domestic savings amount to 267.2MtCO2e in 2018–22. This is higher than the savings assigned on a net UK carbon account basis (the EU ETS cap), and the difference of 19 MtCO2e represents the number of allowances that would be available for sale by UK operators. The second to last row in Table A9 (p213) presents the annual projection of net sales or purchases through the EU ETS. (Any difference between the figures in Table A9, and the inferred purchase and sale figures from tables A4 and A6 are due to the rounding of figures.) Chart A3 (p214) provides a graphical illustration of the expected levels of net sales or purchases through the EU ETS by plotting projections of the net UK carbon account and actual domestic emissions against each other.

Table A5 reflects policies that are already included in the baseline, and does not relate to the reported savings in Table A4. The reference to Table A5 in Table A4 is therefore an error and should be ignored.

# 3. Why are all savings from the traded sector ascribed in Chart Al (p196) to Power & Heavy Industry, when according to Table A6 (p202) savings will also arise in Homes & Communities and Workplaces & Jobs?

The Transition Plan policies implemented in the Homes & Communities and Workplaces & Job sectors that are listed in Table A6 generate savings by reducing electricity demand, resulting in lower emissions from power generation. These savings are therefore assigned, for the purposes of Chart A1, to the Power and Heavy Industry sectors (the traded sector). The savings in Power & Heavy Industry are then corrected so that they correspond to the level of the UK's share of the EU ETS cap.

# 4. Why are the projected ("central scenario") emissions for the Budget 3 period in Table A7 (p212) calculated more optimistically within the possible range than in the preceding budget periods?

The central projection is based on central assumptions of fossil fuel prices, economic and population growth and is estimated in a consistent way for each budget period. Uncertainty ranges around the central projection are then built up from individual components of uncertainty. These include the uncertainty in the assumptions of fundamentals such as energy prices and growth, as well as other uncertainty associated with modelling and policy delivery.

The uncertainty ranges around the central projection increase as the projections look further into the future (207 MtCO2 in budget 1, 249 MtCO2 in Budget 2 and 297 MtCO2 Budget 3). The asymmetry, in the third budget period, in the position of the central projection within the uncertainty range reflects the increasing uncertainty associated with policy delivery, which has a greater effect in the upper bound of the uncertainty as policy under-delivery will result in higher than expected emissions.

<sup>&</sup>lt;sup>6</sup> Note: some typographical errors in the Low Carbon Transition Plan as laid before Parliament on 15 July 2009 have been corrected in the version available on the DECC website at http://www.decc.gov.uk/en/content/cms/publications/ ic\_trans\_plan/lc\_trans\_plan.aspx. The corrections are listed at the front of the revised document.

5. According to Table A8 (p212), there is a large expected reduction in emission in the first year of the second budget period (2013). Table A9 (p213) on sales and purchases through EUETS suggests that the cause is an expected shift from sales of carbon units by UK operators of 16 MtC02e in 2012 to purchases of carbon units by UK operators of 6 MtC02e in 2013. Can you explain why this significant change in the UK's use of EUETS will occur between 2012 and 2013, and what impact there will be on the achievement of carbon budgets if a smaller than expected shift occurs?

From 2012 to 2013, there is a change in the EU ETS period from Phase II (2008–12) to Phase III (2013–20). Importantly, there is a move to a more stringent Phase III EU ETS cap in line with UK and EU climate objectives. From 2013, there is a downward linear trajectory for the EU ETS cap of 1.74% per year. This is in contrast to a relatively flat emissions cap across Phase II. This can be seen clearly in the projected contribution to the net UK carbon account from power and heavy industry for 2014–22, in Table A8. However, there is a significant expected reduction in net UK emissions from 248 MtCO2 in 2012 to 224 MtCO2 in 2013. The main reason for this is that the downward linear trajectory for the EU ETS cap of 1.74% line is drawn through 2011 and 2012 before actually appearing in the lower emissions figures for 2013. In effect, three years of emission reductions are appearing in 2013, hence the significant step down in that year.

The projected sales or purchase of carbon units by UK operators in the EU ETS is presented in Table A9 (p213). These are calculated as the difference between the projected UK domestic emissions in the traded sector and the UK's share of the EU ETS cap. The change from being a net seller of carbon units in 2012 to a net purchaser is in part a result of the change in the UK's share of the EU ETS cap (as shown in Table A8), and not the cause of the step change in figures in Table A8.

The projected shift in "traded" share of the carbon budget, effectively the UK's share of the EU ETS cap, is "locked in" under the EU 2020 package. If UK domestic emissions in the traded sector exceed the level of allowances, then UK operators are required to purchase a corresponding number of carbon units to offset this increase. As a result there is no impact on the traded share of the net UK carbon account, and the UK should not under-perform on its traded sector share of the carbon budgets.

DECC Response to Additional Questions from the EAC on Carbon Budgets following Ed Miliband's Evidence Session on 27 October

1. During the session on 27 October, Members asked a question based on a "2%" cut in emissions on 2008 levels by 2020 for the power and heavy industry sector, reported in the Low Carbon Transition Plan. We now understand from officials that this was a typographical error in some of the print run, which was later corrected to "22%". To ease the confusion, the Committee now wishes to ask: to what extent is a cut of 22% of emissions on 2008 levels by 2020 for the power and heavy industry sector, reported in the Low Carbon Transition Plan, consistent with the Committee on Climate Change's vision for almost complete decarbonisation of power generation by 2030?

The EU ETS drives a 22% cut in emissions in the power and heavy industry sector. Power generation (ie the major power producers) are within this sector. DECC's most recent emissions projections, which accompanied the Low Carbon Transition Plan, show that carbon emissions from major power producers will decline by 47% on 2007 levels by 2020, given our current policies. To be on course to achieve the required level of decarbonisation in 2030, the CCC have said that emissions from power generation need to decline by 50% on 2008 levels. DECC's projections are therefore reasonably consistent with the decarbonisation trajectory required by the CCC.

The expected emissions reduction is less significant for heavy industry (such as refineries, steel mills or cement plants) because it is likely to decarbonise at a slower pace than the power sector. Options to decarbonise electricity, such as increased renewables, carbon capture and storage and nuclear are not likely to be so readily available for heavy industry by 2020. However, there are policies in place to ensure heavy industry emissions will reduce—including their inclusion in the EU Emissions Trading System, and through the Climate Change Agreements and Climate Change Levy package.

# 2. Why does the Low Carbon Transition Plan make reference to 2008 as a base year, rather than other years which are already used in other emissions performance reporting?

It was felt in producing the Low Carbon Transition Plan that it would be useful in some cases to describe emissions reductions against 2008 levels because this gives a clearer indication of the reductions that need to be achieved from current emissions. The legally binding base year for our targets under the Climate Change Act 2008 remains 1900,<sup>7</sup> and the Transition Plan makes this clear when referring specifically to the Act and carbon budgets as, for example, in Chapter 2. In many cases, where it aids understanding, the plan refers to both 2008 and 1990 baselines (see, for example, the first bullet point of the Executive Summary on p4).

<sup>&</sup>lt;sup>7</sup> The "1990 baseline" is defined in the Act as 1990 net UK emissions of carbon dioxide, methane and nitrous oxide and 1995 net UK emissions of the fluorinated gases (hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride).

# 3. You told us that the current carbon price was lower than you would wish. What level of carbon price do the Government consider is needed to drive investment in low-carbon technologies and infrastructure?

The Government do not take the view that any particular price of carbon is the "right" price. Even with the current price of around  $\in$ 14, the EU and the UK can still be expected to deliver the required emission reductions by 2020. This is because the EU Emissions Trading System cap determines the level of emission reductions achieved, and not the carbon price.

However, looking beyond 2020, we will need to meet even more demanding carbon reduction targets. For these, we will need the carbon price to be incentivising greater take-up of low-carbon technologies before 2020. In this context, the current carbon price does appear low. The most effective way of strengthening the carbon price is by limiting the supply of allowances by tightening the cap. The EU ETS cap will be reviewed following an international climate change agreement at Copenhagen.

# 4. What assessment have the Government made of the impact of the credit crunch on availability of low-cost long-term financing for low-carbon and renewable generation projects?

The credit crunch is having an impact. The number of banks in the project finance markets open to energy developers has reduced. The remaining banks have shortened the tenor of debt available to projects and focused more on major core clients rather than independent developers. The cost of debt has increased and deals can take longer to close.

Funding constraints have been a particular problem for smaller and mid-sized, independent renewables developers. In order to mitigate this, the European Investment bank (EIB) and three UK-based banks (RBS, Lloyds and BNP Paribas Fortis) have launched a new lending scheme for small and mid-sized onshore wind farm development. The scheme should improve liquidity in the project finance market. We expect the scheme to facilitate lending of over £1bn over the next couple of years and, based on the experience it draws from this scheme, we hope the EIB will examine the financing of other forms of renewable energy in the future.

# 5. DECC officials recently gave a briefing to the Committee on proposals for carbon valuation which would now reflect the costs of mitigating emissions. How will DECC ensure that the new proposals on carbon valuation are applied in policy decision-making across Whitehall?

All Government Departments must carry out carbon impact assessments for those policy options that will have a significant impact on emissions. This requires analysts to quantify the carbon impacts of their policies, and to value these impacts using the new target consistent carbon values. Alongside the PSA indicator (see below) on the cost-effectiveness of climate change policies, this requirement ensures strong monitoring of the use of the new carbon values, leading to greater enforceability of its use.

Under PSA 27 Indicator 6, Government Departments conducting Impact Assessments are required to report on the proportion of abatement for which the cost falls below the new target consistent carbon price. This is intended to provide an indicator of the cost-effectiveness of emissions reductions policies across Government. This requirement applies to projects that meet a de minimis threshold:

- for policies with a lifetime of less than 20 years, the carbon impact test is required if the stream of C02e savings exceeds 0.1 MtCO2e average per year.
- if the policy lifetime is above 20 years, the carbon impact test is required if the stream of C02e savings exceeds 2.0MtCO2e over the lifetime and an average per year of 0.05 MtCO2e.

Practical guidance on how to apply the new carbon values in policy appraisal was published alongside the revised approach for carbon valuation in UK policy appraisal.<sup>8</sup> We are currently developing more comprehensive guidance on how to value energy usage and greenhouse gases for appraisal and evaluation to supplement current Green Book Guidance. This guidance will explain in more detail how the new carbon values should be used in economic appraisal across Government along with revised guidance on other factors including fossil fuel price assumptions and carbon emissions factors. It will be updated annually.

# 6. In the Traded Sector, why is progress against the UK carbon budget judged solely by the allocation of emissions permits within the EU ETS, rather than actual emissions? To what extent would counting actual emissions be more consistent with the UK's annual reporting of greenhouse gas inventories to the UNFCCC?

The Carbon Accounting Regulations 2009, which set the rules for calculating the net UK carbon account and determining compliance with carbon budgets, were approved by both Houses of Parliament in April 2009, following a public consultation on the proposed accounting system in October 2008. The starting point in the traded sector is actual emissions as reported in the UK greenhouse gas inventory. To take account of trading under the EU Emissions Trading System, a credit is then subtracted (if the UK is a net buyer of carbon units under the ETS), or a debit added (if the UK is a net seller). This has the overall effect of counting the UK's EU ETS allocation against the budget.

<sup>&</sup>lt;sup>8</sup> See "A brief guide to the new carbon values and their use in economic appraisal" available at http://www.decc.gov.uk/en/ content/cms/what\_we\_do/lc\_uk/valuation/valuation.aspx

This approach—which was agreed by a significant majority of consultation respondents—has been taken because the EU ETS is the primary policy tool for delivering emissions reductions in the traded sector and decarbonising power generation. We believe that it would be misleading to count actual UK emissions against carbon budgets, without taking account of EU ETS trading. Doing so could mean, for example, that we could report reduced emissions in the UK, when these might actually be displaced by increased emissions elsewhere in the EU (or vice versa). Access to offsetting within the EU ETS is strictly limited, and the Low Carbon Transition Plan shows our expectation that the UK will vary over the three budget periods between being a net seller and a net buyer of carbon units from abroad (Chart A3, p211 and 214).

It is entirely consistent with the UK's annual reporting of greenhouse gas inventories to the UNFCCC, and with the international rules for monitoring progress against Kyoto targets, under which the impact of trading under the EU ETS is taken into account. The annual statements of emissions required by the Climate Change Act—the first of which will be published by 31 March 2010 for the year 2008—must be completely transparent in setting out actual emissions, as well as details of the number and types of credits and debits to the net UK carbon account.

# 7. The Committee on Climate Change concludes in its progress report that a mechanism for allowing access to the transmission network for wind power generation should be in place by mid-2010 (page 121). What are the Government doing to ensure that such a mechanism is put in place?

The Government recognise that improved access for new renewable generation such as wind power is essential in helping to tackle climate change. As the Committee on Climate Change has recognised in their recent report, Ofgem has already taken the decision to have in place an interim access arrangement to ensure that renewable generation is able to gain access to the transmission network even where it is capacity constrained. However, we agree with the Committee's view of the importance of putting in place an enduring regime for grid access by mid-2010. That is why Government are intervening using Energy Act Powers to see the grid access reform process started by industry through to a timely and successful conclusion. We are working to get this in place by June 2010.

8. In its progress report, the Committee on Climate Change has set out a series of milestones and indicators by which progress in delivering emissions reductions might be monitored. What is the Department's assessment of the utility of these milestones and indicators? Are there areas where other measures might also be needed? Do the Government already collect all the data that would be needed for these milestones and indicators, should they all be adopted?

The Government will respond formally to the CCC's progress report, including the indicators, by 15 January 2010. However, we agree with the need identified by the CCC for a comprehensive framework that will enable future progress on key policies for reducing emissions and underlying drivers to be tracked. Monitoring progress on the basis of historic emissions data alone will not be sufficient due to time lags in receiving data and long project lead times.

The Government are developing a similar indicator-based framework for monitoring progress in reducing greenhouse gas emissions that will complement emissions data and allow us to identify at an early stage where risks to meeting our carbon budgets may lie. The indicators for monitoring progress in different sectors will form part of the Carbon Reduction Delivery Plans all Government Departments are to publish in spring 2009, in which they will set out how they aim to meet their shares of the carbon budgets.

We support the pragmatic and flexible approach that the CCC makes clear it will take when assessing progress against its indicators. It is important to preserve flexibility about where emissions reductions are delivered to meet the carbon budgets if we are to ensure that they are met in the most cost-effective way.

9. What is being done to ensure that individual decisions taken by the Infrastructure Planning Commission are, when taken together, compatible, with the carbon budgets (for example, that gas-fired power stations meeting NPS guidance individually might lock the UK into high emissions if many such power stations were approved)? What is being done to ensure that National Policy Statements reflect emissions reductions targets following Copenhagen?

The Government policies that underlie energy National Policy Statements have been set in accordance with the carbon budgets and targets in the Climate Change Act. The UK Low Carbon Transition Plan describes the contribution to be made by policies in different sectors of the economy, including the power sector, to meeting the first three carbon budgets. The draft NPSs, published on 9 November, set out how the IPC should apply these policies in planning decisions and are therefore fully compatible with the Transition Plan and with carbon budgets. Given this, the IPC will not be required to assess individual applications against the carbon budgets. The draft NPSs instead set out very clearly the terms on which new carbon-emitting energy infrastructure can be approved by the IPC in accordance with the relevant Government policies.

The carbon budgets are legally binding and it is the responsibility of Government to meet them, drawing on the advice of the Committee on Climate Change. Government have committed to tightening the carbon budgets following a satisfactory global deal at Copenhagen. If, after doing this, policies are changed or new policies introduced to ensure that the new budgets can be met, consideration will be given as to whether energy NPSs should be amended to reflect the new policy environment.

11 November 2009

# Written evidence

#### Memorandum submitted by Actuarial Profession's Resource and Environment Group

Oliver Bettis and Nick Silver recently presented a paper at the IARU International Scientific Congress on Climate Change, titled "Risk of Ruin: A framework for reviewing greenhouse gas stabilisation targets" on behalf of the Actuarial Profession's Resource and Environment Group.

The paper is directly relevant to the setting of Carbon Budgets; a copy of the abstract and summary is attached. The final version of this paper will be peer reviewed and presented at an official Faculty of Actuaries meeting in January 2009.

The purpose of the paper is to develop a risk management framework for setting GHG target concentrations.

To summarize our argument; we first define a "ruin" event, an event or events that might be caused by climate change that would be potentially catastrophic for the planet; adaptation would be virtually impossible. Examples include the melting of permafrost leading to the release of methane hydrates or the collapse of the Greenland and Antarctic ice sheets.

A risk management perspective demonstrates that the aim of GHG reductions was to reduce the probability of a "ruin" event to below a level that could be regarded as acceptable.

To do this, we would have to estimate the threshold temperature which gives rise to a ruinous event, the atmospheric concentration of GHG that gives rise to this temperature increase, and society's appetite for risk.

The existing scientific models do not allow us to estimate any of these variables with any degree of confidence. An order of magnitude calculation means that current GHG concentrations produce at least an order of magnitude more risk than society is willing to bear.

The Government's current target, 80% reductions by 2050, is broadly thought to be equivalent to 50% global reductions by 2050. This is generally agreed to represent a 50% probability that average global temperatures will ultimately increase by more than 2C.

This is likely to mean that there is more than a 50% probability that one or more of the ruinous events that we have identified could occur. We consider a more appropriate probability would be a maximum of 5%, possibly less.

Our conclusion is that we must de-carbonize as quickly as possible, and simultaneously develop so called "geo-engineering" solutions.

#### Abstract

The purpose of this paper is to use actuarial techniques to build a risk framework for use by policy-makers in formulating an optimum greenhouse gas stabilization target. Research suggests that society currently underestimates the underlying risk of climate change and resources required for mitigation. The paper examines what is the risk of ruin that society might be prepared to accept, given current available knowledge of the risk distribution.

The concept of "ruin" is defined in the context of climate change. Ruin constitutes severe impacts which have a catastrophic effect on society, such that adaptation would be extremely difficult or impossible. The time horizon at interest and the severity of effects are defined. An example of a situation of ruin would be a steep fall in world food supply or large scale irreversible ice-sheet melting.

Actuaries have developed tools and techniques to model and advise on the effect of extreme events on insurance companies. In recent times insurers have been required to develop capital models to value risks and set capital requirements such that the risk of ruin is below a threshold level which is perceived to be reasonable for the institution to take. This paper adapts this approach to assess the impact of climate change on society.

The paper sets out how a calculation of stabilization targets under a risk management framework would be achieved, but argues that, due to the level of uncertainty of the variables, this calculation cannot at present be made. The conclusion is that, due to the inability of estimating the risk of realistic "ruin" scenarios, only pre-industrial atmospheric greenhouse gas concentrations should be considered safe.

The implications for climate change policy are that research should be concentrated on the tail of the climate sensitivity distribution and the probability of ruinous events so that the target concentration might be increased; de-carbonisation of the economy should be undertaken as rapidly as possible, research is required into methods for removing greenhouse gases from the atmosphere, and "climate management systems" need to be investigated as back-up measures if the risk for deployment can be shown to be less than the risk of ruinous climate change.

### CONCLUSIONS

The paper has identified that there is a high degree of uncertainty in the sensitivity of climate to greenhouse gas forcing. There is a high degree of uncertainty about the amount of shielding the Earth currently receives from aerosols, hence a high degree of uncertainty about the total radiative forcing that the Earth is receiving and has caused the current amount of warming. The paleoclimate records show that ice sheets and hence the sea level is very sensitive to the temperature. There is a long time delay between increased levels of greenhouse gas concentrations in the atmosphere into the atmosphere and the full warming effect.

There is still a large amount of uncertainty regarding the climate sensitivity, and it might not be possible to reduce this uncertainty, at least on the timescale needed to negotiate and implement emissions targets.

#### IT IS NOT POSSIBLE TO RECOMMEND AS SAFE ANY GREENHOUSE GAS LEVEL ABOVE THE PRE-INDUSTRIAL

On a risk management basis the only  $CO_2$  stabilization target that we could be certain would have an acceptable risk of ruin is the pre-industrial level, of around 280ppm  $CO_2$ .<sup>1</sup> It may well be the case that a higher target is in fact safe, but this cannot be ascertained with any degree of confidence at this time.

We think it very unlikely that a target above 350ppm would carry an acceptable risk of ruin. Therefore we can be sure that any acceptable  $CO_2$  stabilization target will be substantially below the current atmospheric level; around 385ppm.

We have not attempted to calculate a time-frame or an emissions reduction pathway for this target, precisely because these will be subject to the same degrees of uncertainty as any other calculations.

To the authors' knowledge, a target concentration of 280ppm is below any that has been published in the literature. However, this target results because of the risk management framework that we have applied. The reason for the low target is:

- There are plausible scientific scenarios that could result in catastrophe for much of humanity.
- There is a high degree of uncertainty about the temperature trigger points at which these would occur.
- It is not possible to assign a probability that a given level of atmospheric concentration of carbon dioxide will not result in a temperature rise beyond a certain threshold.

This means that whatever target probability that we might assign, current scientific knowledge does not allow us to ascertain what atmospheric concentration of carbon dioxide will result in the risk of "ruin" being below this probability threshold.

### 1.1 The current atmospheric concentration of greenhouse gas has an unacceptably high risk of ruin

Assigning the probability level of what risk society would be willing to bear would also be problematic and we have not attempted to do this. The UK Financial Services Authority set this level at 0.5% for the insolvency of a regulated financial institution. Although this is an annual figure so is not directly comparable, it seems unlikely that society would be willing to tolerate much higher levels than this of a climate related catastrophe. This would lead us to suspect that the probability of ruin for most emission scenarios currently envisaged is at least an order of magnitude higher than that which society would be willing to tolerate.

# 1.2 Geoengineering and methods of removing $CO_2$ from the atmosphere should be investigated as a matter of urgency

This has a number of profound implications for climate change policy:

- 1. Research requirements: the target concentration arises because the calculations required are subject to uncertainty. If these uncertainties could be removed, then it may be possible to increase the target GHG concentrations. To undertake this calculation, the probability distribution of trigger events at different temperatures, the tail of the distribution of climate sensitivity to GHG concentrations, and the mechanisms of positive feedbacks on the climate system need to be understood.
- 2. GHG emissions reduction targets: a step change in reductions will be required—to reach a target GHG level below the current atmospheric level, the economy will have to be de-carbonised as rapidly as possible.
- 3. Carbon sequestration: if it proves necessary to achieve near to pre-industrial GHG concentrations then emissions reductions alone will be insufficient. Therefore methods of removing GHG gasses from the atmosphere will need to be developed.
- 4. Climate management systems: Rapid reductions in GHG emissions would cause a reduction in the aerosol shield in the atmosphere leading to a sudden increase in the net warming effect. Also there

<sup>&</sup>lt;sup>1</sup> Recognizing that atmospheric CO<sub>2</sub> concentration has varied naturally within a range during the Holocene period with no catastrophic effect.

is a large time lag between greenhouse gas increases and the full warming effect. Hence even if preindustrial GHG concentrations can be achieved in the long run, it may be the case that a ruin trigger cannot be avoided. Therefore geo-engineering options; methods of artificially reducing the temperature may need to be deployed, if the risk of deploying these options can be demonstrated to be less than the risk of catastrophic climate change.

5. Adaptation: localised climate impacts would need to be understood with sufficient granularity such that adaptation measures could be put in place to avoid societal collapse in vulnerable regions. The possibility of adapting to large-scale catastrophic events that could be caused by climate change, for example multi-meter sea level rises, sudden increases in temperatures or change in precipitation levels will need to be considered.

27 April 2009

### Memorandum submitted by the Aviation Environment Federation

1. The Aviation Environment Federation (AEF) is the principal UK non-profit making environmental association concerned with the environmental effects of aviation and supported by individuals and community groups affected by the UK's airfields and airports. We promote a sustainable future for aviation which fully recognises, and takes account of all its environmental and amenity effects. These range from aircraft noise issues associated with small airstrips or helipads to the contribution of airline emissions to climate change.

### SUMMARY

2. The following summarises our consultation response:

- The budgets recommended by the Committee on Climate Change, and those now published by the Government, are inconsistent with the 2050 target as they fail to include aviation emissions. These emissions, under Government forecasts, are set to continue growing making their future inclusion in the carbon budgets increasingly difficult.
- There currently seems to be a lack of clarity within Government about the Committee's advice on how aviation emissions should be accounted for. We are concerned that the policies of the Department for Transport are currently out of step with the commitment from the Department of Energy and Climate Change to cut all the UK's emissions by 80% of 1990 levels by 2050 and that DfT publications mis-state the advice of the Committee.
- The integrity of the UK's carbon budgets will be compromised if no restrictions are placed on the use of credits from the EU ETS, as the ETS is insufficiently stringent to be compatible with the goal of limiting global warming to no more than 2°C.

# Are the Committee on Climate Change's recommended budgets to 2020 consistent with the UK's target for 2050?

3. We are concerned that the proposed carbon budgets to 2020 fail to cover the UK's international aviation emissions and that in this important respect the budgets would be inconsistent with the UK's target for 2050.

4. There has been a great deal of confusion about whether international aviation emissions are inside or outside the UK's target to cut greenhouse gas emissions 80% on 1990 levels by 2050. The advice of the Committee on Climate Change was as follows:

The 80% target should apply to the sum of all sectors of the UK economy, including international aviation and shipping. To the extent that international aviation and shipping emissions are not reduced by 80%, more effort would have to be made in other sectors.

5. However, the Committee concluded:

International aviation and shipping should not be included in budgets, but there need to be clear strategies to achieve emissions reductions, and the Committee's annual reports of progress against budgets should be accompanied by reports on international aviation and shipping.... The Committee's annual reports on progress in these sectors should keep under review whether at any time it does become appropriate to include either sector within the budget process.<sup>2</sup>

6. AEF welcomes the CCC's recognition that emissions from international aviation must be included in the UK's long-term target and the fact that the Government has accepted this recommendation.<sup>3</sup>

<sup>&</sup>lt;sup>2</sup> December 2008, the first report of the Committee on Climate Change, Building a low-carbon economy—The UK's contribution to tackling climate change, Executive Summary.

<sup>&</sup>lt;sup>3</sup> 16 October 2008, DECC press release

http://nds.coi.gov.uk/environment/fullDetail.asp?ReleaseID = 381477 & NewsAreaID = 2 & NavigatedFromDepartment = True and the second second

7. We are somewhat concerned that some government departments do not seem to have understood the (somewhat technical but nevertheless clear) distinction between medium-term budgets and longer-term targets. A recent Department for Transport publication, for example, stated:

The Committee on Climate Change (CCC) recommended on 1 December 2008 that the scope of the targets and budgets in the Climate Change Act should not be extended to include international aviation and shipping.<sup>4</sup>

8. If there is to be any chance of Government departments demonstrating joined up thinking on this issue it is important that all departments fully understand that commitments that have been made, namely that the 80% target will apply to the UK's share of international aviation (and shipping) emissions; government policy made now needs to reflect this.

9. We believe, however, that leaving aviation out of the carbon budgets is a mistake. We have long argued for the importance of including aviation in the UK's carbon budgeting strategy. In brief:

- (i) We do not accept the argument that a lack of international agreement about how to allocate aviation emissions for the purposes of international climate policy is a good reason for choosing not to allocate them for the purposes of UK policy. The UK Climate Act does not require international assent. Annex I parties to the Kyoto Protocol already report emissions from international bunker fuels (aviation and shipping) annually as a memo item to the UNFCCC; it would be straightforward to apply the same methodology to the UK carbon budgeting system. While it may be argued that such a decision may require review at a future date if international consensus on allocation is forthcoming, we believe it is likely to cause less turbulence and distortion to the budgets than omitting these emissions altogether.
- (ii) The CCC suggests that "the UK carbon budget can be designed to take account of a reasonable estimate of the UK's international aviation emissions and their likely growth even if international aviation emissions are formally excluded from the budget", and that the burden for making deeper cuts to account for estimates of aviation and shipping growth will fall on the sectors within the budgets. In fact the Climate Act requires both the Secretary of State and the Committee on Climate Change, when deciding on carbon budgets, to take into account "the estimated amount of reportable emissions from international aviation and international shipping for the budgetary period or periods in question".<sup>5</sup> Given that this estimate is to be made, we do not understand why it should not be included in a straightforward manner into the budgets.
- (iii) Every credible projection for UK aviation emissions concludes that unless there are radical changes in both government policy and new technologies then these emissions will continue to rise. Failing to include aviation in the carbon budgets and thus allowing them to grow without effective controls is likely to mean that every year we are a step further away from being able to bring aviation emissions within the 80% target for 2050—something to which the Government is now committed.
- (iv) There is still no policy in place, even for the future, to tackle aviation's non-CO<sub>2</sub> impacts. The Climate Act applies to 'targeted greenhouse gases'. While we welcome the decision to take account of climate damage beyond that of carbon dioxide, we note that aviation's non-CO<sub>2</sub> impacts are primarily from NOx and from water vapour; neither of these are in the list of targeted gases as they cause climate damage only at altitude. While there is scope in the Act to amend the definition of targeted greenhouse gases, the fact that the impact of aviation on the climate is around twice that of carbon dioxide alone means that the distortion from omitting aviation from the budgets is twice as serious and makes it harder still to meet the objective shared by the EU and UK of limiting global warming to no more than 2°C.

10. We therefore urge the Environmental Audit Committee to press for Ministers to exercise their powers as specified in the Climate Act to amend the Act to directly include international aviation in the carbon budgets.

# What are the issues around using emissions trading (both credits from the EU Emissions Trading Scheme and carbon offset credits) to meet the UK carbon budgets?

11. We are very concerned about the CCC's recommendation that no restrictions be applied to the use of credits from the EU ETS to meet the UK's carbon budgets.

12. There are two pieces of European climate policy important for the UK's carbon budgets: the EU Emissions Trading Scheme and the commitment to cut Europe's greenhouse gases by 20% of 1990 levels by 2020. Europe has promised to increase this target to 30% if a successful global climate deal is agreed, though the working assumption in terms of sectoral caps is that the reduction will be 20%. These two policy commitments have recently been harmonised in the Climate and Energy Package. This specifies that in order to meet the 2020 target, the burden of reductions is to be split between traded and non-traded sectors; those covered by the EU ETS will need to cut their emissions by 21% while non-traded sectors need to make a cut of 10%.

<sup>&</sup>lt;sup>4</sup> March 2009, DfT, Reforming the Framework for the Economic Regulation of UK airports, Annex 5 section 1.8.

<sup>&</sup>lt;sup>5</sup> Climate Change Act 2008, Clause 10 http://www.opsi.gov.uk/acts/acts/2008/pdf/ukpga\_20080027\_en.pdf

13. The Committee's December report argues that "As Europe's share of international aviation is included within the EU ETS, with a total cap (aviation plus other sectors) which is consistent with climate objectives, there is no necessity to include international aviation emissions within the UK national budget. Aviation will be subject to a carbon price which encourages supply side abatement and demand constraint: and growth in Europe's aviation emissions will have to be offset by more rapid reductions in other sectors within Europe".

- 14. There are a number problems with this short statement, however.
  - (i) The total cap, based on a 20% reduction in greenhouse gases by 2020, is not consistent with the key climate objective of limiting global warming to no more than 2°C. The 20% target is based on political feasibility, not up-to-date climate science. Even the CCC report, in its chapter on budget setting, states in connection with the EU programme that "The 20-30% range straddles the sort of developed country reductions which Chapter 1 suggested are likely to be required in order to meet global climate stabilisation goals: 20% would be too low".<sup>6</sup> Many NGOs believe that even a 30% cut would be insufficient and that developed countries need to adopt an aggregate reduction target of more then 40% to play a fair part in protecting the global climate.<sup>7</sup>
  - (ii) If the cap agreed for Europe includes emissions from aviation but the UK's budgets do not then non-aviation sectors will be allocated higher caps than they should be. Phase III of the EU ETS begins in 2013 and abandons the idea of national totals in favour of a sectoral approach. Nevertheless, the CCC's UK target for 2020 reflects, in part, what the Committee considers is the UK's fair share of the EU commitment. If the next stage is for the UK's capped total to be divided among all sectors other than aviation and shipping then we are surely setting ourselves up for failure in terms of meeting the EU's target. The CCC's goal of defining policy that is consistent with EU policy has, in this respect, failed.
  - (iii) Impact assessments for the inclusion of aviation into the ETS from 2012 suggest there will be very little impact on either "supply side abatement" or "demand constraint". The impact assessment conducted for the European Commission when the scheme was first proposed concluded that between 2005 and 2020, as a result of aviation's inclusion in the EU ETS revenue tonne kilometres would grow not by 142% but by 135%. Emissions would, the report suggests, grow by just 2.8% less than they would have done under business as usual scenarios by 2020.<sup>8</sup> A more recent assessment of the financial impacts of the scheme, by Merrill Lynch, found that the impact on ticket prices will range from between 1.5 and 5.2 Euros;<sup>9</sup> we do not believe that such increases will lead to "demand constraint". An independent report from the Tyndall Centre concluded that the ETS as currently designed will have minimal impact on aviation emissions.<sup>10</sup>
  - (iv) Growth in Europe's aviation emissions will not necessarily be offset by reductions in other sectors in Europe as the ETS allows for up to 50% of the reductions to come from offset schemes elsewhere in the world. Aviation will have direct access to CERs and ERUs for up to 15% of their emissions in 2012, while from 2013 onwards this drops to 1.5%, to account for the fact that aviation will benefit from much more lenient terms than other sectors with respect to both the cap and the auction level. But for the scheme as a whole, up to 50% of the required reductions from 2013 can come from offset credits: an increase in access compared with phase II.<sup>11</sup> Non-aviation sectors will thus have less need for their EUAs and will be able to sell them on to airlines, putting actual reductions from the aviation sector even further out of reach.

### How compatible are current Government policies with achievement of the overall budget?

15. AEF does not believe that the Government's policy for aviation expansion outlined in the 2003 Aviation White Paper is compatible with achievement of the 2050 target to cut UK emissions by 80%. While aviation is currently excluded from the carbon budgets outlined this month with the 2009 budget, it is essential, if the sector is to have any chance of being accommodated in future budgets, that the right policy decisions are taken now.

16. We conclude by quoting Sir Nicholas Stern, who wrote about this subject just prior to the announcement of the 2009 budget:

<sup>&</sup>lt;sup>6</sup> December 2008, the first report of the Committee on Climate Change, Building a low-carbon economy—The UK's contribution to tackling climate change, page 110.

<sup>&</sup>lt;sup>7</sup> April 2009, Climate Action Network International, Position on am Annex I aggregate target.

<sup>&</sup>lt;sup>8</sup> December 2006, Commission of the European Communities, *Impact assessment of the inclusion of aviation activities in the scheme for greenhouse gas allowance trading within the Community.* 

<sup>&</sup>lt;sup>9</sup> September 2008, Merrill Lynch, Aviation in the EU ETS; an incentive for efficiency http://www.london-accord.co.uk/ accord\_2008/reports/merrilllynch\_aviation.pdf

<sup>&</sup>lt;sup>10</sup> November 2008, Bows A and Anderson K A bottom-up analysis of including aviation within the EU's Emissions Trading Scheme.

<sup>&</sup>lt;sup>11</sup> December 2008, Europa Press Releases, MEMO/08/796: Questions and Answers on the revised EU Emissions Trading Scheme http://europa.eu/rapid/pressReleasesAction.do?reference = MEMO/08/ 796&format = HTML&aged = 0&language = EN&guiLanguage = en

The Budget can succeed in accelerating action on climate change only if the rest of government policy is consistent. For example, big transport decisions, such as the third runway at Heathrow, should be taken only if they make sense in the context of a coherent carbon and transport policy for the UK, and, preferably, for Europe as a whole. I would be surprised if the construction of a third runway at Heathrow passed that test.  $..^{12}$ 

April 2009

### Memorandum submitted by the Association of Conservation of Energy (ACE)

INTRODUCTION TO THE VIEWS OF ACE

The Association for the Conservation of Energy is a lobbying, campaigning and policy research organisation, and has worked in the field of energy efficiency since 1981. Our lobbying and campaigning work represents the interests of our membership: major manufacturers and distributors of energy saving equipment in the United Kingdom. Our policy research is funded independently, and is focused on three key themes: policies and programmes to encourage increased energy efficiency; the environmental, social and economic benefits of increased energy efficiency; and organisational roles in the process of implementing energy efficiency policy.

### SUMMARY

- The Intended budget should be adopted irrespective of a global deal on climate change being reached.
- ACE is concerned that the budgets will be legally binding except in "exceptional circumstances"—
  it is vital that all targets and budgets remain statutorily binding.
- All budgets need to take into account of the latest climate science and need to be constantly reviewed.
- Emissions from international aviation and shipping should be included in carbon budgets.
- All existing Government aims and aspirations need to be made mandatory.
- The Committee for Climate Change should set targets for the residential, commercial and public services sectors as well as for Combined Heat and Power, Microgeneration and renewable energy.

The Committee on Climate Change has produced two sets of budgets: the Intended budget (emissions reduction of 42% in 2020), which should apply following a global deal on climate change and the Interim budget (emissions reduction of 34% in 2020), to apply before a global deal is reached.

ACE believes that the Intended budget should be adopted irrespective of a global deal on climate change being reached. The UK needs to reach an 80% reduction in carbon emissions by 2050 regardless of whether a global deal is reached or not. The earlier the UK starts on a path to a low-carbon future, the easier it will be to reach our 2050 target. We advocate strong early targets as we cannot rely on new technologies becoming available in the future. The UK must lead by example to demonstrate unequivocally that it is serious about leading the way in the fight against climate change. Setting tough early targets, without waiting for others, will do just this.

We are concerned that the budgets will be legally binding except in "exceptional circumstances". The Warm Homes Act 2000 set a legally binding target to end fuel poverty by 2016 and in vulnerable homes by 2010. However, a recent High Court judgment ruled that the targets were merely "aspirations" meaning that these targets can now be missed with impunity.

It is vital that the targets and budgets as set out by Government will remain statutorily binding—whatever the cost.

The Tyndall Centre for Climate Change Research has warned that current carbon budgets may not go far enough<sup>13</sup> and ACE believes that all budgets need to take into account of the latest climate science and need to be constantly reviewed.

ACE believes that emissions from international aviation and shipping should be included in carbon budgets.

Current Government policies need to go further in order to ensure that the overall budget is met. All existing Government aims and aspirations need to be made mandatory as, unless these aims are made mandatory, the Association has limited confidence that they will be met.

<sup>&</sup>lt;sup>12</sup> April 2009, Stern N *Enough green talk. Now make it happen.* TimesOnline http://www.timesonline.co.uk/tol/comment/ columnists/guest\_contributors/article6135687.ece

<sup>&</sup>lt;sup>13</sup> BBC News, 20 April 2009, http://news.bbc.co.uk/1/hi/business/7997817.stm

In order for the budgets to be easily met, it is essential that statutory targets are set for emissions at the sectoral level. To this end, ACE is promoting the Climate Change (Sectoral Targets) Bill tabled by Martin Caton MP in February.

Sectoral targets will not only give direction to Government but will also give business the certainty it needs to make the appropriate investment decisions. If each sector is not given specific targets upon which they must report, individual companies and businesses will present excuses as to why they should not have to reduce their emissions. Businesses will state that Government needs to concentrate instead on heavy industry, transport or aviation, and may try to demonstrate that any cuts they make will be negligible. Each sector will try to pass the responsibility for reducing emissions on to the other.

We therefore recommend that the Committee for Climate Change sets targets for the residential, commercial and public services sectors.

In order to ensure that the UK's energy needs are satisfied and to facilitate a move to low-carbon energy sources, ACE also recommends that the Committee for Climate Change develops targets for different technologies such as Combined Heat and Power, Microgeneration and renewable energy.

At the very least, these targets should be no less ambitious than those to which the Government has already committed itself, albeit non-statutorily. These targets should be kept under constant review, to ensure that they remain sufficiently stretching and ambitious.

27 April 2009

#### Memorandum submitted by EEF

### About EEF

With over 6,000 business members from the manufacturing community (employing approximately 1 million employees) and more than 20,000 associate companies, EEF is dedicated to fostering enterprise and evolution across manufacturing to keep industry competitive, dynamic and future focused. As the only membership organisation dedicated entirely to manufacturing, we are an established UK leader in the delivery of business services, government representation and industry intelligence. Commercially driven and re-investing profits for the benefit of industry and members, EEF's trusted influence means that manufacturing companies are particularly receptive to the advice and service offerings of carefully-selected partners with whom we choose to work. Our network of offices in England and Wales keeps us close to our members, allowing us to focus on local issues and thereby to function as a unique community. Our London office provides a focal point for development of our broad portfolio of business services designed to deliver maximum value. From London, EEF provides first-class representation with government and regulatory bodies and supports our local offices in their programmes to influence regional policy. Our structure places us at the heart of the UK business community. EEF's broad service portfolio is delivered by an unparalleled team of experts including 30 economists and policy specialists, 90 HR and legal advisers, 150 health, safety and environment advisors, 20 occupational health specialists and around 200 trainers, based in our regional offices and in centres of excellence nationwide.

### **OVERVIEW**

# Whether the UK's statutory targets for greenhouse gas reductions are consistent with the Government's objective of limiting global warming to no more than $2^{\circ}C$ and whether they are enforceable

1. As carbon dioxide (CO<sub>2</sub>) is a global gas and climate change is a global problem, it is certain that any possible solution must also require global action. The new American administration has increased optimism that an international agreement at the UN meeting of ministers in Copenhagen can be achieved. A truly global agreement will enable GHG emissions reductions to be made at least cost, by countries undertaking action at home but also by offsetting their impact through investment in low-carbon projects in other parts of the World.

2. EEF believe that the most effective, transparent and long-term solution to limiting globalwarming to no more than  $2^{\circ}$ C is a global cap on emissions, delivered through a cap and trade scheme, which would aim to place all participants on an equal footing. This does not advocate setting the same target across all countries, but seeks to deliver a "level playing field" that fully addresses the critical issue of "carbon leakage". We also believe that carbon tax systems could be an equally effective method of reducing global emissions and should not be discounted from future discussions.

3. Only through swift and concerted international agreement and action can global warming be limited to no more than 2°C. Despite setting itself the highest carbon reduction target for 2020, than for any other developed country, there is no reward for the UK acting on its own. It must ensure any action is measured and inline with other developed countries. However the steps that it has taken to date to show its commitment to the challenges of dangerous climate change that we all face is applauded.

# The extent to which the Committee on Climate Change's recommended budgets to 2020 are consistent with the UK's target for 2050

4. EEF agree that early and significant action is necessary if the dangerous and irreversible effects of climate change are to be averted at least cost. We, therefore, consider that the Committee on Climate Change's recommended budgets to 2020—which were recently adopted by the Government—are consistent with the UK's target for 2050. However, we have strong reservations whether this ambition can, in reality, be delivered through current action and commitment.

5. That so much of our ability to meet the 2020 target relies on efforts to decarbonise the UK economy through the introduction of electric vehicles, installation of carbon capture and storage (CCS), facilitating new nuclear build and renewable technology is concerning. These technologies, which will substantially help to deliver our objectives, have yet to be developed or scaled-up to an adequate level of commercial activity and it is highly questionable whether the carbon emissions can be realised from these technologies before 2020.

6. The Chancellor's recent Budget announcement, which adopted the Committee on Climate Change's recommended budgets to 2020, also provided £405 million to support low-carbon industries and advanced green manufacturing. Whilst a welcome investment, other funding announcements, it appears, were brought forward from existing projects and is not, in the main, additional funding which was requested and is required to set the UK on a course towards its 2020 target. EEF criticised the level of funding, initial calculations indicate that the new funds only constitute to about a quarter of one% of government spending.

7. The recent report on green stimulus by Lord Stern and others suggests that the World should spend around 0.8% of global GDP in the next year on green stimulus measures for the UK this would translate to around £11 Billion. Clearly the UK is a long way off achieving this goal. Disappointed that the Chancellor had not gone far enough to meet this ambition, EEF has called for the government to ensure that further funding commitments designed to achieve its carbon reduction goals, and realise opportunities for business, must: be bolder; be new; and be for the long term.

# The suitability of the climate models and the validity of the assumptions used by the Committee on Climate Change in setting carbon budgets.

8. EEF is not best placed to provide detailed analysis on the suitability of the climate models and the validity of the assumptions used by the Committee on Climate Change (CCC) in setting carbon budgets. However, we understand that the models and processes used by the CCC have drawn broadly consistent conclusions with other investigations into the emissions reduction required to limit the risk of exceeding 2°C.

# The basis on which the Committee on Climate Change arrived at the UK's share of the global effort to cut emissions.

9. EEF is not best placed to provide detailed analysis the basis on which the CCC arrived at the UK's share of the global effort to cut emissions. However, we are receptive to the "equal per capita emissions" approach outlined in the CCC report. This assumes that in the long-term every person on the planet is entitled to an equal share of GHG emissions, which would imply a per capita allowance of between 2.1 to 2.6 tonnes  $CO_2$ -equivalent (assuming a global population in 2050 of about 9.2 billion). A global deal on this basis would require that the UK reduces emissions to between 78% and 82% by 2050 versus the 1990 baseline—this includes bunker fuels used for international aviation and shipping and emissions relating to land-use. This is both a fair and equitable approach to tackling a global problem.

# The frequency with which targets and budgets should be reviewed and updated to take account of new scientific evidence

10. Given the inherent uncertainty of climate science, and the variability of modelling techniques and data which may be used to predict behaviour, it is important that a sound body of reputable evidence is used to substantiate claims for change (eg InterGovernmental Panel on Climate Change). New single sources of evidence should notdetermine budgetary changes.

11. Business needs certainty and time to react to possible new investment cycles. Any efforts to review and update the greenhouse gas targets and carbon budgets must take into account actions and impacts to the UK economy. We would strongly recommend that any review was supported by a formal consultative process for relevant stakeholders.

12. Similarly, any review should consider the role that carbon offsetting can play in helping the UK to meet its targets. If efforts to decarbonise the UK economy by 2020 through the introduction of nuclear, CCS, and renewable technology falters, as looks the case, then there is a real likelihood that offsetting provides the only equivalent opportunity for the UK to meet its targets. The government's 34% target for 2020 currently relies on action being met through UK action alone; action which we question may not be practically possible or can be cost effectively achieved.

13. Where it is possible that new abatement technologies are developed faster than originally perceived, could be implemented cost effectively, and deployed nationally, then clearly there is an overwhelming argument to bring the targets forward.

The compatibility of current Government policies with achievement of the overall budget, how individual government departments can ensure policies are consistent with overall carbon budgets, and the potential role of departmental tradable carbon allowances; and 5 EEF submission to the Environmental Audit Committee—Inquiry into the UK's Carbon Budgets

14. As already expressed within this response, EEF is concerned that current government policies and incentives do not go far enough to decarbonise the UK economy and meet its 2020 target. It is essential that development in nuclear and renewable technology is accelerated and that CCS is scaled up for industrial use as soon as technologically and economically possible. EEF welcomed the Chancellor's recent announcement of additional support for carbon capture and storage (CCS) but warned that it must form part of a broader strategy to develop an industrial base and generate employment around this extremely promising technology.

15. The Government's low-carbon industrial strategy was received cautiously by EEF. We believe the commitment to place the UK at the forefront of the low-carbon industrial revolution is, without question, a national priority. And that the economic opportunities, especially in manufacturing, are potentially significant. However, were disappointed that the strategy lacked a clear framework to translate vision it into reality and ensure that the UK is the number one destination for low-carbon businesses. The government must recognise that these are extremely competitive markets and governments around the world are making equally ambitious plans.

16. Government can also follow through on its low-carbon industrial strategy by leveraging the power of public procurement to help accelerate the deployment and development of alternative energy technologies. Amongst other things, this will require creative thinking from public procurers and a procurement process which is better tailored to innovative businesses. Such action will go some way to ensure that government departmental policies are consistent with overall carbon budgets.

17. Government is also in a strong position to exert influence through the nationalised banks to lead on a programme of green procurement and responsible lending which would have significant influence on broader UK commercial and industrial activity.

# The issues around using emissions trading (both credits from the EU Emissions Trading Scheme, and carbon offset credits) to meet UK carbon budgets, including the standards that should apply to such credits

18. EEF believes that the option of meeting domestic targets through carbon credits derived from emission trading schemes is essential. Emissions should be reduced where it is most cost-effective to do so. Therefore, there should be as few restrictions as possible over the quantity and sources of credits which can be used to meet the UK's targets.

19. The success and support for offsetting can only be achieved if credits represent actual emissions reductions. Credits should not be counted unless assurances exist that emission reductions associated with such credits are genuine, sustainable and fully verifiable to a standard comparable to that agreed by the Clean Development Mechanism (CDM) Executive Board.

20. If this mechanism is adhered to then linking these schemes to domestic, or international trading schemes should only add to their ability to deliver reduction targets and achieve the aim of limiting the change in our climate.

21. However, it is critical that any approved carbon credits (eg CDM) must be assessed to be additional ie that the planned emission reductions would not occur without the additional incentive provided by carbon credits. Therefore, we would urge the government to note that 'additionality' is key to the integrity of carbon markets and should be a prerequisite for carbon reduction incentives and regulations in future public policy including the formulation of the UK carbon account. EEF believes that if the UK government is aiming to structure a carbon account that reflects meaningful incremental emissions reductions, additionality is required and needs to be assured. There should be as few restrictions as possible over the quantity and sources of credits which can be used to meet EU targets.

22. Furthermore, for the carbon markets to remain credible enough to be used for compliance against future carbon mandates, the UK needs to protect the credibility of existing carbon markets. Government should encourage carbon offset markets that can help reduce greenhouse gas emissions. This requires that both government and non-governmental organisations find ways to select and target emissions reductions that are additional and measurable.

23. EEF advocates that government need to work closely with EU and international partners to improve the rules of the CDM, but strongly urge that businesses be given adequate information and consulted on the process at an early stage. Standards for additionality need to be clear, stringent and measureable in order to avoid injecting uncertainty into the carbon market.

27 April 2009

# Memorandum submitted by Friends of the Earth

We welcome the opportunity to respond to this inquiry. Our evidence focuses on three issues—the level of the carbon budgets, what is counted in the budgets and integration of the budgets across government policy.

### 1. Setting the Level of the Carbon Budgets

1.1 At what level of risk of exceeding 2C should the carbon budgets be set?

We welcome the commitment of the G8 nations at L'Aquila in July to keep global temperature rises below 2 degrees centigrade.

We note however that the UK's "intended" carbon budgets are based on a global carbon budget associated with a 56-62% risk of exceeding 2 degrees. We believe this is an unacceptable level of risk for something which world leaders say should be avoided, and which has such huge impacts for all humanity. While the choice of an acceptable level of risk is clearly a political and ethical one, if the world's leaders have set a goal, then an acceptable chance of not meeting it must surely be much less than 50%. We note the recent report<sup>14</sup> of the German Advisory Council on Global Change (WBGU) which states that "probabilities of averting damage that fall within the 50-90% range would be considered as completely unacceptable in an every-day context". Their report instead advocates a maximum risk of 33% for exceeding two degrees- doing so would lead to a far lower global carbon budget, and a corresponding far lower UK carbon budget.

The WBGU states that such budgets, while very challenging, are still achievable, but will require a huge step-up in political responses from all countries. They say that we are in "an extreme problem situation with rapidly closing windows of opportunity. . .there appears to be little awareness among the relevant decision-makers. . .of just how little time is actually left to avert dangerous climate change". As an indication of the urgency of action—if the global peak year for emissions is 2015, subsequent annual global emissions reduction requirements are around 5%—very challenging already, whereas if the peak year is delayed to 2020 this "could necessitate. . .rates of up to 9% a year—ie reductions on an almost inconceivable scale".

### 1.2 Move immediately to an "intended" budget.

In this context of extreme urgency, we believe the existing budgets are dangerously misleading for politicians and the public about the scale and speed of action required. It cannot remain appropriate for the UK to retain its "interim" carbon budget (based on 34% cuts by 2020), and indeed its "intended" carbon budget (based on 42% cuts by 2020) is itself inappropriate because it is based on far too high a level of "acceptable" risk. We believe the UK should commit to the 42% target before Copenhagen as a minimum step, and commit to revisit its carbon budgets to put it in line with a 33% chance or lower or exceeding two degrees as soon as possible in the New Year.

We also note that although bigger targets are very challenging, they are achievable. Recent IEA analysis argues there is a "unique opportunity" to move the world away from high-carbon growth, and that significant recent declines in global carbon emissions will make it "less difficult" to make the cuts scientists say are needed.<sup>15</sup> We believe that the Committee on Climate Change (CCC)'s analysis due mid October will say that 42% is possible in the UK, without offsetting, with firm implementation of planned and existing policies. Even more would be possible with new or stronger policies.

### 2. WHAT IS COUNTED IN THE CARBON BUDGETS.

#### 2.1 Emissions in the traded sector

There is an accountancy loophole which results in the Act creating no incentive for strong policies in sectors responsible for over 40% of emissions.

In the "traded" sector (those sectors covered by the EU Emissions Trading Scheme—around 40% of emissions) the progress on the UK carbon budget is judged solely by the UK's allocation of emissions permits in the EUETS, rather than actual UK emissions in those sectors. This bizarre anomaly means the budget amount recorded will always be simply what was allocated to the UK, irrespective of what policies are in place or what effect they have on actual UK emissions. The UK Government has accepted that EUETS is not the only policy which affects emissions in these sectors, and indeed has put in place many others; it is simply wrong therefore to have an accounting system which only judges the effect of one policy.

The Government's first argument for recording allocated emissions appears to be that the EUETS is a capped scheme, so additional cuts in the UK would simply mean more emissions elsewhere in the EU, as the overall cap remains constant. However, this is irrelevant. The Act is about UK not EU emissions, and bringing UK emissions down. Indeed, policies bringing UK emissions down in the traded sector would be financially good for the UK as they would be able to sell permits to other EU nations.

The Government's other argument for recording allocated emissions appears to be that to do otherwise would reduce the incentive for the UK to argue for stronger caps in future EUETS periods. However, first, the Climate Act's budgets are predicated on the belief that there must be adequate EU and global progress on climate change, of which UK emissions are a small but important part. In this context the UK would

<sup>14</sup> http://www.wbgu.de/wbgu\_sn2009\_en.pdf

<sup>&</sup>lt;sup>15</sup> Financial Times, 2009. Recession results in steep fall in emissions. 20 September 2009.

need to be arguing for a stronger EUETS cap in any case, to achieve the overall goal which the UK's 80% is intended to help—ie preventing dangerous climate change. Counting allocated or actual emissions should have no effect on the UK's negotiating strategy.

However, even if it is assumed using recorded emissions does have an impact, then the political reality is that choosing to count allocated emissions would be more likely to result in weaker, not stronger, UK lobbying. This is because actual emissions in the UK are very likely to be higher than allocated emissions. The political reality is that it is harder for countries with higher emissions to lobby for lower caps, because of lobbying from carbon-intensive sectors in those countries.

The bottom line is that the Climate Change Act—as the overriding framework for all UK climate policy must have an accounting system which creates an incentive to deliver these policies and measure their success against the carbon budgets.

The Government accepts<sup>16</sup> that it is "highly likely" these accounting rules will have to be changed anyway at the end of Phase 2 of the EUETS (in 2012), as in Phase 3 there will no longer be any "national allocation" to record. It is likely that some attempt will be made to construct some arbitrary and notional "national allocation" so that the current system can be continued, however it is also easier to simply count actual emissions—this is what the UK does already in its annual reporting of greenhouse gas inventories to the UNFCCC.

We hope the Committee would press the Government to make this simple change to make the CC Act more effective in its core purpose—as the framework for driving strong policies for emissions reductions across all sectors.

## 2.2 Offsetting

At present, the accounting rules allow for offsets to be included in the budgets. We believe this to be wrong. The IPCC is clear that emissions reductions are required in both developing and developed countries, yet offsetting is simply the swap of a promised cut in a developed country for a cut in developing country, when both are required. The UK Carbon Budgets should concern emissions from the UK.

We therefore welcome the Government's commitment to not using offsetting in the non-traded sector in the first budget period, however this does not go nearly far enough. Offsetting is a short-termist economic mistake, which would lock the UK into increasingly expensive high-carbon infrastructure. Offsets also do not add-up in global carbon terms for an extra reason—that it is often not possible to prove that the offsetting activity would not have happened anyway: the requirement for "additionality". For example, 200 Chinese hydro schemes are passing through Clean Development Mechanism (CDM) validation, all claiming that the projects would not have gone ahead without CDM revenues. However, accepting this requires one to believe that China would not build any more hydro schemes without CDM cash—when it is in reality a core part of their energy policy. CDM revenue is a bonus for hydro developers in China, not a deciding factor.

The Government should extend its ban on offsetting to cover both traded and non-traded sectors, and in all budget periods.

In addition, major reform of EUETS is required. The CCC agree that there are major dangers of "lockin" from offsetting. But they state that "As long as the EUETS total emissions target is adequately tight (and with appropriate limits on offset credit purchase into the EUETS) emissions reductions will be achieved within Europe, and new technologies for energy efficiency and renewable energy will be developed?<sup>17</sup> However this is not the case—EUETS is awash with offset credits—its rules allow 50% of all required emissions reductions to 2020 to be made by offsetting. The EUETS is not a closed system guaranteeing EU carbon cuts. The UK should lobby hard to remove this offsetting loophole from the EUETS.

#### 2.3 Budgets should include all UK emissions

It is of course also essential that all emissions are appropriately counted in carbon budgets, and on these points we agree with the comments by Professor Kevin Anderson in oral evidence to the Committee on 23 June 2009.

3. INTEGRATION OF CARBON BUDGETS IN POLICY ACROSS GOVERNMENT

We welcome the publication of the UK Low-Carbon Transition Plan. We have two concerns about how the carbon budgets will be delivered:

- National to local implementation.
- Departmental budgets.

<sup>&</sup>lt;sup>16</sup> DECC, 2009. Guidance on carbon accounting and the net UK carbon account p 1.

<sup>&</sup>lt;sup>17</sup> http://www.theccc.org.uk/reports/building-a-low-carbon-economy p 160.

### 3.1 National-to-local implementation

The Low-Carbon Transition Plan is rightly concerned with delivery, and sets out a range of national policies to meet the budgets. However, we are very concerned that insufficient attention is being paid at present to decisions taken at a non-departmental level. We note Lord Turner's evidence to this Committee in February, stating: "I think there does need to be a process in Government for them to say: 'how do we make sure that the totality of the machinery of Government in all of its departments will make sure that it meets this?", however we note three examples below where there are major gaps still in place; we believe these are indicative of a more general problem regarding delivery at the local and regional level—this area is a crucial element of a successful carbon budget strategy, where further measures will be needed:

— National Policy Statements (NPS).

This month, draft NPS will come out which will set out guidance for the newly formed IPC for making planning decisions on major infrastructure. We are aware that there are already 50–60 applications due to come to the IPC for formal consideration from March 2010. These applications will have a huge impact on the UK's carbon budgets—some such as new grid infrastructure will be essential, others such as new fossilfuel plant could make it much harder for budgets to be met. There is little indication so far that the guidance for the NPS will be integrated with the carbon budgets. It is essential that this is corrected during the parallel consultation and parliamentary processes. We hope that CCC as a statutory consultee of the process will make this case:

— Local Transport Plans (LTPs).

Although new guidance for LTPs mentions the Climate Change Act and its importance, there is no guarantee that local authorities? LTPs will deliver any carbon reduction at all. This is partly due to DfT dropping its assessment of the quality of LTPs. The quality of LTPs is now to be assessed within the local Comprehensive Area Assessment process, but this will not require carbon cuts from LTPs either; indeed, one-third of local authorities have not even signed up to the local performance indicator (NI186) on carbon reduction in their area. The bottom-line is however that LTPs have the potential to make a major impact on emissions, and if they do not deliver, then stronger national policies will be required. As well as a lack of compulsion there are inadequate incentives or guidance for local authorities to deliver transport strategies which cut carbon in line with the national sectoral carbon budget for transport:

— Planning at the local level (eg PPS).

The Climate Change Committee has rightly said that there needs to be a major uptake of in-land renewables to deliver its budgets. However, at present, planning decisions at a local level are a major barrier to the uptake of such smaller-scale developments, particularly on-shore wind. We believe there needs to be far stronger incentives and targets to ensure local authorities do allow such developments to be built, and that the CCC should play a greater role in driving such reforms.

#### 3.2 Departmental budgets and Treasury

We welcome the decision in the low-carbon transition plan to split the national budget by sector, and allocate sectoral responsibilities to Government department. We note that some responsibilities for some sectors are split between Departments—eg responsibility for the "homes and communities" budget is split between DECC, DCLG and BIS.

In this context it is surprising that HM Treasury has not been given any share of sectoral responsibility for any sector, when the Treasury controls tax policy, which has a major impact on carbon emissions in all sectors. As it currently stands, Departments like DECC will have to lobby Treasury for tax measures to deliver its share of the carbon budgets—if HM Treasury had been given a sectoral share then it would have been "bound-in" to the carbon budget process more, rather than being not as directly accountable. The Treasury, is, if anything, even more important than DECC for delivering the UK's carbon budgets, and needs to take a share of the departmental responsibilities.

### Further memorandum submitted by Friends of the Earth

#### NATIONAL POLICY STATEMENTS

### Summary

We agree with Lord Turner's evidence to the Environmental Audit Committee earlier this year that there must be a process to ensure "the totality of the machinery of Government" delivers the UK's carbon budgets.

We regard the 2008 Planning Act as a powerful mechanism in this regard, which has the potential to either guide us to a long-term low-carbon economy or lock us into a high emissions future. The Infrastructure Planning Commission (IPC) will make decisions on consents for applications on major infrastructure such as roads, renewables, nuclear, coal and gas power stations, airports and grid infrastructure. These decisions will clearly have a major impact on the UK's carbon budgets, way into the future.

The IPC are strongly obliged to make its decisions in line with National Policy Statements (NPS). The guidance in NPS, published in draft form this month, is therefore of critical importance. It will be essential that NPS are directly assessed for carbon, and that there will be strong guidance to ensure that the sum of the IPC's decisions keeps the UK within its carbon budgets.

Our evidence below sets out briefly why we believe NPS to be so important, and some suggestions for how the Government could ensure their compatibility with the Climate Change Act.

#### Context

Friends of the Earth believe that in order to fulfil the ambitions of the Climate Change Act 2008, there needs to be both robust climate change budgets set in line with the science and a clear and coherent set of delivery mechanisms across Government to meet those budgets. Lord Turner of the Committee on Climate Change put this point across in his evidence to the Environmental Audit Committee this year: "I think there does need to be a process in Government for them to say: 'how do we make sure that the totality of the machinery of Government in all of its departments will make sure that it meets this [carbon budget]?'" (4 February 2009),

The Planning Act 2008 will be one of the most powerful mechanisms affecting deliverability of these carbon budgets. The Act gives unprecedented legal weight to National Policy Statements (NPS). The Infrastructure Planning Commission (IPC) is obliged to determine applications for Development Consent in line with those National Policy Statements unless a limited set of exceptions apply (section 104(3) Planning Act 2008). As such, NPSs are intended to be determinative of Development Consent applications for nationally significant infrastructure projects, having very considerable implications for the UK's carbon budgets. Some of this infrastructure will be essential to meet the carbon budgets, some could be a major impediment to their achievement. The mechanisms underpinning the NPS and the IPC have therefore major potential to either guide us to a long-term low-carbon economy or lock us into a high-emissions future.

In this context, the content of the NPS and the guidance for the IPC are crucial. The Planning Act explicitly requires the Secretary of State to consider climate change in the preparation of National Policy Statements (S 10(3)(a)). The reason for that duty was to ensure that NPSs were consistent with the provisions of the Climate Change Act including the UK's Carbon Budgets and section 13 policies.

The Government has repeatedly made clear the NPS would include a strong assessment of carbon impacts and a strong policy link to ensuring the carbon budgets are met. For example, Government Minister Lord Hunt of Kings Heath said (6 November 2008 Col 392):

"First, national policy statements will be subject to an appraisal of sustainability, to ensure that environmental, social and economic objectives, including climate change, are properly factored into their development"

"I emphasise that Ministers will be bound by the provisions of the Climate Change Bill once enacted, and will need to ensure that, taken together, government policy achieves the targets that it sets out."

And column 389:

"it is ultimately for ministers to come to a view on the impact on climate change of a National Policy Statement".

Put simply, the national planning and consenting regime put in place by the Planning Act 2008 should assess carbon impacts and support the delivery of the Climate Change Act 2008. If it does not do so it risks significantly undermining the deliverability of the Climate Change Act 2008. Without this we do not see how Ministers will be able to "come to a view on the impact on climate change" of a NPS without assessing carbon, or how it will be possible for the Government to ensure that "taken together government policy achieves the targets that it [the Climate Change Act] sets out." Without carbon assessment, the NPS might also be contrary to the UK's obligations under the SEA Directive (2001/42/EC) and the Environmental Assessment of Plans and Programmes Regulations 2004.

We suggest three ways in which Ministers can ensure compatibility of the NPS and IPC with the carbon budgets in the Climate Change Act:

Assess carbon in the NPS.

- Strong guidance in the NPS for the IPC on the approach to be taken to carbon assessment.
- Dynamic link between NPS and carbon budgets.
- Assess carbon in the NPS.

Carbon assessment of National Policy Statements is a logical part of the overall Climate Change Act regime because it can provide strong guidance to the IPC that major new infrastructure projects should be consistent with national carbon budgets.

It is not difficult to perform this assessment. As one partial example, for electricity generation DECC already sets out likely electricity demand for 2020 (370 TwH) and a proposed energy mix to meet the carbon budgets in the low-carbon transition plan (eg 31% renewables). This, coupled with known retirement rates for existing plant should make it easily possible to set out an overall carbon profile out to 2020 at least, for example in terms of average gCO<sub>2</sub>/kWh for new plant for the electricity related NPS. Similar assessments can be made for other elements of individual NPS or combinations of NPS apply to the other NPS.

We argue that Government should set out the carbon profile of each NPS in sufficient detail to ensure they are consistent with the carbon budgets in the Climate Change Act and that the IPC can make use of that information in making decisions consistent with the Climate Change Act framework.

## Strong guidance in the NPS for the IPC on the sum of its decisions

The IPC will be making decisions on individual applications. While it is likely that any one, for example, gas-fired power station might be compatible with overall carbon budgets, it is unlikely that, for example, the sum of 15 such applications, if granted, would be compatible. What applications come forward will be determined to a large degree by market economics, and given the low carbon price predicted via EUETS out to 2020, it is unlikely that higher-carbon applications will automatically not come forward. In this context, the IPC have a critical role to ensure that the sum of its decisions does not mean that the UK becomes locked-into high carbon infrastructure. To ensure they play an effective role, we suggest three mechanisms:

- NPS must require all applications to the IPC to set out their likely lifetime carbon emissions, for construction, operation and disposal.
- The NPS guidance to the IPC must be clear about the maximum level of carbon increasing infrastructure which can be approved.
- The IPC must provide the Government with a full assessment of the net carbon impact of its decisions, so that Government can amend policy in other areas if required.

### Dynamic link between NPS and carbon budgets

The Government has only accepted the CCC's interim carbon budget, and has committed to reviewing budgets post-Copenhagen. The Government's climate strategy is founded on the assumption that sufficient international action will (eventually) be taken, and so it is inevitable that soon the UK carbon budgets will be revised downwards to ensure a strong chance of avoiding global 2 degree temperature rises (to at least the "intended" budget). However, it is unlikely that these budgets will be revised before the IPC starts making its decisions in March 2010. As the IPC's decisions are for extremely long-lived infrastructure, there is a great danger therefore that the IPC will make decisions based on a set of carbon budgets and attendant policies which will rapidly become out of date and inadequate. To combat this we suggest two mechanisms:

- The guidance in NPS to IPC should be based on stronger policies than for the interim budgets, as it is likely to be obsolete far quicker than the lifetime of the NPS, and should be based on the "intended" CCC budget from the start. In addition, the CCC are already advocating a stronger set of policies to "outperform the first budget" to overcome the impacts of the recession on carbon prices.
- If carbon budgets are revised beyond the intended budget, then fast-track revisions to policies in the NPS must be made and updated guidance issued to the IPC within 3 months. The initial NPS should be clear that its guidance will change if budgets are revised downwards, ahead of the planned 5 year revision cycle.

October 2009

## Further memorandum submitted by Friends of the Earth

I listened with interest to the Committee's evidence session with Lord Turner and with Ed Miliband last week.

### 50:50 chance of two degrees (Q228 and 229)

The Committee asked about the acceptability of the choice of a 50:50 chance of two degrees. Lord Turner pointed out that 99% chance of avoiding two degrees was exceptionally difficult, and that some greater chance had to be accepted. He then said, "indeed we are trying to have a 50:50 chance of not going above 20 at all. There is no particular science. Why would one care whether that chance is 52 or 48? But it gives one some sort of anchor. The crucial thing is limiting the extent to which we go above 2°" and, later, "We do not think there is any particular magic about a 50:50 chance as against a 55:45 chance of going above 2°". Our view is that although there may be indeed little difference between 52 and 48%, there is a large difference between 50% and (say) 15%, 25% or 33%. (Later on in his evidence Lord Turner implicitly agrees with this point, that changes of the level of around the 20% level are important when talking about three degrees, stating the big difference between 15% and 35%.) Lord Turner is right to say that the choice of "anchor" is an inherently judgemental process, but we strongly believe that there is a very strong case for making that anchor lower than 50%. There are many bodies which are saying this—for example the German WBGU and the Tyndall centre.

Another way of looking at this is to note that the G8 and the UK Government have said that the political goal is to "NOT" exceed 2 degrees. Lord Turner is absolutely right that this cannot be an absolute guarantee, and this discussion is around acceptable risks. To this end, we point to the IPCC definitions of "likelihoods"—

IPCC Guidance notes—Likelihood Scale: Virtually certain > 99% probability of occurrence; Very likely > 90% probability; Likely > 66% probability; About as likely as not 33 to 66% probability; Unlikely 33% probability; Very unlikely < 10% probability; Exceptionally unlikely < 1% probability

http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-uncertaintyguidancenote.pdf

We would make the argument that a goal "not" to exceed 2 degrees must surely have a maximum likelihood of "unlikely", and that therefore the CCC should use a budget based on an absolute maximum of 33% probability of two degrees.

#### Allocated vs actual emissions (Q265)

The Committee asked why the Government do not count actual rather than allocated emissions in the traded sector. Mr Hughes, answering on behalf of Mr Miliband, said that although there was no national allocation beyond 2012, it would still be possible to work one out. This may be true, but Mr Hughes did not answer why it was better to use an allocated figure rather than actual figure. He stated that EUETS was important, but also that, "In a sense, that is only one part of the strategy; the other part of the strategy is decarbonisation of energy within the UK, particularly electricity". This is exactly right—EUETS is just one policy which affects UK traded sector emissions—in that case, given that the Climate Change Act is about UK emissions, it surely is more appropriate to count actual emissions (ie judging the progress of ALL policies in the traded sector) rather than allocated emissions (ie solely counting the UK's initial allocation in the EUETS, just one policy). We do not feel that the Government have properly answered Mr Caton's question on this issue. We believe it is not a minor point—if this method of accounting continues, then for the purposes of assessing compliance with the legal requirements of the Act, it does not matter WHAT actually happens in 40% of the entire carbon budget.

6 November 2009

### Memorandum submitted by the Institution of Mechanical Engineers

#### SUMMARY

In response the Committee's inquiry into carbon budgets, the Institution of Mechanical Engineers would like to emphasise two concerns. These are in response to:

- The validity of the assumptions used by the Committee on Climate Change in setting the budgets. There assumptions are based on little engineering evidence and take no account of the UK's capacity to deliver the changes necessary to achieve the stated goals. This arbitrary method of setting targets without engineering advice results in significant uncertainty.
- The compatibility of current Government policies with achievement of the overall budget. In general, we do not believe that current Government policies will be sufficient to achieve the overall carbon budgets suggested by the Committee on Climate Change—regardless of whether they are based on engineering evidence or not.

### "the validity of the assumptions used by the Committee on Climate Change in setting carbon budgets"

1.1 The Committee recommended the overall emissions target to 2050 as an 80% reduction relative to 1990 and budgets for the periods 2008–12, 2013–17 and 2018–22 leading to at least a 34% cut in greenhouse gas emissions by 2020. The overall target has already been accepted by Government and is legally binding under the Climate Change Act. If the budgets are also accepted these will become legally binding and have far reaching implications for the UK's economy, citizens and industries, calling upon them to meet targets that are groundbreaking in an international context.

1.2 In this context, the Institution of Mechanical Engineers is concerned that in coming to its recommendations the Committee does not carry out a rigorous and detailed analysis of the feasibility of achieving the overall target and budgets, in either policy or engineering capability terms. Instead it undertakes a high level view of what might be possible from an understanding of currently available technologies. Indeed, these concerns were echoed by the Innovation, Universities, Science and Skills Select Committee Inquiry, *Engineering: Turning Ideas into reality*, which argued that engineering advice is lacking in the formulation of important policies and targets. As such the Committee on Climate Change's recommendations are based on significant uncertainty.

1.3 The UK has a limited current and potential resource of money, appropriately skilled people and industrial capacity available to meet the challenge of climate change and the Institution is particularly concerned that:

- Significant effort on the part of the UK's engineering community will be required to design, deliver, implement and maintain the technological infrastructure, systems and devices needed to meet the overall target and budgets. However the work of the Committee does not include the undertaking of detailed studies to determine what is feasible in engineering terms.
- There is no detailed consideration of the industrial capacity and skills base available, or likely to be available, in the UK's engineering community to actually deliver the infrastructure, systems and devices required to meet the budgets.
- There is an over-reliance on immature technologies to meet the budgets without any rigorous assessment of how these technologies can be delivered, by when and at what cost.
- The issue of how emissions of the Kyoto recognised greenhouse gases will be measured consistently and fairly across all sectors has not been satisfactorily addressed to date.

1.4 The Institution therefore recommends that the Environmental Audit Committee urges Government to:

- Give a wider remit to the Committee on Climate Change, and sufficient time, to develop and recommend detailed specific national plans based on a thorough analysis of what is realistically achievable and measurable. These plans should recommend the targets and budgets and define the timescale of delivery (adopting targets and budgets for which detailed analysis of how they are going to be achieved, by whom and by when, has not been undertaken is a recipe for failure).
- Work with the engineering profession to put in place national plans across all sectors, on the basis of engineering feasibility, capacity and skills, to ensure that the UK has the ability to meet targets and budgets that become legally binding.
- Not unduly push the UK's economy, citizens and industry too far by aspiring to lead on the setting
  of binding theoretical targets and timescales possibly beyond our ability to deliver.

#### "the compatibility of current Government policies with achievement of the overall budget"

2.1 In general, we do not believe that current Government policies will be sufficient to achieve the overall carbon budgets suggested by the Committee on Climate Change—regardless of whether they are based on engineering evidence or not. We are particularly concerned that:

- Too much faith is placed in market mechanisms, particularly the EU ETS. Neither of the first two phases of the ETS has produced carbon prices high enough to incentivise the scale of investment in low-carbon technologies that will be needed, nor have they provided any long-term certainty over carbon prices to investors. Without significant reform, future phases of the ETS are unlikely to be any different.
- There is too much Government emphasis on large-scale, centralised supply-side solutions, especially for electricity (eg coal & CCS, nuclear and offshore wind). While these do offer the prospect of large carbon savings in the longer term, their complexity and high capital costs inevitably mean they will take many years to build. Focus on demand-side savings and smaller-scale, de-centralised supply options is needed to make significant cuts in emissions between now and 2020.
- There is a lack of real Government leadership in developing low-carbon solutions. We have no shortage of ministerial statements and consultation papers; what's needed is action in support of the goals and objectives set. Public sector procurement and the tax system are vital components of reducing total carbon emissions but are not yet being used effectively. The current appetite for

economic stimulus and the public ownership of large sections of the banking industry provide a real opportunity to deliver a low-carbon future with much more urgency than might have been considered prudent when, for example, the 2007 Energy White Paper was written.

- 2.2 The Institution therefore recommends that the Committee urge Government to:
  - Instigate a wide-ranging programme to progressively, but urgently convert existing buildings to higher standards of energy efficiency. Priority areas include leveraging the public sector's power as a procurer of commercial buildings, to build markets and supply chains for energy efficient refurbishment in the sector.
  - Promote and incentivise investment in district and community heating projects with local "waste" being used as the fuel resource.
  - Introduce a statutory national target on energy conservation in support of the EU primary energy savings commitment of over 20% below projected business-as-usual levels by 2020.
  - Provide a long-term framework giving investment signals for businesses to deliver major energy system change. Consumers, industry, commerce and government should be rewarded for becoming "part of the solution".

22 April 2009

### Memorandum submitted by the National Physical Laboratory

### EXECUTIVE SUMMARY

The National Physical Laboratory is a global leader in measurement science (metrology).

A necessary condition for stability in any market is a consistent means to quantify the commodity being traded that is accepted by all market players. At present this condition is far from being met for the Carbon market.

Multiple and inconsistent measurements, calculations and estimation protocols for GHG emission and avoidance are a fragile basis for the present and an inadequate basis for the future carbon market—and a burden for business.

NPL would like to see the Government invest in metrology research and development to produce the necessary technology and standards required for the operation of a robust global carbon market and post-Kyoto geo-political agreement.

Taking a lead in the development of international carbon measurement standards would significantly advance the goal of making the UK the best place the world to locate or build a low-carbon business and help secure its position as the centre of the global carbon market

### ABOUT NPL

The National Physical Laboratory (NPL) is one of the UK's leading science and research facilities. It is a world-leading centre of excellence in developing and applying the most accurate standards, science and technology. At its heart, NPL is the UK's National Measurement Institute—developing and maintaining the national measurement standards, and supporting infrastructures required to ensure quality of life and economic benefit.

For example:

- We developed science and technology to enable accurate and consistent measurement of the calorific value and flow of natural gas—which has become increasing important for facilitating international trade and underpinning the market, as the price has risen so dramatically in the past 10 years.
- NPL, with the Environment Agency, devised the concept and delivery mechanism for the UK wide Monitoring Certification Scheme for Air Pollution Control (MCERTS). NPL also developed a dedicated suite of test and calibration facilities to ensure instruments carrying out these tests can conform to the requirements of the scheme.
- Following on from the Royal Commission report (2006) into nanotechnology, NPL started work on nanoparticle measurement and characterisation. This will address the current and future measurement and characterisation requirements for toxicologists, eco-toxicologists and environmental scientists both in the laboratory and in the field. NPL led the first internationally recognised standard in Nanotechnology on definitions—critical for underpinning the growing market for this emerging technology.

### CARBON MARKETS: MEASUREMENT UNCERTAINTY-MARKET INSTABILITY

### The importance of measurement

Measurement is like running water or street lighting—largely taken for granted until it stops working. To develop new products and processes companies need to measure performance, and in order to trade companies must have a system of defined measurements with which to exchange goods or services.

Measurement touches almost every part of our everyday life; for example:

- Measuring the quality and quantity of gas delivered to your home.
- Ensuring the right dosage of drugs or other treatment to deliver known benefits.
- Monitoring the quality of the air we breathe and developing technologies that will reduce pollution.
- Ensuring an international time standard so we can communicate and travel throughout the world.

### What does the carbon economy need?

Responding to the threat of global climate change is clearly a national and international priority and requires a range of coordinated activities, including the establishment of an explicit price for "carbon", with trading schemes such as the EU Emissions Trading Scheme (ETS) at the heart of such activity.

"The European carbon trading system is a 'failure' and will not help the UK to meet its emission reduction targets, electricity generator EDF warns a committee of UK MPs

Asked by MPs on the committee whether the European scheme was insufficient to meet these targets, Humphrey Cadoux-Hudson, managing director of new nuclear build at EDF, agreed. 'As currently framed today that is the case. What is needed are rules that will create a market that will allow us to create low-carbon technology.'

'The thing that drives the price of something is certainty. The recording and verification of emissions creates uncertainty, as does the entry of new countries into the system.'"

guardian.co.uk, Wednesday 29 April 2009

Carbon trading is a rapidly growing business. Despite the slide into global recession, the value of the market grew by more than 80% to \$118 billion in 2008, with approximately half of the growth coming from volume and half from price. The EU ETS makes up the majority of the market—accounting for ~70% of the volume and ~80% of the value of trade in 2008. In 2009 recessionary and other pressures are likely to see a reduced growth rate. However, it is predicted that the global market will still exceed \$150 billion.<sup>18</sup> But are the conditions in place to ensure this rapidly growing new market is robust and stable?

One necessary condition for stability in any market is a consistent means to quantify the commodity being traded that is accepted by all market players. At present this condition is far from being met in the national and international markets for Green House Gases. In the case of this "Carbon" market multiple and inconsistent measurements, calculations and estimation protocols for GHG emission and avoidance are a fragile basis for the present and are likely to be an inadequate basis for the future carbon market—and a burden for business.

As the market grows and the price rises, differences in techniques for quantifying emissions and the uncertainty in the actual magnitude of a "tonne" of CO<sub>2</sub> will start to prompt a very difficult question—is the marketplace fair?

### The CBI

In the UK, a report published in May 2009 by the CBI<sup>19</sup> highlights the fact that "with businesses facing growing regulatory pressure to reduce their emissions footprint, measurement and reporting are increasingly becoming major business issues". The report calls for a single, common standard on how businesses report their greenhouse gas emissions. They identify a number of regulatory and voluntary frameworks covering emissions reporting and argue that the use of competing standards could undermine corporate efforts to slash carbon emissions.

A clear and more consistent carbon reporting standard for all businesses is essential if UK businesses are going to successfully reduce emissions. "Transparent measurement and reporting of corporate emissions data is likely to become an important factor in driving corporate change and creating corporate advantage, so it's vital we get it right,"

Richard Lambert, Director General CBI, May 2009

<sup>&</sup>lt;sup>18</sup> Source: New Carbon Finance.

<sup>&</sup>lt;sup>19</sup> "All together now: a common business approach for greenhouse gas emissions reporting". CBI, May 2009.

### Measurement Challenges

There is a lot of research going on in emission measurement, but agreement has not been reached on issues such as:

- Which emissions should be measured?
- Where in the process should measurements be made?
- What measurement techniques should be used and with what frequency?
- What level of measurement uncertainty is appropriate?
- How to demonstrate consistency between emission and emissions avoidance?
- How to validate the "low-carbon" or "carbon-neutral" claims of new technology?

Until there is an internationally accepted framework for quantifying "carbon", based on sound measurement science and technology, embodied in standards, protocols and legislation, carbon trading will remain largely unregulated and the market will be unstable and, potentially, fatally flawed.

### Variability Of Emissions

"Average emissions differ significantly from source to source and, therefore, emission factors frequently may not provide adequate estimates of the average emissions for a specific source. The extent of between-source variability that exists, even among similar individual sources, can be large depending on process, control system, and pollutant. Although the causes of this variability are considered in emission factor development, this type of information is seldom included in emission test reports used to develop AP-42 factors. As a result, some emission factors are derived from tests that may vary by an order of magnitude or more. Even when the major process variables are accounted for, the emission factors developed may be the result of averaging source tests that differ by factors of five or more. Whilst this information does not include CO<sub>2</sub>, the US intends that CO<sub>2</sub> now be considered as a pollutant and therefore one can expect efforts now to reduce the variability of emissions data."

# Extract from the US Environment Agency Handbook

Such issues are not only a threat to the stability of the market. Lack of trust between nations over the basis on which national GHG inventories are calculated could also potentially de-rail a global agreement on climate change post-Kyoto.

# The role of NPL

NPL is already playing a key role in this area. It is leading the development of international standards for some of this work and has recently proposed setting up a "Centre for Carbon Metrology" in conjunction with other organisations such as the BSI Group to focus on three areas:

- Establishing a measurement and standards infrastructure that can provide a solid foundation for carbon trading/pricing.
- Providing independent performance assessment, calibration and validation of low-carbon technologies.
- Bring measurement expertise to climate data, particularly where it is an input to modeling reducing the uncertainty in climate projections and enabling policy for climate change mitigation and adaptation to be placed on a firmer footing.

The Centre for Carbon Metrology is an opportunity to continue to demonstrate the UK's leadership in the area of climate change, to contribute to making the UK the best place the world to locate or build a low-carbon business and to retain a role as the centre of the global carbon market.

12 June 2009

