Economy Committee – 24 June 2014

Transcript of Item 8: Investigation into Climate Change Risks to the London Economy

Jenny Jones AM (Chair): Welcome to our guests. We have Juliette Daniels, who is with the London Climate Change Partnership (LCCP); Nick Beecroft from Lloyd's of London; Daniel Dowling, Assistant Director of Climate Change and International Development from PricewaterhouseCoopers; Professor Chris Rapley, Chair of the LCCP; and Professor Samuel Fankhauser, Co-Director of the Grantham Research Institute on Climate Change at the London School of Economics (LSE); so welcome to everybody.

What are the general risks posed to London's economy by climate change?

Professor Samuel Fankhauser (Co-Director, Grantham Research Institute, LSE): We have, of course, in the UK the Climate Change Risk Assessment (CCRA). The UK is one of the countries that has a legal basis to think about the impact of climate change and every five years we have to look at the CCRA.

If we look at the first CCRA, which is now about two years old, the sorts of things that are in there as the key risks to the UK - it does not necessarily go into London - are flooding and drought, so either too much water or too little water. There are issues related to international impacts that are probably not so much in the CCRA but are clearly important to London because London is such a cosmopolitan place. Impacts across the globe through travel, cultural links and supply chains get imported into the country and into a place like London in particular. Heat waves are in there as a health risk. It is true that mortality in winter is still a lot higher than mortality in summer, but the balance is gently tilting as the climate is warming. Those are the main risks.

Opportunities I have already mentioned: fewer cold-related deaths and there is some speculation that agricultural yields might go up. That is good for farmers, but because globally yields will go down, agricultural prices will go up, so it is not necessarily good for consumers.

Jenny Jones AM (Chair): On the international aspects, can you see that this competition for resources that you are implying could lead to other disturbances?

Professor Samuel Fankhauser (Co-Director, Grantham Research Institute, LSE): People write about it. There is literature emerging and it is striking that in the security community, including in the United States of America (USA), the security business, the army and Homeland Security are starting to look at the potential risks of climate change related to unrest and migration.

I would not say the evidence is very strong on that. There is some evidence. I have just read a PhD thesis from a student we have that creates a link between the French Revolution and climate change back in the 18th century, so there is some evidence coming but it is not very strong. It is certainly a risk that one should keep an eye on.

Jenny Jones AM (Chair): Can we learn from New York? They have done some extensive thinking about this.

Professor Samuel Fankhauser (Co-Director, Grantham Research Institute, LSE): I think they are learning from us as much as we learn from them, so I cannot say whether one is leading the other. They have

had a lot of experience after Hurricane Sandy in terms of emergency responses and just how prepared they were. However, I have not done a comparison between New York and London, so I could not tell you where the clever bits were in each of the towns.

Jenny Jones AM (Chair): Do you think that adaptation is going to be necessary?

Professor Samuel Fankhauser (Co-Director, Grantham Research Institute, LSE): Absolutely. If you look at all the climate projections, the most proggressive outcome that people talk about is 1.5°C warming. The standard that people talk about is 2°C warming. We are currently on track for something between 3°C and 5°C. Whatever the number is, we have to adapt to the amount of warming that will be there.

Jenny Jones AM (Chair): What benefits can adaptation give us?

Professor Samuel Fankhauser (Co-Director, Grantham Research Institute, LSE): The benefit-cost ratios are actually quite high. In the UK, a number that I find quite striking is that the benefit-cost ratio of flood defences is at least 8:1. The Treasury or the Department for Environment, Food and Rural Affairs (Defra), whoever makes the decision, does not approve flood defences unless they have a benefit-cost ratio of 8:1. They are all incredibly cost-beneficial.

Other measures like saving water have an immediate and obvious benefit in terms of cost savings. There is probably a bit of an adaptation industry; somebody has to provide all the heat-resistant crops, the cooling systems, the engineering. There is an industry there but, to be honest, it is tiny at the moment.

Jenny Jones AM (Chair): Perhaps I could bring Chris in as well. Which sectors of London's economy are the most vulnerable to this sort of thing?

Professor Chris Rapley (Chair, London Climate Change Partnership): The evidence is that it is the small and medium-sized enterprises (SMEs), who I am told represent over 90% of the business in London; so that is quite a significant issue. The point is the extent to which they have either the capital, the time or intellectual capacity, if you like, to think through these rather longer-term strategic issues when they tend to be living more hand-to-mouth, perhaps, than some of the bigger companies that can take risk management in a deeper and more profound way.

I wonder if I could just come back, to add a couple of things to Sam's [Fankhauser] comments, which I agree with completely. The one area I do think we need to bear in mind and is often forgotten because it is rather longer-term, is the slow sea-level rise, the slowing shifting averages and temperatures and so on. What you find is that many companies - and you know that it is good when the finance director is enthusiastic - are seeing an advantage in making themselves more resilient to the climate system with which they are already confronted. This is either through the direct effects - Heathrow airport, for example, learning that because things are becoming more variable, it needs to have a lot of snow equipment as well as coping with the fact that its runways will melt in the summer - or the way that companies feel climate change elsewhere around the planet in terms of supply chains. Many companies are already feeling that. For example, the extreme heat wave that hit Russian potato production a few years ago had a big impact on UK companies that suddenly had to source those from elsewhere not only that year, but the seed potatoes were gone for the next year. It caused that whole market to go into a bit of turmoil.

It is these slow, impacts where one has major infrastructure projects, that one has to start taking into account now in the engineering design. Crossrail, for example, is installing, at massive cost, infrastructure which will be around, one imagines, for at least 100 years or more. It somehow or another has to take into account not only

what it experiences now, but what it is likely to experience in years to come. It also has to justify expenditure which on the face of it now may not seem easy to justify but which, with the predictions we have, we know has to be invested in in the future.

There is a third area associated with that and it is sort of 'blight'. If changes are taking place, let us say, on the timescales of the leases of the major properties which are part of the investment background that London's economy is based on, you could envisage rapid changes in response to slow predictions. If the market became spooked about the value of certain properties because on the timescale of their lease they might become worthless through flooding, heat or whatever, you could get a sudden shock into the system which is completely unpredictable but quite possible and plausible. This gets quite nuanced and subtle and has to be thought about quite carefully.

Jenny Jones AM (Chair): We are going to come on to businesses and so on in a minute, but I am just thinking about the financial sector. Presumably, it is not just about housing, the financial sector and the impact on assets that are at the moment held could be quite significant, do you think?

Professor Chris Rapley (Chair, London Climate Change Partnership): I think so. I will give a non-London example. Twenty years ago, either Munich Re or Swiss Re decided that it would not invest in or pick up reinsurance business in the Low Countries, not because it had calculated that there was a higher risk of inundation but because they could not calculate what the risk of inundation was and the uncertainty was sufficient. Being an actuarial-based organisation, they had plenty of business elsewhere where they could calculate the cost. I am just trying to underscore the fact that there are some very subtle things that can happen, but they can have a big impact.

Jenny Jones AM (Chair): Would either of our business guests like to come in on this?

Daniel Dowling (Assistant Director of Climate Change and International Development, PwC): I would like to pick up on a couple of points, if I may, particularly on the international threats and opportunities that Sam [Fankhauser] mentioned, but we also need to consider the supply chain impacts on business in London. I think the situation is far more severe than that. London, as a globalised city, is importing a great deal of risk through financial services and through the supply chains of our largest businesses. I accept that small and medium-sized enterprises (SMEs) are most vulnerable, but if we are looking at the total economic risk to London's competitiveness, I would be very concerned about what the financial services sector and our large fast-moving consumer goods (FMCG) and retail companies are doing about this.

The issue there is that our understanding of physical risks in the UK is reasonably good and we have the capacity to respond. Those risks that we import from abroad, we have far less control and understanding over. That is an issue we are yet to grapple with, yet to quantify in any way and really yet to understand fully, partially due to some of the subtleties but for other reasons, too. We need to differentiate a bit. That is just one part.

I also think we need to start monetising the risk to understand the investment decisions we can make in response. We are currently exposed to a significant amount of risk and in future we would expect climate change to magnify some of those risks, but actually understanding that risk profile is the issue here for London.

Nick Beecroft (Emerging Risks and Research Manager, Lloyd's of London): I would echo those points. On the supply issue, from the point of view of the insurance industry, which is in the business of transferring those risks, we have seen supply chains become increasingly vulnerable to shocks, which are very often driven

by extreme weather events. The Thai floods in 2011 are the perfect case in point where business parks had been built on flat, cheap land, which equals a floodplain.

What we are doing is trying to develop risk transfer solutions for globally connected supply chains. We are finding that devising those solutions is becoming increasingly difficult because the exposure to, in particular, extreme weather events, we are finding very, very difficult to project forward based on the historical data we have.

That builds into the second point, which has already been mentioned when talking of Swiss Re, Munich Re and so on. In order to monetise risk and to assess risk, we rely very heavily upon modelled outputs. What we are finding is that climate change is fundamentally shifting the foundation that those models are built upon, so we are having to try to build uncertainty into our forward projections.

One example which I think brings out the point is Hurricane Sandy in New York, which has already been mentioned. Research we commissioned with one of the modelling companies suggested that the insured losses from Hurricane Sandy increased by around about 30% due to the 20-centimetre rise in sea level that we have seen around the southern tip of Manhattan since the 1950s; so we are already seeing dollar values emerging from outcomes related to climate change-driven events.

Our challenge is to really try to build that forward-looking assessment into how we price that risk. I would say that is very much a developing area. Our key priority is to enhance our ability to monetise that forward projection of risk.

Jenny Jones AM (Chair): I am curious about your language here because you said you are "building uncertainty into your forward projections". I thought you might have used a word like "flexibility", but it was "uncertainty".

Nick Beecroft (Emerging Risks and Research Manager, Lloyd's of London): Yes. Something that climate change challenges us to do is to be very clear and very mature about the level of uncertainty that is built into our decision-making, because we are inevitably trying to project forward. That means it is an assessment and that means we need to be very honest about the level of uncertainty we are seeing. In terms of planning and so on, it almost certainly leads to flexibility.

Jenny Jones AM (Chair): Nobody has said anything that anybody disagrees with so far?

Professor Chris Rapley (Chair, London Climate Change Partnership): The only thing I would add is that it is really important to understand that there will always be irreducible uncertainties in the ability of the climate science community to provide advice and predictions on what any region like London may experience. One knows qualitatively. We have already been through the list of things that the city is likely to experience, so we know in general, but to be explicit about exactly what level of sea-level rise or exactly what temperatures it has to cope with is very difficult. Although the science community is always very keen to continue working to, quote, 'reduce uncertainties', the truth of the matter is that it often actually increases uncertainties. It increases knowledge, but it also increases uncertainties as it discovers that things are more complicated than it ever thought they were.

One of the things I have been very impressed by is the Environment Agency's Thames Estuary 2100 plan, which takes a decision pathways approach. It says, "We know this is going to be uncertain, so let us start from that and work backwards. When do we have to make decisions and, when we make those decisions, can we make them in such a way that if we subsequently discover things are worse or better than we thought, we can

adapt accordingly?" This is seen and admired from around the world. This is one of the things that London has managed to do and gain a reputation for. It cuts that Gordian Knot of paralysis that people confronted with uncertainty often suffer. It says, "OK, let us just accept the uncertainty. Now, how are we going to deal with it in a practical way?"

Juliette Daniels (Partnership Manager, London Climate Change Partnership): I would like to highlight one aspect of the impact on the economy that we have not yet touched on: the benefits to the London economy that could be brought by selling our adaptation services worldwide. London's low-carbon and environmental services sector was valued last year at approximately £25.4 billion and it is a sector that is growing and there is great opportunity for increasing London's market share worldwide.

We are actually working with the Greater London Authority (GLA) at the moment on a project valuing London's adaptation economy. One of the things we are going to do with that project is to understand what interventions we need to take to make the most of those opportunities worldwide. We know that there are other cities already out there selling their adaptation services. Cities like Rotterdam and New York are putting a lot of effort and a lot of governmental support behind selling those services. As Chris [Rapley] says, London is recognised as a leader in adaptation, but perhaps could do more to promote that.

Jenny Jones AM (Chair): You talk a lot about adaptation. What about mitigation measures? We could sell those as well, surely.

Juliette Daniels (Partnership Manager, London Climate Change Partnership): Absolutely. That is an established and growing market.

Professor Samuel Fankhauser (Co-Director, Grantham Research Institute, LSE): Just to add a bit of nuance, there is an adaptation economy or a resilience economy. I have three observations on that. As a contribution to the overall economy, it is still very, very small. Over the last couple of years, however, it has grown faster than the economy as a whole, so that is good news.

Jenny Jones AM (Chair): It is a good investment?

Professor Samuel Fankhauser (Co-Director, Grantham Research Institute, LSE): It is a good investment. Then there is a 'but' again to finish it. Other countries' adaptation economies have grown even faster than ours, so it is a case of looking at UK Trade and Investment and the various bodies we have that promote UK business to see whether there is an opportunity there or not.

Jenny Jones AM (Chair): Thank you.

Fiona Twycross AM (Deputy Chair): I just wanted to ask a little bit more about importing risks. Presumably that is around where things are produced and where services are outsourced?

Daniel Dowling (Assistant Director of Climate Change and International Development, PwC): Yes. There are two things which I would tend to separate.

One is investments abroad and the very difficult problem of trying to assess and quantify the level of risk within an investment portfolio where you have 25% of this and 5% of this in all sorts of areas, often through brokers and tiers of financing with all sorts of different financing structures. That is very difficult to unpick.

For the financial services sector, it is more about understanding what they can about the criteria for investment they would use and their overall investment strategy around how to manage the balance of investment in long-term assets, which have both these chronic risks and also big physical shock-related risks from disasters. Additionally, supply chain risks, which are manufactured goods, products and food items, will be subject more to supply interruption and price volatility.

Therefore, there are two different packages of risk which we are completely interdependent and interconnected with as London. I just do not think we understand the scale of that issue.

A piece of work we completed for Defra last year looked at this issue quite generally with the threats and opportunities for the UK in terms of the international climate change circumstances. We certainly concluded those international threats are likely to be larger than our threats at home. Getting some tangible facts around that would be the next step.

Professor Samuel Fankhauser (Co-Director, Grantham Research Institute, LSE): Could I perhaps add something to that? The Adaptation Sub-Committee is looking at supply chains this year and we will report in about a month's time.

I guess I am allowed to give you a little bit of a sneak preview. Some of the preliminary results that are coming out of that show that our supply chains go through everywhere on the planet, including some very, very vulnerable countries. It tends to be that it is the far end - the beginning - of the supply chain where most of the risks are and most companies are only managing the first couple of stages of the supply chain, so the bit with the risk is actually not managed very well.

Fiona Twycross AM (Deputy Chair): Because they cannot manage it or because they are not actually looking at managing it?

Professor Samuel Fankhauser (Co-Director, Grantham Research Institute, LSE): It is probably a combination of the two. If you remember the horsemeat [scandal], we figured out just how complicated those supply chains are and nobody really understood them. What companies tend to understand is who their supplier is and perhaps who the supplier of their supplier is, but beyond that it becomes too messy. The risks are beyond that.

Fiona Twycross AM (Deputy Chair): Thank you.

Murad Qureshi AM: Adaptation is interesting. I can think of only one adaptation we have made and that was actually, thankfully, the Greater London Council (GLC) with the Thames Barrier. What other things are we selling? I do not know. I just cannot think of anything else. Last night we had a very good report from the Environment Agency and the London Waterways Commission about the extent to which the Barrier is fit for purpose. It certainly is for tidal flood risks but not necessarily for river flood risks.

Juliette, could you just extend your comments about us being able to sell what we have learned through adaption in London abroad?

Juliette Daniels (Partnership Manager, London Climate Change Partnership): The Thames Barrier, as you rightly point out, was built to protect against tidal flood risk and not fluvial. That was actually a benefit that they discovered they could do after they built Barrier and is an added extra. The Thames Estuary 2100 programme, as you know, looks at risk up to 2100 from tidal flooding.

There is a lot else that we are doing on adaptation in London. There is the GLA's Drain London programme, which has looked at mapping surface water flooding and interventions to reduce that risk, which is actually much more diffuse and much less known about generally by people in London. Because you have this big, iconic Barrier, it is very easy to relate to, but a lot of the other risks are less easy to understand.

From a LCCP perspective, we have done a lot with the health sector on mapping and understanding their risks with climate change, not just direct risks to health but also risks to the health services and their provision of services in London.

We have done a lot of work with other organisations to understand interdependencies. The LCCP itself is a model that we have exported to other cities such as Toronto, Durban and New York because it brings in partners from other sectors who are not obliged by law to work together on adaptation but do so because they see benefits in it. It is actually an innovative way of drawing together the city as a whole through champions in different sectors, to understand their risks and understand what risks they rely on in other sectors.

Murad Qureshi AM: The Thames Barrier, quite honestly, is the most important legacy that the GLC left and let us be grateful for that. I am not sure that we at the GLA can lay claim to that.

Subsequently, if we are selling abroad, it is in a context. Internationally, Daniel, you mentioned us possibly selling these adaptations. The reality is that the developed world has reneged on its Kyoto agreement commitments, extending them from December 2012 to December 2020. Can we really be in the business of selling that when we have reneged on those commitments?

Daniel Dowling (Assistant Director of Climate Change and International Development, PwC): I will not comment politically on what has taken place around the negotiations.

Murad Qureshi AM: That has happened, though. You are not denying that we have actually extended the goalposts for those targets?

Daniel Dowling (Assistant Director of Climate Change and International Development, PwC): They need to be reframed, perhaps, in the context of what is possible and achievable as a global society, not just as the UK. We have held quite a good leadership position right from the beginning of not just Kyoto but the entire United Nations Framework Convention on Climate Change (UNFCCC) process. We are seen as a leader. It has helped us develop mitigation and adaptation-related services and products. We are in a pretty good position, but that is just a personal opinion.

On adaptation services, we are going to have to adapt anyway. Yes, there are the really important issues of carbon emissions, greenhouse gas targets, etc. We are going to have to adapt anyway. Some of the services we can export are the quality of our engineering services in this country and the quality of our consulting and advisory services, which are two industries that are already well ahead on this stuff. Adaptation services are not always about big pieces of infrastructure that you replicate abroad. That is one way of doing it, but actually what you do is to replicate the design and services behind that abroad. The actual infrastructure and construction may well take place via a local contractor. Our water industry is world-renowned and there is some great experience there to export as well.

We have to understand that adaptation is a very integrated and mainstreamed issue. It is not like renewable energy, where you can pick big bits of infrastructure, invent technologies and export them. There are adaptation technologies, but a lot of adaptation is around adjustment and adaptation of the actual core infrastructure, built environment and management of the natural environment. It becomes about tweaking all

the different parts of a system to build its resilience and that is why some of our service industries are actually extremely well placed, as well as our technology.

Murad Qureshi AM: The point I am trying to make, Jenny, is that there is a difference between what nation states sign up to and what cities can do. Actually, city states should be signatory to subsequent climate change agreements. Let us hope we can push that here.

Jenny Jones AM (Chair): We might be hearing from the C40 Cities Climate Leadership Group (C40) at some point in our scrutiny. Daniel mentioned the carbon reduction targets that we have signed up to. What happens to all the assets, oil and gas and so on? Are they going to be stranded? What happens if we cannot use them? What is going to happen to their value?

Daniel Dowling (Assistant Director of Climate Change and International Development, PwC): I am not going to offer great insight just now, other than to say that the stranded assets issue is well recognised at the moment and there is a movement underway to try to understand better how to manage those. There are obviously expensive technology solutions, in many cases, carbon capture and storage and those types of technological solutions. How to manage the relative decline in fossil in terms of assets over time is clearly a major challenge.

Jenny Jones AM (Chair): It is interesting. People often do look to technology and not to reduction.

Professor Chris Rapley (Chair, London Climate Change Partnership): There is a strong divestment movement underway in, for example, universities and other organisations where the membership of students and staff can apply pressure when they are taking decisions about whether they divest themselves of assets that have carbon associated with them in one way or another. This is an evolving and really interesting story because it is certainly true that the supposed carbon holdings of major carbon companies might well prove to be less secure than they have imagined up until now.

Professor Samuel Fankhauser (Co-Director, Grantham Research Institute, LSE): Can I say something positive about that, or try to, anyway? It is true if you just do the basic atmospheric physics that we can burn about one third of currently known reserves and then the atmosphere is full, which means two thirds have to be written off in one way or another. The good news, in a sense, is that this is now fairly well known by many people, including many investors. I would not say it has fully sunk in, but I talked to Shell, for example, a couple of weeks ago. They are fully aware of that. They crunched their own numbers and have come to different results, but that is fine. They are aware of the risk and manage the risk.

In a sense, why is that good? It is good because we can then have an orderly divestment. The thing that we do not want is that we wake up one morning and figure out we have to write off two thirds of the balance sheets of those companies because that would be ugly. If you can do it over time and realise how it is going, you can have a more orderly unwinding. That would be important.

Jenny Jones AM (Chair): Just to go back to my original question about the size of the risk, Nick, I understand Lloyd's has done a lot of work on this. Would you like to comment on where it comes as a risk on your list of risks?

Nick Beecroft (Emerging Risks and Research Manager, Lloyd's of London): Climate change represents, from our perspective, possibly the biggest impact emerging risk we look at for two reasons. We have already talked about changing patterns and extreme weather events. From an insurance industry point of view, our exposure to natural catastrophes, both directly and indirectly through effects on things like supply chains and

investment portfolios, represents one of the biggest single losses that can be incurred to our industry and to our clients.

We have already touched on some of the broader effects, like the potential for disruption to food systems and the potential for it to drive things like political violence. This means that climate change has the potential to act as a threat-multiplier for us. It does generate a range of opportunities in terms of innovating new forms of risk transfer, but it certainly also has the potential to multiply threats across our entire portfolio.

In that sense, it really challenges us. I have already talked about the forward-looking requirement here. It challenges every aspect of our business. It really does present probably the most pressing test of - and I mean this as the financial services industry - our claim to be innovators. Climate change is probably the most acute test of that challenge to innovate that we face.

Dr Onkar Sahota AM: I want to explore the existing strategies businesses have to deal with resilience. What specific steps are London businesses taking in relation to climate change?

Professor Samuel Fankhauser (Co-Director, Grantham Research Institute, LSE): I have two observations. One is that more often than not, they do not call it 'adaptation to climate change'. They call it something else. They call it 'business continuity'. They call it 'risk management'. They call it 'supply chain management'. A fair amount of larger companies are certainly engaged in that line of business. The data is not always there because this is such an area of competitive advantage that you do not necessarily want to tell the world how well you manage your risks. It is inherently quite hard to understand what is going on.

We have some indicators. The number of firms that have signed up to the Environment Agency's flood warnings, for example, is going up. It is plateauing, but it has gone up. The number of companies that have business continuity plans is increasing. With SMEs a bit less so than other companies, but that is continuing to happen. Investment decisions mostly in infrastructure tend to be more climate-aware, so we are seeing aspects of that.

It would be completely wrong to say that companies are fully aware and fully alive to the issues. There are other things that do not happen. Property-level flood protection, for example, is still something that does not happen a lot. Permeable paving and sustainable urban drainage systems are still very few. There are a lot of things that there should be more of, but we cannot say businesses are doing nothing.

Dr Onkar Sahota AM: What is driving this change?

Professor Samuel Fankhauser (Co-Director, Grantham Research Institute, LSE): One of the differences between adaptation and mitigation is that adaptation is in your self-interest. You do not like your supply chain interrupted. You do not like to get flood damage.

Dr Onkar Sahota AM: Are things like national adaption plans some of the drivers that are making businesses appreciate what needs to be done?

Professor Samuel Fankhauser (Co-Director, Grantham Research Institute, LSE): It is a source of information. The UK National Adaptation Programme is probably mostly directed towards the public sector as a co-ordinating instrument. It is not an exercise in central planning to tell everybody what to do. What it does do, however, is raise awareness and businesses start to pay attention. In an ironic way, the last winter has certainly helped to raise awareness of some of those issues and businesses are responding to that.

Professor Chris Rapley (Chair, London Climate Change Partnership): Could I just add my experience of seeing businesses that are taking adaptation seriously? As Sam says, they often do not broadcast this because there is a competitive advantage, but also quite often they feel they are so far ahead of their consumers and customers that it is not something that is necessarily in their interests to broadcast too much.

The reason that it works so much more easily for adaptation than perhaps mitigation is that the finance director can see an immediate return on the investment, because most companies feel the impact of climate variability or climate change in one way or another. The investment already increases resilience in a measurable way in the immediate term and in the short term. Small, incremental steps in terms of imagining or investigating how these threats are likely to magnify again can be justified in a sensible business plan that everybody recognises more or less as business-as-usual. That is much easier than trying to jump forward 20, 30, 40 or 50 years and figure out how you need to adapt, which again tends to paralyse people.

The other co-benefit that I hear many companies report is that when they do this, firstly, they often find that what they thought was going to be a cost turns out to be a benefit because there is improved efficiency, lower costs and so on. Secondly, you hear so many of them talking enthusiastically about the impact on staff morale, reduced staff turnover and reduced staff absenteeism because the workforce feels it is part of an organisation that has a larger-than-self outlook on the world. That is one of these things that is hard to put in an Excel spreadsheet but has a real impact on the progress of the company.

Daniel Dowling (Assistant Director of Climate Change and International Development, PwC): Could I maybe illustrate this with an example? Two weeks ago, a large UK retailer launched the findings of its first proper and detailed studies into climate and climate change risks across their supply chain. That piece of work tackled the real issue of language and communication and the way a business uses information. For the barriers, unlike carbon emissions, there is no easy metric to capture it all together and quantify it in a nice pyramid of actions. Instead, you have the language of risk, which is less common to people. Once you get outside the insurance piece, which is very well dealt with and again a very good export for us, there is a struggle to understand how the business will make investment decisions. This retailer quantified its risk at detail by product, by country, by month and by year, so it understood its risk profile over time. This was a pilot project to say, "Can we really understand this and do anything about it?" Once that quantification could take place, the information was received by the board, which then felt empowered to make decisions about the business going forward.

It was incredibly powerful. I think they are proud of the work. It has definitely given them a competitive advantage. It has helped them form their business strategy, not to conclude what decisions they would make, but when you are buying food products on a commoditised, horizontal market with spot prices and being fairly opportunistic, it exposes you to the recycled risk in the overall system and nobody has a reason to act definitively. If you create a vertical business model where you understand where you are sourcing from – thinking about horsemeat again – and you are investing in that supply chain in the areas where you know you can manage your risk well, suddenly you are securing your supply because your customers want low-price, available food on the shelves. By creating a vertical business in that respect and by taking ownership of your issues and risks, right down to the poor and vulnerable farmers at the bottom of the supply chain, you are actually getting a competitive advantage.

Some of those points and that sort of language is where businesses need to get to, not just thinking, "This may be a problem for us. Let us improve our general continuity plans".

Dr Onkar Sahota AM: The trend out there is not one of co-operation but one of competitiveness. People are not co-operating with each other on how they cope with the climate challenges, but they see it as an advantage, "How can we keep our thing secret so we can be more competitive?"

Daniel Dowling (Assistant Director of Climate Change and International Development, PwC): It can be. This particular retailer held a press launch two weeks ago and shared their information.

Jenny Jones AM (Chair): Who was it?

Daniel Dowling (Assistant Director of Climate Change and International Development, PwC): It was Asda.

Professor Chris Rapley (Chair, London Climate Change Partnership): Perhaps I could just embellish that. Another major company involved in all sorts of products, particularly food products, was explaining at an event where they were telling other companies about their experience, so they were not keeping it secret. They were passing on best practice. They told a very interesting story. They said they have 10,000 products, each of which probably has 10 supply lines. The bewildering challenge of confronting all of that, given that many of these supply chains have multiple links, caused them first of all to say, "We had better start with the high-volume stuff". Having worked on that for a bit, somebody came into the office one day and said, "I think we are doing this wrong. The thing that differentiates our meat pie from our competitor's meat pie is that special spice that we put in it, which is a very low-volume product but is what differentiates our product from everybody else's".

The point of the story is that once you start getting into this exercise, you learn all sorts of things about how your company really works and it allows you to make a more resilient and profitable company. There is another co-benefit: it is forcing you to analyse things that you would not otherwise have looked at.

Daniel Dowling (Assistant Director of Climate Change and International Development, PwC): In terms of collaboration, there is some competitive advantage and we would expect companies to exploit that in a reasonable way when they can, not to the detriment or impact on others. There are also a lot of shared issues where an industry needs to tackle it together, or geography, such as the Bangkok industrial estates that suffered in the 2011 floods found. If you are all going to suffer together, you all have a motivation to work together, too. It depends. As with all things, with adaptation you tend to need to find contextual solutions, not actual technologies.

Dr Onkar Sahota AM: What about the SMEs? Are they working on this? Earlier on, you were saying that the SMEs are the ones that do not do very well in this area. Is there anything we can do to encourage them? What are they doing about things?

Professor Samuel Fankhauser (Co-Director, Grantham Research Institute, LSE): I would say that it is a hypothesis rather than a proven fact that the SMEs are doing less well. There are some pieces of evidence, like the fact that they are less likely to do business continuity planning.

What can one do to help? The first thing would be to actually understand what is going on. We do not really know it and it would be nice to truly understand what the attitude towards and understanding of climate risks in SMEs is. Secondly, a lot of it has to do with information and the provision of the tools that companies have to use. The third is probably certain incentives that you can give to companies because companies respond to incentives like regulation, differentiated taxation and things like that.

Jenny Jones AM (Chair): I will ask a few questions about what more the Mayor could do at that point, so we might come back to that. Thank you.

Fiona Twycross AM (Deputy Chair): I just wanted to broaden it out briefly beyond the definition of the London economy as just being about business and the financial sector. Obviously, employment in London and the broader economy in London involves universities, the third sector, local government and the National Health Service (NHS), so it is much broader than that. What sort of planning would the non-business, non-finance sector be doing or would that just not be something that is factored into any of their plans at the moment?

Professor Chris Rapley (Chair, London Climate Change Partnership): Sam [Fankhauser] and I represent, if you like, the higher education sector. There is research interest in this and you can look at any of the five major universities in London and find massive activities looking at urban planning through interactions with climate change and basic climate change research.

Fiona Twycross AM (Deputy Chair): I mean the actual universities as employers and as institutions in their own right and for their own business continuity planning, for want of a better word. I know you are doing the research, but is that being translated into the universities themselves seeing it as a risk for the university sector?

Professor Chris Rapley (Chair, London Climate Change Partnership): Yes, within their financial constraints, they are investing sensibly and prudently for the future they know they are confronting.

You may know that I was Director of the Science Museum for four years a few years ago and I can tell you that the building grew like Topsy[1]. The easiest part of the building to bring to modern standards is the most ancient. The 1960s stuff is very heat-leaky and inefficient. There is a major programme of investment in reducing the carbon emissions and improving the energy efficiency of those buildings (a) because it is a sensible business option and (b) because it is an iconic statement to the visitors to the museum that this is something the museum takes very seriously. The other museums in that area are doing the same.

In the theatre sector and the London music sector, there is an organisation called Julie's Bicycle that links together those as a partnership. They, too, recognise the need to invest in both mitigation and adaptation. This is a fairly lively area. Again, in terms of exporting innovative ideas from London, something like Julie's Bicycle is an extraordinary story and one that others are very interested in.

Jenny Jones AM (Chair): Nick, is Lloyd's actually advising a lot of the people you work with? Do you give advice on your climate change planning?

Nick Beecroft (Emerging Risks and Research Manager, Lloyd's of London): Lloyd's centrally does not provide that advice, but the brokers who act as our intermediaries to the clients do work very closely with clients to develop risk management/risk transfer solutions. I would share maybe a personal story. I have been in this particular role only a few months and I have been really struck by the profile of climate change, both adaptation and mitigation, as a priority for the insurance industry.

The industry has no capacity to insure climate change. We cannot continually keep paying the costs of the same climate-driven events generating the same damage. That naturally generates a very powerful financial

[1]Topsy, a character in *Uncle Tom's Cabin* by Harriet Beecher Stowe, who believed she didn't have parents and instead claimed "I spect I grow'd. Don't think nobody never made me."

incentive for all of our discussions with clients about how we can avoid that event generating that kind of impact again. I would say that as an industry we face a very clear market-driven incentive to drive both adaptation and mitigation.

Murad Qureshi AM: Coming back to the area of questioning that Onkar [Sahota] started with existing strategies to improve business resilience, we have touched on the goods and services side. Can we come to the investment portfolios of the financial sector? Nick, can you tell us how the sector is managing the risk of global warming to investment portfolios that may be managed in the City?

Nick Beecroft (Emerging Risks and Research Manager, Lloyd's of London): This is slightly outside my area, but hopefully I can offer you some insight. Again, we come to the point about competitiveness and confidentiality. There is an issue there with sharing of information. The issue of stranded assets arising from disinvestment from carbon has already been mentioned and that is one example of a strategic issue which is starting to directly influence investment strategies. Particularly in insurance - and I think this is true of other industries as well - we are forced and we are regulated to be very forward-looking and to hold capital against quite extreme events. The fact that we are required to remain solvent against extreme events means that we are having to factor into our investment strategies increasingly frequent extreme events. Both awareness of longer-term issues, like the decarbonisation drive, and also the immediate regulatory requirements are starting to shift our investment priorities.

Murad Qureshi AM: I just wanted a few examples. The one that struck me is not actually a climate change one. The Presbyterian Church in the USA has decided to disinvest out of the Occupied Palestinian Territories, but that is an assessment of political risk. Is there something like that where you can show me in an investment portfolio where an investor has pulled out, or is certainly thinking of doing that on the basis of warnings on global warming?

Nick Beecroft (Emerging Risks and Research Manager, Lloyd's of London): I do not think I could, but that is largely because that is outside my area of expertise.

Daniel Dowling (Assistant Director of Climate Change and International Development, PwC): I will try to add a bit of colour. I mentioned the Thai floods in 2011. I am not going to use corporate names here, but there are examples behind my comments. There was a lot of disruption to hard drive manufacturing, which was concentrated in Thailand. There were also food and beverage companies that were severely damaged. The scale of that damage at a regional level, due to a lack of proper planning or understanding of the extreme weather events that could occur, led to some of those organisations choosing to distribute - quite sensibly, I guess - their production facilities from Thailand. The impact there was a lack of continued investment in parts of the Thai economy, so Thailand lost out there. Somebody else gained and the businesses themselves have a more resilient footprint for production going forward, but it obviously affects the dynamic. There were real decisions made. I know one particular factory that was damaged but, even though they were insured, they chose not to rebuild there and did not produce from Thailand again, so it certainly happens in terms of the impacts.

Making the proactive choice to invest or not invest is a slightly different question and probably harder to do. The one example I would perhaps bring up here is the European Bank for Reconstruction and Development, which, albeit a multilateral development bank, is based in the City of London. For all their infrastructure investments, they include a proper assessment of climate and climate change-related risks. That affects not only their ability to lend but the conditions of the lending they will provide. In time, those assets will begin to improve at portfolio level, so I think that is quite far-sighted. We have to remember that a lot of investors hold on to assets for five or seven years.

The problem is that when we are talking about climate change, rather than just climate risk in the current sense, there is a temptation not to take responsibility for that risk and hope it does not happen to you. That is something that is being addressed in the USA through the Securities Exchange Commission, which has a regulatory procedure to require all investors to disclose their climate change-related liabilities. Interpret it as you wish, but if an investor has a major problem as a result of a climate-related event, I think that regulatory process could be used to penalise them.

Murad Qureshi AM: We use this term very generally, 'climate change'. It happens all the time, actually. It is a constant. What we are talking about is global warming. Is that the one that is being factored into investment decision-making in portfolios of investment around the world?

Daniel Dowling (Assistant Director of Climate Change and International Development, PwC): The thing you need to factor in is, in the context, what hazard type currently exists. Say the issue is drought to a hydro dam. I am not particularly interested in a bunch of hazards that do not exist in that location. I want to know the frequency and intensity of drought periods both now and in the future and how my investment will change over time as that risk profile changes over time. It is always a very specific issue that you have to deal with when it comes to being quantitative about risk.

Murad Qureshi AM: Coming back to the Thailand example, presumably that affects me as a consumer if I find I cannot get hold of my Thai beer. Is that the kind of level you are talking about? Breweries are, by and large, in cities and water supplies usually affect them considerably.

Daniel Dowling (Assistant Director of Climate Change and International Development, PwC): There was an interruption to the automotive industry. There were profit warnings from two of the biggest global automotive manufacturers. There was a price spike in the cost of hard drives, which involved a lot of desktop computers. I think the manufacturers actually took the hit on behalf of the consumers, but if that happens all the time, the viability of the business is threatened. Yes, it permeates through to the consumer both in the food examples I gave earlier, if not properly managed, and the same for some of commoditised and manufacturing supply chains, too. Quite how and where those risks will manifest is what we do not know yet and we do not know how exposed London is to that.

Professor Samuel Fankhauser (Co-Director, Grantham Research Institute, LSE): Just to give a tiny example on that, again, the Adaptation Sub-Committee, in our work on supply chains, looked at the representative consumption basket - the one that gives you the consumer price index (CPI), the representative set of things that we consume - and went through the supply chains of the items in that basket and checked which ones are more likely to come from risky places. It is not unexpected, actually. It is textiles, it is food and drink and it is electronics. A large part of the value-added of those products comes from highly vulnerable countries. I forget the exact number but I think it could be all the way up to 20% of the value-added.

Murad Qureshi AM: On a basket of goods for a normal consumer? OK.

Jenny Jones AM (Chair): Daniel, I think you said businesses do not really want to think about the potential impact of climate change. Do you think that is one of the biggest barriers to actually getting businesses to start adapting and mitigating? Do you think they cross their fingers and hope to survive?

Daniel Dowling (Assistant Director of Climate Change and International Development, PwC): No, I do not think it is that at all. The problem is that when they want to think about it, and they do want to think about it, they have poor risk information and they are not very good, or we are not very good collectively, at

building and articulating a proper business case for action. Without the data input, in a sense, and the business case output, rather than relying on core business metrics and drivers, we start relying on leadership and demonstration and examples, which is therefore very important but is not enough. The tools are there. We need to build our capacity, even in London. With all the services and skills we have here, we still need to build better, more sophisticated ways of understanding and responding to these risks.

Professor Chris Rapley (Chair, London Climate Change Partnership): Perhaps I could just add a fairly well-known fact, but it is worth recording.

The scientific community by and large has come to a set of basic conclusions about climate change with which they would all agree: that is that the world is warming and it is incontrovertible that humans are now a major driver and a major factor behind it, despite the fact that of course the climate has always changed, which, by the way, tells you that it is a slightly frisky system. This comment about how the climate has always changed is often used rather dismissively, but it tells you that the climate system is quite sensitive to small drivers. It is actually a warning, not a comforting piece of news. The climate community would by and large accept the fact that there are risks and there are things that we can do about it. Various studies have been done to show there is a 97% consensus. These are argued about endlessly, but the vast majority would agree with certainly the first two of those statements.

The media, however, continues to present the issue as unresolved and controversial and we could talk about why that might be. Research shows that the media takes its cues from the powerful elites and there are still many people in society who are unconvinced about this issue. That does seem to me to offer those who are confronted either at the personal level or at the business level with something which is an additional burden the opportunity to say, "Let us not worry about this now. Let us wait until the issue is resolved". Actually, the issue has been resolved but they simply do not know that. That is an insidious undercurrent in all of this.

Jenny Jones AM (Chair): Thank you very much for saying that because there are people in this very building who do not believe that there is an anthropogenic cause to climate change, so I will clip out the note from this meeting and send it to them.

Fiona Twycross AM (Deputy Chair): I want to talk a little bit about incorporating climate scenarios into adaptation strategies. A lot of these will be based around the 2°C target, which a lot of people would argue is unrealistically low in terms of some of the projections of what actually is going to happen. Should businesses be considering the risks posed by warming above 2°C in their adaptation plans?

Professor Chris Rapley (Chair, London Climate Change Partnership): Yes. Sam [Fankhauser] said earlier that in spite of the fact that after Copenhagen [United Nations Climate Change Conference, 2009], countries came forward with voluntary commitments and the UK has been a leader in this sense. The route we are on at present, if we project it forward, suggests that we could expect 3 to 4°C of warming. Some would argue more. This is very difficult to estimate and these figures are guidelines. They are not exact. However, the fat tail of extreme events, the slightly improbable but hugely damaging ones, is something that one certainly needs to consider.

Perhaps I could just give an example. There is an interesting book that was published a couple of months ago on Fukushima. It is called *Fukushima* and it was written by three scientists. It may very well be that they come from a slightly anti-nuclear background. I do not know, so I do not know if the book is biased or not. If you read the book, what emerges is a rather interesting conclusion. The manufacturers of the power plants, the regulators in the United States, internationally and in Japan, the Japanese Government and the operators all thought through disaster scenarios up to a point and then said, "There is no point in considering beyond that

because that is so unlikely it will not happen". The thing they did not consider happening was a Richter-9 earthquake and a massive tsunami. This meant that when that happened, there was no plan. It was just left to the people on the ground to try to deal with it in real time.

There is an object lesson there that it is very easy for people to be intimidated into feeling that they are, quote, 'being alarmist' when they think of these extreme situations, but not to do so leaves you in a very vulnerable position. The fact that climate change is at present on track for something worse than we would have wished, suggests that people really need to think through these extreme scenarios and figure out what they might do in the unlikely circumstance that they are confronted with them. It would be good practice, it seems to me.

Fiona Twycross AM (Deputy Chair): Is that where Jenny's [Jones] point about mitigation would come in as well?

Professor Chris Rapley (Chair, London Climate Change Partnership): Yes, it is.

Professor Samuel Fankhauser (Co-Director, Grantham Research Institute, LSE): I would agree very much with what you have just said, Chris. There are only two subtleties I would add.

One is the time dimension to it all. Over the next 20 or so years, probably even 25 or 30 years, the climate is pretty much baked in. Our actions that we take now in terms of mitigation affect what happens from 2030 onwards. What happens for the next 15 or 20 years we sort of know, in a sense, so there is less uncertainty over that. That is the first point.

The second point is that when we talk about 2°C of warming, it is a global average. That does not mean it is going to be 2°C everywhere. Over land areas, the warming tends to be a lot more than 2°C. It tends to be the oceans that are cooler and, because you have an average of 2°C, the temperate over the land mass has to be higher.

Fiona Twycross AM (Deputy Chair): Are businesses and national and London government looking at scenarios for over 2°C?

Juliette Daniels (Partnership Manager, London Climate Change Partnership): I just wanted to come in on the point about uncertainty. It relates well to your question. You can fall into a bit of a trap of looking just at scenarios and thinking that you have to pick one to adapt. Actually, if you take a context-first approach and look organisationally at your thresholds and your tolerances within your operations and your organisation, you will have a very good understanding of the types of action you can take in different scenarios without having to know what that future is going to be. A lot of adaptation actually occurs within an organisation or within a system of organisations and understanding how that system works. Then you can adapt to various different scenarios once you can understand that.

Professor Chris Rapley (Chair, London Climate Change Partnership): The Environment Agency has done a terrific job on the Thames Estuary 2100 plan. A question I asked them was: what is the maximum sea-level rise that you could protect large areas of London against? They said that there are 400kms of dikes, there is the Thames Barrier and so on, so you could spend enormous amounts of money to protect up to a certain level, but at some point you have to retreat and you have to abandon certain areas. They were talking about, say, four to five metres of sea-level rise, so this has to be a few hundred years in the future, even at the most pessimistic estimates, although we are seeing the polar regions accelerate in their level of melting, so we may have to confront those.

Going back to that comment earlier about spooking the investment community, if you know that there is a growing danger that some of your assets are at risk on a couple-of-hundred-year timescale, it is not just a flick in the eye geologically or even from the point of view of civilisation. It is actually of material interest to investment communities now. Those sorts of questions are ones that businesses really need to confront.

Daniel Dowling (Assistant Director of Climate Change and International Development, PwC): Could I just answer your question directly, Fiona [Twycross]? Certainly in the work PwC has done with its clients, yes, we consider more than one scenario and I would always recommend looking at a higher emissions scenario which would result in a higher level of warming. You have to understand, what if it is worse than we thought.

Fiona Twycross AM (Deputy Chair): Do you set a figure on what that higher scenario would be?

Daniel Dowling (Assistant Director of Climate Change and International Development, PwC): There is a practical way. You would choose a mid-level and a high-level scenario. We use do a 2°C and a 4°C scenario as a reasonable spread. That tends to align with some of the new emission scenarios that the Intergovernmental Panel on Climate Change (IPCC) has published, so a higher and a median case. In a lower case, it is slightly less helpful to do all of that work because you would hope you will be OK.

The variability that Sam [Fankhauser] mentioned is important. When you actually disaggregate global warming levels to local vulnerabilities and sensitivities in different countries, you are dealing with 4.8°C or 5.6°C of localised warming, even under a 2°C global average. That is why you get real risk numbers. You cannot grow crops in certain locations anymore even under a 2°C scenario, which is not a safe scenario. It is the best case.

Jenny Jones AM (Chair): Of course, there are all sorts of health risks and new diseases that can come in and so on. Juliette, I know your job is to be incredibly positive and to make sure that we see the up side of things, but is this the sort of language that you are using within your partnership: an understanding that although we are working to this 2°C increase, it could be substantially more?

Juliette Daniels (Partnership Manager, London Climate Change Partnership): Yes. Within the partnership, we have a range of organisations that are already, if you like, the choir. They recognise the importance of climate impacts and they recognise that it is a challenge they need to engage with, which is why they are investing their time and their organisational capacity and working with others on it.

There is more of a challenge to transmit that to those who are not already convinced and we find it is often best done peer-to-peer within the sector. Businesses hear this kind of news better from the examples of other businesses. As Daniel [Dowling] was saying earlier about the Asda example, it can be a very powerful message to tell to other businesses about their supply chains, whereas if it comes from a climate scientist or someone working in a different field, it may feel a little bit remote from what their day-to-day work is.

Stephen Knight AM: I am going to ask you a little bit about what the Mayor is doing to help London's economy and London as it is now and what he should be doing. Perhaps, Juliette, I wonder if you could give us a rundown of the ways in which the Mayor is actively helping London's businesses and London adapt to climate change.

Juliette Daniels (Partnership Manager, London Climate Change Partnership): We have the LCCP for starters, which does have members from some areas of the business community, although by all means not comprehensive. The insurance sector, London First and commercial property organisations in particular are interested in this kind of work already. The Mayor provides some funding towards the LCCP and provides office premises here, too. We work quite closely with his environment team.

In addition to that, we have been working with the Better Buildings Partnership, which also has close alignment with the GLA, on a commercial property forum to help them understand what their priorities are for the impacts of climate change.

The GLA is also working quite a lot with Thames Water on water efficiency programmes across London, particularly in social housing. The LCCP did a demonstration project on the actual costs and benefits of social housing retrofits for adaptation in London. They are also looking at drainage issues on a wide scale. It is mainly focused on large infrastructure, but also through European funding projects, retrofitting projects and that type of thing.

Stephen Knight AM: OK. Thank you very much. I will come back to you in a minute, but I wonder if I can hear from the London business community about whether or not London-based businesses are making use of mayoral initiatives in their adaptation plans for climate change. How useful are the mayoral initiatives that you are aware of?

Daniel Dowling (Assistant Director of Climate Change and International Development, PwC): I will answer in the capacity that I can, acknowledging that there will be other people within my business at least who will have views on this.

I will start by saying London was, if not the first, one of the very first to address this issue properly and comprehensively, at least in the local physical sense. London businesses have been given the opportunity to engage and understand more about the physical risks that exist within the city. There are a number of support packages and information that can be used. Major businesses located down the Thames Estuary corridor have different means of engaging more specifically in their more localised contingency planning efforts, etc. We have two very large buildings, both housing 5,000 or 6,000 people, right on the Thames. I know that we are very aware and keen to continue co-operating with the authorities in London on those issues.

If London is going to stay ahead of the pack and take the next step forward, it needs to map these climate dependencies abroad. That is the elephant in the room for me. We have made good progress on local issues. I do think we need to do more - and I do recognise there are practical issues around flooding, etc - if we are going to get ahead of the other cities that now also have similar plans and procedures. New York's announcement of the winners of its huge competition for resilience projects was pretty fantastic.

Stephen Knight AM: Is that mapping overseas something the Mayor ought to stimulate or be involved with in any way, or is that outside his scope or remit?

Daniel Dowling (Assistant Director of Climate Change and International Development, PwC): I will let him decide what his particular levers would be, but I think somebody needs to co-ordinate a multi-sector approach. I do favour a sector approach to looking at those international risks, similar to the National Adaptation Programme and London's Climate Change Adaption Strategy, to create a central focal point for the issue and then allow and empower sectors to pursue their interests within that. That would be my view.

Stephen Knight AM: That is very interesting. Can I ask Nick the same question?

Nick Beecroft (Emerging Risks and Research Manager, Lloyd's of London): We are members of the LCCP and I would say that it is an example of a shared forum, which is critical to us. I cannot give you specific examples of Mayoral initiatives that have generated a real difference for us. What I would say is that we are looking at a global systemic issue. London has a critical point from our perspective. London is a critical node

in that system through which this risk is transmitted and amplified. I would very much echo what Daniel has said: It is networks of cities globally that do have the potential to make real, meaningful progress in this area. An awful lot of our business originates from the USA and city-based forums that are looking at resilience are very, very important for us to develop our business and to understand how we can grapple with the nature of the risks. London has the potential, by combining with other cities, to make some meaningful difference there.

Stephen Knight AM: Cities are so interdependent that unless risk is managed across all of them, you might as well not bother. That is the message.

Nick Beecroft (Emerging Risks and Research Manager, Lloyd's of London): That is one aspect. There is city-to-city, but there is city-to-supply chain, which is more of a city-to-rural connection. I spent last week in Ethiopia and they have a very exciting economic opportunity ahead of them, particularly based on an agricultural economy, but rapidly soon to be industrialising and urbanising. There is a city-to-city link there, but if our manufactured products start being produced in vulnerable African countries - again, our international risk profile is with New York and others in a financial sense - when you follow the pathways down to the actual investments, the manufacturing and the raw production of materials, that is the risk profile that we need to understand better.

Professor Chris Rapley (Chair, London Climate Change Partnership): I would just add that I have been Chair of LCCP for a year and a half now. My experience is that his [the Mayor's] team, I find, have been excellent, hugely supportive and very encouraging. I was given the opportunity to brief the Mayor about what the LCCP is doing, which he knew about to some extent anyway. He did certainly react and register to the objective of the LCCP or one of the objectives, which is to not only make London the most climate-resilient major city in the world, but to be seen to be. It is then seen as an attractive place for incoming investment and jobs, not only because it is a safe location to locate your business, but also because it has the experience that is partly represented around the table here, so that one is embedded in a milieu where one can advance these ideas with other professional people. I had the impression that the Mayor was strongly in favour of that. Why would he not be? I think he saw that point.

Stephen Knight AM: The question is: did he get this issue that unless he can show some global leadership, as a leader of a major city, in terms of persuading other city leaders to take similar action, then London would suffer as a result of other major trading cities not being prepared?

Professor Chris Rapley (Chair, London Climate Change Partnership): In a 45-minute interaction I cannot say. One would hope so.

Jenny Jones AM (Chair): One would hope.

Stephen Knight AM: That is interesting. Clearly there are some things that the Mayor is focusing on. A lot of the focus is around working with business improvement districts (BIDs), I understand. The LCCP has been helping to target mitigation work in local communities via BIDs. Is that right? Can you tell us something about that, Juliette?

Juliette Daniels (Partnership Manager, London Climate Change Partnership): Yes. I should have mentioned the C40 when I was talking about mayoral initiatives, and that is an important way that we engage with other world cities on the subject of climate change.

On the issue of BIDs, the LCCP, along with the GLA and Victoria BID, undertook a green infrastructure audit called i-Tree. We produced a report which looked at what economic value the green infrastructure and the trees provide in the business district, in terms of improved air quality, carbon storage and reduced flood-risk.

That was a great example of the value that is provided. It has gone on to inspire the GLA working with a further 15 BIDs to identify opportunities for increasing green infrastructure, one of the reasons being to increase resilience. It does, of course, have a lot of other co-benefits around health and air quality as well.

A number of the BIDs are now delivering green infrastructure projects on the ground because they can see the value in that it increases in attractiveness, makes it a nicer place to be, and increases resilience as well.

Stephen Knight: I wonder if I could ask whether anyone has any other ideas about what the Mayor ought to be doing in terms of helping London's businesses to be more resilient.

Professor Samuel Fankhauser (Co-Director, Grantham Research Institute, LSE): To go back to first principles, what is government there for and what can you leave to the private sector? What government is there for is three broad things.

One is the provision of public goods. There are certain goods that the private sector or the market does not provide in itself. Flood defence falls into that category, but information falls into that category as well, including understanding our international risk profile. That is the first set of things, and you can debate what the job of London is and what the job of national government is. That is a more complicated discussion. However, clearly that is a government job.

The second one we have not talked a lot about, is providing the right incentives for businesses to do the right thing. That can come in the form of regulation; zonal planning, building codes, things like that. You could insist a little more about sustainable urban drainage systems, for example. You could insist a little bit more about things like property-level flood defence where that is needed. It is not a mayoral job. It is also regulation of, for example, water companies. You have to give the right incentives to businesses to do the right thing, to adapt.

The third is that government is usually there to support the vulnerable or, in the business context, those companies that will not figure it out themselves. We have the suspicion that is support for SMEs in particular, but it might be broader than that. That is technical assistance to help them with understanding climate models and climate risks, to help them deal with certain tools, like making sense of the UK Climate Projections 2009 (UKCP09) climate scenarios, and be a general cheerleader for adaptation. There are a lot of things that can be done there.

Stephen Knight AM: Communicating the real risks, particularly to SMEs who might not have it yet.

Professor Samuel Fankhauser (Co-Director, Grantham Research Institute, LSE): Yes, exactly.

Stephen Knight AM: It is a key part. I am interested certainly in building regulations because the Environment Committee was told recently that the current building regulations were based on weather patterns between 1920 and 1950, in terms of rainfall and so on, the diameter of guttering needed in buildings and that sort of thing. Clearly there is a big job to be done in updating the regulations.

Professor Samuel Fankhauser (Co-Director, Grantham Research Institute, LSE): Absolutely. Again, it goes back to the issue of uncertainty. We do not know. We know exactly what the climate was in the 1920s but we do not fully know what it will be 10 or 20 years from now. It is actually quite hard to get those building regulations right. However, you can still update them and make sure they are flexible enough to deal with the most likely outcomes.

Jenny Jones AM (Chair): We know the gutters at the moment are too small. That is what we already know.

Stephen Knight AM: Does anyone else have a view on this issue of things that the Mayor can do in terms of provision of information or incentives in particular? Are there other incentives the Mayor ought to be driving, any particular ideas?

Daniel Dowling (Assistant Director of Climate Change and International Development, PwC): Planning incentives already do play a role in this, perhaps. I do not know how coherent planning incentives are between different boroughs for zoning, green space, green infrastructure, and also within the building structure, resilience stuff, rainwater harvesting, permeable surfaces, sustainable urban drainage systems, etc. That is certainly one clear area.

As an aside, I know the Environment Agency has a climate-ready service for business, but thinking back to the previous Carbon Trust models where there were some energy efficiency audits and things provided at very low cost to small organisations, I just wonder, to make the support to SMEs real, perhaps some sort of London-based service that can help organisations just tackle the 101 on this stuff could be useful. I do not think it needs to be complicated.

Stephen Knight AM: In terms of the Mayor's own investment, the infrastructure and plan for London, is that something in which proper account has been taken of climate change issues, in terms of whether it has been driven forward? I am conscious that the most recent progress report published earlier this year on the long-term infrastructure investment plan for London did not mention climate change once. That is a rather worrying thing, given that it is looking at London in 2050. Perhaps there are some question marks there.

Is anybody aware of the extent to which planning is going on around climate change in terms of long-term infrastructure? Juliette, is that something that you are aware of through your work?

Juliette Daniels (Partnership Manager, London Climate Change Partnership): Yes, I understand that it will be factored into the London Infrastructure Investment Plan. I would like to see the London Enterprise Panel have more of an emphasis on climate change, because I think that is a major opportunity. If you look at some of the local enterprise partnerships in the north of the country, they have really majored on resilience of the economy as something they can be strong on, can support funding on and can be proud of. Therefore, there is opportunity to do more, although the London Enterprise Panel has made reference to it so far in its investment strategy.

The adaptation economy report that we are working on with the GLA at the moment should identify some clear actions for the Mayor, which may involve interventions that can be taken to increase our market share of the adaptation economy. The GLA, being a big organisation in its own right with its own supply chain, its own buildings, infrastructure, staff and premises, seeing leadership through mainstreaming [resilience in its own estates][2] would be a positive way to go.

I just wanted to mention as well in reference to Daniel's comment about tools for London that Climate UK has what we call the Business Resilience Health Check, which is a tool for small businesses. It does not just look at climate change because response to feedback was that they wanted to look at risk and resilience in the round with climate change as part of it. That is available free for all businesses online, should they choose to take it. There could be some sort of London-branded promotion of that perhaps to support that service.

Stephen Knight AM: Do you know what the take-up of this advice is? Are many people downloading? It is available online. It should have figures for --

Juliette Daniels (Partnership Manager, London Climate Change Partnership): I do not know the figures off-hand.

Stephen Knight AM: It would be helpful for us to know to what extent it is being used and therefore whether it is being properly promoted or whether it is the correct scale of advice.

Professor Chris Rapley (Chair, London Climate Change Partnership): If I could just inject one thought which underpins a lot of this, all of this planning has to be based on knowledge. You need basic datasets to start from so that you have a firm foundation. One of the things that the partnership has been doing - which,

[2] Clarified by the LCCP following the meeting.

after all, is supported by the GLA and so on - is looking at, for example, meteorological data around London. It turns out we have 25 different sources of meteorological data which all have been in the past incompatible and not necessarily easy to access. We have run a project where we have analysed that and we are now looking how all of that can be brought together in an integrated way into a portal so that London businesses can make use of it both now and for the future.

We were talking just before we came in about Transport for London. They needed to understand where their hotspots are going to be, how hot the tunnels are going to get, where we are getting problems now and what we are going to do about it. They have done their heat map of the tube. They know where they have problem areas and they have already started to invest in systems by which they can keep those tunnels cooler so that they can be usable with more people, more quickly and in a changing climate.

Stephen Knight AM: They have taken into account the changing climate aspects?

Professor Chris Rapley (Chair, London Climate Change Partnership): Exactly. I mentioned Crossrail. One of the original designs for one of the Crossrail tunnels was seen to be inappropriate in a warming world and a warming city. Therefore, changes were made to the design of it so that it was more climate-proof.

The point that I am injecting we have not touched on before, but you do need basic data and, surprisingly, that is often very hard to get hold of. Therefore, one of the things the partnership is doing is trying to ensure that those resources are made available to people, and the partners are doing that individually as well.

Jenny Jones AM (Chair): I am feeling it is a concern that SMEs are perhaps not linked in to this because they are 90% of London's businesses. That is a lot of people and a lot of money that needs to be made aware.

Stephen Knight AM: The last part of my question was going to be: is there more the Mayor can do to learn from the New York experience after Hurricane Sandy and New York's plan to recover from Hurricane Sandy? Is there more that we ought to be learning from the whole approach that New York has taken?

Juliette Daniels (Partnership Manager, London Climate Change Partnership): In PlaNYC, which actually preceded the Hurricane Sandy incident, quite a lot of the thinking was taken from work that London had already done on adaptation and London's adaptation strategy, so it is bit of a cyclical process of learning from each other.

We have done a fair bit of work since to understand what New York has learnt from that incident. We had a direct web-link presentation into the LCCP and also separately some work with London Resilience to really understand the details of how their plans and their expectations of what the impacts would be compared with what the actual impacts were. They found their flood risk maps were wrong and the extent of flood risk was much greater than they had previously thought. What has happened is that a lot of what they had already planned for in PlaNYC has been reinforced. They do still need to do those actions. It sped up their process of adaptation, but along similar lines that they were already going to take.

Stephen Knight AM: Have we checked that our flood maps are not similarly in error?

Juliette Daniels (Partnership Manager, London Climate Change Partnership): It is difficult to measure against a future that you cannot know. Certainly we have updated our surface water flood maps. The Environment Agency has just done a refresh of its London flood maps to incorporate surface water flooding, which is a big issue and affects more than 1.2 million properties in London but it is a much more diffuse risk than fluvial flooding or tidal risk.

Stephen Knight AM: And where the rain falls to some extent.

Professor Chris Rapley (Chair, London Climate Change Partnership): There is a deep human psychological issue here, is there not? If you look at Copenhagen which suffered this major event, if you look at New Orleans, if you look at New York, there is a tendency to see these things as theoretical and work away at them and then it really sharpens up your thinking if you get hit.

The corollary to that is if you do a really good job, and I am sorry to keep going on about the Environment Agency, but if we look at the flooding that we had in January and February, the impact on London was minimal because they had planned carefully and prepared well. The water that did flood went where it had to go to avoid it being even worse.

Stephen Knight AM: Had it not been for the Thames Barrier, which was never designed to deal with fluvial flooding in the first place, then presumably it would have been much, much worse?

Professor Chris Rapley (Chair, London Climate Change Partnership): Much, much worse, plus a lot of other measures, for example diverting channels upstream and the way they managed the water flow down the Thames and elsewhere. It is like the Millennium Bug. You will find people who say that was an enormous waste of money preparing for the Millennium Bug because it never happened. To which you might say, "The reason it did not happen was because everybody prepared for it". Not happening leaves you with a false sense of security often, whereas actually the investment paid off. You cannot clone the world and show what it would have been like.

Stephen Knight AM: What would have happened if you had not spent the money?

Professor Chris Rapley (Chair, London Climate Change Partnership): Exactly.

Stephen Knight AM: Yes, that is a big issue with climate change generally, is it not? I was struck earlier when you mentioned your Fukushima example of the nuclear power stations in Japan. While we were looking at the Thames Barrier and the flooding with the Environment Agency last year, one of the risks that were told there was not a plan for because it was so unlikely was a failure of the Thames Barrier. The flooding implications of that would be so vast that one almost dare not think of it. It is a piece of machinery and pieces of machinery can fail for one reason or another.

Professor Chris Rapley (Chair, London Climate Change Partnership): It does seem to have been pretty well engineered though because it was used a great deal more often that was originally intended.

Jenny Jones AM (Chair): Which means it could break down.

Stephen Knight AM: It begs the question that if it was not there, would it breach?

Professor Chris Rapley (Chair, London Climate Change Partnership): Yes.

Murad Qureshi AM: All credit to the GLC.

Jenny Jones AM (Chair): It would be interesting, perhaps, to advise the Environment Committee to rethink that, to suggest that perhaps we should look at the Thames Barrier breaking down.

Murad Qureshi AM: We have the latest update on the Waterways Commission. It is quite a reflection from the Environment Agency, and I am glad to hear actually people are being complementary of the Agency's work

because during the floods themselves they had a torrid time politically and they are losing a lot of staff as well and we should not forget their work in London.

Can I just throw the light to some of our utility companies? You have mentioned Thames [Water] and that is the obvious one with water and flooding. To what extent can they help prepare businesses for global warming in London?

Professor Chris Rapley (Chair, London Climate Change Partnership): We have heard several times that peer-to-peer discussion is a very powerful way of transmitting these messages. They have a powerful role to play because they are taking this seriously. They are doing things to prepare. If they tell their story others will pick up on it. It as simple as that. We know that they have their plans, they are looking forward, they are making a sensible assessment. If others know about that, then that has an influence on them. I am not sure what else I can say.

Murad Qureshi AM: I do not know if you could extend a discussion to energy companies. Is there something they could be doing? We are in interesting times insofar as, if there is an issue that has been given more airing than global warming, it is energy security. On the back of that, are there things that we could do for global warming?

Professor Chris Rapley (Chair, London Climate Change Partnership): Yes, but there is a general principle here and it goes right to the root of one of the problems that this issue has exposed. That is that scientific and technical experts talk to each other. They trade facts. They have a very formalised way of discussing these issues, which requires huge collateral knowledge, a lot of experience, training and what-have-you. Then, when they talk to other people, they do not change gear and drop into storytelling and narrative. It is when you hear the anecdotes, it is when you hear the stories, the experiences the businesses had; the story of the meat pie where it was not the potatoes that were the problem, it was the spice. People get that. They get the storytelling. Therefore, as a general principle, what I would encourage is people who are engaged in this just telling their stories and that will draw other people in and increase the amount of engagement.

Daniel Dowling (Assistant Director of Climate Change and International Development, PwC): Generally our water companies have been working for at least two decades on this. I think they understand the issues well. There are obviously some constraints through the asset management planning process and the revenue issue that they struggle with.

Same for energy companies, but National Grid and some of the large and smaller energy companies are pretty active in this area. Key infrastructure providers understand these risks generally and have looked into the solutions they need to deliver. Simple things like putting cables underground are very expensive, but can be done where necessary. The network distribution and transmission risks are reasonably well understood. Some of the generating risks associated with a big power plant are a bit trickier because they are long-term fixed assets. Twenty-five or thirty years ago we were not thinking properly about these issues, so some expensive modification is required, some further work on supply chains of fuel supplies, etc, perhaps.

One thing that London is doing is that its decentralised heat and electricity strategies are quite important because rather than having, in simple terms, one big cable feeding the whole city, there are lots of self-sufficient islands of resilience that are operating. Whilst that brings some new risks, it also insulates certain areas from an impact in one area of the city taking out a whole district, just like we saw in New York during Hurricane Sandy. That is a good thing.

Our building at PwC has a tri-generator in the basement. In fact, both of our large buildings have them. That means that if the grid goes down, we still have electricity.

Murad Qureshi AM: Another sector which is key and does have a lot of SME involvement is the waste management sector. What is happening there? Are they taking these issues on board?

Daniel Dowling (Assistant Director of Climate Change and International Development, PwC): What sort of risks are you thinking about in the waste sector?

Murad Qureshi AM: I do not know. That is why I am asking you. However, are you just trying to convince yourself? You told me the water utilities and the energy companies are to some extent pursuing it.

Daniel Dowling (Assistant Director of Climate Change and International Development, PwC): I do not think the waste sector has the same exposures, frankly.

Professor Samuel Fankhauser (Co-Director, Grantham Research Institute, LSE): One sector not to forget is information technology (IT) because of the way we communicate in an emergency. It is no longer true that we just switch on the radio; we switch on a lot of other things. In communicating in an emergency, we rely so much on IT that this has become a very crucial sector.

Professor Chris Rapley (Chair, London Climate Change Partnership): What we are exploring here is, in risk management you manage two factors, sometimes more, but two factors at least. You manage down the likelihood that something awful will happen, but you also manage down the impact if it does happen. In earthquake work, you have building codes to try to prevent buildings falling down, but if they do fall down you have an emergency plan that helps you rescue people.

One of the things that the partnership has been doing - and, Juliette, you will have to remind me of the name of the exercises because I have never actually sat in on one but I have heard about them and been impressed by them - is to not only look at real circumstances and see how the integrated performance of the services attempting to recover London from some sort of incident worked, but also think about scenarios and exercises where the different emergency services and the utilities and others are confronted with a situation and see how well they work together, exposing exactly the sort of thing that Sam [Fankhauser] just said. In one of those exercises, it had been assumed that the mobile telephone network would still be up but it probably would not have been, so what do you do under those circumstances? I have been quite impressed with that work.

Juliette Daniels, Partnership Manager, London Climate Change Partnership: It is called Anytown. It is a project that LCCP is working on with London Resilience to try to plan out from the immediate emergency response and to look at adaptation options for how we tackle those interdependencies between different types of infrastructure. How do telecommunications and energy interact? How do energy and water interact? What does that mean for our ability to respond to emergencies? We were quite surprised at some of the things that we found might fall down that you would expect to still keep running. That has been a useful exercise for us.

It is probably also worth saying that on a national scale we have the Adaptation Reporting Power, which major infrastructure providers were asked to report on back in 2010 across the country, including private companies. There is now a new round of the Adaptation Reporting Power, which is only voluntary, so we may see some reduction in the numbers of organisations that report on that this time. There is still an Infrastructure Operators Adaptation Forum, however, which is run by Climate Ready, an Environment Agency service, at a national level, where infrastructure providers come together voluntarily because they recognise that they need to understand those interdependent risks and those dependencies on one another's services.

Professor Chris Rapley (Chair, London Climate Change Partnership): Just following up on that, this is a forum not only to think about things theoretically but also to learn from other people's both positive and negative experiences. For example, in the case of New Orleans the flooding there had some interesting origins.

The survey of the levees had been done many, many decades before using theodolites, not using modern global positioning systems (GPS). Some of the levees were substantially lower than they thought they were. Therefore, even though they were supposed to be designed for a certain surge, they were actually physically lower than they should have been and some of the interventions that had been put in - they had put in vertical strengthening concrete slabs into the clay - acted as levers when the water rose and actually then breached the levees.

The point is that the partnership offers the opportunity for the infrastructure and facility providers to hear about what has happened in other cases and learn from those misfortunes and successes. That again is a very powerful contribution.

Nick Beecroft (Emerging Risks and Research Manager, Lloyd's of London): If I could just offer very quickly, scenarios are used very heavily in our industry. They are really fundamental, to connect to a couple of points that have been made, firstly to connect the scientific and the knowledge community decision-makers. They are an absolutely fundamental tool to translate what can be very technical and difficult to conceptualise knowledge into meaningful outcomes that can be used for decisions.

The second point is to break us out of our cognitive biases that we find across the entire spectrum of risk that we provide solutions to. Generally people want to buy a solution to the risk that they have just encountered. One of the vital things that scenarios do is allow you to test your assumptions, and they allow you to build imagination into your planning. The kind of process that Juliette [Daniels] has spoken to is fundamental if you are going to get to grips with the nature of what we are talking about obviously.

Jenny Jones AM (Chair): Using imagination. Politicians do not do that, do we?

Fiona Twycross AM (Deputy Chair): Just very briefly, and this is moving away from the topic completely, I just wanted to think about motivation. You mentioned universities looking at how they can limit their carbon dioxide (CO_2) emissions. I just wonder why people do that. At the moment it does not feel like people are doing that because they see an impact on themselves. They maybe see it as part of their broader corporate social responsibility.

I wondered whether there was a point at which it needs to be shifted to a different part of the annual report, in a way. Where people put things in their annual report says a lot about what they think about an issue. At the moment, I suspect that if big businesses write about what they are doing to limit CO_2 emissions, it is not part of their discussion of risk management in relation to their own business. It will be part of a broader social responsibility. Until you actually get that as part of, "This would affect our business", in everybody's minds, it would just be tucked away as part of an annual report that is kind of, "Yes, we are responsible". Is that unfair of me to think that is the case currently?

Professor Chris Rapley (Chair, London Climate Change Partnership): There is another factor. Quite often the investments that are made have an immediate payback anyway. For example, if you go to the Science Museum, the carbon emissions were reduced by 10% one year and 27% the next year, and the investment paid back over a decade or so in terms of reduced energy costs and lighting costs and so on. That is the key. If you can combine something which has a degree of altruism and concern for ethical duty to future generations with a hard-nosed business case as well, then it is very powerful; everybody is happy under those circumstances.

However, my experience with companies is that as often as not; it is an inspired and inspiring leader who says, "We are going to commit ourselves to this because I think it is the right thing to do and there will be co-benefits", and then, as I said, often the co-benefits go beyond what they expected. They find that it saves them more money than they expected and it engages the staff in a way that they had not anticipated.

Professor Samuel Fankhauser (Co-Director, Grantham Research Institute, LSE): I think we are making progress in that direction. On the adaptation side, it is always supply chains and things like that. That is called business risk and good companies manage that.

On the emissions side, there is a set of policies we now have. Certainly among the big emitters, I cannot think of any big emitting company that does not manage its carbon emissions subject to the regulation they are under, so that has shifted away from corporate social responsibility to the chief financial officers (CFOs). There are still a lot of issues and imperfections in the sense that CFOs like investments that grow the company as opposed to investments that save money and all those sorts of things, but carbon, certainly by the big emitters, is managed now.

Murad Qureshi AM: There is just one point I am still not quite clear about and it is aimed at those representing the London business economy. How risk-averse are you? We know about the public sector and how risk-averse they have to be. There is a discounted rate. It is all there and cost-benefit analysis. How does your assessment of risk tie up with the public sector's risk aversion in response to global warming?

Nick Beecroft (Emerging Risks and Research Manager, Lloyd's of London): Our business is founded on risk, so we --

Murad Qureshi AM: What I am saying is it is a comparative thing. What I want to do is assess what yours is against what I understand, which is the public investment. Are you any less or more or --

Nick Beecroft (Emerging Risks and Research Manager, Lloyd's of London): I am not familiar enough with the public sector appetite for investment to make a really meaningful judgement on that specific question. What I would say is that when taking on significant levels of risk, we rely very heavily upon scenarios and models that can generate outcomes that are derived from scientific judgements. We do not take a punt on earthquake risk in major cities, for example, to reach the decision about what level of risk we are willing to accept for that kind of thing. We rely very, very heavily upon modelled outcomes and historical loss data but, crucially, scenarios that predict what the likely impact of a given event would be. We are not in the business of taking punts; we are in the business of taking the best scientifically-backed judgement that we can in order to provide a profitable level of risk transfer.

Murad Qureshi AM: My response to that is, when you talk about punts, I am not going to the bookies for a punt, "Give us some odds", but it is the same kind of game, dare I say, of probabilities of scenarios. The only one that some of us here can have any comparative with is when we see, for example, a 6% discount rate on public investments. Surely you must have a rule of thumb of some sort across most of the scenarios when you are underwriting them.

Nick Beecroft (Emerging Risks and Research Manager, Lloyd's of London): The basic rule of thumb is that we are regulated to hold capital against a 1-in-200 event for any particular risk that we underwrite. We then judge each specific risk on its merits and crucial to that is uncertainty, so in the area of emerging risks we tend to find a lot of uncertainty and so we will very often want to build upwards from a 1-in-200 event.

Murad Qureshi AM: OK, tell me if my maths is right, but that is lower than the public sector, is it not?

Professor Samuel Fankhauser (Co-Director, Grantham Research Institute, LSE): Yes. You are expressing it in terms of the discount rate you want to have for the thing to be acceptable and public sector discount rates. The Green Book of the Treasury I think gives a 3.5% discount rate.

Murad Qureshi AM: Less than 6%.

Professor Samuel Fankhauser (Co-Director, Grantham Research Institute, LSE): I do not know of a single private company that would be happy with 3.5% return; they invariably want more than that. They are also willing to take more risks, to be honest, and they just need to get the return to go with that risk.

Daniel Dowling (Assistant Director of Climate Change and International Development, PwC): That is the point I was going to make. Actually, business is conservative but accepts a different profile of risk and reward, so if there is a risk taken, there needs to be a suitably high yield available there to meet that risk. Then maybe to Nick's [Beecroft] point, beyond rules of thumb, actually what we tend to work on with our clients is we start off with risk appetite. "As an organisation, what is at stake? What is your appetite for risk? What are the drivers for you to take risk now rather than in the future? How do you balance those risks again the possible opportunities they present?" That comes down to a leadership decision a lot of the time, but you will find that utilities are more risk-averse than those who are operating in more liquid markets, where they can diversify their risk in different types of ways, so the same principles.

Murad Qureshi AM: If the opportunities are there, the risk might be reduced. OK.

Jenny Jones AM (Chair): I wanted to close this by just pointing out that New York appears to have put a price on how much it is costing it to weatherproof or climate change-proof the city. It is talking about a $14 billion investment, possibly rising to more than $19 billion. Has anybody done this for London?

Professor Samuel Fankhauser (Co-Director, Grantham Research Institute, LSE): I am not aware of it. The only numbers I am aware of is people trying to estimate the cost of climate-proofing in developing countries and that was relevant because in the international negotiations, there was an expectation that rich countries would pay for that. Those numbers are all unbelievably hand-waving and I really would not believe them, but since you ask, they come out in the range of 60 billion to 100 billion on average over the next 20 years to climate-proof developing countries where there is a lot less stuff to climate-proof around. Much of that will go into infrastructure and much of that will go into water and coastal defence, a little bit goes into things like health, and then it soon becomes unclear whether we are talking about adaptation or just development.

Professor Chris Rapley (Chair, London Climate Change Partnership): The answer is that I do not know of that figure and I do not know anybody who has produced that figure.

Jenny Jones AM (Chair): But, Sam, if you extrapolate from a country to London, smaller but with more infrastructure --

Professor Samuel Fankhauser (Co-Director, Grantham Research Institute, LSE): Yes. I cannot do it here straight in my head, but I can see how one would go about it. The way that some of those figures came about is that one asks, "What is the annual rate of investment in a city?" The assumption is that you upgrade when you replace rather than retrofit and then you have assumptions as to which fraction of those investments need to be climate-proofed and which ones do not and what the add-on is, then you get back-of-the-envelope figures on the basis of that. That could be done for London, but the range around it would be huge.

Daniel Dowling (Assistant Director of Climate Change and International Development, PwC): London has a different risk profile to New York, so we have to understand --

Jenny Jones AM (Chair): What, lower risk or higher risk?

Daniel Dowling (Assistant Director of Climate Change and International Development, PwC): Good question. Different, definitely. We do not have hurricanes here, generally, so primarily their investment is about managing that hurricane risk. We have other types of risk to deal with, which maybe we have quantified; I have not looked into it. It will certainly be different, and I am sorry to bang on about the same thing all the time, but that may be the cost of protecting the buildings, roads and power infrastructure of New York, but it is not going to protect the economy because as a global city as well, it has its risks invested all over the world, so I am not sure how much of it is here.

Jenny Jones AM (Chair): The IT impact would be phenomenal if that went, yes.

Professor Chris Rapley (Chair, London Climate Change Partnership): The other thing is there is always a tendency to want to grasp at simple things like a simple number or whatever. In the end, I am not really sure how helpful that is. Somebody was pointing out the other day that if 20 years ago we had been at a committee like this and we had been saying, "The world should discard all its analogue devices and go digital", people would have been trying to figure out how much that would cost and saying how impossible it was. There are certain things that just happen organically because there are good reasons for them to happen, and trying to figure out what the cost is upfront is maybe not the most helpful thing to do. It might actually put you off.

Jenny Jones AM (Chair): I was trying more to get a feeling for the scale because my feeling is that the scale is huge; that is really what I was trying to get at.

Professor Chris Rapley (Chair, London Climate Change Partnership): It is certainly true. If you aggregate up all of the investment that is going on, it comes to a big number and that is just because London is a big, complicated city.

Professor Samuel Fankhauser (Co-Director, Grantham Research Institute, LSE): You have to put it in relation to all the investment that is going on anyway. I would have thought the increment of all the investment that has happened in infrastructure, in buildings and in everything, the little of bit of extra you need to climate-proof adds up to a big number, but relative to what you do anyway, it may not necessarily be a big number.

Professor Chris Rapley (Chair, London Climate Change Partnership): To some extent - disregarding discount rates and so on - Stern [Baron Stern of Brentford, Chair, Grantham Research Institute, LSE] was saying, "We are talking about 1%, 2%, 3% of the economy", or something like that, which seems quite a small number compared with what we spend on other things.

Jenny Jones AM (Chair): You also made the point that if we do it now, it is cheaper than if we do it later.

Professor Samuel Fankhauser (Co-Director, Grantham Research Institute, LSE): Yes, that is right.

Professor Chris Rapley (Chair, London Climate Change Partnership): Yes, yes.

Jenny Jones AM (Chair): Incrementally.

Daniel Dowling (Assistant Director of Climate Change and International Development, PwC): About a third of the economy is directly exposed to weather and climate risk, and then for the rest of the economy has more indirect linkages, so we are talking about 1% or 2% versus - and I do not know what the losses would

be - high exposure. It feels fairly rational. I certainly comment on the new development next door to me in Islington that goes up. The planning requirements are such that they need improved drainage, a sedum roof and various measures. That is all happening already. It is not completely new measures and they have some things already underway. I very much agree with the idea of contextualising investment within what we are already doing and planning into asset cycles as much as possible, rather than trying to launch a huge big number on the economy as a cost, which is not entirely true.

Professor Chris Rapley (Chair, London Climate Change Partnership): Perhaps I could just add to that. One of the common fallacies - and here I am, a physicist tumbling into the world of economics, which is a dangerous thing to do - is that it does seem to me that so often the reference assumption is that business-as-usual has no cost and that therefore insulating against the future is always seen as a cost against a non-cost. Actually, it is against Daniel's [Dowling] point that there are costs associated with business-as-usual and there are some things you cannot adapt to and so how do you cost those? In a sense, they are an infinite cost. Anyway, it is not my specialist area.

Jenny Jones AM (Chair): It is very interesting, thank you.

Juliette Daniels (Partnership Manager, London Climate Change Partnership): A quick final point from me on the climate-proofing. It is a bit of a misleading term because you cannot spend any amount of money and insulate yourself completely from any climate impact. It will be felt and it depends on what as a city your appetite is and your capacity is for adaptation. A lot of the action that needs to be taken will not be about physical infrastructure. It will be about social capacity to adapt and about organisational capacity to adapt, which may be more around time and engagement than it is around hard capital expenditure and is much more difficult to measure.

Professor Chris Rapley (Chair, London Climate Change Partnership): I do have one issue and I am sorry to toss it in at the end but we can leave it hanging. If we are successful in the LCCP and if we do generate for London the image of a city that has taken this seriously and is an attractive place for inward investment of people and jobs, then of course it will add to another problem: that is that London will be a very attractive place for people to come, and it is already squeaking at the seams, so one needs to factor that into account. The UK, being a maritime environment, will probably not see quite the same extremes that you will see in other parts, massive droughts and so on, although we have to see if that works out or not given the recent experiences. The fact is that London will be a very attractive place and that will bring with it its own series of issues and problems which need to be thought of: transport, infrastructure, buildings, schools, hospitals.

Daniel Dowling (Assistant Director of Climate Change and International Development, PwC): That is very important. I have been talking a lot about our investment abroad, but I do agree very much that we have to be a resilient investment for the new capital that is growing so fast around the world. My complementary point to that is simply that in 2012, for the first time, there was more foreign direct investment in developing countries than developed, so let us not forget that it is not just an existing exposure that is out there. It is a rapidly growing exposure and it just so happens that those developing countries have greater risks than we do. It is the final time I will say it, in a different way.

Murad Qureshi AM: They are growing more rapidly as well, the mega-cities. It makes what we are planning for seem quite incidental in comparison to what has happened annually.

Jenny Jones AM (Chair): I live in London, and it is London I am going to worry most about, I am afraid. Thank you so much for coming. It has been a very good base for the rest of our report, so thanks very much.