



Energy and Climate Change Committee

Oral evidence: [The economics of climate change](#),
HC 807

Tuesday 5 November 2013

Ordered by the House of Commons to be published on 5 November 2013

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Members present: Sir Robert Smith (Chair); Dan Byles; Ian Lavery; Dr Phillip Lee; Peter Lilley; Albert Owen; Graham Stringer

Questions 1-56

Witness: **Professor Lord Stern**, President of the British Academy and former Chief Economist at the World Bank, and IG Patel Professor of Economics & Government at the London School of Economics, gave evidence.

Q1 Chair: Thank you very much for agreeing to come and give evidence on the economics of climate change and to update us on your views. It is a little while now since you did the review, and as circumstances have moved on and economics have changed, are there any aspects of it you think have changed as a result?

Professor Lord Stern: I am very happy to respond on that. Let me say at the beginning that I express my own views and not the views of the London School of Economics, in which I have a number of positions, or the views of the British Academy, of which I am President, or the views of the British Museum, of which I am Deputy Chair of Trustees. I hope that is obvious, but I just wanted to underline that.

The Stern Review was published in October 2006. We are here in November 2013 and clearly we have learnt something in the meantime. Looking back, I think the Stern Review was a bit optimistic about growth, particularly if we look at the science, which looks increasingly worrying in many ways. Emissions are on higher paths than we thought, some of the features are coming through more quickly than we thought, and some things left out of the science models, like the dangers of the thawing of the permafrost emitting methane, look more worrying than we thought. Looking back, I would have made the assumptions about growth and the implications for growth of a very hostile environment stronger, in the sense that I would have been more worried about future generations being possibly worse off and, in some areas, substantially worse off than the current one.

Of course, this was published in 2006, before the financial crisis, and we have had in many countries a period of interest rates on the floor and unemployed resources. That would have been a good time to invest in the growth story of the future, which is a wave of technological change not exactly similar, but similar in many ways, to what we have seen a number of times in the past, from the mechanisation of textiles at the end of the 18th century through railways and steel and motor cars and so on. So the second thing I would emphasise is that we did not anticipate the recession then and this would have been a good time to have invested in the real growth opportunities. Those are the two things I would want to emphasise about the overall lessons we have learnt since then.

Q2 Chair: How do you feel about Government policies and the strength of the signals they are sending to meet our climate change obligations?

Professor Lord Stern: I spoke in the Lords yesterday on the Teverson amendment. I broadly welcome the Energy Bill and the energy market reforms; I think they are on the right lines. My concern is Government-induced policy risk. We have seen quarrelling within the Coalition, suggestions of reviews of the Fourth Carbon Budget constraint and suggestions of reviews of green policies or green levies. That undermines confidence. I have spent long periods as Chief Economist of the EBRD, which is largely an investment bank, Chief Economist of the World Bank, and head of the Government Economic Service here, so I have long experience discussing with investors round the world. Government-induced policy risk is a serious obstacle—in many cases the most serious obstacle—to investment.

I think what we have seen in energy market reform is along the right lines, but it does worry me that the Government itself is creating risk to investors—it is not just this Government, but previous Governments—and that has resulted in a very strong pressure on overall capacity. That is something I find worrying. We have deterred investment by vacillation over policy and an attempt to do something about it now, which I welcome, has itself been undermined.

Q3 Chair: When you talk to investors they do raise the concerns of political risk, but there is also still a statement that in the UK up until now, if there has been a mechanism, the Government has not reneged on it like Spain did, where they changed the incentives retrospectively.

Professor Lord Stern: I would agree with that. The approach in the UK, including this Government's, has been pretty good on the whole. I have said what worries me is the atmospherics. The reviews and suggestions about backtracking, and we have seen suggestions about backtracking, are undermining what is in many ways a rather sensible approach.

Q4 Chair: Do you think, on the specific energy debate at the moment, on bills for consumers, and debating where the money comes from—whether it should come from levies on the consumer or from general taxation—is one thing, and debating about whether to actually do the outcomes is another part of the debate?

Professor Lord Stern: Without a carbon price, without some kind of carbon policies, you are subsidising the dumping of a damaging set of gases into the atmosphere. You are letting people have for free something that is deeply damaging. That is a market distortion, and I spent much of my professional career arguing the virtues of markets in allocating resources and in discovery and so on. If you let people do damage for nothing, in whatever context it is in, you are essentially subsidising that activity.

In large measure I think that answers your question, but there is more to the answer than that. The answer to the question is that people should pay the cost of the resources they consume and the damage they do, just as when they buy a meal at a restaurant they pay for the rent at the restaurant, the time of the people who have cooked the food and served it to them and for the food itself. You expect to pay the costs and that is how markets work. The first part of the answer to the question is that people should pay the cost of the inputs and this is an input into the activity.

On the other hand, of course, you want to protect the poorest in your communities, and that is a desire most Governments share. Clearly there are vigorous discussions about how best to do that, and there should be vigorous discussions how best to do that, but protecting the poorest in the community should come out of general taxation. By the way, if you did price carbon properly, you would have rather a lot of revenue in order to do just that.

Q5 Chair: Do you see the new climate economy project bringing anything to the global understanding of climate change?

Professor Lord Stern: I hope so. I do not know if you all know about that. Should I explain briefly what it is?

Chair: Briefly, yes.

Professor Lord Stern: A number of Governments, including the UK Government, Norway, Sweden, Ethiopia, Colombia and Indonesia, have got behind a commission, which will be chaired by Felipe Calderón, the President of Mexico up to last year, and which is designed to look at the economics of the transition to a low-carbon economy. It is about the economics of the new climate economy. On the commission, we have a number of former finance ministers, presidents and prime ministers and half a dozen CEOs of the big firms in the world, so this is oriented to those who take economic decisions and those who invest in a serious way. I emphasise that because much of the international discussion of this issue is carried out by environment ministers. I bow to no one in my admiration of environment ministers, but generally they do not take the big economic decisions in society.

We wanted to look at this from a very direct, pragmatic, economics perspective and look at the policies, technologies and investments that are likely to be necessary to make this transition to a new carbon economy. We will be reporting in September. I am one of two vice-chairs of this commission and I also chair the economics advisory panel, a rather distinguished one: for example, it has on it Danny Kahneman of Princeton, who recently won the Nobel prize in economics, Phillippe Aghion of Harvard, arguable the leading growth theorist in the world, Dani Rodrik, another professor at Harvard, and Ottmar

Edenhofer, who is the chair of working group III of the IPCC, which is looking at policy. I think it is a rather distinguished economics group, but it is firmly on the economics of transition.

It is designed to be set in a way that is accessible and, we hope, persuasive—but we have to do the work first—to those who make investments, that is why we have on it half a dozen CEOs of big firms, and those who make economic decisions, which is why we have ex-finance ministers, prime ministers and so on.

Q6 Dr Lee: You made an interesting comment about carbon tax: if you set it at the right level you will be able to get enough money in to help the fuel-poor. Am I right that is what you just said?

Professor Lord Stern: Yes.

Q7 Dr Lee: The less well-off spend a greater proportion of their income on heating and running the car. That is regressive, so if you apply the carbon tax they are going to have to pay more for that fuel. It is almost circular, is it not? You get yourself into a situation where you are taxing them and then giving them back the money. I wonder whether it would be better for us not to tax the fuel but, if Government is going to intervene, to make people more fuel-efficient. Is that not a more sensible approach, not least because it would be economically better if we use less energy for every 0.1% of growth we can secure? I wonder why you think a carbon tax is an appropriate way to address fuel poverty. I do not quite follow the logic.

Professor Lord Stern: I completely agree with you about the importance of energy efficiency and you have probably seen the report of Sir John Hill of the London School of Economics on fuel poverty, which points directly to energy efficiency as being the most important way of helping poorer people cope with energy bills. I agree with you and I agree with Sir John Hill.

I am trying to agree with the second part of what you said, because I don't agree with the first part of what you said. What you are doing is stopping giving people something for nothing where that something is deeply damaging. You would expect prices to reflect the costs and that is what this is doing. To call it a tax is to beg that question in some ways. I do not mind calling it tax, but we have to recognise that what it is doing is stopping people doing for nothing something that is deeply damaging, and that is emitting greenhouse gases into the atmosphere.

For people of whatever standard of living—and I have worked a lot of my life in very poor economies, particularly 40 years in India and 25 years in China and elsewhere—the best way to overcome poverty is to have a price system that works and have opportunities for work and education and a transfer system that supports those people who are worse off. To price something below market, as I would argue you are doing without the carbon tax, is generally bad economics and bad for growth.

Q8 Dr Lee: I hear all that and I understand, but back in the political reality in which I have to exist—

Professor Lord Stern: I do, too.

Dr Lee: —the reality is that at the moment coal is extremely cheap. I am sure a lot of people in this country could be employed digging coal out of the ground and I suggest they would tend to be people who are at the bottom end of the income scale. We are not doing that because we have made a political decision to not burn coal. I subscribe to the view that not burning coal is a good thing until we can capture the carbon and CO₂, but we cannot deny the fact that that is going to have an adverse impact upon employment opportunities for people who are not skilled. I think there is this constant balance between what you are saying, which I think over the longer term makes sense, but over the short to medium term does not resonate with people who do not have jobs or cannot afford to heat their homes.

Professor Lord Stern: In this country we are using coal quite intensively. About 25% of our electricity comes from coal, so what we are discussing is moving away from coal and I think that is something both you and I support. We have to recognise that if you make a transition from one way of generating and using energy to another, it is exactly that it is a transition and there will be some dislocation. It is not win-win-win for everybody, but we have to make that transition for the reasons I and many others have argued.

The policy challenge is to try to do it in a way that gives as little dislocation as possible, but such dislocation as is there is managed. There are going to be people round the world who work in coal who, over the next 20 or 30 years, will gradually have to move into other things. We lost shipbuilding and motor cycles and other things in the UK and you have to manage those transitions if those kinds of things are happening.

In this case, we are arguing that this should happen. Whether or not we lost shipbuilding, as a piece of economic history you can argue whether it should have happened, but in this case we are arguing quite explicitly that the move away from coal should take place unless, of course, we do carbon capture and storage. I hope that for somewhere between \$50 and \$100 per tonne of CO₂, you could have a carbon price that over the medium term could indeed support carbon capture and storage from coal and that, of course, would change that story. This is an example of the kind of research and development we have to do and the kind of discovery we have to look for, but we must not pretend everything is win-win-win. There will be dislocations along the way. Good policy has to manage them.

Q9 Ian Lavery: You say 25% of electricity is generated by coal. Is it not a fact that this year we burnt more coal and produced more electricity from coal than we have in the previous years because of the coal on the market from America, because of the shale gas exploring and so on, and that at times 50% of the electricity generated in this country is from coal?

Professor Lord Stern: I was with you right up to the end. What was the last thing?

Ian Lavery: Is it not a fact that, because of coal's flexibility, at times 50% of the electricity generated in the UK is from coal-fired power stations? You seem to dismiss coal, you see. You dismissed it in your report. You dismiss coal all the time and I am basically unashamedly a coal man.

Professor Lord Stern: I understand that. Basically, from the point of view of the greenhouse gases, coal is the dirtiest of the fuels. Over the medium term, as I was just discussing with Mr Lee, if we do carbon capture and storage there could be a strong future for coal and I would be strongly in favour of putting more research into carbon capture and storage. That would, of course, change the whole position, but at the moment unabated coal is the dirtiest of the sources of electricity.

There is a difference between base load and peak and, even going a fair way forward you might occasionally want to use coal for peak electricity. It could have a modest role as backup, but not as base load and what we are seeing at the moment is a very strong base load for coal. It is just the way life is. If coal were cleaner there would not be a problem, but it happens to emit twice the CO₂ when burnt as gas does.

Q10 Mr Lilley: It would please my colleague Mr Lavery and displease Lord Stern that over the last half hour 48% of our electricity has come from coal, but I wanted to focus on your report. The British Government, both this one and the previous one, based its energy policy on the Stern Review and cite it always to justify its policies, both in detail and in general. In your review you say the cost of mitigating, i.e. preventing, global warming in future will hopefully be 1% of GDP. The benefits of doing so will be upwards of 5% and indeed even higher than 20% of GDP, so benefits would be five to 20 times the costs. But the IPCC in its last report, which came out after yours, concluded that, “Analyses of the costs and benefits of mitigation indicate that these are broadly comparable in magnitude” and so it “could not establish an emissions pathway or stabilisation level where the benefits exceed the costs”. Why are your conclusions so different from those of the IPCC?

Professor Lord Stern: I would have to look at that quote very carefully to see what it really means, because it is not my understanding of the view of the policy group of the IPCC.

Mr Lilley: This is the fourth review, the one that has been published. We have not yet heard from them.

Professor Lord Stern: Yes. I would want to look very carefully where you obtained that quote, Mr Lilley, because I have had experience in the past of very misleading cherry picking. I am not convinced that is the view of Working Group III of the IPCC, as you have tried to summarise it.

Mr Lilley: I hope you will come back to the Committee if you have a different explanation. I am just using English in the normal way.

Professor Lord Stern: Well, no, you have quoted a number of times from my own report in ways that have been deeply misleading. I would like to have a look at that one, but it is not my understanding of the view of Working Group III of the IPCC, either in AR4 or, as it will be coming, in AR5. I am happy to answer questions on the Stern Review, on the 1% and the 5% to 20% and where that comes from.

Q11 Mr Lilley: Splendid. One of the small sources of the disagreement could be the fact, could it not, that you calculate the cost of preventing emissions rising above 550 parts per

million, double what they were at the beginning of the Industrial Revolution, with the benefits that would have ensued had we prevented any increase in CO₂ emissions above 280, let alone above 550. You are comparing apples and pears, or apples and half apples.

Professor Lord Stern: I find that a very puzzling interpretation. We were looking in the Stern Review where we started at that time, which was around 435 parts per million of CO₂ equivalent and looking at the costs of holding the concentrations of greenhouse gases in the atmosphere to 550. We were not comparing it with 280; although it is of course true around 280 was the concentrations of greenhouse gases in the atmosphere in the 19th century.

Q12 Mr Lilley: But you certainly do not calculate the damage that would be caused by an increment in CO₂ above 550 and compare that with the cost of preventing any increment above 550?

Professor Lord Stern: We were looking at the broad strategy that said, “What if you kept it to 550 and what if you let it go?” We were comparing those two—

Q13 Mr Lilley: No, you did not. You said, “What about all the damage done by all CO₂ emissions above the pre-industrial level of 280?”

Professor Lord Stern: That is not a correct interpretation. What we were looking at in—

Q14 Mr Lilley: It is not just my interpretation. It is Professor Tol’s and even your attack dog, who has been writing to me criticising what I have done, does not deny that is what you do.

Professor Lord Stern: What we did in the Stern Review is we said, “Here we are at 435 parts per million. Let us compare business as usual”, just letting it go, “with a strategy that holds to 550 or below”. We were looking essentially at the costs and benefits of doing that.

Q15 Mr Lilley: Another reason that may account for the difference between your conclusions and those of many other economists and what I had, until now, thought was the conclusion of the IPCC economic section last time could be that you use a low discount rate for discounting the benefits of avoiding future costs. I am not one of those who say you should not use a low discount rate. If you are entitled to use a low discount rate it is a subjective thing and you give an ethical reason for doing it, but implicitly you do not use that low discount rate in discounting the opportunity cost of the investments that have to be made to prevent it. This is not a point that I have made; Professor Mendelson and others have made it. If you did use the same discount rate to discount the costs of preventing high emissions as you used for the benefits of preventing high emissions the costs would be far higher, would they not?

Professor Lord Stern: Again, there is so much confusion in the way you put it about the meaning.

Q16 Mr Lilley: I thought it was quite clear.

Professor Lord Stern: No, it was not. Can I explain to you why it was not? This goes to the heart of much of what we are talking about here. Discounting looks at a benefit that appears some number of years from now in relation to a benefit that might appear now, and that is the discount factor. Those relative values could be worth half as much or they could be twice as much. Discounting could go one way or the other, but that is the idea of discounting.

Q17 Mr Lilley: Does that not apply to costs as well?

Professor Lord Stern: It does. Let me go through because this is an important point and obviously we certainly need to go through it with some care. That is the discount factor, that relative value, and the discount rate is the rate that value falls. Of course, it will depend on the good you are looking at and it will depend on the moment in time, so there are many discount rates. In particular, the discount factor and thus the discount rates that emerge will depend on what you assume about whether the people down the track will be better or worse off than we are. I think we share that.

Looking back at the Stern Review, I said right at the beginning, Sir Robert, that we were rather optimistic about growth. I think from that point of view discount rates were possibly on the high side if you are looking at consumption benefits going into the future. Then, of course, you have uncertainty, which we took into account explicitly through looking at the expected benefits, looking the various probabilities of different kinds of outcomes. You imply that we ignored uncertainty at one or two points in the paper, which we quite explicitly did not. There is a headline there.

If you look at the cost side, you are looking at the opportunity cost of different kinds of inputs into that story. On the cost side you are looking at what costs occur to firms in different circumstances and that is why, in many ways, you would use the opportunity costs they face. In a world with very imperfect markets you will find many different kinds of discount rates according to who it is that is facing the problems, because our markets are not perfect. That is why you would not expect to have the same discount rates for all goods, for all activities, for all people.

We use the discount rates appropriate for the question being asked. So when looking at benefits you look at what happens to consumption to people at different periods in the future. If you are looking at the cost side you are looking at the costs that firms face. It is a matter of imperfect capital markets and different kinds of constraints facing different people. You would not expect those things to be the same.

I should add that I was sitting in the Treasury doing this. I was also responsible, as head of the Government Economic Service, for the *Green Book* and you will see it very clearly argued in the Stern Review that the approaches we took were entirely consistent with approaches of the *Green Book*, not surprisingly since I was responsible for the *Green Book*. The edition we were working with was written before I came and, no surprise, it was consistent with what we did.

Q18 Mr Lilley: That was a very long answer but I think when we read the transcript we will find—

Professor Lord Stern: But the—

Mr Lilley: May I just make the point?

Professor Lord Stern: Yes, please go ahead.

Mr Lilley: When we read the transcript we will find you say you use a different discount rate for costs than what you do for benefits, which is not explicitly stated in the report.

Professor Lord Stern: The concept of the discount rates, and I wanted to try to explain it quietly and slowly because it really matters—

Q19 Mr Lilley: I was not disagreeing with you. Unlike a lot of people, I do not disagree with you. It is perfectly reasonable to take a very low discount rate if you want to, if that incorporates your ethical values, as long as you apply it to costs as well as benefits.

Professor Lord Stern: It is at that point that you misunderstand, because different players face different prices and you are looking at the costs that occur in different sets of different parts of the economy.

Q20 Mr Lilley: That is very helpful. Just one final point if I may, Chairman. Again, it reflects the ethical treatment of how one treats future generations and I entirely accept there is an ethical dimension to this. Personally, if I thought there was a serious risk of an ineluctable and unavoidable process that would lead to the extermination or immiseration of humanity, I would not fuss about doing any discounting. I would want to stop it, but, for those who need to rationalise their views mathematically as sometimes I do, you could work out a way of rationalising it mathematically. In general, I am in favour of helping poor people and letting the rich carry on.

On your forecasts, even on the most severe circumstances, which you show on page 178 of your report, you show the effect of global warming—a 95th percentile, on an assumption of “a high climate, market impact, risk of catastrophe and including non-market impacts”—will reduce GDP by 37% below what it would otherwise be in 2200 but, even so, people in that generation would be, on the forecast of growth in the report, seven times as rich as they are today. Why should we try and make those people, instead of being seven times as rich, ten times as rich at the expense of stopping poor people today having the benefits of coal, gas, whatever?

Professor Lord Stern: The reason we make investment decisions is that we look at the costs and benefits, taking into account the living standards of those who pay and those who get the benefits. That is true of anything, whether it is high speed rail or a third runway at Heathrow. What we are talking about here is looking at the costs that occur to this group and the benefits that occur to that group, taking into account, as we did in the Stern Review, their relative standard of living and explicitly putting into it the kinds of values that the Treasury embodied in the *Green Book* on income distribution.

In other words, we quite explicitly took income distribution into account. You could make the same argument, Mr Lilley, about any investment. This is a big deal, but if you assume growth then any investment is evaluated in terms of its impact on this growth path and you could argue against any investment along the lines you have just made. The reason that is not a helpful way by itself of appraising investment is it does not look at the detail of the costs and benefits, and that is what you do when you do a cost-benefit analysis.

I think the argument you just put could be set against any investment in the growth context and I do not think you would want to do that, but I come back to the point I made, Sir Robert, right at the beginning. Looking back, I think we were overly optimistic about growth, particularly by that I mean the threat to lives and livelihoods in the future from unmanaged climate change.

Q21 Mr Lilley: But what you are effectively saying is that there is a factor in your equation that leads you to put more value on increasing the incomes of people 200 years ahead, from seven times what we earn today to ten times what we earn today, than any reduction in living standards today and over the next 50 years through this process of transition to very high cost sources of energy.

Professor Lord Stern: They are not—

Mr Lilley: High, excluding the external costs.

Professor Lord Stern: They are not very high costs. If you go to the work of the Climate Change Committee, you will see that the increased costs, for example, in the UK are pretty modest relative to the kind of increase we have seen associated with gas prices. If you look at the cost of energy bills from 2004 to 2012, you will see that they have gone up from a bit over £600 to a bit over £1,100. The vast majority of that has been the gas price, and it has not been the green story at all. Probably £30 or £40 of that increase over those eight or nine years might have been green policy.

We have to be very clear that these are not massive costs, but I go back to what I said before. You look at the magnitude of the investments. You look at the benefits from the investments. You look at the incomes of the people to whom they accrue. You look at the uncertainties. That is what we do when we do cost-benefit analysis. You could advance the same argument against any investment in the context of a model or a set of assumptions that assume growth. What I am underlining is that since the Stern Review the assumption of underlying growth, particularly in the context of the magnitude of the risk and the science, is not something I would want to make now.

I do not know if you have read it, but I did send you all an article I published last September, just six weeks or so ago, in the *Journal of Economic Literature*, which is the most prominent place in our academic profession for this type of discussion, where I went through, in great detail, why I felt that those underlying growth assumptions were not appropriate in this kind of context. For those of you who do not have it, I am more than happy to send you a link, but I have tried to set out in some detail why I think that growth story is now something that is not an assumption we can make with confidence.

Q22 Dr Lee: That neatly leads to my questions on the role of GDP and growth in climate change policy making. Joseph Stiglitz has stated, “Our preoccupation with GDP makes it difficult for politicians to back policies that are good for society and for the environment but which might not result in an increase in GDP.” Is GDP the right measure for making climate change policy decisions?

Professor Lord Stern: No, not by itself. You want to look much more broadly. For example, in this context, I have emphasised risk to lives and livelihoods. Unmanaged climate change could lead to hundreds of millions of people having to move and that could result in deep conflict and we could risk very large numbers of deaths as a result of those kinds of moves. If you are writing about the great famine, the Great Leap Forward in China, I think you would want to look at the 30 million or so people who died, and I do not think the first thing you would look at was the GDP series for China through that period. I think this is a very big issue in this context, the risk to lives.

There is the risk to environment itself. As I said, I have been working in China for about 25 years now and those of you who have been to Beijing recently will have seen the deep damage that is done to the environment by the smog there and thus to health. The ways in which communities function are very important. If you look at lives, environment, the functioning of communities—I could go on, but I have mentioned things that are highly relevant to this particular policy context.

Q23 Dr Lee: Not just economic measures?

Professor Lord Stern: I do not mind—

Dr Lee: In the round, you do not—

Professor Lord Stern: I do not mind how you classify. What I do reject is the idea that economics is only about GDP. It has never been my economics. I was a member of the commission that was asked for by President Sarkozy and which was chaired by Stiglitz and Sen. I was a member of that commission, so it is not surprising that Joe, who I should reveal is a friend of more than 40 years, and I agree on that, I guess because we are both right.

Q24 Dr Lee: You have already mentioned that, on reflection, the underlying assumptions of growth in the original report were perhaps a bit rosy. If continued economic growth in developed nations is unsustainable, how does that impact on the economic case for climate change?

Professor Lord Stern: I think growth of the kind that we have been doing is unsustainable. I do not think growth is unsustainable. What we need to do is to break the link between consumption and production on the one hand and emissions and other environmental damage on the other and it is perfectly possible to do that. It is growth of the kind we have been following that is unsustainable.

Q25 Dr Lee: Do you think we are still having that type of growth?

Professor Lord Stern: Yes. What we are doing in many countries including, to be fair, the UK, is trying to work out how best it can make that change; how it can manage that change in a way that deals with the dislocations and keeps the costs down to a minimum. As we do manage that change, we are going to find—going to back to what I said earlier—as we have seen in past waves of technological change, they are full of innovation, learning, discovery, investment and growth. Chris Freeman, who died a year or so ago, was a famous economic historian who looked at waves of technological change, and he began that story with the mechanisation of textiles and went through, as I described, with steam and rail and then on to steel, motor car mass production and then, of course, ICT.

Now you see those waves of technological change bringing innovation, investment and growth, and you are doing things in different ways. That is the opportunity that we have and when we do it I think we will find it is cleaner, quieter, safer, more energy secure and more bio-diverse. I think there is a great future for growth, for a while, of a very different kind and we are seeing lots of discovery. We are learning how to do that. This is what the Calderón report will be about.

Q26 Dr Lee: My personal concern is that most technological change in the last 100 or so years has come during times of conflict. Computers, rockets, a variety of different inventions that have been driven by the need to win a war and I wonder whether the problem with the whole climate change is that it does not appear like a conflict, but in fact it is. How would you suggest politicians could frame that? To me, that would be a better way of pitching it to the public, instead of hugging polar bears. Do you know what I mean? There is this sense that, yes, people like polar bears but, ultimately, they also like to heat their homes and feed their families. How do you pitch it in a sort of “Dig for Britain” poster way? Do you get what I said?

Professor Lord Stern: I do.

Dr Lee: That is what will drive the technological change that is required.

Professor Lord Stern: The science has made it very difficult for us in this sense. This is something that is full of risk and uncertainty. We cannot forecast exactly what these effects would be and we know, from psychology and behavioural economics and so on, that people’s understanding and ability to cope with and understand risk and uncertainty is limited. It takes us potentially far outside the range of human experience.

We have not seen 3°C on this planet as global average surface temperature in the 19th century. We have not seen that for 3 million years or so. We have been around as homo sapiens for 250,000 years and basically, our experience and our civilisation is in the holocene period, since the last ice age. I emphasise that because it is not just risk and uncertainty; it is potentially taking us way outside human experience, which we do not deal with very well. It comes with long lags and it is associated with the aggregate of what we do and not what one individual does. In other words, it is all the emissions put together, not just an individual’s emissions.

If you put that—risk and uncertainty, outside human experience, long lags, and that it is the aggregate not the individual contribution that is the driver—it is about as difficult to mobilise political support as it could be and all of that comes from the science. That is a measure of the difficulty in communication here, but the risks involved are potentially immense, as we have been discussing with, for example, increases of 3°C and 4°C and upwards, which is possible, possibly leading to hundreds of millions of people having to move; rewriting the relationship between human beings and the planet. That is the scale of the risks we face.

In looking at the communications issues, it is very important to dig into the science to see and appreciate exactly what it is that we are trying to communicate. It is not “we getting across to people”. That is not the right language. It is people as a whole talking this through; if you like, John Stuart Mill’s approach to democracy and Government by discussion. If we, as a community, can discuss and look at these consequences then you will find people increasingly, as many do already, start to recognise the urgency of action.

It is a bit like drunk driving. When I was at university, those laws were not yet there and when they came in there was a great discussion about restriction on individual freedom. We eventually got to the point of regarding drunk driving as irresponsible by discussing the evidence and going over the risks, and I think this is the kind of discussion we need to have. It involves academics like me. It involves institutions like the British Academy and the Royal Society opening up public discussions and it involves politicians like you talking it through in a balanced and evidential way. I do not see any other way of doing it.

In that discussion the kinds of metaphors and illustrations we use will of course make a difference but, ultimately, it is bringing a collective understanding to the immense risks that we face and only there can we see the necessary political will to act strongly. I am not that pessimistic, as that political will is increasing in different parts of the world. As I say, the climate change legislation and policies in this country are quite good relative to elsewhere.

Q27 Dr Lee: You have already made reference to working in China. The Government will tends to be stronger in autocratic areas than democratic areas, in my experience. For example, one province in China shut down its industrial production for two weeks to hit its targets. Clearly, if we did that in the north-east of England, you can imagine the response. Do you perceive a real challenge of modern democracy and, dare I say it, not great political leadership on the global stage at the moment—I am being very careful in my words. Do you see that as a real problem and a challenge with regards to climate change policy because we are increasingly very much worried about Twitter and tomorrow’s headlines instead of taking a longer term perspective, particularly in western democracies, at the moment?

Professor Lord Stern: If you take a long-run view, democracies are quite good at taking stable, reasonable decisions. I already mentioned the Great Leap Forward and Chinese famine as examples of what can go wrong outside democracies. As Amartya Sen has constantly underlined, he is not aware and I do not think any of us are aware of a major famine in a democratic country with good communications and discussion.

I think, on the whole, democracy is the best way of dealing with these things, but this is a particularly difficult subject for public discussion for the reasons I have described. It

means there is a greater responsibility on you as politicians, myself and my colleagues as academics, journalists and people in the media, to conduct that discussion in a responsible, measured and evidential way, while underlining the very big risks that we face. I do not think I would take the view that you need some kind of autocratic regime to get to good places. Our climate change legislation did come from all parties getting together in a sensible and evidence-based way and I hope we can continue to do that.

If you look around the world, I thought President Obama's speech of June this year in Georgetown University was pretty strong, setting out an agenda for the second term, which he did not have to do. Angela Merkel and Sigmar Gabriel in Germany—presumably there will be a Christian Democrat-Social Democrat coalition—have quite strong understanding of these issues. Xi Jinping, the new president of China, has been very clear that the Chinese model is unsustainable.

There are days when I am a bit pessimistic about things coming together but, if you look at leadership around the world, there is a chance that in COP 21, in Paris in December 2015, we may get somewhere. In the meantime China is changing, Mexico is changing and we have climate legislation here. So, in the meantime, you do see some progress but it is clearly not fast enough.

Q28 Dr Lee: Finally, the IMF predicts that real GDP in advanced countries is expected to grow “at an anaemic pace”. If we accept that the west is likely to follow a low-growth future, how should that change the Government's climate change policy?

Professor Lord Stern: It does not say “negative growth”. It says “anaemic growth” and, broadly speaking, that is an assessment I, as someone who was chief economist to the World Bank and looks carefully at these things still, would share, but that is anaemic growth—positive. Suppose we had zero growth from now on, but no change in technique. We as a world would be emitting about 50 billion tonnes of CO₂ equivalent, which is what we are emitting now. That is way too high for anything like a 50-50 chance of hitting 2°C. We would have to get that 50 billion tonnes down to below 20 billion tonnes around 40 years from now.

Stopping growth without changing technique just would not deliver. It just would not deliver. Whichever way you look at it, anaemic growth or strong growth, you have to come to the conclusion that, if we are to have a decent chance of holding to 2°C and avoiding dangerous climate change, we are going to have to change the way we do things. It is changing the way we do things that is fundamental, breaking the link between output and emissions.

Q29 Dr Lee: On that basis, this constant, “Should we have consumption based measures of CO₂ or territorial based measures of CO₂”—do you think that debate is worthy? Personally, I think it should be a consumption-based measure because we all make choices and individuals make choices, but I detected in China that they were very concerned about going down that path because their economy is predicated on the west over-consuming. That was my judgment. In terms of negotiations here, where do you sit on that?

Professor Lord Stern: I think both consumption and output measures of emission have their role to play. I do not think we should choose one or the other; both are relevant. If two countries trade with each other and one exports stuff that is quite intensive in carbon to somebody else, they both gain from that trade. That is what we teach in economics, in David Ricardo and the gains in trade. They are both involved in the transaction. They are both gainers. I think that both output basis and consumption basis are relevant parts of a discussion and I would not choose one or the other.

China has seen the dangers that it faces. China is the biggest emitter and it realises that how much it emits directly affects what happens to China. It also recognises that other people look at China in thinking about their policies. So China is taking this very seriously. Its seriousness is enhanced, of course, by the direct experience of smog and so on, which is causing intense damage to the health of its people. China would rather like to win the green race that it sees as beginning, and that is the kind of race and competition that we need as a world. We need competition generally and we need competition in this area too.

China's seriousness about this is clear. It does not necessarily depend on strong growth elsewhere and, if you have been following the Chinese economy and discussions around the 12th and 13th plan, which I have been involved with to some degree, you can see that they are looking for the balance of the economy to shift to domestic demand. They are looking for the share of consumption to go up and they are looking for the composition of that consumption to be more focused on services, much in the way that it is in richer countries. In terms of trade, in terms of the balance between investment and consumption and in terms of the make-up of consumption, they are thinking through all those issues. I would not write China's prospects down as depending entirely on some model of growth in the west that we have seen up until now.

Q30 Ian Lavery: Just on the question of modelling climate change, there are wide views among economists on the future cost of emitting a tonne of carbon. It ranges, if the information I have is correct, from \$12 per tonne to somewhere in the region of \$100 per tonne. Why would this be the case?

Professor Lord Stern: The models that people use, the integrated assessment models in the jargon, are quite sensitive to the assumptions you feed in on the way in which emissions grow, the way in which damages occur, approaches to discounting and so on. Different people build different assumptions into those models and that is why you get a very big range of outcomes. My views on the balance of those models are in print. In the *Journal of Economic Literature* piece that I sent to you, looking at the way in which these models were structured, the very modest approach to damages, the optimistic assumptions of growth, the way in which they left out a number of the risks in the science that are relevant—looking at all those things, I argue that, on balance, the integrated assessment models that produce the kind of calculations you just quoted, Mr Lavery, those models systematically underestimate.

If I just take the one that the Americans have been using, which has been associated with Michael Greenstone of MIT and others, they currently have \$35 a tonne of CO₂ as the cost of carbon and I have argued that that is a gross underestimate. I have tried to explain in my answer why you get these broad ranges. My own view is that, for example, the current

central estimate of a prominent model in the US, which is \$35 a tonne, is a gross underestimate.

The conclusion I draw from all this is that going at this in a different way can make more sense and the different way is to say, “What kind of paths do you need to follow to avoid dangerous climate change and what kind of price of greenhouse gases and CO₂ do you need to generate those models” so looking on the supply side as well as the more social cost of carbon, which is an impact side. I rather prefer going at it that way.

Q31 Ian Lavery: You have just mentioned the integrated assessment models and you recently commented on the integrated assessment models, saying they “grossly underestimate the risks of climate change.” If we accept that and take this into account, how much attention should we pay to the Stern Review conclusions, which were based on the integrated assessment model?

Professor Lord Stern: What I have argued is that they have some value as a benchmark. What I have argued is that, if you take that as a benchmark, we can say with some confidence that that costs are higher than the ones that they give, but you do not have to choose—

Q32 Ian Lavery: Is there not a contradiction in terms there?

Professor Lord Stern: No. What I am saying is that these integrated assessment models have their value. You would expect different models to give different results. That is the way in which economic discourse takes place. We learn from those models and one thing that I have argued is that, for the reasons I have described in some detail in my piece, those models are giving a rather strong underestimate of the social cost of carbon. That is a lesson that you learn from looking at the models.

I would also like to point out to you that the integrated assessment modelling was one chapter, chapter 6, in the Stern Review. Most of the Stern Review was looking at the different kinds of risks of different kinds of policies in a way that did not depend on the integrated assessment models. That was one chapter in 27 and the rest of the chapters were not based directly on that. They were looking at different kinds of risk in different kinds of ways that, of course, are complementary to that.

Q33 Ian Lavery: The economic models used to derive the social cost of carbon are highly sensitive to input assumptions, including what we have already discussed this morning, which is the choice of discount rates. What is the argument for basing policy on models that appear to the layperson to be overly sensitive to apparently subjective input assumptions?

Professor Lord Stern: I think I have already answered that question, Mr Lavery. You have a range of models that give you different insights into questions. You see how different assumptions affect answers. I suggest that we can come to the conclusion that, looking at those models, they give a lower bound, some benchmark, on the social cost of carbon. I have argued that, say, if you take the Greenstone model that was used in the United States

that comes out with \$35 a tonne of CO₂, we can suggest that the carbon price should be much higher than that. That is throwing some light on an argument.

You should never take one model as the answer to any question and that is not what economic models are about. An economic model is a sentence in an argument. It helps you understand the issues that are involved and, in this case, it helps you understand the magnitudes that are involved because, as I have argued, it puts a lower bound on the social cost of carbon.

Q34 Ian Lavery: Is this fairly similar to actuarial valuation, with these different inputs?

Professor Lord Stern: It is true that what the actuary thinks about your life expectancy depends on how he models the risks that you face and having a discussion about the assumptions the actuary is making is quite helpful to understanding some of the issues. I think we should see modelling in this kind of spirit. It is explicit and it helps you understand some aspects of the problem, but you should not expect one model to give you a simple, unambiguous answer. If you take a collection of models; if you look outside the models and ask what the big issues are outside the models, then you can come to a balanced judgment on the policy issues and that is what we tried to do in the Stern Review.

Q35 Graham Stringer: Professor Stern, you are a distinguished academic. Why did you not get your report peer reviewed?

Professor Lord Stern: It was a Government report and you do not normally send Government reports off to the learned journals, but we had very extensive commentary from different academics around the world as we were working. As soon as the Stern Review was published I was asked to give the Richard Ely lecture, which is the biggest lecture in the calendar, in many ways, at the American Economic Association. I think we sent you that paper as well. It was subject to very careful assessment and discussion and lively academic discussion, which should be there, but this was a Government report and we shared it with many academics as we were writing it. There is a long list of thank-yous at the front of it and you can see that we went about it in a way that was unusually sharing and unusually seeking of criticism for a Government report.

Q36 Graham Stringer: It is an important report, though. Let me put it this way. Do you think it would have been beneficial, in terms of the debate and the criticisms that have been made and the analysis that has been made of your report, if it had been peer reviewed? At the end of the day, it is a Government report and it falls into the same category then as the Barker report and the Eddington report of being a position statement of the Treasury at a particular point in time.

Professor Lord Stern: I worked with Sir Rod Eddington on the Eddington report, so I know a bit about that. I chaired the academic advisory panel. He asked me to chair that academic advisory panel. What we did on that is we got together a number of leading academics and we subjected the kinds of arguments that were being put to academic scrutiny. When we were doing the Stern Review, we started putting the team together

during the summer, and it was assembled in October of 2005. In January 2006 I gave a talk at Oxford University where I set out some of the preliminary analyses, again exposing it directly to academic criticism, which is a good thing. I think we went about the Stern Review in a way that was unusually open in terms of seeking out criticism, but you do not submit a 700-page report to the learned journals. That is not the way the learned journals work and we could not ever have done that. What we did do is seek out the criticism and we were open for evidence and I think we were as open and self-critical and sharing as any other Government report that I am aware of.

Q37 Graham Stringer: Are the Government policies that are being pursued in tackling climate change making progress or are we going backwards?

Professor Lord Stern: A little bit like the curate's egg. I think the policies that we have been discussing in the Lords and you have been discussing in the Commons over these last weeks on energy market reform are, on the whole, steps in a good direction. I said earlier in our discussion that these had been somewhat queried or undermined by, for example, returning to possible reviews of the Fourth Carbon Budget, a suggestion that we might be rolling back green levies and so on. I think a good direction is being undermined by uncertainty and Government-induced policy risk, which has been generated by the current discussion. There is a risk of going backwards, but that risk of going backwards is itself damaging because it is choking off investment.

Q38 Graham Stringer: Is it not a fact that we are going backwards? If you look at the United Kingdom's or Europe's carbon footprint, it is increasing and has increased over the previous summer and a lot of the debate talks about emissions. Emissions have gone down but overall, when you look at consumption plus emissions to work out the total carbon footprint, it is going up. One of the reasons for that is that we are importing goods made in China and India and other places, so the overall carbon budget is increasing. Does that not indicate a failure of the policies?

Professor Lord Stern: We were just discussing earlier, along the lines of the discussions with Mr Lavery, that in the last year or two the use of coal has gone up in the UK and that has led to an uptick in emissions and we discussed why that had happened. It is not just the story of imports.

Q39 Graham Stringer: Overall, though, over a 20-year period, emissions are down, are they not?

Professor Lord Stern: Yes, they are.

Q40 Graham Stringer: But imports are up. We are effectively subsidising Chinese imports, are we not?

Professor Lord Stern: I have already given an initial answer to that question in the discussions with Mr Lee. I think that having a consumption-based measure, along the lines you are describing, and an output-based indication of emissions from a country would be

valuable and I think it would be an advantage to set those numbers side by side. If low-cost manufacturing moves out of your country into other countries but you are still consuming those products, then in thinking about the emissions that you are responsible for, that would be one part of the story. I can only reiterate what I said in my answer to Mr Lee. I think both of these measures are of interest and the fact that emissions go up on a consumption-based measure is directly relevant.

Q41 Graham Stringer: I think we agree on that, but isn't the point that the current policies are producing negative outcomes in terms of what is required and do you not think we should look at them in that context?

Professor Lord Stern: I certainly think we are not doing enough, and I think in the last few years there has been a real risk of going backwards. I would be in favour of an intensification of the policies.

Q42 Graham Stringer: It is not a matter of not doing enough. It is doing the wrong things, is it not? If we are exporting—

Professor Lord Stern: Looking for a carbon price, looking for energy efficiencies, investing in R&D—those are not the wrong things. Over the medium term, some kind of border adjustment for differential approaches to policy on carbon in different countries would be appropriate. If we are talking 10 years down the track or 20 years down the track, for China or the EU to say that if some country is exporting to it and that country has not properly priced for carbon, then there is a case for a border adjustment there, a tariff to take into account their inability to price carbon.

I think we have been following sensible policies. There is a risk of backtracking. The Government, through the risk associated with the internal quarrelling and the reviews, is undermining the story, as I have emphasised a number of times in this session, but I do not think we have been doing the wrong thing. I think we have not been doing things strongly enough and we have not been clear enough in that approach, which means that we have been going too slowly.

The risk that you point to associated with imports from other countries is best tackled by thinking 10 years or so from now and announcing now—this would have to be a Europe-wide thing—that we will be planning to impose a border tariff, which would be entirely justified in my view under WTO rules, to take account of dirty policies elsewhere. You might find that China, as it is moving strongly, might end up making the same statement.

Q43 Graham Stringer: You have been very strong in your *Blueprint* paper and in other places saying that we should spend more money on research, I understand.

Professor Lord Stern: Yes.

Graham Stringer: You say that 1% globally should be spent on research. Following the current policies, according to Liberum Capital, over the next 16 years we are going to

spend £226 billion extra in the way we produce electricity than if we continue to produce electricity as we are doing now. You may or may not accept Liberum's figures, but it is going to be a lot of money. Do you not think it would be better to spend a much larger percentage of that money on research now to get us into the next or the next-but-one generation of renewables, rather than going into technologies that are immediately very expensive?

Professor Lord Stern: I cannot comment on those figures because I would need to look at them and there are so many figures that do come around, some well-founded and some much less well-founded, but you did suggest that these are extremely expensive and I do not think that is right. I refer you again to the calculations of the Climate Change Committee, who suggest that in the remainder of this decade the overall dual bill, electricity and gas, might go up by £100 or so—8% or 9%—as a result of those policies and that quite a lot of that, perhaps all of it, could be offset by energy efficiency. I do not accept the “extremely expensive” language that you have used.

What I would argue, however, and I think we agree strongly on this, is that we are under-investing in R&D. To improve investment in R&D you need direct involvement in the R&D itself, but in many cases you are going to encourage activities through private market incentives. For example, feed-in tariffs have been used in different parts of the world for solar and they have encouraged enormous technical progress in solar. I am making a distinction here between R&D in which, I agree with you, we should invest much more but, in addition, I am making the further point that things like feed-in tariffs allow experience and learning on the job and moving to scale. That is what we have seen in solar, where the price per kilowatt hour of a solar panel has dropped by a factor of five or six over the last seven or eight years. That has not been narrow R&D in the sense that people sometimes talk about it. That has been learning by doing, experimenting, the hard grind of engineering and so on.

The same is true with the very big improvement in fuel efficiency of cars. An awful lot of that has been the hard grind of the engineering, learning by doing, but encouraged by emissions standards in the US and Europe and elsewhere. It seems to me we need both the R&D in the narrow sense but also the encouragement to learn by going to scale, learning by experience.

Q44 Graham Stringer: I think £226 billion is a lot of money.

Professor Lord Stern: I would have to look at—there are so many numbers flying around.

Q45 Graham Stringer: I accept you have not seen these particular figures, but—

Professor Lord Stern: I have seen the Climate Change Committee and they are a serious group.

Q46 Graham Stringer: Yes. I have not seen those figures.

Professor Lord Stern: I suggest you focus on that, as well as those.

Q47 Graham Stringer: You talk about how one of the reasons why these figures are not as large is that you can get benefits from energy efficiency. Professor Dieter Helm in his book *The Carbon Crunch* is highly critical of your reliance on McKinsey's figures in the *Blueprint* book and says that there is very little evidence that those efficiency savings will take place. He is quite scathing about that analysis. I am sure you have read Professor Dieter Helm's book. I would be interested in your response to his criticism.

Professor Lord Stern: One of the joys of academic life is people have different views, and I interact quite a lot with Dieter Helm. I think he is too pessimistic on that front. McKinsey's is not the only source. If you look at the International Energy Agency, for example, which is a very serious outfit in this area, they are quite clear and strong about energy efficiency. There are many other studies, so the idea that I just rely on one is not one that I would accept.

Q48 Graham Stringer: No, I think he says you over-rely on one. His essential point is that—

Professor Lord Stern: You can collect together many more studies on energy efficiency.

Q49 Graham Stringer: His essential point is that if there was so much efficiency there, if it was like picking up pound notes or dollar notes off the sidewalk or the pavement, the private sector would have gone in and done it, but it is more difficult to get those energy savings both in the domestic market and in the Government sector.

Professor Lord Stern: I disagree with that. If you look at what happened, say, to a big American firm like DuPont, they decided to have a very strong focus on energy efficiency and they found a few billion dollars a year. The idea that everybody always explores all the opportunities that are open to them and relentlessly, with full information and magisterial computing abilities, always searches out ways of reducing costs is not something that I would accept. You see in many firms that a very strong focus on energy efficiency produces strong results. We have seen many times that the imposition of emissions standards, for example, often in the face of complaints by car companies, turns out to generate quite a lot of energy efficiency. I do not accept the idea that if you see a £20 note on the street it must be counterfeit, otherwise somebody would have picked it up. That is cheap economics, I think.

Q50 Graham Stringer: Thank you. Just two last questions, if I may. Bjørn Lomborg has recently published work saying that your analysis, among others, overestimates the negative impact of global warming and underestimates the benefits and there are a number of immediate benefits, the most obvious being less people dying in the winter if it is warmer, but there are other benefits from global warming. What would be your comment on that?

Professor Lord Stern: Bjørn Lomborg is an entertaining read, but it is not serious scientific research. If you look at Working Groups II and III, which are impact and policy from the IPCC, you will see the kind of overall effects that they describe as deeply worrying. We are risking going way outside human experience, as I described before. The

reasons for living where we do, which are associated with rainfall, ports, rivers, sea levels, North Indian monsoon and so on, could be radically redrawn over a period of five, 50, 100, 150 years, some effects coming sooner. That is the scale of the effects we face. You will maybe find a few benefits here and there to some places for a while, but those things, for any rational judgment, are way smaller than the kind of risks and the much bigger picture that we see.

Chair: I know we are running slightly late, but if there is time for one more set of questions—

Professor Lord Stern: I have to go and chair a meeting of the British Academy.

Q51 Albert Owen: I will be very brief, and apologies for not being here at the beginning. Moving on to the European Union emissions trading scheme, is the price collapse of the ETS simply down to poor politics?

Professor Lord Stern: Down to what, sorry?

Albert Owen: Poor politics.

Professor Lord Stern: Partly. Poor economics also. Basically, you would expect the price of an emissions permit to be influenced by supply and demand, and if you fix your supply on the basis that the economy is likely to grow and the economy does not, then you are likely to have an excess supply and the price is likely to fall. They should, in my view, be withdrawing some of those permits to sustain the price and they should be going for stronger targets in 2030.

Q52 Albert Owen: True. Wasn't over-allocation in the beginning part of the problem?

Professor Lord Stern: You could argue it was over-allocation in the beginning also, but basically there are too many permits in relation to history and in relation to a recession, and that is poor economics, I think. Politics, of course, kicks in when you try to do this and then there will be a number of vested interests who protest, as they have done, but I think it is a failure of economics and a failure of politics.

Q53 Albert Owen: Do you think Britain's introduction of a carbon price floor of its own is helpful?

Professor Lord Stern: I think it makes sense in giving a clear sense of direction as to where we are going. As I have argued a number of times in this session, it is policy risk that has been inhibiting investment. If you do not have confidence in where the Government is going and where policies are going, it makes investment difficult.

Q54 Albert Owen: Is it sensible economics?

Professor Lord Stern: I think so. I have tried to set out that it gives you clarity in where you are going and it emphasises that the medium-term story, which is what we have to be looking at and which I think most sensible people would recognise is where we have to go, is indeed where you intend to go. In that sense, I think it is good economics because it is giving confidence about the direction and that direction is itself sensible.

Q55 Albert Owen: Back to Europe. If the EU countries cannot come to an agreement on the effective cap and trade system, what hope is there for a global system?

Professor Lord Stern: You have to look at experiments with cap and trade elsewhere. There are seven provinces in China that have embarked on that experiment, so let us see how that goes. You have regional trading schemes in California and in north-eastern United States and we have to hope that the European Union will get sensible about the emissions trading scheme. What I would like to emphasise and what I have emphasised earlier is that many countries are getting on with it, so you do not necessarily have to rely on one all-singing and all-dancing world carbon market.

Q56 Albert Owen: Wasn't everybody looking at Europe at one time and we were the frontrunners and now we have messed up? What kind of message does that send?

Professor Lord Stern: We did mess up and it is a bad message.

Albert Owen: Good. Good answer. As I say, there is a good message in that. I think I am finished.

Chair: Thank you very much for your time. I think there were a couple of exchanges where you felt you might want to write to us with your analysis of the figures that were given. That would be helpful.

Professor Lord Stern: I will check back over. Not many, but I hope the two people on your left will point out where they think that is necessary.

Chair: Yes, the Committee will write highlighting those. Yes.

Professor Lord Stern: Yes. I would like also to say that I do hope that Tim Yeo's issues are resolved quickly. I have interacted with him quite a lot over the years. Thank you, Sir Robert, for the chairing of the meeting.

Chair: Thank you and I hope we have not held you up too much.

Professor Lord Stern: That is all right. It was explained to me that I was one of the very small category of people who did not have to come, as a Member of the other place, but I am happy to be here.

Chair: Thanks.

