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The New Energy-industrial Revolution and International Agreement on Climate Change

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ABSTRACT

At the heart of the analysis of, and progress on, action on climate change, at both country and international levels, must be an understanding of three sets of issues. The first concerns scale: of the risks from unmanaged climate change; of the necessary response; and of the great economic and social opportunities from the new low-carbon energy-industrial revolution. Low-carbon growth will be more dynamic, creative, cleaner and more bio-diverse; high-carbon growth will self-destruct. Second, in trying to work towards international action we must understand how key countries and blocs are moving: action in one country will be influenced by confidence in where others are going. Many have moved in positive directions in recent years. Third, action on the scale required will involve policy at the national level ("bottom-up") and collective action at the international level ("top-down"): progress and agreement will depend on an understanding of how they support and encourage each other.

Keywords: Emissions, International agreement, Energy-industrial revolution, Copenhagen, Cancún, Durban

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1. INTRODUCTION

Progress on an international agreement on climate change, indeed any serious public discussion of policy, must begin with, and be predicated on, an understanding of the immense scale of risks from unmanaged climate change, the corresponding scale of the necessary response and the great opportunities that are likely to lie in the great economic transformation.

Second, crucial to progress will also be a recognition and understanding of how other countries and blocs are moving. A deepening international understanding of what others are doing is key to building trust and overcoming barriers.

Third, we must understand that both national action and international agreements will be necessary if we are to act as a world on the scale required: national actions are supported by

confidence in what others have agreed to do and the building of international agreements will depend on confidence in the national action of others.

We begin with a discussion of the risks. Unless the world embarks now on a new low-carbon energy and industrial revolution it will be very difficult to manage the huge risks associated with climate change. Continuing with 'business-as-usual' (BAU) for the next few decades will bring grave risks. Greenhouse gas concentrations (or stocks) have increased to around 440 parts per million (ppm) of carbon-dioxide-equivalent (CO₂e). If we continue with BAU for a century we would likely add at least 300 ppm, taking concentrations to around 750 ppm CO₂e or higher around the end of this century. Such a path would bring somewhere in the region of a 50-50 chance of a warming of more than 5°C¹, a temperature not seen on Earth for more than 30 million years. *Homo sapiens* has experienced nothing like this, being present for around only 200,000 years, and our civilisations, in terms of arable farming, villages, towns and so on have been here for only 8,000 or 9,000 years, since the emergence from the last ice age.

Such warming would likely cause disruption on a huge scale to local habitats and climates, for example through flooding, desertification, and water scarcity. Hundreds of millions of people, perhaps billions, would probably have to move, with the associated risks of severe and extended conflict.

While none of the predictions can be made with certainty—this is about risk management—it is clear that the potential risks are huge and the probabilities are not small. Unmanaged climate change will put at risk the great advances in development of the last few decades, which have seen hundreds of millions rise out of income poverty, great improvements in health and life expectancy, and major advances in education and literacy. A high-carbon growth strategy is likely to destroy itself and is not a serious medium-term option.

Presence of uncertainty around the consequences and prospects of progress in technology might be taken to suggest a "wait-and-see" approach. That would be a profound mistake and it is crucial that this is clearly understood. First, there is a flow-stock process here, from emissions to increasing concentrations, and it is very difficult to reduce these stocks on a major scale in the medium term. Second, infrastructure and capital investment involve "lock-in" with much of the relevant capital having a technical lifetime of a few decades. Delay is very dangerous: we are already at a difficult starting point in terms of concentrations of greenhouse gases and weak action or inaction for a decade would make stabilisation of concentrations at acceptable levels much more problematic.

The new energy and industrial revolution and the transition to low-carbon growth is a far more attractive path. This is likely to be a period of innovation, creativity and growth, and will involve substantial investment across the economy, characteristics of past periods of economic and social transformation. And low-carbon growth, when achieved, will be more energy-secure, cleaner, safer, quieter and more bio-diverse than its predecessors. Low-carbon is the future growth story.

Such growth in material and other living standards is necessary for the next two or three decades in the developing world if we are to rise to the two defining challenges of our century: overcoming world poverty and managing climate change. Failure on one implies failure 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. This is not to argue that higher growth rates can or should continue for ever—that is a question that can and should be re-examined in the context of breaking the link between economic activity and greenhouse gas emissions.

The scale of transition which is necessary will require strong action across all countries and all areas of activity. At the heart of this action will be energy efficiency, the introduction of new low-carbon technologies and halting deforestation. It will require a wide range of public policies to address a range of market failures, the most important being (i) carbon pricing and regulation, (ii) investment in and support for research, development and deployment (R,D&D) of existing and new technologies, (iii) enabling networks/grids (public transport, for example), (iv) support for relevant long-term risk and capital markets, (v) provision of information, (vi) methods for valuing and acting on biodiversity, (vii) regulation to improve the functioning of property markets, and so on.

Adaptation to the impacts of climate change must also be a priority as we are already committed to substantial climate change from past and future emissions. This is especially relevant for developing countries that will be hit earliest and hardest. Adaptation is essentially development in a more hostile climate. It is a fundamental part of the development story and its importance should not be underestimated or overlooked.

But an understanding of what can be done and “optimism” about the attractiveness of the alternative paths are not the same as optimism that such paths will be followed. Clarity on what is required and on understanding of its attractions are necessary but not sufficient for action. The investments and actions required are major, involve risk and there are strong opposing vested interests. There are also intense and understandable sentiments in developing countries about the responsibilities of rich countries and fear in most countries that if they act, others may not. There is also a wide variation in perspectives on prospects for action in different parts of the world: prospects in the U.S. look pessimistic at the Federal level; prospects in China for change in patterns of growth are encouraging, with its 12th five year plan (2011–2015) focusing strongly on the transition to low-carbon growth.

A recognition of how other countries and blocs are moving will be key to creating a shared understanding and building the mutual trust necessary for action on the scale required. Both policy at the national level (“bottom-up”) and collective action at the international level (“top-down”) in the form of some sort of international agreement or understanding will be necessary. “Bottom-up” and “top-down” are complementary. One of the key purposes of this paper is to examine how they can interact and support each other in ways that will bring countries together and enable stronger action on a global scale.

We must do all this during a decade of great challenge, including radical debt management and deficit reductions, severe international macro imbalances, sustaining a fragile recovery, serious political instability in a number of regions, continuing major recasting of the international division of labour, and so on. While these challenges may threaten to distract us from the urgent task of the reduction in emissions, action on adaptation, and the promotion of the transition to low-carbon growth, we will do better on each challenge and move forward more quickly if we understand them together. Their confluence represents opportunity.

This paper examines, on an empirical basis, key issues in the national and international management of climate change. The empirics are founded in basic principles of policy and of international action. The analysis and discussion draws strongly on the personal experiences of Nicholas Stern in national and international policy-making and discussion, including attending high-level meetings and international summits over the last few years. Jean Tirole’s paper in this issue is complementary and examines this topic from a more theoretical perspective. As ever, theory and practice should be intertwined and support each other.

The next section examines the scale of the necessary emissions reductions and the attractiveness of the alternative path of low-carbon growth. Section 3 examines the recent history of international climate change negotiations and explores how and why key countries have moved in recent years. Section 4 examines the challenges and prospects for future international cooperation and agreement, starting with the next United Nations climate change conference in Durban in 2011, with a focus on the mutually reinforcing role of “top-down” and “bottom-up” approaches and policies. Section 5 concludes.

✎ 2. THE SCALE OF THE CHALLENGE AND THE NEW LOW-CARBON ENERGY-INDUSTRIAL REVOLUTION ✎

The required urgency of action to limit the growth of greenhouse gas emissions is demonstrated in [Figure 1](#), which illustrates global emissions paths consistent with limiting average global temperature increases to no more than 2°C, with a 50-50 probability. Given that temperatures higher than this are taken in international negotiations to be dangerous, a 50-50 probability is a rather modest interpretation of this goal. Whilst there are some, albeit limited, options on timing of reductions, global emissions paths that can achieve a 50-50 chance of meeting the 2°C goal would need to peak within 10 years. Starting at the current (2010) global level of 47 billion tonnes of CO₂ e p.a., the most plausible paths pass well below 35 billion tonnes of CO₂ e in 2030, and well below 20 billion tonnes of CO₂ e in 2050. These numbers, 35 billion tonnes in 2030 and 20 billion

tonnes in 2050, are crucial (see [Stern 2009](#)) and must be at the heart of discussions and of understanding. If we are serious about a reasonable chance of 2°C they are essentially global constraints. If we break them as a world it will be very difficult to catch up later. We cannot negotiate with the laws of physics and chemistry.

The necessary emissions path corresponds to emissions per capita of around 7 tonnes in 2010, 6 in 2020, 4 in 2030, and 2 in 2050, since world population is close to 7 billion now and is likely to rise to around 9 billion in 2050. For comparison, the U.S., Canada and Australia are currently well over 20 tonnes per capita CO₂e, Europe and Japan 10–12, China close to 7, India below but close to 2 and much of sub-Saharan Africa below 1. This is a story of strong inequality in current emissions and an even stronger story of inequality in the history of emissions, with the rich countries, currently around 1 billion population, responsible for more than 60% of current concentrations.

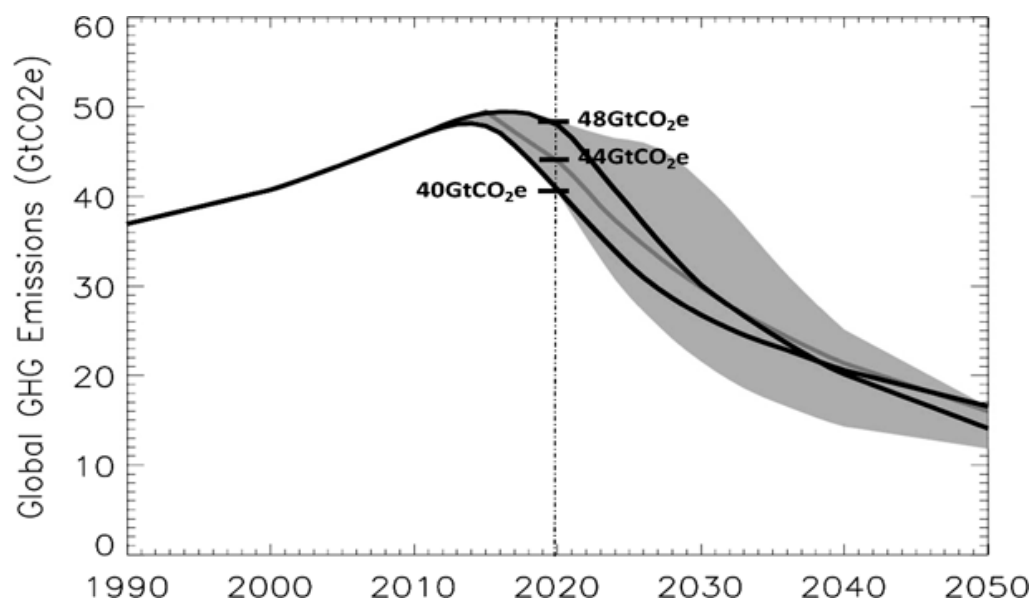


FIGURE 1

Paths for global annual emissions that lead to a reasonable chance of a temperature rise of no more than 2°C.

Note: the shaded area represents the range of emissions paths that are consistent with a reasonable (50-50) chance of the 2°C goal and the three lines show specific paths within this range.
Source: [Bowen and Ranger \(2009\)](#).

Given this inequality, some have argued, and one can understand why some might be drawn to that position, that developing countries should not be pressured or expected to constrain their emissions growth in the near future. However, it is total global emissions over the coming decades that matter for reducing the risks of dangerous climate change, and developing countries emissions now account for more than half of annual global emissions. Inaction or BAU from the developing world would overlook the fundamental global constraints on continuing with high-carbon growth, locking their economies into an unsustainable development path that would ultimately threaten their recent development gains. The past, current and likely future inequalities in emissions should play a role in understanding the equity of global agreements, and thus influence financial, technological and other arrangements. But from the basic arithmetic of the overall constraints, the absence of strong emissions reductions by developing countries could not be part of, or a basis for, any international set of actions that achieved a 2°C path; if currently rich countries emitted exactly zero in 2050, the currently developing country emissions average per capita would have to be less than 2.5 tonnes CO₂e. The legal, or otherwise formal or informal, nature of developing country emissions reductions² is another matter to which we return. A shared understanding of the facts of the basic arithmetic and of the inequality should surely be part of any serious discussion.

Challenge and inequality are not confined to emissions. The impacts of climate change will hit developing countries earliest and hardest and development in a more hostile climate will be more difficult and costly. These are also the countries and people who are least able to afford the costs of adaptation, and who have contributed much less than those in the rich world to the

current levels of greenhouse gases in the atmosphere. This fundamental inequity suggests a strong imperative for the rich countries to provide strong support to developing countries, in addition to current development commitments, to fund the extra costs created by climate change and to help build more resilient low-carbon economies. There should be a recognition that development commitments were mostly set before the severity of the challenge of climate change had been widely understood.

Emissions reductions and adaptation over the coming decades involve what many are now recognising as a dynamic and exciting transition to low-carbon growth and a new low-carbon energy and industrial revolution. The transition to low-carbon growth, if well-managed, constitutes a very attractive path. Past industrial revolutions, e.g., steam and railways, and electricity and steel, involved a transformation that saw two or more decades of strong innovation, investment and growth, with investment flowing to the pioneers. Such transformations involve periods of 'creative destruction' (in the Schumpeterian sense), where new firms and ideas drive out the old, generating a dynamic period of innovation, opportunity, employment and economic growth. This idea of 'creative destruction', combined with modern growth theories that incorporate endogenous technical change and learning-by-doing, is central to an understanding of this concept of dynamic and transformative growth (see, for example: [Perez, 2002](#); [Acemoglu et al., 2009](#); and [Aghion and Howitt, 1998](#)).

Many economies are already acting to establish themselves as the pioneers of this new energy-industrial revolution. A competitive 'green race' has begun with South Korea, China, some parts of Europe, and California in the lead. The flow of ideas from industry and research institutions over the last five years has been astonishing. Costs have been slashed in some key existing technologies (e.g. solar), deployment has moved quickly (e.g. wind), new ideas are mushrooming (e.g. nano-batteries, algae ...), and many firms have achieved, by careful focus, large improvements in energy efficiency. It is possible, and a risk that cannot be ignored, that 10 to 15 years from now, countries and firms who are left behind are likely to be perceived as 'dirty' and may be shut out of important markets.

An international agreement will be central to the policy action required to promote, accelerate and broaden this exciting and dynamic new low-carbon growth path. Such an agreement is more likely to succeed and endure if it is based on three fundamental principles. First, it must be effective—it must lead to cuts in emissions of greenhouse gases on the scale required to reduce the risks from climate change to acceptable levels. Second, it needs to be efficient—it should be implemented in a cost-effective way, with mitigation focused where and when it is cheaper. And third, it must take account of the fundamental inequalities between developed and developing countries, and across countries and regions more generally, we have described above.

However, there are strong arguments for concern that we are moving too slowly and that international collaboration is fragile, or not possible, at least soon. An inability to reach an international agreement would leave individual country action uncoordinated, leave fundamental inequalities unaddressed, increase the cost of action, slow the transition to low-carbon growth, risk dangerous delay in emissions reductions, and increase the risk that as a world we fail to take action on the scale necessary to reduce the risks associated with dangerous climate change.

3. TOWARDS AN INTERNATIONAL AGREEMENT: COPENHAGEN AND CANCÚN

Copenhagen

Discussions and meetings around international action to reduce emissions and adapt to a changing climate began nearly two decades ago with the establishment of the international treaty the United Nations Framework Convention on Climate Change (UNFCCC).² It is important to examine the lessons of recent UNFCCC discussions and meetings concerning the challenges of achieving global agreement and the prospects for the next meeting, Conference of Parties (COP) 17, in Durban in December 2011. Whatever the outcome in Durban, the lessons are likely to stand.

COP 15, the United Nations climate change conference in Copenhagen in December 2009, was cold, chaotic and quarrelsome. The outcome was very disappointing in many ways: it was far

from a success and it failed to produce the comprehensive agreement people were looking for. But it could have been much worse. Despite the problems, it created important foundations for progress and a document, the Copenhagen Accord, which has proved resilient and of real value.

There were many problems with Copenhagen that prevented greater progress including poor recognition of the total magnitude of the emissions reductions required, mistrust, misunderstanding and acrimony between countries, and the unwieldy and unproductive procedures and organisation where 192 countries were involved, at least in principle, at each stage of the negotiations.

The sources of mistrust and misunderstanding should be carefully examined if progress is to be made. Developing countries have a strong sense of injustice arising from the scale of past emissions from high-carbon growth in developed countries, and from the request now (essentially a requirement for managing climate change), when they are striving to overcome poverty, that they find a different path to higher incomes. This was embodied in the distinction between Annex I (developed) and non-Annex I (developing) in the Kyoto protocol with 'binding' commitments for the former and non-binding for the latter, together with the principle (interpreted differently by different players) of "common but differentiated responsibility" (CBDR). There was strong suspicion before and at Copenhagen that there was an intention by rich countries to abandon this distinction. Further there was an understandable concern amongst many developing countries that to adopt binding targets might slow development.

The suspicion and mistrust was amplified by the appearance that the rich countries had tried to fix the draft agreement amongst themselves and would then attempt to force it on developing countries. There was frequent talk of an 'ambush' via a draft 'take-it-or-leave-it' agreement. In our view that appearance of 'pre-cooking' amongst rich countries did indeed have some substance. There are old habits from the G8 era which are still there amongst rich countries and these will have to be abandoned, indeed should already have been abandoned, if trust is to be rebuilt. Recent experience (summer 2011) of the appointment to the head of the IMF (again following an outdated "for Europeans" convention) shows that such habits die hard and are still with us.

Rich countries on the other hand thought that some developing countries were failing to recognise the basic arithmetic on future emissions. Some in rich countries thought too that their industries could be left uncompetitive if they acted strongly whilst developing countries did not. Some thought that developing countries were making impossible demands of them on emissions reductions (40% 1990–2020 cuts). Some argued that their domestic politics would prevent them from making strong commitments if China and other rapidly growing emerging market economies were not seen to be committed to strong action. Further some developing countries were apparently seeking levels of financial support, in the many hundreds of billions of dollars per year that would be politically impossible for rich countries to deliver, particularly when so many are still trying to recover from economic and financial crises. In addition, they saw some states, particularly amongst oil-exporting countries, as deliberately trying to wreck a deal. These perspectives, whether or not justified, are political realities and pose problems that must be examined directly if they are to be overcome. However, on many of them deeper mutual understanding can be created.

Many countries felt that their own special circumstances or political constraints were poorly understood by others. Far too many came with "red lines" that they refused to cross and far too few came with constructive plans on how to go forward and with a flexible mandate that allowed negotiators to make compromises and deals. It is crucial that there be both mutual understanding of the politics and decision-making mechanisms of other countries and margins for being flexible in negotiations.

Distrust was fed by acrimony over monitoring, reporting and verification (MRV). Rich countries felt that they were being forced to deliver on emissions reductions but that poor countries could simply indicate general intentions and not be open in the measurement of outcomes, or could not be "held to account" more generally. Some developing countries saw MRV as an intrusion on sovereignty when they were not obligated (because they were members of non-Annex I) to deliver specific emissions cuts and feared 'foreigners' crawling over their enterprises or new forms of intrusion, espionage and conditionality.

While the above is expressed in terms of 'many developed countries' or 'many developing countries' much of this commentary applies directly to the U.S.-China relationship at Copenhagen. This is not to attribute any blame. There is no point in the blame game and it is damaging. The key

here is to analyse and understand those areas of Copenhagen that did not go well in order to understand how to go forward.

There was also much progress made prior to and at Copenhagen. This progress is often poorly understood and has not received sufficient recognition. The conference focused country efforts and was directly responsible for the development of policies, plans and ambitions for emissions reductions that would otherwise not have been developed and adopted. In particular, many countries, including China and the U.S., presented emissions reductions targets for 2020 and beyond for the first time in the run-up to Copenhagen (or at Copenhagen or very shortly afterwards). The outcome of the conference, the Copenhagen Accord, reflected this work and provided a basis for further discussions about an international agreement. The two-year deadline for international agreement set at COP13 in Bali for the end of 2009 did provide a strong focusing of the minds and intentions.

The Copenhagen Accord was put together by a small number of countries, Brazil, China, India, South Africa, and the U.S. (although others were influential) in the last 48 hours (Thursday December 17th and Friday 18th, 2009) of the two-week meeting in Copenhagen. It was agreed by the Presidents and Prime Ministers of these countries and 'noted' by the UNFCCC at its meeting on the Saturday morning, 19th. It has 12 paragraphs and 3 pages. That is a "Presidential" or "Prime Ministerial" length and is a refreshing break from the lengthy (200+ page) tomes produced by bureaucrats who have become professional UNFCCC negotiators.

To recognise and understand the role of Copenhagen and the Copenhagen Accord it is necessary to understand its content. Even though it is a short document, it does cover the main issues and provides a foundation for examining key elements of international agreement more generally.

The first two paragraphs of the Accord cover the 2°C target and the necessity for deep cuts and early peaking of emissions if the target is to be achieved. Paragraph 3 emphasises the importance of support for adaptation, particularly in the poorest and most vulnerable countries. Paragraphs 4 and 5 cover the responsibilities of developed and developing countries respectively to implement their emissions reductions plans (whether explicit targets or actions) as submitted for the appendices to the Accord (the deadline for plan submissions was January 31st 2010, six weeks after Copenhagen). The wording was such that developed countries are 'committed' to the reduction targets and the developing countries 'will implement mitigation actions'. Paragraph 6 agrees on the need to establish REDD+ (action on reducing emissions from deforestation and degradation and promoting afforestation and reforestation) and a brief paragraph 7 refers to the promotion of cost-effectiveness including via markets.

Paragraphs 8, 9 and 10 set out the intention to establish a Green Climate Fund and to generate financial flows of US\$100 billion annually by 2020 'to address the needs of developing countries' and to establish a High-Level Advisory Group to study potential sources of revenue. It refers also to providing US\$ 30 billion of new and additional resources 'Fast-Start Finance' for the period 2010–2012.

Paragraph 11 'decides to establish a Technology Mechanism' and paragraph 12 calls for an assessment of the implementation of the Accord by 2015 including reference to a possible stronger temperature target of 1.5°C.

The 2°C target, the US\$ 100 billion p.a. 2020 target for financial flows, the High-Level Advisory Group on new sources of finance, and the progress at Copenhagen on REDD+ were all significant advances. And on these three crucial points the Accord created a platform for further advance.

When world leaders and their negotiating teams left Copenhagen last December, it was unclear how solid a platform the Accord would create. The Accord was widely viewed as fragile, but it turned out to be more resilient than feared and progress has been made since.

That the major emitters would submit action plans by January 31st 2010 was far from assured; but it happened. To date³, 114 developed and developing countries have associated themselves with the Copenhagen Accord, and seventy-five countries, which are collectively responsible for more than 80 percent of current annual global emissions of greenhouse gases, have submitted targets and intended actions that are now listed in the appendices to the Accord.

If countries deliver the "high intention" reductions specified in the appendices to the Accord, these plans would result in global annual emissions of about 48 billion tonnes of CO_e in 2020.

While this would imply that emissions would peak before 2020, it would nevertheless fall short of a “climate-responsible” (giving a 50-50 chance of holding to a 2°C increase) target of 44 billion metric tonnes (see [Figure 1](#)). In understanding “climate responsible” we should recognise that, whilst annual emissions of 48 billion tonnes could still, at a stretch, be consistent with a 2°C goal, they would, if that consistency were to be established, involve substantially more difficult and costly annual reductions of emissions during the decades after 2020. The actions that are proposed between now and 2020 in the appendices to the Accord represent a reduction of 7–8 billion tonnes compared with an estimated level of emissions of 55–56 billion tonnes under BAU. Thus, the planned actions would take us two-thirds of the way, from a BAU path of about 56 billion tonnes in 2020⁴, to the 2°C path which would require around 44 billion tonnes p.a. in 2020.

Whilst international and national understanding of the issues has advanced in the last 5 years, this outcome suggests there does not yet seem to be sufficient recognition and understanding of the scale of the risks from BAU and the magnitude of the necessary change. The world must emit an average of no more than four tonnes per capita of CO₂ e by 2030, and about two tonnes per capita by 2050. At the same time, we must recognise not only that change on the scale required is possible but that the transition to low-carbon growth is likely to be dynamic and creative with powerful innovation that will drive growth. We will return to this subject but the great attractions of the alternative path constitute a crucial element in the argument. Understanding these attractions must be a key foundation of agreement.

Not only were the intended reductions required in the Copenhagen Accord submitted in the early part of 2010, but also as indicated in the Accord, a High-Level Advisory Group on Climate Change Financing (AGF) was established by the Secretary-General of the United Nations. Under the co-chairmanship of the prime ministers of Ethiopia and Norway it completed its work in the autumn of 2010.⁵ The AGF reported on options for generating, by 2020, US\$ 100 billion per year, including both public and private resources, as flows from developed to developing countries in order to support developing countries in both the adaptations to the climate change which will take place and the mitigation required to reduce emissions.

There was also progress on Fast-Start Finance with several countries submitting their plans including the UK, U.S., Canada, Australia, Japan and Norway. The UK has consistently shown leadership, with its share of fast-start funding, £1.5 billion, recently confirmed by the government and included in its larger International Climate Fund plan.

Progress has been made on the structure of action for preserving and planting forests. During 2010 Indonesia adopted a 2-year moratorium on new logging concessions and there have been ambitious plans and action to halt deforestation in Brazil. Promised funding for action on forests has reached several billion dollars. There will of course, in Indonesia and Brazil and elsewhere, be stops, starts and occasional regress, but preserving the forests and poverty reduction are increasingly seen as mutually supportive and part of the same development story. And there are some richer countries, such as Norway, giving strong support.

Progress has been made post-Copenhagen on the plans and commitments of key developing countries such as China, India and Brazil. For example, China’s 12th five-year plan (published and adopted in March 2011), that runs from 2011 to 2015, confirms that China is committed to the transition to a low-carbon economy. This commitment has been under-appreciated around the world and the 12th plan, work for which was essentially completed in 2010, has greatly increased the opportunity for awareness and understanding of China’s proposed actions. This plan will initiate fundamental structural change designed to limit emissions growth and place China at the forefront of the new energy-industrial revolution.

China will promote seven strategic industries: energy saving and environmental protection (including energy efficiency, advanced environmental protection, recycling); new energy (including nuclear, solar, wind, biomass); clean-energy vehicles (including plug-in hybrid vehicles and pure electric cars); next generation information technology (including next-generation communications networks, internet, network convergence, new flat-panel display, high-performance integrated circuits and high-end software); bio-technology (including bio-medicine, bio-agriculture, bio-manufacturing); high-end manufacturing (including aeronautics & astronautics, marine engineering equipment, high-speed rail, high-end smart equipment); and new materials (including special function and high-performance composite materials).⁶ China plans to increase the share of GDP

in these industries from around 3% today to 15% by 2020. This may require around US\$ 5 trillion in investment in the next decade and see output in these industries increase from around US\$ 150 billion today to around US\$ 1.5 to 2 trillion in 2020 (Stern, 2011). Likely investment in China in these industries will probably average in the region of half a trillion dollars per annum in this decade. The 12th plan also sets a target for reductions in emissions per unit of output (emissions intensity) of 17% and reductions in energy per unit of output (energy efficiency) of 16% over the plan period.

This progress post-Copenhagen gave some confidence that some of the building blocks for a sensible political agreement were being put in place for the next meeting of the parties to the United Nations Framework Convention on Climate Change held in Cancún at the end of 2010.

Cancún

The Cancún conference was far more constructive than Copenhagen, both in atmosphere and outcome. The political agreement that was reached confirmed broad acceptance of the principles outlined in the Copenhagen Accord and there were modest but significant advances across a range of areas. Indeed one way of understanding the outcome of Cancún was that it essentially brought into the UNFCCC, as an agreement, the Copenhagen Accord which was only “noted” in Copenhagen in late 2009.

On emissions reductions the Cancún agreement includes and confirms the commitments from all the major emitters in the Copenhagen Accord, agrees countries should peak emissions as soon as possible, confirms the overall 2°C target to limit temperature rise, and agrees a review from 2013 of the adequacy of this long-term target. On finance the Green Climate Fund was established to pursue the Copenhagen goal of mobilising US\$ 100 billion in public and private sources of finance for developing countries by 2020. The first meeting to prepare for the Green Climate Fund (the Transitional Committee) was held in April 2011, the second was held in July 2011 in Tokyo, and the third was held in early September 2011.⁷ There was also progress on a framework for reducing emissions from deforestation and forest degradation (REDD+), new technology mechanisms consisting of a Technology Executive Committee (to identify how to better deploy and diffuse technology in the developing world) and the Climate Technology Centre and Network (to build capacity and deploy clean technology and adaptation projects), and a new ‘Cancún Adaptation Framework’ to better plan and implement adaptation projects in developing countries.

There was significant progress on Monitoring, Reporting and Verification (MRV). Developing countries will now produce biennial update reports on their greenhouse gas emissions, which will be reviewed under an international consultation and analysis (ICA) process. The idea is to make the calculations according to shared methods and data sources in a way that can be reviewed fairly straightforwardly by an external body or panel. A registry was also established to record developing country mitigation actions seeking international support.⁸

There were six major reasons for progress in Cancún: few countries wanted a repeat of the acrimony at Copenhagen—no country wanted to be seen as the ‘villain of Cancún’; the Copenhagen platform, principles and submissions to the Accord, with progress made during 2010, provided a strong foundation for advance; the direct and informed involvement of the Mexican President and Foreign Minister, who demonstrated a command of both strategy and detail; the strong focus on learning the lessons of Copenhagen in terms of the transparency and openness of the negotiation process; China’s confidence having completed work on the 12th 5-year plan (in its ability to achieve and probably exceed its emissions intensity targets); and a more united and purposive Indian delegation (in Copenhagen it had been badly divided, inhibiting the role of a key country and adding to the acrimony).

4. PROSPECTS FOR INTERNATIONAL AGREEMENT IN THE COMING YEARS

Progress on international agreement and a strategy for constructing it depends critically on an understanding of three key sets of issues. We have touched on all three in preceding sections but we should look more closely at facets of each of the three to assess prospects for future agreement.

4.1 The scale of the risks and necessary emissions reductions together with the great opportunities that lie in the new energy-industrial revolution

If we, as a world, went no further than delivering on the Copenhagen-Cancún targets for 2020 it would be very difficult to achieve 2°C with a 50-50 probability. The Copenhagen-Cancún path seems to be in the range of a 3°C increase (with 50-50 probability). We have to be clear about the scale of risks: the planet has not seen 3°C for around 3 million years. This is not a risk of some minor or even major inconvenience with low probability. BAU, with its implied major risks of 5°C or more, could invoke a catastrophic transformation of the relationship between human beings and the planet with substantial probability and taking place very rapidly in historical time. And a 3°C path, whilst much better than BAU, is still very dangerous and takes us far beyond the experience of *homo sapiens* in the 200,000 years of their presence.

Scientists have pointed to 2°C as a danger level in large measure because of the raised dangers of tipping points such as the collapse of the Amazon forest, the warming of the permafrost and likely associated release of methane, and radical damage to the life of our oceans and dramatic drop in their carbon-absorptive capacity. Delay even for a decade is very dangerous: it would likely put 2°C out of reach.

On the other hand, the study of the economic history of the last five waves of technological change from the mechanisation of textiles in the late 18th century to the current information and communications technology (ICT) revolution (see [Perez, 2002](#)) reveals that they bring innovation, creativity, investment and growth, with investment flowing to the pioneers. We can already see this new low-carbon energy-industrial revolution in its early stages and it is a great advantage that it overlaps with the ICT revolution. And when low-carbon growth is achieved and the forests are protected, economic activity will be more energy-secure, cleaner, quieter, safer and more bio-diverse. This is a very attractive proposition. High-carbon growth, on the other hand, will destroy itself.

These arguments apply to all countries, and particularly strongly to developing countries. They have less locked-in infrastructure and can leapfrog the “dirty stages” followed by the rich world. And many of the technologies, such as off-grid solar photo-voltaic (PV) power can bring real participation to many of those excluded from the modern economy.

Thus the “horse race” between climate responsibility and growth is false. It is fundamental to the progress of international negotiations that this is recognised. But we must also recognise both that major investments must be made and there will be dislocation—that is the nature of industrial revolutions. Understanding and recognising the inequitable past history of emissions is also vital: such recognition surely indicates a major responsibility for the rich countries to support the required investments and to share technologies.

4.2 How and why key countries and blocs have moved on climate change in recent years

The second set of issues involves the understanding of how and why countries around the world are changing in their policies and emissions. International agreement has to be founded in an understanding of the economics, politics and culture of others. Even in this integrated world with rapid information flows it is sometimes depressing to see that lack of understanding right up to the highest levels of government.

The last 2 or 3 years has seen hesitation, fractiousness and sometimes regress in some of the rich world, including the U.S., Europe, Canada and Australia. Part, although not all, of this has been due to the campaigning of special interests who would wish to maintain the status quo in terms of hydrocarbons. They, and others, deliberately exaggerate the costs of action and ignore the benefits of learning, innovation and a more energy-secure and cleaner economy and society. Some even go so far as to attack the scientific basis for climate change, in so doing ludicrously rejecting 200 years of serious science and the carefully-considered work and assessments of their national academies of science. This is not the place for extensive discussion of these cynical and deliberately misleading attacks but it is unfortunately true that they have hindered sound and analytic decision-making and have led to confusion and hesitation from the general public.

Growth in the rich countries has been much more vulnerable to the financial crises since 2007 than in emerging markets. The associated slow-down and recessions have monopolised

policy discussion. This has diverted attention from medium- to long-term challenges. The continued drift backwards by the U.S. national authorities, at least in Washington DC, shows few signs of abating in the short term, and is no doubt based on their reading of domestic politics. There are also indications the EU may be stuttering in its push to raise its legally binding emissions reduction ambitions from 20% to 30% cuts 1990–2020 (a vote in the European parliament in early July 2011 failed to endorse a raising of targets to 30%). The diversion has been a serious mistake. A slowdown is precisely the time to invest in the sustainable growth story of the future. The private sector has been rebuilding liquidity—thus good government policy could unleash a wave of creative investment to drive a recovery. But the policy signals must be clear and credible over the medium and long term.

Despite the recent difficulties in rich countries, we have seen substantial change across the world over recent years in the understanding of climate change, its risks and the opportunities in changing patterns of growth. Movement over the last 2 or 3 years has been strong in the emerging markets and the developing world. Across the continents, from China and Korea to Brazil, Colombia and Mexico, to Ethiopia and Rwanda, we see intense focus and impressive climate change action plans, for both mitigation and adaptation. The change is based not only on an understanding of their great vulnerability to climate change but also on a growing recognition of the opportunities in the transition to the low-carbon economy.

China's 12th five-year plan, as argued, is of special significance. Three key drivers of the next stages of growth are domestic consumption, the cleaner economy, and innovation. This is a fundamental break from low-cost, high-energy manufacturing for export using “catch-up” technologies. The implications for competition, the green race and the international division of labour are profound.

We must also recognise the scale of movement in the rich countries as, despite their recent difficulties, there are many positive stories to tell here. In the U.S., from California to New York, many cities and states are strongly committed to climate action. Many firms, including several of worldwide significance, are making radical and pioneering changes. Silicon Valley is a fountain of creativity for the low-carbon economy. Texas is installing wind energy on a major scale. The opportunities for solar (particularly with a good grid) in the Southwest of the U.S. are immense. In our view, as these technologies demonstrate themselves and the understanding of where China is going starts to grow, chances of Federal action, currently low, will improve perhaps in the second half of this decade. As ever, forecasts of political change have to be treated with circumspection, but experience of what is possible and the power of the example may well be of some influence.

4.3 The relationship between and role of national actions (“bottom-up”) and international understandings (“top-down”) in the effective management of climate change

This third set of issues builds on the first and second. Because there is mistrust of others, action in a particular country is hindered. Some will argue that their own action will be insignificant and others will not follow. Or that they will become uncompetitive. That is a key reason why international discussion and progress towards an agreement is so important to national decisions. If the people of a country see other countries moving now, together with the possibility of international agreement in the coming years they may see their own action as part of a bigger whole and the potential growth of new markets for the ideas and technologies they may be developing.

Notwithstanding problems of the mistrust of where others are going, which are very much part of real politics, it is striking how many countries argue that it is important to do the responsible thing whatever other countries are doing. This has been argued powerfully, for example, by Mauritius, which is surely very small in the global emissions picture. But the argument is echoed in many countries across the world both at government level and, for example, in the rise of green parties. After all, if climate change harms and kills people in the future and arises in large measure from emissions, many would, and do, think it simply wrong to deliberately themselves avoid taking opportunities for cutting emissions.

The power of the example will be immensely important here too. And it is encouraging that in enterprises large and small, villages, towns, cities and countries, strong examples are multiplying. Countries or cities which are showing the attractions of low-carbon growth are likely to be very

influential.

From the other perspective, what happens internationally depends strongly on the national decisions of countries. The more we can see increasing national commitment around the world the easier it will be to get the international agreements which can in turn feed back to a strengthening of the national willingness and determination to act. Further, the greater the perception of the advantages from acting in terms of innovation and low-carbon growth, the easier it will be to get international commitment by countries. Many have argued that as soon as the technical feasibility and low-cost of doing without substances that damaged the ozone layer were clear, it was easier to find international agreement to do so.

Let us now turn to the meaning of an “international agreement”. We trust that our discussion of the national (“bottom-up”) and international (“top-down”) aspects of decision-making shows how misguided it is to suggest that we should go either one route or the other. It is surely wrong to suppose that we can move fast enough or strongly enough through national decision-making alone, unless there is progress on international understanding and decision-making.⁹

And the position that says “our country will commit to no national action until we see the ‘full-blown’ international agreement” is a recipe for no action at all. Analytically, therefore, it makes sense to drop the arguments about “national versus international” and proceed in the more sensible direction of how to get national and international to support each other in a way that allows effective action on the scale and timing required.

In our view there has also been an overly rigid and formal emphasis on the term “legally binding”. The key is confidence in where others are going. Anyone with a knowledge of the history of China’s delivery on the targets of their five-year plans will have confidence in the likelihood of their achieving them. Now that China’s Copenhagen-Cancún targets are in their five-year plans we should have strong confidence they will be achieved. Note that China is most unlikely to make those targets something which might be internationally enforceable in some way. But the plans become law within China and are the means by which the leadership judges itself and is judged internally. Contrast confidence in this target, which is not legally binding, with Canada’s Kyoto target (a 6% reduction on 1990 levels by 2008–2012) which was in principle legally binding and which they clearly have little intention of achieving, with current (2009) emissions around 17% above 1990 levels. Clearly the greater confidence is in China’s target.

We must therefore see the challenge of creating international agreement as in large measure about building this confidence in the action of others: Cancún 2010 was an important step forward.

What are the possibilities for Durban (COP17) in December 2011? The importance of the three sets of issues discussed previously and difficulties with an emphasis on “legally binding” tell us that we should not expect a firm and strong “legally binding” agreement in Durban: the assessment we have offered of progress on these three issues surely suggests that we are not yet in a position to conclude that agreement. Ambitions for Durban should be relatively modest and try to consolidate and build on the Cancún agreement on the specific dimensions outlined in our description of the Copenhagen Accord.

The Kyoto agreement (with binding targets for rich countries but not for others) runs out in 2012. There are some who argue that agreement on Kyoto II will be a litmus-test of success or failure in Durban, which takes place on the eve of 2012. But we must recognise that the U.S. and Japan are very unlikely to sign an extension of Kyoto. That would put Europe more or less on its own amongst the major countries. It is not impossible that Europe might find a way forward for itself, in part because carbon offsets are in demand from European firms and there is a willing supply from non-Annex I countries. The rainforest countries are particularly interested here and are arguing to that effect. Other Annex I countries might associate themselves. While this would not be a “full-blown” Kyoto II it would be something. If we make, however, a comprehensive agreement on Kyoto II the criterion for success or failure in Durban, we risk setting ourselves up for failure.

A way forward may be to recognise that there has been progress on the task of translating intentions into action and that there will be continued demand for offsets from Europe and Japan. Thus, one potentially productive set of tasks would be around creating an alternative method to the Clean Development Mechanism that is less restrictive in what counts as emissions reductions¹⁰ and is less bureaucratic:¹¹ thus to concentrate on improvement in, and possible expansion of, trading.

As we have argued, however, the Copenhagen-Cancún targets are of real value. If the discussions concentrate on how they can be achieved and how they can be strengthened, including on taking forward action on finance, technology, forests, and carbon-trading, rather than a yes-no on a comprehensive Kyoto II deal, then Durban could see real progress.

On finance, discussion has been too heavily centred on the *modus operandi* of the Green Climate Fund. There should be stronger focus on how to provide such a fund with funds. Heavy concentration on how to spend an empty fund does not make much sense. Whilst the probability of funds arriving depends on how they will be spent, the current conversation is unbalanced. The recommendations of the Advisory Group on Climate Change Financing, published in November 2010, should provide a sensible agenda (see [AGF, 2010](#)). They include, on the public side, funds from carbon taxes or auction quotas, funds from reduction of hydrocarbon subsidies, from taxes on aviation and maritime transport, and via greater capital for the international financial institutions. Private flows can be fostered by support from developed countries for sound climate-oriented policies in developing countries, risk-sharing via international financial institutions, and well-functioning carbon offsets. The AGF also provided suggestions for promoting the “wise spending” of these funds.

The technology mechanisms have started to get under way, albeit slowly, and further progress should be possible. There has been much greater progress on measures to combat deforestation. These are less politically sensitive in rich countries than other areas of support and should continue to be pursued strongly.

At some point it is likely to be necessary to tackle the question of unanimity in decision-making for the UNFCCC. At present with nearly 200 countries there will always be some countries that choose these gatherings to grandstand and make life difficult. Examples in Copenhagen and Cancún are the “ALBA” countries (including Bolivia, Cuba, Ecuador, Nicaragua, Venezuela) or some oil-focused countries such as Sudan or Saudi Arabia. It may be that peer pressure, as in Cancún, can allow agreement on progress in Durban. However, when it comes to constructing a comprehensive agreement, it may be necessary to accept that there will be some who will not be on board.

5. CONCLUSION

While the negotiations continue to produce only modest progress, the evidence from the science grows ever more worrying. The absorptive capacity of some oceans is falling, damage to biodiversity and ecosystems is happening faster than predicted and deforestation in key countries is rising again after progress in recent years. And global emissions have resumed their strong upward growth trend after a temporary pause caused by the world economic slowdown, now mostly driven by growth in developing countries.

However, while the world economic slowdown and continued economic instability has diverted attention away from climate change in some rich countries, there are positive signs elsewhere that momentum is robust. The dynamics over the last two years have increasingly been driven by China, India, Brazil, Mexico and Indonesia. These countries are recognising their role in leadership. Whilst there will no doubt be accelerations and decelerations, momentum and action in these countries on climate change appears to be fairly resilient to the wavering we have seen in many developed countries.

Across the world there are important and major changes in technologies, in business, and in politics. These include new perspectives on nuclear energy following Fukushima: these are likely to push forward actions in some countries, such as Germany, that will promote renewable energy sources. Business around the world is beginning to accept that high-carbon is risky and is getting riskier, and that low-carbon offers great opportunity, growth and less risk. This is leading to calls from business for greater policy certainty and clarity, as was evident during Stern’s chairing of the Green Growth segment of the Seoul G20 Business Summit in November 2010 (the day before the political summit). Such increased certainty could generate investments which could unlock large pools of liquidity looking for higher returns. There is a growing understanding both of the benefits and the dynamics of the transition to the low-carbon economy, and of the benefits of the low-carbon economy itself.

Leaders in this transition can now be found across households, local communities, firms,

states and nations. The power of the example is growing. Various groups are taking strong unilateral action to position themselves at the head of this new energy-industrial revolution.

Whilst technical progress on renewable energy is rapid and encouraging, we are also seeing technical progress in hydrocarbons including “fracking” for gas (and to some extent for oil). It is possible that this could promote a switch from coal to gas for electric power which could in turn lower emissions over the medium term and be a “bridge technology”. But there may be difficult environmental issues in the process of fracking and dangers of long-term lock-in of technologies and infrastructure. The role of gas in the transition to a low-carbon future is an important and open question.

Over the medium term, agreement must be founded on a deepening of understanding of the three sets of issues discussed throughout the paper. First, progress at country and international levels requires understanding of the scale of the risks and the urgency of necessary emissions reductions, together with the great opportunities that lie in the transition to low-carbon growth and the new industrial revolution. Economic history tells us that such transitions may involve many decades of innovation, creativity, investment and growth. And when achieved low-carbon growth will be more energy-secure, cleaner, quieter, safer and more bio-diverse. Surely a more attractive path. At the same time such revolutions involve major investments and dislocation. It is a mistake to pretend all is win-win-win.

Second, progress also requires understanding of how and why key countries and blocs have moved on climate change in recent years. Such understanding will inform and help to build trust and mutual confidence.

Third, we must understand the relationship between, and the role of, national actions and international agreement in the effective management of climate change. It would be very difficult to move fast enough or strongly enough through national decision-making alone unless there is confidence in progress on international understanding and decision-making. Arguments about national versus international action (“top-down” versus “bottom-up”) are unproductive and often misunderstand their complementarity. The more sensible discussions concern how to get both national and international action to support each other.

The country-by-country targets for emissions reductions arising from Copenhagen (COP15) and agreed at Cancún (COP16) are of real value. The focus during the conference in December 2011 in Durban (COP17) should be on their delivery and how they can be strengthened, together with advance on the key subjects of financial support from rich countries for developing countries, of technology, of forests, and of carbon trading. If the focus is here and the more constructive spirit of Cancún is maintained, Durban could show modest progress. If we set agreement on a renewal of a comprehensive Kyoto agreement, which expires in 2012, as the key test of success or failure at Durban, then we are likely to be setting ourselves up for failure. A comprehensive failure would be very damaging. It would allow some key countries to be diverted from stronger action on emissions and result in the risks of dangerous climate change growing ever stronger.

The current pressure for such diversion is already strong. But while a focus on immediate financial crises is important, if we look only for short-term solutions we risk sowing the seeds of the next crises. Strong action to promote low-carbon growth and the new energy-industrial revolution is a much more attractive path than trying to resuscitate business-as-usual. We will do better on each if we tackle the immense risks of climate change and many of our most pressing challenges in the financial and economic crises in a coherent, integrated way. Without a resumption of economic growth in countries most strongly affected by the financial and economic crises, the issues of deficit and debt cannot be resolved: it is surely sound economics and risk management to foster a growth path that is sustainable. If leaders are unable to move past short-term issues the large gap between what can and must be done on climate change and what will be done will continue to grow wider, with grave risks for our economies and for our environment.

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Footnotes

¹ Compared to the average 19th century temperature, usually calculated over the period 1850–1899. The temperature increases by a little behind the concentration increases.

² The UNFCCC was founded in 1992, four years after the Intergovernmental Panel on Climate Change (IPCC) was established. The parties to the UNFCCC have met annually in Conferences of the Parties (COP). In 1997 the Kyoto protocol was adopted, which set mandatory emissions targets for developed countries, and entered into force in 2005 following Russian ratification. These targets expire at the end of 2012.

³ October 2011.

⁴ A “BAU” path is inevitably hypothetical, predicated on the assumptions defining BAU, but 56 billion tonnes seems fairly plausible for 2020 BAU.

⁵ Membership of AGF included a range of high profile and experienced individuals including: Trevor Manuel, former Finance Minister of South Africa; Sri Mulyani Indrawati, former Finance Minister of Indonesia, now Managing Director of the World Bank; Larry Summers, former U.S. Secretary of the Treasury; Christine Lagarde, then Finance Minister of France, now Managing Director of the International Monetary Fund (IMF); and Stern.

⁶ See [HSBC \(2010\)](#) for further analysis of these industries.

⁷ The UNFCCC report that the Transitional Committee is on track to conclude work on the design of the fund for approval at COP 17 in Durban. A final meeting of the Transitional Committee will be held in October 2011. (http://unfccc.int/files/press/press_releases_advisories/application/pdf/pr20110909_genevatc_gcfclose.pdf).

⁸ For more information on progress at Cancún see http://unfccc.int/files/meetings/cop_16/application/pdf/cop16_lca.pdf

⁹ That is why the so-called “Hartwell paper”, suggesting “bottom-up” only, is so confused and misguided. See [Prins et al. \(2010\)](#).

¹⁰ For example, the CDM includes energy efficiency projects, methane recovery projects, industrial process changes and transport projects, but excludes forest conservation and avoided

deforestation projects, and carbon capture and storage projects.

11 The CDM is on a project-by-project basis and projects have to be cleared both inside the country and by the CDM Executive Board in Bonn. Each project must first complete a complex project design process to establish a baseline, demonstrate additionality, and an effective monitoring process. The project is then independently evaluated and approved by the host country. At the next stage the CDM Executive Board review the proposal and if approved the project may progress to the engineering stage. During operation independent monitoring and reporting of emissions reductions is required, which includes on-site inspections and the production of an independent annual certification report. Finally, the CDM Executive Board considers these annual certification reports and issues tradable Certified Emission Reductions (CERs) to the project participants.

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