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Managing climate change and overcoming poverty: facing the realities and building a global agreement

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MANAGING CLIMATE CHANGE AND OVERCOMING POVERTY: FACING THE REALITIES AND BUILDING A GLOBAL AGREEMENT

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The challenges: division and destruction or collaboration and a new way of growth

The two defining challenges of the 21st century are overcoming poverty and avoiding dangerous climate change. If we fail on one of them, we will fail on the other. Unmanaged climate change will irretrievably damage prospects for development during the course of the century, and action on climate change which hinders development over the next two decades can never build the global coalition on which action on climate change depends. The global responses to these challenges must therefore be carefully designed and built with mutual understanding and collaboration. If strong action is taken now, a successful response to both challenges will be manageable and affordable. If we fail to act together now and let mistrust and squabbling prevent an agreement on strong action, the consequence will be damage and conflict on a global scale.

A core element of the world's response to these two challenges must be a global agreement on climate change at Copenhagen in December 2009. In the short time remaining before Copenhagen, governments around the world must come together to agree the structure of a global deal on climate change. The agreement must lay the foundations for a future era of dynamic low-carbon growth that succeeds in both cutting emissions and sustaining the growth in developing countries which is necessary to reduce poverty. I believe that an ambitious and comprehensive deal is possible, but only if crucial steps are taken over the remaining weeks and months to break the deadlock we appear to be in. That deadlock consists of an approach by rich countries which collectively involves inadequate emissions reductions and unwillingness to make financial commitments without being able to approve the plans for developing countries to move to low-carbon growth. And on the part of developing countries, an unwillingness to make commitments on reductions without a clear indication of financial support from the rich countries, together with an unwillingness to have their own plans for low-carbon development determined by, or subject to the approval of, the rich countries. The developing countries also find the level of commitment by rich countries to domestic reductions in the next two decades both too small and unconvincing.

Broad principles for moving forward together, recognising the difficulties and acknowledging the links between the twin challenges, were agreed in Bali at the 13th Session of the Conference of the Parties (COP 13) to the United Nations Framework Convention on Climate Change (UNFCCC) in December 2007 when the two-year process of building an agreement for COP 15 in Copenhagen this year was launched.

We must base the agreement on the foundations laid out in the 'Bali Roadmap' and subsequent meetings:

a) deep cuts in rich countries (at least 80% by 2050 compared with 1990) and nationally appropriate mitigation actions by developing countries;

b) financial support from rich countries to developing countries;

c) enhanced action on technology development and transfer; and

d) strong action on deforestation.

Building on this agreement at Bali, a global deal is more likely to be agreed and sustained if it is based on three basic principles than if its foundations are unclear:

Effectiveness – it must lead to cuts in emissions of greenhouse gases on the scale required to reduce the risks from climate change to acceptable levels;

Efficiency – it must be implemented in a cost-effective way, with mitigation focussed where and when it is cheaper; and

Equity – it must take account of the fact that it is poor countries, with fewer resources and technologies that are being, and will be, hit earliest and hardest by the consequences of climate change, while rich countries have a greater wealth and technology and particular responsibility for the cause through their past emissions.

In this lecture I examine the key elements of a global deal on climate change and how to build it, in the light of current discussions and negotiations along the road to Copenhagen. The argument is structured as follows. In the next section, I describe the challenge of managing climate risks with growth and development. Second, I suggest a new approach for defining global targets, which I think more clearly explains the action that is necessary in the world's major emitting economies. Third, I discuss the policies and measures that are necessary to underpin a global deal and to secure a low-carbon future. Finally, I will discuss ways in which the world might meet the challenge of securing a deal at Copenhagen over the coming weeks and months.

Throughout the discussion and consideration of the difficulties both of agreement and action, we must remind ourselves of what is at stake. On the one hand, failure implies destruction on a massive scale. On the other we can find our way to a new form of growth

which is energy secure, cleaner, quieter, safer and more bio-diverse. And the transition to this form of growth over the next few decades will probably be the most dynamic and innovative in our economic history. It will be something like electricity or railways in earlier periods, or the rise of information technology more recently, but probably still more dynamic and on a larger scale than these radical economic transformations. Put another way, high-carbon growth would kill itself, first from very high prices of hydrocarbons and secondly and more fundamentally from the hostile physical environment it creates. On the other hand, low-carbon growth presents a very attractive and prosperous future. Pessimism and cynicism will be self-fulfilling; we must find a way.

1. The targets: combining the management of climate risks with growth and development

Risks and targets

We begin in a challenging place. The concentration of greenhouse gases in the atmosphere that cause climate change have already grown from 285 parts per million (ppm) of carbon-dioxide-equivalent (CO_2e) in pre-industrial times to over 435 ppm today. We are adding to this at a rate of 2.5 ppm per year, and that rate is rising. If we carry on with 'business as usual', the concentration of greenhouse gases could rise to 750 ppm or more by the end of the century. According to the UK Met Office's Hadley Centre model, summarised in table 1, a concentration of 750 ppm would result in a roughly 50% likelihood that the world will be 5˚C hotter than pre-industrial levels. That is not a remote possibility of some minor event, but a large probability of a devastating transformation of our planet.

It is difficult to imagine what it would be like to try to live in a world that has experienced a rise in global average temperature of 5˚C. Lives and livelihoods would be disrupted in every country. Sea level rise would fundamentally re-draw the outlines of our continents. Patterns and flows of rivers could be radically different. There would be many areas that would become deserts.

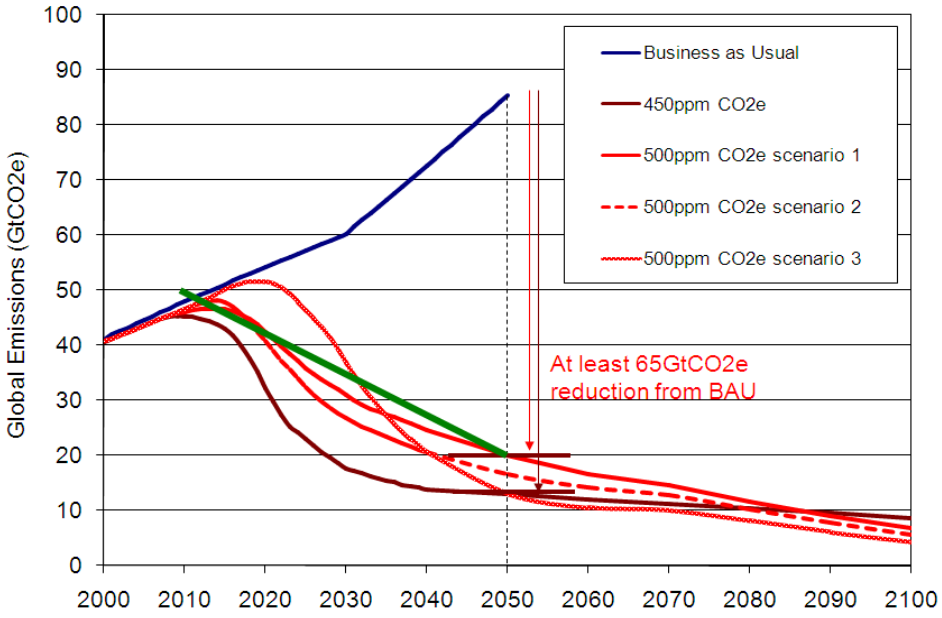
Table 1: Concentration levels and temperature increases

Populations would be threatened by reductions in the availability of basic necessities, such as clean water and food. When global average temperature was last 5˚C lower than pre-industrial levels, the last ice age 10,000-12,000 years ago, ice sheets came close to London; populations were closer to the equator than the ice sheets. The planet has not seen 5˚C upwards for more than 30 million years. Humans who have been in existence for around 200,000 years have never experienced these global average temperatures. Such changes alter fundamentally where humans can live: hundreds of millions would have to move. The outcome of such migration in very short historical time, 100 or 150 years would lead to severe, prolonged and global conflict. We must never in our examination of the details and difficulties of action forget the magnitude and nature of the stakes. The potential costs of inaction are immense; far higher than any plausible estimates of the costs of action.

We know only too well the impact of poverty around the world. But what may be less well-known are the risks to which poor people will be most exposed and vulnerable at increases in global average temperature substantially below the 5˚C we have just been considering. Potential global sea level rise of several metres would inundate many low-lying coastal areas, such as much of Bangladesh. Climate change would also lead to significant food and water shortages. The United Nations estimates that by 2080, climate change could lead to an extra 600 million people affected by malnutrition and an additional 1.8 billion without enough water. In a world ravaged by climate change, the struggle against poverty would become still more difficult for hundreds of millions of people. This would make the fundamental challenge of advancing along the dimensions of the Millennium Development Goals (MDGs), such as reducing child mortality and eradicating extreme poverty and hunger, even harder and would be likely to stop and reverse progress.

Thus it is imperative that when we think of the problems of development, we understand that they are inextricably linked to the problems we face in tackling climate change. Failure to tackle one will undermine efforts to deal with the other: ignoring climate change would result in an increasingly hostile environment for development and poverty reduction; but to try to deal with climate change by shackling growth and development over the next 2 or 3 decades would damage, probably fatally, the cooperation between developed and developing countries that is vital to success. Developing countries cannot ‘put development on hold’ while they reduce emissions and change technologies.

Figure 1: Pathways to stabilisation



In order to reduce the risk of climate change, the world must act together and commit to and achieve targets for emissions reductions. Most assessments of sensible risk management imply that we should prevent greenhouse gas concentrations from rising above 500 ppm CO_2e and then work to bring them down to 450 ppm. Figure 1 shows what global emissions reduction trajectories consistent with a 500 ppm CO_2e pathway need to be. All trajectories demonstrate that global emissions need to peak within the next 10 years and reduce by 2050 to at least half the concentration in 1990 i.e. to 20 gigatonnes (Gt) of CO_2e. Comparison of trajectories with the linear path clearly demonstrates that slower action now needs to be compensated by stronger action in future years, in order to reach the desired target.

Holding below 500 ppm would expose the planet to a probability of global average temperature rising by 5˚C or more of around 5% compared with 50% or more under 'business as usual'. It would give a reasonable chance of holding below 2°C. Looking longer term it makes sense to aim for stabilisation markedly below 550ppm to reduce the risk of passing dangerous tipping points associated with the destruction of the rainforests and the release of methane from the permafrost. It is such risks that lead scientists to describe temperature increases above 2°C as dangerous.

The global challenge in reducing emissions is major. But it is far smaller than those that would arise from not reducing them. If we do not set ourselves strong targets now, and put

in place the policies necessary to move towards them in a clear, purposive and measured way, the result will be a degraded planet, a hostile environment, and a world of conflict and growing poverty. On the other hand we can achieve, by such action, low-carbon growth and a world where we can win the other major battle of our century, the fight against world poverty. We either succeed on both the defining challenges of our century, or we fail on both; there is nothing that is stable in between.

2. A new approach to defining global targets

If the world is to hold concentrations below 500 ppm CO_2e and then try to reduce from there, then we must ensure annual global emissions peak within the next 10 years and reduce to half 1990 levels, or about 20Gt CO_2e at most, by 2050. Annual global emissions of greenhouse gases were about 40 Gt CO_2e in 1990; they are around 50 Gt today. While 1990 is a natural benchmark, in terms of the UNFCCC, it is important to realize that in terms of absolute global targets, it has less relevance: today we are where we are. Thus, the challenge is to reduce from around 50 Gt CO_2e in 2010 to around 20 Gt CO_2e in 2050. To be on the right path, total world annual emissions in 2030, half way through this 40 year period, would have to be in the region of 35Gt CO_2e (see Figure 1). Thus, intermediate targets for 2020 and 2030 are necessary now for the rich countries and very soon for all countries. The targets starting from today's 50Gt are simple: 35Gt by 2030, 20Gt by 2050. Setting three points (50, 35, 20) on the path largely determines the shape of the trajectory for annual emissions over the next 40 years; equivalently it determines, within a small range, the total cumulative emissions over the next few decades, which some scientists have identified as a key indicator for future climate change.

Thus we propose an approach of using absolute numbers rather than framing targets as a percentage reduction on a particular base year. Absolute numbers are preferable to percentages for two reasons: they allow us to keep a check on the basic arithmetic of the targets (so that they 'add up') and they avoid having to argue a theoretical reference baseline for percentages.

Combining growth ambition and emission targets

If these emission targets are to be met without affecting the ambitions for growth in developing countries, it is evident that the emission intensity of output will need to change drastically over the next decades. This is a clear and fundamental conclusion from what we might call the 'brutal arithmetic'. If we want to achieve both the strong emissions targets

and the desires for growth then simple arithmetical logic requires a large fall in emissions per unit of output. In other words we must break the link between emissions and output.

Table 2 provides an outline of four scenarios that demonstrate the extent of cuts necessary to achieve the interim 2030 target of 35 Gt CO_2e. The entries in table 2 are expressed both as total Gt CO_2e and as per capita emissions: the former expresses the basic elements of the total emissions which are the essence of the problem of climate change and the latter is a basis for thinking about how (average) individuals in different countries contribute to the problem. I chose 2030 rather than 2020 for this table because more options open up if we think of two decades: the constraints of building new infrastructure are less severe and there are more opportunities for discovery and innovation. On the other hand 2050 is sufficiently far away for politicians to make commitments somewhat lightly. The data used in table 2 are drawn from global data bases, which provide consistent and comprehensive sources. However, agreement on particular numbers of current emissions and precise future targets requires close collaboration and co-operation by all parties.

Table 2: Emissions scenarios 2030

Emissions scenarios 2030
Constant growth: China & India 7%; Indonesia & Brazil 5%; US & EU/Japan 2.5%

Emissions		USA		EU 27 & Japan		China		India		Indonesia & Brazil		Rest of World	
Trajectory consistent with 35Gt CO2e in 2030	Year (total Gt)	tCO2e per capita	Total (GtCO2e)	tCO2e per capita	Total (GtCO2e)	tCO2e per capita	Total (GtCO2e)	tCO2e per capita	Total (GtCO2e)	tCO2e per capita	Total (GtCO2e)	tCO2e per capita	Total (GtCO2e)
Scenario 1: em/output: India & China constant; US, EU27 & Japan, Indonesia & Brazil cut by factor of 2 by 2030	2030 (35Gt)	16.6	6.2	10.1	6.2	21.4	31.3	5.3	7.9	17.0	8.3	-6.4	-24.8
Scenario 2: em/output: India cut by factor of 2, China cut by factor of 4; US, EU27 & Japan, Indonesia & Brazil cut by factor of 2 by 2030	2030 (35Gt)	16.6	6.2	10.1	6.2	5.3	7.8	2.7	4.0	17.0	8.3	0.7	2.6
Scenario 3: em/output: India & China constant; US, EU27 & Japan, Indonesia & Brazil cut by factor of 4 by 2030	2030 (35Gt)	8.3	3.1	5.0	3.1	21.4	31.3	5.3	7.9	8.5	4.1	-3.7	-14.5
Scenario 4: em/output: India cut by factor of 2; China, US, EU27 & Japan, Indonesia & Brazil cut by factor of 4 by 2030	2030 (35Gt)	8.3	3.1	5.0	3.1	5.3	7.8	2.7	4.0	8.5	4.1	3.3	12.9

Assumptions	USA		EU 27 & Japan		China		India		Indonesia & Brazil		Rest of World	
Emissions	tCO2e per capita	Total (GtCO2e)	tCO2e per capita	Total (GtCO2e)	tCO2e per capita	Total (GtCO2e)	tCO2e per capita	Total (GtCO2e)	tCO2e per capita	Total (GtCO2e)	tCO2e per capita	Total (GtCO2e)
E2010	23.6	7.5	12.1	7.5	6.0	8.1	1.7	2.0	14.6	6.2	7.0	20.9

Sources: Climate Analysis Indicators Tool (© AIT) & Global Carbon Budget Project.

Population (bn)												
E2030	0.37		0.61		1.46		1.49		0.49		3.89	

Source: UN 2008 World Population Prospects

The scenarios focus on five nations or regional groups: USA, EU/Japan, China, India, Indonesia/Brazil and includes the Rest of the World as a separate group.[1] The first five collectively account for the major sources of global emissions and represent the world's major population centres (with a predicted population of 4.3bn in 2030). We have put the EU and Japan together since they start with similar emissions per capita and have similar emissions per unit of output: they also have similar 2020 targets. A corresponding argument holds for grouping Indonesia and Brazil together in the sense that their shared problems of deforestation put them as the world's third and fourth largest emitters. I assume economic growth at 2.5% for the USA and EU/Japan, 5% for Indonesia and Brazil and 7% for each of China and India; the growth rates are a blend of ambition and past experience. We want to explore how these growth rates can be achieved whilst meeting global emissions targets. The scenarios then look at different assumptions concerning emissions per unit of output.

Within the blocks, the scenarios vary according to two different assumptions concerning emissions per unit of output in India and China: remaining constant in both India and China; and halving in India while dividing by 4 in China. The assumptions concerning India relate to her much lower emissions per capita in 2010 (close to 2 tonnes CO_2e versus around 6 tonnes for China) and to her lower standard of living (also her 'starting' emissions per unit of output are substantially lower than China's). Scenarios also vary according to two different assumptions concerning the remaining groups: halving or dividing by four.

The table shows that only scenario 4 has any plausibility in terms of implications for the 3.9 billion people in the Rest of the World in 2030. Even that scenario would imply that the per capita emissions of the USA, EU/Japan, Indonesia/Brazil and China would substantially exceed those in the Rest of The World by 2030. Scenario 4 would imply a peak in emissions for China around 9 or 10 tonnes per capita near 2020 and India to peak at around 4 or 5 tonnes per capita well before 2030. Rich countries would have to reduce drastically starting now.

Even with these alternative scenarios, the broad architecture is clear: unless the USA, EU/Japan, Indonesia/Brazil and China reduce emissions per unit of output by a factor of 4 over the next 20 years, it will not be possible to grow at the desired rates and to reach the emission goals that sensible risk management requires.

The next step is to look at illustrative scenarios in 2020 for different trajectories consistent with annual emissions of 35 Gt CO_2e in 2030. Table 3 presents scenario 4 from table 2, but with annual emissions per unit of output targets for the year 2020. We first take a base case (Base 4a) with a 44

[1] EU refers to the 27 member countries of the European Union.

Gt CO_2e target range in 2020 which is roughly consistent with a linear downward slope to 2030, and assume India cutting by a factor of 1.5 and all other groups halving. This scenario with absolute emissions falling strongly from now on, which would prove a significant challenge, given that we start with a particular infrastructure, especially for India and China. We then compare to Base 4b, which affords 48 Gt CO_2e in 2020, allowing one extra gigatonne for each of the USA, China, India and the Rest of the World. The results seem more feasible against current country emission reduction 'offers' or policies, but it should be remembered that a global target of 48 Gt CO_2e would require going well below 20 Gt CO_2e in 2050, in order to be on a pathway to stabilisation at an atmospheric concentration of 500 ppm. The second two scenarios, Headroom 4a and 4b, give relatively more headroom to India and China in 2020 compared with the other groups. Scenario 4a looks reasonable against current country 'offers' or policies, and remains consistent with a 44 Gt CO_2e target in 2020. Scenario 4b again affords one extra gigatonne to each of the USA, China, India and the Rest of the World. However, again it should be remembered that a 2020 target of 48 Gt CO_2e implies much stronger action later.

Overall, table 3 demonstrates a new way of thinking about mid-term targets, which does not depend on agreement over a particular base year to measure emissions. Rather, with absolute targets starting from now, we can see how one feasible division of responsibility between the world's major emitters (scenario 4) can be helpful in assessing current country mid-term 'offers' and policies. For the reasons above, I present 44 Gt to 48 Gt CO_2e as a possible range in 2020, with a strong emphasis towards 44 Gt as the climate responsible target.

Table 3: Adding up to 2020 – Illustrative scenarios in 2020

Adding up to 2020 - Illustrative emissions scenarios in 2020
Constant growth: China & India 7%; Indonesia and Brazil 5%; US, EU & Japan 2.5%

Emissions		USA		EU		China		India		Japan		Indonesia & Brazil		Rest-of-World	
Trajectory consistent with 35 Gt CO2e in 2030	Year (total Gt)	tCO2e per capita	Total (GtCO2e)	tCO2e per capita	Total (GtCO2e)	tCO2e per capita	Total (GtCO2e)	tCO2e per capita	Total (GtCO2e)	tCO2e per capita	Total (GtCO2e)	tCO2e per capita	Total (GtCO2e)	tCO2e per capita	Total (GtCO2e)
Base 4a: em/output: India cut by factor of 1.5; China, USA, EU27, Japan, Indonesia and Brazil halving by 2020.	2020 (44Gt)	13.9	4.8	7.7	3.8	5.6	7.9	2.0	2.7	8.1	1.0	11.0	5.1	5.4	18.7
Base 4b: Base 4a + 4Gt equally distributed to US, China, India and Rest-of-World	2020 (48 Gt)	16.8	5.8	7.7	3.8	6.3	8.9	2.7	3.7	8.1	1.0	11.0	5.1	5.7	19.7
Headroom 4a: em/output: India cuts by factor 1.15; China by factor 1.5; USA, EU27 and Japan halving; Indonesia and Brazil cut by factor 2.25 by 2020.	2020 (44Gt)	13.9	4.8	7.7	3.8	7.4	10.6	2.6	3.5	8.1	1.0	9.8	4.5	4.6	15.8
Headroom 4b: Headroom 4a + 4Gt equally distributed to US, China, India and Rest-of-World.	2020 (48 Gt)	16.8	5.8	7.7	3.8	8.1	11.6	3.3	4.5	8.1	1.0	9.8	4.5	4.9	16.8

Sources: Climate Analysis Indicators Tool (CAIT) & Global Carbon Budget Project.

The scenarios presented above demonstrate the importance of all major emitting economies acting immediately to reduce emissions per unit of output. This means acting strongly on energy efficiency in the first years, to capture the opportunities that are easily accessible and reduce energy per unit of output. In later years this needs to be combined increasingly with changing the energy mix towards low-carbon options as energy efficiency options become harder to achieve and renewable energy sources become cheaper. Research, new ideas and investment in new technologies now will be required if the opportunities for changing the energy mix are to be realised. Rapid technical progress is essential. The combination of these two effects, reducing energy per unit of output and emission per unit of energy, could allow both the growth and the emissions targets to be achieved. The alternatives would be to slow growth or to be reckless with the climate. Surely the right answer is to cut right back on emissions per unit of output.

No major country, least of all a rich one, can claim to have good reason to 'contract out'. We must do this together. Actual emissions targets for 2050 in all major countries are *not* the same as quotas or allocations of emissions rights. In 2050, emissions have to be around 2 tonnes per capita CO_2e. This is essentially arithmetic: if there are 9 billion people in the world and annual global emissions are not more than 20 Gt CO_2e in 2050, the annual emissions per capita cannot be on average more than 2.2 tonnes. There will be few major blocks of population much below this level, therefore there cannot be major blocks above. Thus regions like EU and Japan, around 10-12 tonnes per capita in 1990, have to cut actual emissions by 80% in the period 1990 to 2050, and countries such as the USA with much higher emissions in 1990 should have still stronger percentage targets. This is the quantitative basis for the often quoted targets of at least 80% reductions between 1990 and 2050 by rich countries.

It is important to notice that the targets I have just described, and the implications they have in terms of reductions in emission intensity, have nothing to do with equity: they are just simple arithmetic based on what the science tells us on risk. What this means in terms of how close current commitments take us, I will come back to later. Similarly I will return to issues of equity and flows of finance.

3. A structure for action: underpinning a global deal and securing a low-carbon future

I have already described the risks to the planet from business-as-usual emissions. Thus for the world, low-carbon growth is the only viable and sustainable form of economic growth in the future. We confuse the issues if we try to create an artificial 'horse race' between development and climate responsibility.

The starting point for a low-carbon future must be leadership in the rich countries: they have the wealth, technology and main responsibility through past emissions for the difficult starting point. They must demonstrate that low-carbon growth is possible whilst strongly supporting mitigation and adaptation in developing countries. There are four main parts to the role the developed world must play:

(i) strong performance over the next decade towards meeting targets for 2020 and 2030, which are tough and fully consistent with a path to reductions in annual global emissions to at most 20 Gt CO_2e by 2050. Through putting in place strong policies and measures to achieve emissions cuts the developed world will drive the level of overall global ambition;

(ii) financial support through the carbon markets and elsewhere for action on emissions reduction in the developing world, including strong support in the battle against deforestation; by the 2020s the necessary flows to support reductions in emissions by developing countries are likely to be in the region of $100bn per annum.[2]

(iii) the development of new technologies for low-carbon economic growth, which should be shared with developing countries; and

(iv) substantial assistance in adaptation to those impacts of climate change which are now inevitable over the next few decades; by the 2020s the necessary additional support (over and above existing commitments on official development assistance) is likely to be in the region of $100bn per annum.[3]

For their part, developing countries, although they have contributed less to the build-up of greenhouse gases in the atmosphere than the richer industrialised countries, should nonetheless establish and implement their own climate change action plans, starting as soon as possible. Whilst they must start now if global goals are to be achieved, it is reasonable that their progress should depend on continuing evidence of strong action by the developed countries on the requirements described above. We cannot avoid the conclusion, however, that the feasibility of the necessary commitments, and timely peaking, will require strong climate change action plans in developing countries and support from developed countries now. The mechanisms for support by rich countries should be organised around the climate change action plans of poor countries; it is their development. This approach was envisaged in the discussions at COP 13 in Bali in 2007, and COP 14 in Poznan in 2008 and is summarised in the 'Bali roadmap'. In my view, the developing countries should set out their vision for a low-carbon future for the world and not just themselves. They will

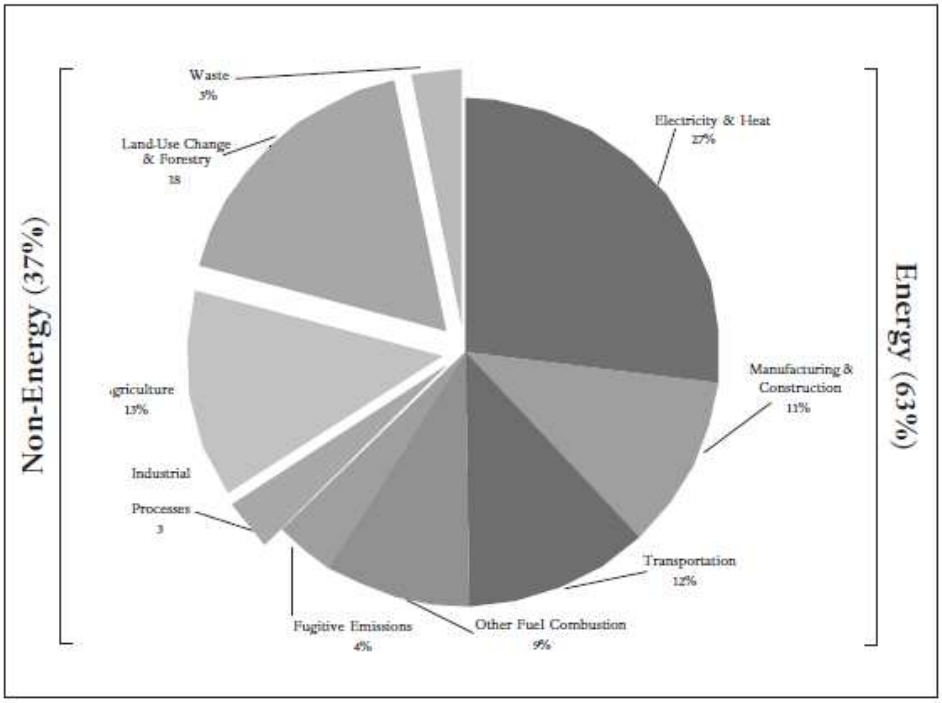
[2] See 'A Blueprint for a Safer Planet' ('The Global Deal' in the USA), Stern, 2009.
[3] See, for example, the analysis of the Human Development Report 2007-08 which indicated costs around $85bn p.a. by 2015.

be the 8 billion out of the global population of 9 billion in 2050. In this fundamental sense it is their world. It is the rich that bear the primary responsibility for past emissions and current concentrations. However, action, by sheer force of numbers, has to be strong in the developing world too.

Because in some parts of the economy, such as agriculture, drastic cuts of emissions per unit of output will be difficult (although substantial reductions are possible even here), those sectors where they are possible would have to see their emissions per unit of output reduced to close to zero. If the overall requirement in a rich country is for a cut of 80% in emissions between 1990 and 2050, and one major sector cuts by less than 80%, then another will have to have cut by more than that to reach the overall goal.

Different countries have varying levels of emissions by sector, depending on local characteristics, including the structure of production and natural endowments. But for the world as a whole, the breakdown of sources of energy emissions is illustrated in the figure below:[4] The categories used in this chart reflect the IPCC Common Reporting Framework used by the UNFCCC. 'Electricity and heat' accounts for all power and heat plants, including combined heat and power (CHP). 'Other fuel combustion' comprises mostly commercial and residential buildings emissions.[5]

[4] Care is necessary in comparing figures on breakdowns across sectors. In addition to variations across countries, sometimes emissions figures are given as energy only and sometimes CO_2 only. We generally refer to all sources and all greenhouse gases unless otherwise stated.
[5] See www.cait.wri.org/downloads/cait_ghgs.pdf.



Source: Climate Analysis Indicators Tool (CAIT) Version 5.0, Washington DC: World Resources Institute, 2008.

Energy-related sectors account for around 63% of the total. Within the 37% from non-energy sectors, the 'land-use change and forestry' source is mainly deforestation and peat fires. These emissions are on a scale larger than those from road, sea and air transport put together, and more than half comes from two countries, Brazil and Indonesia. Stopping deforestation can be a major contribution to reducing emissions, and in principle it could be done quickly and at reasonable cost as we will see later.

Low-carbon growth of the necessary scale can be a reality if we so wish but it requires action across all sectors, all countries and with a broad range of possible technologies. If any sectors, countries or technologies are excluded, action later will have to be much more intense and thus more difficult and costly.

We have to do four things. The first is to make much more efficient use of energy, which is used very wastefully across the board – in buildings, industry, transport, power generation, agriculture and so on. The second is to halt deforestation. Progress on these two can be very rapid. The third is to put existing (or close to existing) technologies to work quickly. In electricity these include wind, solar, hydro, wave and tidal, geothermal and nuclear; and since hydrocarbons will be used for some time we must move quickly on CCS for coal and gas. Emissions from cars can be reduced rapidly through the design of engines and control systems, by the better use of vehicles and improved infrastructure,

and by driving habits, choice of car and choice of transport; much greater use of electric cars can be made fairly rapidly. The fourth is to invest strongly in new technologies which are on the medium-term horizon, although in many cases not so far off. These include still further improvements in solar power, better batteries, enhanced photosynthesis, new generations of bio-fuels, nuclear fusion and so on. The possibilities are both exciting and enormous.

We should not see the route to the low-carbon economy merely or mostly in terms of cost and burden-sharing. These are investments and opportunities if we can deliver on the requirements I have just described.[6] They will deliver many co-benefits; the growth will be more energy-secure, cleaner, quieter, safer, and more bio-diverse.

This is a very attractive world and it is not fanciful. It can be built using policies and technologies we broadly understand and can develop and implement. It is a world where we can realise our ambitions for growth, development and poverty reduction across all nations, but particularly in developing countries. And previous examples of rapid change in investment and technologies show that we can achieve, in the timescale that is necessary, the deep cuts in emissions necessary for a safer planet.

Basically, we can see our way forward with respect to sectors and technologies. We have much to learn, and will learn, along the way but we know how to set off. This paper is not the place to discuss detailed price, regulation and institutional policies but we have an understanding of these too. Thus we know the necessary scale of action, where to act, and how to incentivise action. What we need now is political will and global agreement.

4. A global deal on climate change

The 15th Session of the Conference of the Parties (COP 15) to the United Nations Framework Convention on Climate Change (UNFCCC), to be held in Copenhagen in December 2009, will be

[6]The HSBC, Climate Change-September annual index review entitled 'Climate Revenues – An Industrial Reality', by de Lima and Sumon, September 14th, 2009 estimate that global climate revenues have already risen 75% in 2008 to $530 billion and HSBC estimates that climate revenues from the equity market could exceed $2 trillion by 2020, on the basis of recent growth rates in revenue for global companies[6].

critical in determining the policies for the period beyond 2012 that succeeds the Kyoto Protocol. The Copenhagen meeting will be the most important international gathering since the Second World War. The risks it must grapple with and the policies it agrees must be truly global. We can see the basic framework that would deliver a global deal whilst there will be much further work to do on detail after Copenhagen. Now is the time to agree that framework.

I have already outlined the simple framework in terms of what I think are feasible and clear mitigation targets from today's 50 Gt CO_2e: 35 Gt by 2030 and 20 Gt by 2050. Let us take scenario 4 from tables 2 and 3 to compare how far away the world currently is and what more needs to be done to achieve a global deal.

Table 4: Current Commitments in 2020[7]

Current Developed Country Proposals				
	Low		**High**	
		Emissions in 2020 (GT CO2e)		**Emissions in 2020 (GT CO2e)**
US	1990 levels	6.1	20% on 2005	5.8
EU	-20% on 1990	4.5	-30% on 1990	3.9
Japan	-25% on 1990	1.0	-25% on 1990	1.0
Other developed countries		4.9		5.1
Developed country total		**16.4**		**15.7**

[7] Where national emission targets for 2020 have been made numerically explicit by countries or regions, as is the case for the EU and Japan, we have taken those numbers as given. The table shows how much the main policies in China and India can save in emissions in 2020. To calculate emission savings from energy-related targets (i.e. all except India's afforestation target), the analysis uses energy and emissions data from the World Energy Outlook (WEO) 2007. The analysis assumes that the renewable, solar and nuclear targets displace energy demand/supply from fossil fuels and therefore save emissions. This makes use of emission factors from the WEO 2007. To calculate emission savings of India's afforestation target, the analysis uses IIASA BAU data and a 3tC/ha absorption rate from a paper by the Indian Council of Forestry Research and Education."

Current Developing Country Proposals			
Country	**Current policies**	**Savings in 2020 (GT CO2e)**	**Emissions in 2020 (GT CO2e)**
China	Energy Intensity target 20% by 2010	0.5	
	Renewable energy 15% by 2020	0.5	
	Nuclear target 75GW by 2020	0.3	
			11.2
India	Solar Mission 20GW by 2020	0.03	
	Renewable electricity 15% by 2020	0.07	
	Increasing forest cover 6 million hectares by 2017	0.07	
			3.6
Other developing countries			18
Total developing countries			**32.8**

Table 4 measures emission reduction policies of countries in table 2, in order to understand how near or far we are from meeting the goal of 44Gt by 2020. Targets are converted to reductions measured in gigatonnes of carbon-dioxide-equivalent by making an assumption about the rate of growth of emissions in each country. Some national emission targets for 2020 have been made explicit by countries or regions, for example for the EU and Japan. And where the targets are expressed as a energy productivity target[8] or cover a period that ends before 2020, such as the 20% energy-to-output reduction target China has committed to in its 11th Five Year Plan (2006-2010), we have assumed that the same intentions are rolled into subsequent plans to cover the period up to and including 2020 (assumptions are also made about economic growth rates in order to convert energy to output targets to emission reductions in gigatonnes)[9]. The table presents both the 'low' and 'high' intentions/commitments , commitments from each country or region where they are known. It also assumes that intentions or commitments are entirely met through domestic action.

While a rigid interpretation that action must be entirely domestic will be inefficient, neither is it possible to meet any national commitment entirely through purchasing reductions from abroad. The required commitments on national emission reductions presented in table 2 are ambitious and it will be possible to pay for a proportion of any national commitment by purchasing credits from abroad. But we must not double count. If actual emission reduction are less in country A because emissions are bought from country B, the emission reduction in country B must be more. We must focus on actual emission reductions if we are to be realistic and transparent about 'adding up'. Whilst offsets can generate greater efficiency and financial flows the reality of reductions and finance will be embodied in actual emission reductions and actual flows of funds.

[8] Note that emissions per unit of output targets can be stronger than energy per unit of output since emissions per unit of output can change as, for example, renewable and nuclear technologies come online. For example a 20% target emission per unit of output or 10% emissions per unit of energy target combine to give a 28% reduction in emissions per unit of output (0.9 x 0.8= 0.72).

[9] An economic growth rate of 7% is assumed averaged over the period of the 11th five year plan and the periods to 2020.

If we look at the numbers in table 4 with respect to the global target of no more than 44 Gt CO_2e in 2020 (and the various ways of breaking this down), we can understand the scale of further action required. Action delivered against the 'low' ambition intention would result in over 49 Gt CO_2e total emissions in 2020. This is above what many, including myself, would judge to be a 'climate responsible' mid-term target for the world. Indeed, at this level of ambition many countries will have underperformed (not taken significantly strong action) relative to the required targets with many underperforming significantly. This is not necessarily true at the 'high' ambition level where total world emissions would be around 48 Gt. On current assumptions the difference between 'low' and 'high' is small. This level of ambition just about reaches the high end of a possible 2020 target, although, if 48 Gt CO_2e is all that is achieved in 2020, the world will need to act much more strongly in subsequent years and go below 20 Gt CO_2e in 2050. Thus, looking at the whole world, between 3 and 5Gt extra are needed from somewhere to hit the 44 Gt CO_2e target (even assuming success of current country 'offers' and policies).

We should not be rigid about the precise figures for annual emissions in 2020 or any other particular year. There could be a little more emissions in one year and a little fewer in another. But the limits imposed by the overall arithmetic for total emissions over the next few decades are very real and give a very powerful indication of the scale of action required. Only a comprehensive agreement that involves both rich and developing countries can achieve the cuts in emissions necessary to avoid dangerous climate change. Further to this, not only must current commitments be met but all parties must dig even deeper, a further 3-5 Gt CO_2e, to ensure we meet the demands of a responsible climate target. And we should note again that commitments should be met at home as far as possible. If the EU, for example, relies on offsets for meeting its targets then actual reductions in the developing world must be still stronger (although there would be finance from the carbon markets).

If we cannot cut emissions by this level by 2020 through more concerted domestic action, surely we can identify opportunities to reduce the deficit by at least 2-3 Gt CO_2e, and more strongly in subsequent years? In order to meet the shortfall, countries will need to go beyond their existing intentions or commitments and equity suggests that developed countries should bear the lion's share of the responsibility to make up the difference. There are a number of possible forms that this could take.

Tropical deforestation is an international issue, requiring urgent international action to support tropical forest nations; it is their countries ' development which is involved, and it is they who should formulate their own plans of action. Overall around 8 Gt CO_2e p.a. comes from deforestation. Public

resources will be needed on a large scale, including to support advances in agricultural productivity, together with reforms to help in building appropriate institutions and governance structures. Back of the envelope calculations suggest that it would cost around $15 billion per annum to halve emissions from deforestation in the next decade[10]. If developed countries, including those in our scenarios, committed to fund a third of the total at $5bn per year, we could remove over 1Gt extra of emissions from the atmosphere relative to Brazil and Indonesian targets already assumed . Arguably the sum should be more like $10 billion per year or more since Brazil and Indonesia have the right to strong external support for their current plans.

Developed countries could agree to provide targeted concessional finance around defined (sectoral) programmes to reduce carbon intensity, provide incentives for technology diffusion and adoption, and support developing country R&D and technology efforts.

A further possibility is enhanced direct support by developed countries for the actions plans of developing countries, beyond existing commitments on official development assistance (ODA). While financing action on climate change in developing countries is not solely the responsibility of the developed world, the developed countries should be prepared to support the low-carbon plans of the developing countries. Developing countries need to be able to plan and implement their low-carbon and climate resilient development programmes in the knowledge that there will be finance for them. That requires predictable and adequate long-term financial flows which the developed countries can help to provide: flows of US$100 bn for mitigation[11] and US$100 bn for adaptation[12], as mentioned earlier, are of the right magnitude. Such financial support should be discussed in combination with the simple targets discussed earlier. At present we risk a deadlock. Waiting to define precisely one commitment by one group before the other is defined by the other is a negotiating game that we cannot afford to play. In other words rich countries cannot delay financial offers until they see targets from developing countries, and vice versa.

China, India, Brazil and other developing countries could come forward with ambitious plans as the basis for international finance. These plans should be respected for what they are: national plans which are not required to be negotiated with others in the context of the global deal; they represent

[10] See 'Climate Change: Financing Global Forests', *The Eliasch Review*, Eliasch, October 2008, UK Office of Climate Change.
[11] Around half of the $100 billion for mitigation might come through the carbon markets.
[12] See, for example, the analysis of the Human Development Report 2007-08 which indicated costs around $85 bn p.a. by 2015.

the commitment developing countries take to their own people. Rich countries should recognize them as commitments of this nature. Low-carbon growth strategies in developing countries should be embodied in national action plans that integrate adaptation, mitigation and development. These plans will guide implementation and facilitate access to the necessary funding. Integrating the adaptation and low-carbon growth objectives into the national action plans will reinforce the coherence and the effectiveness of the different measures. Clear developing country proposals for their own national action plans, as a means to implement adaptation, mitigation and development measures, will also help to secure the required additional funding in both the short and long term. Under the principle of common but differentiated responsibilities, the leading developing countries have already said that they are able to and will finance a substantial part of their own action themselves.

We must recognise very clearly that this cannot sensibly be a story of rich countries placing detailed conditionalities on the development programmes of poor countries as is all-too-common in development aid. If there is conditionality then history and equity point to it being the other way around. In other words , the action of the developing countries is conditional on the performance of the rich countries along the four dimensions described above.

Finance

Funding to support developing countries should come from both public and private sources. Public money is likely to be required for much of the necessary adaptation investment and to directly support some mitigation action where no private investment is available. Revenues from carbon markets should constitute an important incentive for private investment in mitigation. But some public money may be necessary to support developing country plans by sharing risks with the private sector, particularly in the early days of the carbon markets, to leverage private investment. There will be, therefore, a requirement to mobilize additional public finance. The main sources should be (i) national carbon taxes, (ii) national permit auction revenues, (iii) international auction revenues, as in the Norwegian proposal, (iv) international transport levies, (v) general government revenues (associated with fresh borrowing or taxes): all are relevant and a mix would be more stable than just one. If the will is there then there is a range of means to raise the funds. And the $200 bn p.a. by 2020 likely to be involved would be around 0.4 of rich country GDP – tiny in relation to the issues at stake. All sources should be blended with development funding in as simple a way as possible: both stability of funding and linking to results will be important.

The institutional architecture for a global deal should promote equity, efficiency and mutual trust. The administration of funds should be simple and efficient; limiting the number of new institutions and using existing development channels where possible to support adaptation to climate change and the transition to a low-carbon economy, in way that is well-integrated into development programmes and with governance embodying full developing country representation. The Regional Development Banks, with the support of other multi-lateral and bi-lateral institutions should play a leading role in administering the funds so that funding for adaptation and development are fully integrated and fit with the needs of developing countries. At the national level, ensuring efficient and transparent national and local institutions will help build mutual trust and increase the effectiveness of mitigation and adaptation activities.

Given the inequities of the history of emissions, and the implications of climate change for future development, rich countries must adopt and deliver strong emission reductions. However, they should do much more than this. There is a strong imperative for the rich countries to provide more funds to developing countries, in addition to current development commitments, to fund adaptation i.e. the extra costs created by climate change. They should also provide financial support through the markets and elsewhere for mitigation action in the developing world, strong support in the battle against deforestation, demonstrate, well before 2020, that they themselves can deliver credible reductions, without threatening growth, and that they can design mechanisms and institutions to transfer funds and technologies to developing countries.

One of the mechanisms will be the carbon market. I argued at the end of section 2 that actual emissions for all major blocks of population will have to be no higher than 2.2 tonnes CO_2e per capita. But given the pattern of past emissions there are arguments that allocations of permits to rich countries should be on a lower basis that this. The lower the allocation to rich countries the greater the financial flows.[13]

Breaking the deadlock: leadership and decisions

We now recognize the problems and understand what must be done to combat climate change. What we need now is leadership and collaboration to achieve a global deal. Collaboration on climate change will have to be on a greater scale than the world has ever seen. But if we succeed here it will make collaboration on all our other important international issues far easier. Indeed, bringing a few of them together in implicit understandings may mean that it is easier to move forward on any one of them. That kind of perspective, putting the big issues together, can take place only at the

[13] See 'A Blueprint for a Safer Planet' ('The Global Deal' in the USA), Stern, 2009

Presidential or Prime Ministerial level. It cannot arise only amongst trade ministers talking about trade, environment ministers discussing the environment, and finance ministers working on financial issues.

We need political leadership which is not only thoughtful and measured but also courageous. That leadership must set out the compelling scientific and economic case for strong action. It must show not only the severe dangers of a planet in peril, but also that if we act sensibly and strongly starting now, we can dramatically reduce those risks at reasonable cost. That leadership must be courageous too in confronting the short-term, narrow and often confused ideas of self-interest which will make a lot of noise and argue for postponement of action, or in some cases for little or no action. It is a time for clarity and strength in vision, decision and implementation.

That leadership can and must also be inspirational. Strong action on climate change will not only protect the lives and livelihoods of our children and grandchildren and allow them to experience something of the wonder of the natural environment which we now see. Low-carbon growth will deliver much more than this. It will also create an industrial revolution which will drive growth in the coming decades. It will also be a more co-operative world where we have a much better chance of dealing with the many global problems, above all of deep poverty, that we face and will face as common citizens of a small planet.

This is indeed an inspirational story. But it is also a practical story, indeed the only practical story. We have a short window of opportunity to turn it into a reality. Whilst it is time for leadership, we must all contribute to the creation of this reality: from my own world of the university and of policy analysis; from those who will invest in the new opportunities; and from those who will change the way they consume. We know what we have to do; the prize is enormous. The people and politicians of the world, community by community, nation by nation, will now determine whether we can create and sustain the international vision, commitment and collaboration which will allow us to take this special opportunity and to rise to the challenge of a planet in peril.

Just two and a half months from Copenhagen, the most important international gathering of our time, we risk deadlock from mistrust and lack of ambition. We must as a world rise above this and it must be the rich countries that take the lead. I am greatly impressed by the analyses being made and the plans being constructed in the developing world. There is a widespread and growing understanding in countries both of the dangers and the opportunities. But they need strong cuts, examples, and finance from the rich countries. We need agreement on this vision this year. And we can do it this year.

There is both a fierce urgency, and a big opportunity for not just developed countries but also the developing world to show leadership. The developed world must face up to its responsibilities on both development and climate change. It will require radical change and real resources. We can not only manage the profound risks of climate change we can also find a much more attractive and stronger form of growth: a growth that can last and that helps us overcome world poverty. I believe that the developing world, if the rich world plays its part, will accelerate its actions and we can together create an international collaboration which can transform the way the world works together.

We know what we have to do. 2009 offers unprecedented opportunities. Let us not waste them.

We can overcome some major obstacles to a strong deal on climate change in Copenhagen by focusing on four key issues.

First, we must recognise what we have to achieve in terms of global emissions. In order to have a reasonable chance of avoiding an increase in global average temperature that exceeds 2˚C, we need to reduce annual worldwide emissions from the present level of about 50 gigatonnes of carbon-dioxide-equivalent to no more than 20 gigatonnes by 2050. There are a number of possible trajectories which could meet this target and control total annual emissions over the period to the level necessary, but none of them would allow any more than 35 gigatonnes by the mid-point of 2030. These are the key figures, 35 gigatonnes of carbon-dioxide-equivalent by 2030 and 20 gigatonnes by 2050, that must guide any agreement on national targets for emissions reductions. By focusing on these totals for global annual emissions, and not percentages relative to earlier levels, we can focus where the science takes us, on the overall path of annual emissions over the next few decades. In other words, we must focus on whether the planned national emissions targets are consistent with the constraints of the global emissions totals.

Second, the need for national targets both to add up and to be equitable means that rich countries, including the European Union, Japan and the United States, need to achieve emissions reductions of at least 80 per cent by 2050, compared with 1990. Developing countries, including China and India, also need to limit and decrease their emissions, but in ways that are consistent with their ambitions for continued economic growth and the reduction of poverty.

Third, if we assume that annual global emissions will peak within the next five years and will reduce at a substantial but realistic rate thereafter to give a reasonable chance of avoiding a temperature increase of more than 2˚C, global annual emissions must be cut to between 44 and 48 gigatonnes of carbon-dioxide-equivalent by 2020. If we only reach the upper end of this range, much bigger annual

reductions in emissions would be required in subsequent years, and cuts of more than 50 per cent by 2050 compared with 1990 to prevent a rise of more than 2˚C. Thus, it would be safer to aim for the lower end of the range for 2020. An analysis of the current policies and commitments among the most important rich and developing countries in terms of emissions indicates that we would be close to the top of that range in 2020, so we must find ways of making further cuts in the next two decades to reach a reasonable trajectory.

Finally, rich countries should give their strong backing to climate change policies, including those that are designed to halt deforestation, and low-carbon growth plans in developing countries in a variety of ways, including through additional financial support, beyond official development assistance, of US$100 billion per year for mitigation and US$100 billion per year for adaptation by the 2020s.

If we can get to grips with these issues, then we can achieve an agreement that is effective, efficient and equitable. It will allow us to avoid the profound risks of climate change, to overcome poverty worldwide and to usher in an exciting new era of prosperity based on sustainable low-carbon growth. Through innovation and investment in new greener and more energy efficient technologies in the next two or three decades, we can create the most dynamic period of growth in economic history. And what is more, a low-carbon world will also be quieter, cleaner, more energy-secure and more biologically diverse. Let us not allow mistrust, pessimism and lack of ambition to prevent us from achieving these aims. Instead let us have real vision and leadership in both developing and developed countries which seize the opportunities offered by Copenhagen, for us, our children and future generations.