Foreword

As we begin the 21st century, the world faces two challenges which will define our future: the prospect of catastrophic change crisis and the battle against world poverty. Furthermore it faces, in the short term, the most severe financial and economic crisis for 80 years. The financial crisis was caused by an inadequate management of risk in the financial sector. Similarly, the severity of the climate crisis will be dependent on our management of the risks from greenhouse gases. The risks however differ fundamentally. Our actions on the financial crisis will shape whether we lose a few or several percentage points of GDP and whether it lasts for a year or two, or a decade. The consequences of mistakes in managing the climate crisis are of an entirely different magnitude, possibly leading to major and irreversible consequences for life on this planet.

Emissions trading has emerged as one of the most important tools for reducing these climate risks. It has the particular advantage over other policies that it can provide finance and technology to assist developing countries towards a clean development path. In doing so, it builds positive incentives into the effort to achieve coordinated action across nations. The market it creates promotes efficiency and the caps on which it is based give greater confidence in quantity reductions than a purely tax-based mechanism. Further, the allocation of caps and how they are auctioned or sold provides for flexibility in industrial strategy and the process of adjustment. Providing a strong, stable carbon price is the single policy action that is likely to have the biggest effect in improving economic efficiency and tackling the climate crisis.

Clarity on policy and prices is all the more important now with companies facing great uncertainty because of the financial crisis: the two risks compound each other, dampening investment, making it all the more important that we take actions now that will markedly reduce uncertainties about future carbon policies and prices.

The stock of greenhouse gases in the atmosphere currently stands at around 430ppm CO_2 equivalent (CO_2e) and is increasing at about 2.5ppm

CO_2e each year. This can be compared to pre-industrial global stocks of greenhouse gases, which were around 280ppm CO_2e in 1850: this has probably increased average global temperatures by around 0.8°C above pre-industrial levels. If humankind were to continue under business-as-usual (the 2.5ppm being added each year is rising), then by 2100 we would have an atmospheric concentration of around or more than 750ppm CO_2e, which would eventually imply approximately a 50 per cent chance that average world temperatures would be 5°C warmer than 1850.

To help understand what this means, we should recall that the last time the world was 5°C cooler than today was 10,000 to 12,000 years ago during the last ice age. At this time, glaciers came down to latitudes as low as London and New York. The last time the world was 5°C higher was when the world was covered in swampy forests in the Eocene period more than 30 million years ago; and remember that *Homo sapiens* is only 100–200,000 years old. A shift upwards in temperature of a similar magnitude, over the course of the 21st century, would see dramatic changes in the physical geography of the world and the redrawing of coasts, rivers and weather patterns. Where people could live, how they could live their lives and the human geography of the world would also be redrawn. Geopolitical stability would be threatened with collapse, as floods trigger mass migration, as cities, even entire nations, disappeared under water and other parts became deserts or battered by hurricanes. For instance, one of the early impacts could be the melting of the Greenland ice cap, which alone could raise sea levels by around 4 to 8 metres globally and spark a chain of destabilizing, unpredictable feedbacks in the global climate system.

In the *Stern Review* on the economics of climate change we estimated that this unmanaged climate change would be equivalent to losing at least 5 per cent of global GDP each year relative to a world without or with relatively small climate change, and up to 20 per cent if a wider range of impacts and risks is taken into account (this is an average over regions, time and possible outcomes). With world GDP currently around US$50 trillion each year[1] this places the costs of climate change at between US$2.5 and US$10 trillion per annum in today's dollars. Looking back at these estimates of the magnitude of losses, we know today with access to the latest science that they are likely to be conservative. More rapid growth of emissions than anticipated and the reduction of the estimated absorptive capacity of oceans imply a faster rise in stocks of the greenhouse gases than estimated. The 'GDP loss'

approach has its role to play in understanding the huge costs of inaction but the more direct approach in terms of an examination of possible effects on lives, habitats, ecosystems, location and conflict seems to offer a more direct, transparent and accessible perspective. We can then think of the problem as one of 'risk management' and ask the 'insurance question' of whether the 'insurance payments' are worth the gains in terms of risk reduction. For most people the answer (given costs of action of 1 or 2 per cent of GDP for a few decades[2]) would be a resounding 'yes'.

To manage these risks responsibly, the stock of greenhouse gases in the atmosphere should be held below some target level and brought down from there. Realistically, I believe that it is probably too late to hold below 450ppm (most scientists would look for stabilization below this). We will be there around 2015. But we can hold below 500ppm CO_2e and work to bring concentrations down from there. This would not remove risks but could lead to eventual concentration levels that gave an 'acceptable' probability of holding below 2°C. Certainly the risks would be dramatically lower than business-as-usual.

If we take the 50 per cent target for reductions in annual global emission flows articulated at the 2007 G8 summit at Heiligendamm in Germany and in 2008 at Hokkaido in Japan, then by 2050 annual global emissions will need to be close to 20GtCO_2e[3] (assuming these reductions are, as they should be, relative to 1990).

Because around two-thirds of the existing stocks of greenhouse gases have been created by industrial countries, equity requires that the rich world should reduce their emissions more than poor countries. Their wealth and stronger technological skills add to the responsibility to lead. Some countries and regions have already recognized this in their long-term 2050 targets. For instance, following his election as President, Barack Obama, proposed that the United States adopt an 80 per cent national target (reductions 1990 to 2050). Canada and the UK also have 80 per cent targets, France 75 per cent and Australia a 60 per cent target.

By 2050 the world's population is expected to increase from 6.7 billion people today to around 9 billion. This growth in population is almost entirely centred in the developing world, where the population is expected to increase from around 5.7 today to around 8 billion by 2050. Per capita emissions (CO_2e) range from over 20 tonnes in countries like the US, Canada and Australia and around 10 to 12 tonnes in the European Union

to 5 to 6 tonnes in China, 1.5 tonnes in India and much less than 1 tonne per person in much of Africa. If annual flows of emissions are to be 20GtCO_2e in 2050 and there are 9 billion people on the planet, it is a simple calculation to see that per capita emissions will need, on average, to be around 2 tonnes per person.[4] For Europe and Japan an 80 per cent reduction would yield around 2 tonnes per capita (stronger reductions in the US, Australia and Canada would be necessary to reach this level). Of course, quota allocations are not necessarily the same as actual emissions and given historical responsibilities here there is a strong argument for such allocations being lower per capita in rich countries.

If the rich world were to emit zero in 2050, the countries currently seen as 'developing', 8 billion out of the 9 billion, would have to have an average of 2.5 tonnes per capita by 2050, for the 20GtCO_2e flow of emissions to be achieved. They are least responsible for the bad starting point and earliest and hardest hit. It is for them to set out the overall terms of a global deal and to place the necessary conditionalities on the rich world: strong targets, early demonstration of low-carbon growth, carbon finance, sharing of technology and strong assistance with funding for adaptation.

So far I have outlined many of the key elements of what realistically might constitute a new Global Deal on climate change. World emissions must fall from around 40GtCO_2e to 20GtCO_2e per annum by 2050 to have a chance of holding concentrations below 500ppm CO_2e. A possible global agreement, its foundations and the challenge of building and sustaining it are set out in my recent book *A Blueprint for a Safer Planet*. All countries must be involved.

We understand the scale of necessary action. We can identify the key areas for action: energy efficiency, low-carbon technologies and halting deforestation. And we know the types of economic instrument necessary; crucially this requires a price for greenhouse gases to correct the market failure of the damage caused by emissions. Of great importance too will be appropriate regulation and support for new technologies. And a major global programme combining development with halting deforestation, shaped by the countries where the trees stand, will be crucial. We will learn greatly along the way but the direction is clear. The challenge now is political will.

Put simply, we have to manage a transition, rapid in historical terms, to low-carbon growth. There will be significant costs over the coming few decades. But the rewards will be still greater than the fundamental returns of

managing climate change and protecting the planet. We should see those costs as investments with very high returns in the short, medium and long term.

In the short term a green fiscal stimulus can be a key element in taking us out of the current slowdown. For example, through work on energy efficiency, such as the insulation of houses, we can provide opportunities for unemployed construction workers. And we can do this in a way that lays the foundation for strong growth in the next two or three decades and avoid the mistake, which we made in emerging from the slowdown from the collapse of the dot.com bubble a decade ago, of sowing the seeds for the next bubble as we emerge from the slowdown.

In the medium term, the next few decades, low-carbon technologies will be a major driver of growth, analogous to or stronger than the railways, electricity, motor cars or information technology.

In the longer term we will have low-carbon growth, which will be cleaner, more energy secure, more biodiverse and probably quieter and safer. And it will be growth. High-carbon growth will kill itself, first because of high hydrocarbon prices, and more fundamentally from a very hostile physical environment. Low growth is unacceptable in a world of poverty and aspiration. That does not mean we can propose or envisage perpetual growth; but over the next several decades, only low-carbon growth can overcome world poverty. Thus we will succeed or fail together on the two defining issues of this century. If we do not manage climate change we cannot overcome world poverty and if we try to manage climate change in a way which, over the next few decades, prevents rising living standards in the developing world, we will not be able to construct the necessary global coalition for the management of climate change.

We can and must rise to both these challenges. The arguments concerning what to do and how to do it are clear and overwhelming. Weak or delayed action will be extremely costly. The creation of political will requires strong and powerful arguments. That is the responsibility of us all and an important contribution of this book.

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Notes

1 US$50,000,000,000,000.
2 See HM Treasury (2006) *Stern Review on the Economics of Climate Change*, HM Treasury, London, www.hm-treasury.gov.uk/sternreview_index.htm; or Stern, N. (2009) *A Blueprint for a Safer Planet: How to Manage Climate Change and Create a New Era of Progress and Prosperity*, Bodley Head, London.
3 20,000,000,000 tonnes.
4 Remembering that a gigatonne is a billion tonnes.