



CLIMATE CHANGE, RISK AND URBANISATION

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I am going to try to do three things, and it may be a little risky in the twenty minutes that I've got. I am going to try to tell you something about the Stern Review on the Economics of Climate Change and what its basic conclusions and analytical approaches were; try to link that with cities; and finally say something about how I think India can play a leadership role in taking on the building of a global deal on climate change.

The Stern Review was on the economics of climate change and it was exactly that. It was the analysis of the costs and benefits of action and inaction and still more important the techniques we can bring in terms of policy to give the right kind of incentives to get the kind of policies we need. There is quite a lot of heavy difficult economics in there. Now, I realize that you are not all economists in this room, that is mostly your fault – you had some choices in your past which you didn't take. But nonetheless, I'm going to give you some economics but I'll try to be both fast and gentle because I want to get on to the city story and the role of India in the global deal which is the only way which we are going to tackle this problem. I should say that I am not an expert on cities, I was born and brought up in London and am one of the very few professors in the LSE who was born and brought up in London and it is my home and I take it very seriously. And I've lived for long periods in Delhi and Bangalore and I've been working in India since 1974. But I haven't been studying cities as such so I've been trying, in preparing for this talk, to think about the links between climate change and cities which I will share with you.

But let's move fast into the economics of climate change. First is to look at what the problem is. The problem is that our economic and other activities yield the flow of greenhouse gases. The flow of greenhouse gases build up into a stock, a stock that traps

the heat that warms the planet, and it is the warming of the planet that changes the climate, and it is the changing climate that has the consequences for us in the way we live our lives. That is the simple logic of the story but it's key that we keep that simple logic in mind because it is the stock that causes the problem and it is the flow that we control, and that means that anything we do happens slowly and it does mean that we cannot turn the clock back because what has built up into that stock cannot easily be extracted. So that flow of stock through the long time period as a process is very important and secondly, it is very important to see this as an issue of risk. We can control the risks, we cannot predict exactly what is going to happen to the climate but we can talk about what the probabilities are.

What we are trying to do here is to bring down the risks. We cannot eliminate them but our action can bring them down strongly. So that is the logic of the problem and how does this work? It is not particularly through the temperature by itself, it is mostly through water. This is about storms, floods, droughts, and sea level rise. Heat stress and shortening of growing seasons, they do matter too but the bigger part of the effect of climate changes comes through water in some shape or form. Global warming is not good language, that is an intermediate part of the process to what causes the problem and what changes the physical geography of the world, and therefore, the human geography of the world is climate change operating largely through water.

We are seeing recording effects now from temperature increases under 1°C, going to go somewhere between two or three even if we act very responsively, and that is not a terribly comfortable place to be. If we do not act responsively we are headed out here and that is very dangerous indeed. 5 °C is enormous. 5 °C less than where we are now we were in the last Ice

Age 10,000-12,000 years ago. There was an ice sheet down close to Watford. For those of you who do not know where Watford is, it is just a few miles north of London. And correspondingly everybody who was alive then and of course a number of human beings 10,000-12,000 years ago were living around the equator. If we went up 5 °C, there would be massive movements of population away from the equator. 5 °C is an overall average of the land mass around the equator over land, the average would be 10 or 15. That would still be an average across the year. You would see extremes of temperature much higher than that. Much of the area around the equator would become inhabitable. You would see massive movements of population to higher latitudes and all the conflict that is associated with it. I don't have to remind you in this part of the world of the conflict that arises when population moves.

What are the probabilities? The stocks here are measured. 450 parts per million is where we will be in just a few years from now, in about 5 to 10 years. It gives us a 50/50 chance of being either side of the 2 °C. The red here is the confidence interval with a 90% probability falling in that, and 5% off the bottom end and 5% off the upper end. As I said, this is all about risks and probabilities. If we go on with business as usual we are headed down here by the end of the century and actually a bit higher than this and that would take us to a 50% probability of being in either side of the 5 °C sometime next century. It is very important to understand the odds with which we are playing and this really is gambling the planet in a very direct sense.

The good part of the story of course is that averaged over space, averaged over time, averaged over possible outcomes, the losses of this kind of movement measured very crudely in economic terms would be upwards to 5% GDP per annum and under assumptions nearer to 20. There are a lot of assumptions involved in that, so don't take the economic model too seriously. The basic message is that the costs of inaction, the costs of business as usual is very high. And the next part of the message is that this is what we have to do about it. The blue line is where the emissions will go and these lines here are what we have to do to have any chance of bringing these risks down.

Now notice that this involves action fast. We have to have emissions peaking within 15 years or so and

falling pretty rapidly thereafter. This top line corresponds to stabilizing the stock of greenhouse gases in the atmosphere around 550 ppm of the CO² equivalent. That would give you a 50/50 chance of being on either side of 3 °C above pre-industrial times, that is a pretty risky place to be. It involves non-trivial probabilities of being above 4 °C and under some models, small probabilities of being above 5 °C. This path here is the most risky that we should be contemplating. And many of my environmentalist friends emphasize rightly, so in my view we should be aiming right below that. So this gives you the idea of the magnitude of the problem which is what I've been talking about up to now. This gives you the magnitude of the action. Emissions have to peak in 15 years and they have to fall pretty sharply, so that is a pretty strong set of actions. We are as a world giving off about 40-45 gigatons (Gt) of CO² equivalent with the population of about 6 billion. Giga is billion so divide 40-45 by 6 and 7 tons a year is the average CO² per person in the world. We are going to have to cut that by half, that is the Heiligendamm targets of June this year which Angela Merkel courageously led at the G8 Summit. We are going to have to cut by half, half of 40-45 is 20-25. The population of the world in 2050 will be around 9 billion, so we have to be averaging 20-25 divided by 9. We have to be averaging 2 or 3 tons per person by 2050. We are already averaging 7 and we are growing as a world pretty rapidly so you can see the dimensions of the action that we have to take.

And of course you have to look within at the great inequity in all this. The rich countries are the cause of most of the problem and it is the poor countries that are going to be hit earliest and hardest. There is a double inequity in all this. If you just look at the bottom here, tons per person in the US is above 20, Europe is 10 and above, China close to 4, India just 1. Remembering that we should be aiming at 2 to 3 as an average worldwide in 2050, India is the only major part of the world that is under that and that is why India has such a strong moral position to exercise leadership on this point. It has to argue two things. One, that our target should be very strong, that the Heiligendamm targets and of course Dr. Manmohan Singh was there in the G8 Summit in June, we have to argue that those Heiligendamm targets are the right kind of targets by cutting the flows by 50% by 2050. We also have to argue as friends of India, that the biggest responsibility for adjustment is elsewhere.

But if you look at the story of where we have to be in 2050 at 2 or 3 tons per capita and that India is growing very rapidly from 1 ton per capita, India as well as demanding a great deal from others has to be part of this story. It is just such a big country.

Where do we have to act? We have to act across the board. Emissions come from everywhere: two thirds from energy, one third from other things, and deforestation is an extremely important part of that story. What does it cost? It costs around 1% of GDP which is a significant sum of the world's GDP. It is like a one-off 1% increase in our costs. That is a big sum but it is also a small sum relative to the risks that we avoid. The better we do it the cheaper it will be. Since the Stern Review was published on the whole a number of estimates have come in suggesting that the costs may be a little less than that. But of course, if we do it badly and we follow bad policies the costs of adjustment can be more than that. Depends whether we do it well or whether we do it badly.

This is a McKinsey diagram and as a typical McKinsey diagram it has a lot of stuff but what it is telling us is that there are lots of ways of cutting back which actually have a negative cost. Most of that of course is energy efficiency. If you save energy, you reduce emissions, and you save money. There is a tremendous scope for that. As you move up, you move to higher cost activities, carbon capture storage for coal is going to be absolutely crucial in this process. We know China is going to use a lot of coal in electricity generation, we know India is going to use a lot of coal in electricity generation, so too is Poland, Germany, United States and many other countries. We are going to need a price for carbon in all this that supports capturing carbon storage for coal. We are going to need a price for carbon at 30 or 40 dollars per ton of CO². Unless people have the right kind of incentives, it does mean a price for carbon, a price for the damage that they are inflicting on other people. Unless the incentives are there, there are not going to get to where we need to go. So we are going to need quite a high price for carbon and we are going to have to go up here somewhere. Let's get this energy efficiency and let's get those things as soon as we can, but we have to go further and that is a very important part of the story.

How do we do it? There is a lot of economics in that. For example, in incentives you need carbon trading for price of carbon; you need taxes as part of the story; you need to push technology along. You have to get people to understand the problem. People will do a lot of things because they believe them to be right and not simply because they are incentivised to do so. We need to operate on all these fronts and of course, deforestation is going to be a very important part of the story. Deforestation is currently responsible for CO² emissions about the same size as all the transport that now exists – air, road and sea. Comparing deforestation and energy efficiency are the two cheapest and fastest ways that we can bring down emissions. But of course they themselves will not be enough to go a lot further.

So let me move on to cities and here I am moving to your area. As they say in the civil service, I am moving out of my comfort zone. I'm alright on the economics of climate change but on cities, other than being a city dweller I am not a scholar. But let me just try to share some of my early thoughts. We are going to hear much more about these subjects from people who know much more about cities and how to manage them than I do. But as I emphasized at the beginning, most of this is about water – storms, floods, droughts, and sea level rise – and of course, a lot of our cities really are close to the sea. The sea level rise part of the story is probably at the end of our century, beginning of next. Sea levels rise slowly and inextricably. But it is inextricable so we better prepare for it. The floods, droughts and the storms that are here now and they are going to get worse.

I don't have to tell you what Mumbai experienced just a couple of years ago or what Bihar is experiencing now. And remember the density of population of the Indo-Gangetic plane is very high and that means that there are a lot of cities all over the place on the Indo-Gangetic plane which many Westerners have never heard of but there are many cities of hundreds of thousands and millions of people in that area. Hence, when those areas flood, these cities flood too. Why is this happening? In large measure it is because we are losing the snow and the ice of the Himalayas. This line here is the decrease of the snow and glaciers and in this case the glaciers off the Himalayas. It is absolutely enormous. In the last 40 years we have seen a 15% reduction. What does that do to the water flows

in this part of the world and of course in China, Afghanistan, Pakistan and Bangladesh? It means that that sponge that holds the precipitation when it falls in the rainy season is getting smaller. Dr. Manmohan Singh speaks of the water tower of Asia, that is another analogy. Sponge. Water tower. They hold the water which means that you get rivers flowing in the dry season and you don't get such torrents in the rainy season as there is something to catch it. If that retreats you get torrents in the rainy season and floods of the kind that you just saw in the case of Bihar. And what we are also going to see is dried up rivers in the dry season, which of course undermines the canals, irrigation, and the fact that it comes with intensity and runs straight off into the rainy season, straight into the rivers and the Arabian Sea via Bangor. Hence, wherever it goes it doesn't sink in and recharge the water table.

The two big sources of irrigation in north India - ground water and from the rivers through canal irrigation - are going to go under enormous threat. That is on top of course the enormous task of managing those very rapid flows of water off the Himalayas which is going to become much more severe than the past. Hence, that is where a lot of the floods are coming from. The cyclone in Mumbai just a couple of years ago is an example of the extreme events which are going to become more extreme and more frequent. And the monsoon in India is very likely to become badly disrupted and the Indian scientists are working on that right now with all the implications. These are all very serious stakes and India is very vulnerable. Remember we are seeing 0.8 °C now and we have got another 1.5 to come. Even if we are amazingly responsible about it all there is a tremendous adaptation problem to all this, as well as a reduction. It is very important to link adaptation to development. Adaptation to a changing climate and the development process are not separate agendas. They have to be blended together. Development itself brings diversification, it brings more flexibility, it brings stronger human capital and the ability to adapt. Development itself is a very powerful form of adaptation and at the same time, development has to recognize in ways that I have just mentioned how the climate is changing on us. Let's not separate adaptation and development, they are part of the same process.

How do cities adapt? Let me give you London, my hometown as an example. London is going to get wetter winters and drier summers. London sewers cannot cope with extra precipitation that we are going to be getting as a result of climate change. It is not a matter of replacing Victorian sewers with plastic, they have got to become much bigger because they will have to take much more water. London underground was not designed to be air conditioned and it will be very expensive to do it. But we are either going to spend that money or close it down in the summer. I guess we will spend that money, but that is just an example of the costs of adaptation in one city which is affected by climate change but not as badly as many others around the world. Different parts of the world are starting to think through these problems. Now let me talk briefly not only about adaptation but how to cut back. And we have to remember that cutting back on these emissions is going to take place largely in cities because that is where the majority of the world population now live and it is a fraction that is now increasing and it is still where the bigger majority of energy consumption originates. So this cutting back on energy has to be led by cities. There are some examples of new cities. Norman Foster and his team designing Masdar, a zero-carbon zero-waste city in Abu Dhabi. Dongtan in China, near Shanghai, is another car-neutral city that is moving forward very rapidly. Somewhere closer to London, Woking has actually cut right back on its emissions, mostly by energy conservation, energy efficiency, but also by generating some of its own electricity in low-carbon ways by feeding it back into the grid and it's done it in a way that enabled them to reduce taxation in the city, not increase it. Woking is somewhat of a joke for those who live in London but actually it should be taken seriously as an example of somewhere that is acting. I give it because Woking is an old town while the other two are new ones.

Why should cities be able to do a great deal? Cities are full of networks and networks have, what we call in economics, an increasing return to scale. You get more than the double of output for doubling the inputs. An example here is that you can really reserve resources through public transport combined with heat and power and enabling people to sell their electricity back to their local grids. In cities people are closer to other people, therefore people learning by watching can be more important. We get skill agglomerations

so financial organizations, the technical people who know how to save energy, the organizational side of things who know how to bring the plumber and the roof insulator into the right place at the right time. You can package that with financial institutions and you can fund all these energy saving things in the right way without the person whose house has been made more energy efficient having to come up with any money. All these kinds of things you can do to the kind of skills in agglomerations. London Mayor Ken Livingstone and Deputy Mayor Nicky Gavron will be here in a few weeks and they themselves will tell you about some of their ideas about joint-procurement and standard setting.

It has to be a global deal and it has to be an equitable global deal and it has to be a global deal on scale. We have to confirm in Bali in just one month's time that the Heiligendamm targets are cutting aggregate flows of greenhouse gases by 50% by 2050. Rich countries have to take on targets of at least 75% by then. California has got 80%, France has got 25% and I am hopeful that the UK will raise its 60% target to 75% in the near future. It is not a question of setting targets but of delivery.

The trading mechanisms to trade carbon will allow finance flows to poor countries of the world including India so that India can have some contribution from outside in financing the changes and we have to make that as simple as possible. Deforestation is going to cost real money but for 10 or 15 billion dollars a year my guess is that you can halve the amount of deforestation. That is incredibly good value. We have to demonstrate and share technologies. What we cannot have is British, German, or American industries developing these low-carbon technologies and selling them at rip-off prices to the rest of the world. We are in a position which is not dissimilar from HIV/AIDS where it is absolutely crucial that the technologies are developed and shared very quickly. And we have to have a delivery on the commitment of the Overseas Development Aid made in Monterrey in 2002 and Gleneagles in 2005 because development in the face of this changing climate is more costly than we had earlier thought it to be. The origins of the extra cost is largely in the actions of the rich world over the last 100 years or so. Hence, these are the two broad strands of the world.

What about India? India is very vulnerable and India has a very enormous stake in this as we illustrated. However, India at the same time has very little responsibility for the state in which we are now in as a world. India should be pushing very strong ambitions but insisting on equitable allocations of responsibility. The last note here is slightly personal because the Stern Review has about 700 pages, some people have read it, but there are a lot of people who tell me that there is nothing about the policies of India. I am talking about the policies of India now and I do give support for the very strong targets. The Heiligendamm targets are absolutely crucial but it is certain that India should fight its corner very strongly because whilst India has to adapt and has to be part of the story reducing emissions, it is other people who should be taking stronger action. Hence push the rich countries very hard, don't take any less than 75% reductions by them for the 2050 targets, really push for the development of the carbon trading because it is those financial flows that are going to help finance India's investments. Push the technological story very hard. But finally, let me underline this point here – it is easy to say that it is tough to do but we need much more intensive study of the dangers that India and this part of the world are running as a result of climate change. They are severe and adaptation is going to be costly but as a friend of India, I believe that unless we all think that through in great detail now we are not going to make the investments in flood control, in the problems of drought, in the changing agricultural technology, the protection of the sea level rise. We are not going to make those protective investments early enough unless we start now.

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