



THE BALI ROAD MAP:

Key Issues Under Negotiation



UNDP ENVIRONMENT & ENERGY GROUP



THE BALI ROAD MAP:

Key Issues Under Negotiation

Disclaimer

The views expressed in this publication are those of the author(s) and do not necessarily represent those of the United Nations, including UNDP, or their Member States.

Acknowledgements

UNDP acknowledges the generous support from the United Nations Foundation and the governments of Norway and Finland towards the project, "Capacity development for policy makers to address climate change", which allowed the preparation of this document.

This document was designed by Rebecca Buttrose. Production and review by Amy Schofield.

TABLE OF CONTENTS

Foreword	3
The Bali Action Plan: Key Issues in the Climate Negotiations – Summary for Policy Makers	5
Climate Change Mitigation Negotiations, with an Emphasis on Options for Developing Countries	23
National Policies and their Linkages to Negotiations over a Future International Climate Change Agreement	69
Adaptation to Climate Change: The New Challenge for Development in the Developing World	119
Negotiations on Additional Investment and Financial Flows to Address Climate Change in Developing Countries	161
The Technology Challenge: Considerations for National Government Policy Makers to Address Climate Change	209
Key Issues in Negotiations on Land Use, Land Use Change and Forestry, with an Emphasis on Developing Country Perspectives	249

FOREWORD

Nearly all sectors of society contribute to greenhouse gas emissions and are affected by climate change. The magnitude and the impact of the problem require a co-ordinated, effective response – both nationally and internationally – to both move societies towards less carbon-intensive pathways and make inroads towards achieving the Millennium Development Goals (MDGs) and reducing poverty.

The scale and scope of the challenge means that every policy and investment decision will have to be assessed in light of its greenhouse gas reduction capacity and its contribution to long-term sustainability. Policy makers must also find solutions to directly improve the well-being of millions of poor and vulnerable people adversely impacted by the effects of climate change.

At the international level, governments recently agreed under the United Nations Framework Convention on Climate Change (UNFCCC) process to step up their efforts to combat climate change. With the “Bali Road Map”, governments will seek to reach agreement on a number of forward-looking issues essential for reaching a secure climate future by the 15th Conference of the Parties in December 2009. This includes the “Bali Action Plan” – the UNFCCC negotiations on long-term cooperative action, which center around the four thematic “building blocks” of adaptation, mitigation, technology transfer and deployment, and financing.

In order to effectively participate in, and develop positions for, such a challenging and complex negotiation process, developing countries – in particular those with medium- and small-size economies – will be required to involve and increasingly co-ordinate various government policy makers across key sectors at the national level, as well as other relevant stakeholders. This will require raising the awareness of not only environmental policy makers, but all policy makers about the key issues and elements of the Bali Road Map and the impact it could have on their sectoral areas. Strengthening their capacity to develop, implement, and evaluate cross-sectoral national policy options in response to climate change and the international negotiations can offer policy makers a key opportunity to move toward sustainability.

Under the aegis of the UNDP Environment & Energy Group project, “Capacity development for policy makers to address climate change”, UNDP commissioned a series of documents that address the key issues under consideration for the Bali Action Plan building blocks, with a focus on the developing country context. We also included a document on land use, land-use change and forestry, which is a key sector for many developing countries. The documents have been prepared by leading international experts – many from developing countries – and translated into all UN languages in order to inform policy makers across the entire spectrum of economic sectors.

UNDP is committed to capacity development and believes it can play a crucial role in the ability of countries to address climate change in a sustainable manner. We hope that this compilation of documents will be widely used by developing country negotiators and national climate teams to inform policy makers during this critical phase of the international climate negotiations.

Veerle Vandeweerd

Director, Environment & Energy Group
Bureau of Development Policy
UNDP

THE BALI ACTION PLAN: KEY ISSUES IN THE CLIMATE NEGOTIATIONS

SUMMARY FOR POLICY MAKERS

CHAD CARPENTER

OBJECTIVES OF THE PROJECT

The UNDP project, “Capacity development for policy makers to address climate change” seeks to strengthen the national capacity of developing countries to assess climate change policy options across different sectors and economic activities. The project will run in parallel with the “Bali Road Map” process agreed at the UN Climate Change Conference in December 2007, which includes the “Bali Action Plan” – the United Nations Framework Convention on Climate Change (UNFCCC) negotiations on long-term co-operative action on climate change set to conclude by the end of 2009.

To effectively participate in, and develop positions for, this challenging and complex negotiation process, developing countries – in particular those with medium- and small-size economies – will be required to involve and increasingly co-ordinate various government decision-makers across key sectors at the national level, as well as other relevant stakeholders. This will require raising the awareness about the key issues and elements under discussion and strengthening capacity to develop, implement and evaluate policy options in the context of the international negotiations.

The overall goals of the project are twofold:

- To increase national capacity to co-ordinate ministerial views, participate in the UNFCCC process, and negotiate positions within the timeframe of the Bali Action Plan; and
- To assess investment and financial flows to address climate change for up to three key sectors and/or economic activities.

The project will support these goals by expanding the knowledge base on climate change issues and broadening access to this knowledge so that policy makers, parliamentarians, technical experts, and other key stakeholders can participate and share experiences at the national, sub-regional, regional and global levels. As a result, both the technical understanding of key climate change issues and their economic and policy implications within the context of the Convention will be enhanced.

The assessment of investment and financial flows will play a particularly important role. At the national level, it will help countries understand the magnitude and intensity of the national effort needed to tackle climate change in key sectors and economic activities. It will also help facilitate the integration of climate change issues

into national development and economic planning. At the international level, an assessment of investment and financial flows will help maximize national participation in the international climate negotiations by providing more accurate estimates of funds needed for mitigation and adaptation. By providing useful inputs to the international debate, a financial flows assessment can help provide that an appropriate financial architecture plays a key role in any long-term cooperative action.

To assist policy makers in understanding the complex issues under discussion in the negotiating process, UNDP commissioned a series of background briefing papers on the key issues under the four main “building blocks” of the current international negotiations – mitigation, adaptation, technology and finance – as well as land use, land-use change and forestry (LULUCF).

This document contains summaries for policy makers of these briefing papers. All the briefing papers are available in the UN languages on the UNDP web site at: <http://www.undp.org/climatechange/documents.html>.

THE BALI ROAD MAP

At the United Nations Climate Change Conference in Bali in December 2007, governments from around the world – both developed and developing countries – agreed to step up their efforts to combat climate change and adopted the “Bali Road Map”, which consists of a number of forward-looking decisions that represent the various tracks that are essential to reaching a secure climate future. The Bali Road Map includes the Bali Action Plan, which charts the course for a new negotiating process under the UNFCCC, with the aim of completing this by 2009. It also includes the current negotiations under the Kyoto Protocol, and their 2009 deadline, which focus on further quantified emission reduction commitments for industrialized countries, as well as negotiations on the ongoing work pertaining to key issues including technology, adaptation, and reducing emissions from deforestation.

The Bali Action Plan

The Bali Action Plan, adopted by the Conference of the Parties (COP)¹ as decision 1/CP.13, launched a comprehensive process to enable the full, effective and sustained implementation of the Convention through long-term cooperative action, now, up to and beyond 2012, in order to reach an agreed outcome and adopt a decision at its fifteenth session in Copenhagen in December 2009. The COP also decided that the process would be conducted under a new subsidiary body – the Ad Hoc Working Group on Long-term Cooperative Action under the Convention (AWG-LCA) – that shall complete its work in 2009.

The Bali Action Plan is centred on four main building blocks – mitigation, adaptation, technology and financing. Parties also agreed that the negotiations on a long-term agreement should address a shared vision for long-term cooperative action, including a long-term global goal for emission reductions. Furthermore, the future discussion should address enhanced national/international action, including the consideration of:

- measurable, reportable and verifiable nationally appropriate mitigation commitments or actions by all developed countries, and;
- nationally appropriate mitigation actions by developing country Parties, supported and enabled by technology,

financing and capacity-building, in a measurable, reportable and verifiable manner.

Other subjects for the future discussion include the use of sectoral approaches; approaches to enhance the cost-effectiveness of mitigation actions, including market mechanisms; and the issue of reducing emission from deforestation and forest degradation in developing countries (REDD).

Two-Track Approach: The UNFCCC and the Kyoto Protocol

Future international action is being addressed by a “two-track” approach. In parallel with the Bali Action Plan negotiations under the UNFCCC (also referred to as the Convention), negotiations are also underway under the Kyoto Protocol. Provisions of the Kyoto Protocol also address the key issues being discussed under the Bali Action Plan and there are many linkages between the two processes. For example, on mitigation, Parties to the Kyoto Protocol are currently discussing the next round of commitments after 2012, when the first round of commitments will expire. Furthermore, Parties are working on an analysis of the different tools and rules for developed countries to reach reduction targets and ways to enhance

THE CONVENTION (UNFCCC) TRACK

- Focuses on four “building blocks”: adaptation, mitigation, technology transfer & deployment, financing
- Reducing emissions from deforestation and forest degradation (REDD) also discussed
- Mitigation actions from developing countries
- Mitigation commitments from developed countries

THE KYOTO PROTOCOL TRACK

- Agree on developed country emission reduction targets by 2009. At their third session in 2007, Parties to the Kyoto Protocol took note of the conclusions by the Intergovernmental Panel on Climate Change (IPCC) that greenhouse gas (GHG) emission reduction commitments between 25 and 40% below 1990 levels were needed on the part of industrialized countries for the period beyond 2012 to limit a mean global temperature increase, with GHG emissions peaking within the next 10 to 15 years before going down
- Means to achieve targets: market mechanisms, national policies, accounting issues, role of land use, land-use change and forestry (LULUCF), etc.

¹ The COP is the supreme decision making body of the UNFCCC.

the effectiveness of tools such as the market mechanisms. The Kyoto Protocol also addresses adaptation. Under the Kyoto Protocol, the Adaptation Fund was established to finance concrete adaptation projects in developing countries. Parties are currently continuing their discussions to further operationalize this important fund.

Meetings of the AWG-LCA and the body working on new commitments under the Kyoto Protocol – known as the Ad Hoc Working Group on further Commitments for Annex I Parties under the Kyoto Protocol (the AWG-KP) – are held in conjunction with one another. The future relationship between these two tracks (i.e., will they remain separate or will the discussions be brought together) is another question being considered in the negotiations.

The road to Copenhagen: progress to date

The **first session of the AWG-LCA** took place in Bangkok, Thailand, from 31 March to 4 April 2008. At this meeting, the AWG-LCA agreed to undertake its work, seeking progress on all the elements assigned to it by the Bali Action Plan, in a coherent, integrated and transparent manner, and identified specific workshops to be held in 2008. It further agreed to organize its work at each session to include each of the elements, taking into account the interlinkages among them, and the work of the Convention's subsidiary bodies in the context of the Bali Road Map.

The **second session of the AWG-LCA** took place in Bonn from 2 to 12 June 2008. At this session, the AWG-LCA focused its work on building a common understanding of the elements of the Bali Action Plan. The group held three focused in-session workshops on advancing adaptation, transfer of technology, and investment and financial flows. Parties presented a number of concrete ideas and proposals on how to address the “shared vision”, mitigation, adaptation, technology and finance. The AWG-LCA concluded by inviting Parties to submit specific textual proposals on the elements contained in the first paragraph of the Bali Action Plan, which spells out the key issues to be addressed, taking into account the interlinkages among the elements.

The main focus of **third session of the AWG-LCA** in Accra in August 2008 was to continue to exchange ideas and clarify key elements of the Bali Action Plan (decision 1/CP.13), including a “shared vision for long-term

cooperative action,” mitigation, adaptation, technology and finance. Two in-session workshops were held on:

- Cooperative sectoral approaches and sector-specific actions, and policy approaches; and,
- Policy incentives on issues relating to reducing emissions from deforestation and forest degradation in developing countries (REDD), and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries.

The Accra climate change talks resulted in the adoption of conclusions on long-term cooperative action and on the 2009 work program under the AWG-LCA. Parties also agreed to compile ideas and proposals on the elements of the Bali Action Plan for discussion at COP 14 in December 2008 in Poznan, Poland.

Ongoing work under the Kyoto Protocol

At its most recent session, held in Accra alongside the AWG-LCA, the AWG-KP focused on the means for industrialized countries to reach emission reduction targets, with delegates addressing the flexible mechanisms (the market-based mechanisms under the Protocol) and land use, land-use change and forestry (LULUCF). Parties also considered an agenda item on “other issues” comprising: greenhouse gases; sectors and source categories; approaches targeting sectoral emissions; methodological issues; and spillover effects.

UN Climate Change Conference in Poznan (December 2008)

The next sessions of the AWG-LCA and the AWG-KP will be held in conjunction with COP 14 in Poznan, Poland. COP 14 will be an important stepping stone on the way to COP 15 in Copenhagen. Countries have agreed that in Copenhagen, an ambitious climate change agreement will be reached to follow on the first phase of the Kyoto Protocol, which expires in 2012. At Poznan, Parties to the UNFCCC will take stock of progress made in 2008 and map out in detail what needs to happen in 2009 to get to that agreement.

POLITICAL OUTCOMES FROM PREVIOUS SESSIONS OF THE COP

COP 1	Berlin Mandate	Launched a process to decide on stronger commitments for Annex I Parties
COP 2	Geneva Declaration	Renewed the momentum of the Kyoto Protocol negotiations (taken note of, but not adopted)
COP 3	Kyoto Protocol	Set legally binding targets and timetables for cutting the greenhouse gas emissions of Annex I Parties
COP 4	Buenos Aires Plan of Action	Set out program of work on issues under the Protocol; Established deadline for completion as COP 6 in 2000
COP 5	No declaration	Held “exchange of views” on selected topics during the high-level segment (seen as mid-point toward COP 6)
COP 6 parts I-II	Bonn Agreement	Part I could not reach agreement, so resumed in Bonn Part II reached the Bonn Agreement (political package) Between Part I & II, the US announced it would not ratify the Kyoto Protocol
COP 7	Marrakesh Accords	Translated Bonn Agreement into decisions setting out detailed rules for the implementation of the Protocol and took important steps toward implementation of the Convention
COP 8	Delhi Declaration on Climate Change and Sustainable Development	Reaffirmed development and poverty eradication as overriding priorities in developing countries and highlighted the importance of adaptation
COP 9	No declaration	President’s summary of round table discussions included in report of the session
COP 10	Buenos Aires Programme of Work on Adaptation and Response Measures; seminar of government experts	Calls for action on issues to address the adverse effects of climate change and response measures; seminar to promote an informal exchange of information on mitigation and adaptation, and on policies and measures
COP 11/ CMP 1	Decisions establishing the AWG-KP and Dialogue	Under the Protocol, a new working group was established to discuss future commitments for developed countries for the period after 2012. Under the Convention, a dialogue on long-term global cooperative action to address climate change was also launched. Parties to the Kyoto Protocol also formally adopted the “rulebook” of the 1997 Kyoto Protocol, the so-called ‘Marrakesh Accords’, which sets the framework for implementation of the Protocol
COP 12/ CMP 2	Nairobi Work Programme on Impacts, Vulnerability and Adaptation	The program was adopted by the SBSTA and subsequently re-named by the COP. Decisions related to financial flows were adopted and the two Montreal processes made progress
COP 13/ CMP 3	Bali Road Map	Includes a number of forward-looking decisions that represent the various tracks. It includes the Bali Action Plan, which charts the course for a new negotiating process designed to tackle climate change, with the aim of completing this by 2009

UNDP BALI ACTION PLAN BRIEFING PAPERS: SUMMARIES FOR POLICY MAKERS

To assist policy makers in understanding the complex issues under discussion in the negotiating process, the following section contains summaries of six background briefing papers prepared by UNDP. The papers discuss key issues for the four main “building blocks” currently under discussion in the international negotiations – mitigation, adaptation, technology and finance – as well as LULUCF, and include short histories of the international negotiations for each of these topics.

Summary of “Climate change mitigation negotiations, with an emphasis on options for developing countries”

by Harald Winkler, Energy Research Centre, University of Cape Town

Mitigation – the reduction of emissions of greenhouse gases (GHGs) – has been at the heart of the climate negotiations from the outset. As the next round of negotiations focuses on what developing countries might do on mitigation, the topic takes on an increased importance. However, reaching agreement on action on mitigation presents a major challenge. What is common for both developed and developing countries is that they take “measurable, reportable and verifiable” mitigation action, as called for under the Bali Action Plan. For developed countries, these should be in the form of commitments to absolute emission reductions. For developing countries, mitigation actions need to be developed in a bottom-up manner to achieve reductions relative to baseline emissions, and be supported by technology and finance. There are a number of specific proposals under consideration by Parties and developing country policy makers will need to carefully consider the implications of different approaches for their respective countries.

A wide variety of approaches to future actions have been proposed. These approaches reflect differing views among governments on the criteria to be used for considering these actions. The key concern of some countries is that any agreed actions be equitable, such as ensuring equal entitlements to emit for each person.

Some approaches emphasize the need to ensure continued economic development, while other proposals focus primarily on technological approaches. The proposals, many of which are complex and detailed, are briefly highlighted below:

- *Kyoto-style fixed targets:* These targets take the form of an agreed percentage reduction against annual emissions in a base year, 1990. An absolute number of tons of CO₂ to be reduced is calculated. By starting from the countries’ own emissions, the approach “grandfathers” existing differences between countries in emissions. This is the approach for industrialized countries under the Kyoto Protocol.
- *Per capita:* The “per capita entitlements” approach takes as its starting point the equal right of each person to use the atmosphere as a global commons. In a pure per capita approach, there is no reference to current emissions levels, but simply a global budget allocated equally to countries based on population. Some developing countries favor per capita approaches. However, the approach is less attractive to less populous nations, who would argue that there is more than one dimension to equity.
- *Brazilian Proposal:* The Brazilian proposal bases its burden-sharing approach on historical responsibility for change in temperature to individual countries. A key difference to most other approaches is the use of cumulative historical emissions rather than current annual emissions. For the Brazilian proposal, of

particular significance are the gases and sectors (forestry) chosen; the end date for analysis; and the representation of atmospheric chemistry in the model. The approach requires significant data, and this may limit applicability.

- *Emissions intensity:* This approach requires reductions of emissions relative to economic output (i.e., emissions compared to GDP) and therefore allows for growth in emissions if there is economic growth. To account for different national circumstances, commitments could be formulated as a percentage decrease from each country’ own emissions intensity. These goals would be harder to meet if economic growth remains lower than expected, given the reduced capacity. If successful, reduced intensities should assist in de-coupling emissions from economic growth. The approach is often considered “softer” than absolute targets since it quantifies emissions in relative terms.
- *Sustainable development policies and measures (SD-PAMs):* This approach suggests that developing countries themselves identify more sustainable development paths and commit to implementing these with financial support. It starts by considering a country’s own long-term development objectives. Next, policies and measures are identified to make the development path more sustainable. Each country would define what it means by making development more sustainable, but when registering SD-PAMs, the international community would have to agree.
- *Evolution of the CDM:* A major way in which developing countries are already engaging in mitigation is through the Kyoto Protocol’s CDM. The CDM is a project-based mechanism that allows cooperative action between countries that have a cap on emissions and those that do not. This shifts the focus from where mitigation takes place to who pays for mitigation. Extending the CDM beyond a “project basis” is not a commitment to reduce emissions domestically, but it could be an important form of nationally appropriate mitigation action in developing countries.
- *Global Triptych:* The Triptych approach focuses on three sectors – electricity generation, energy-intensive industries and “domestic sectors” (including residential and transportation). Triptych was originally used to share the burden of the Kyoto targets within the European Union. Analysis has considered extending this sectoral approach to all countries. Apart from taking a sectoral approach, Triptych also takes into account the technological opportunities available in various sectors.
- *Sectoral Approaches:* People can mean many different things when they use the term “sectoral” – including: sectoral CDM; benchmarks across trans-national sectors; technology transfer in specific sectors; the sector-based Triptych approach; and sectoral crediting mechanisms. Given the various types of sectoral approaches, two distinctions may help: *Is the proposal to implement at the domestic, national level only, or transnational?; Is the focus on a new agreement, or the efforts that Parties make?* Different ends of the spectrum would then be domestic sectoral efforts and transnational sectoral agreements.

Agreeing to actions that are measurable, reportable and verifiable – known as MRV mitigation actions – is a key component in the Bali Action Plan and central to the negotiations about the future of the climate regime. Indeed, MRV is central to the balance between action on climate change and support, since it applies to both nationally appropriate mitigation actions and to the provision of technology, financing and capacity building. A way of making some progress may be to focus on details – clearly defining what is meant by measurable, reportable and verifiable.

Summary of “National policies and their linkages to negotiations over a future international climate change agreement”

by Dennis Tirpak, in collaboration with Sujata Gupta, Daniel Perczyk and Massamba Thioye

Developing country policy makers will need to consider the national policy instruments they will need to contribute to the fight against climate change.

As discussions on the international level are underway through the Bali Road Map, a national level discussion can help governments reflect on the types of policies they should use, as well as how to seek internal and external financial resources and how to reflect their views in the negotiations of a future climate change agreement.

There is a rich array of policy instruments being used by developing countries to achieve national objectives, such as improving local air pollution and reducing poverty. Most of these policies also reduce emissions of greenhouse gases. These policies, measures and instruments include: regulations and standards, taxes and charges, tradable permits, voluntary agreements, informational instruments, subsidies and incentives, research and development, and trade and development assistance. Depending on the legal frameworks available to countries, these may be implemented nationally, regionally or locally. They may be supplemented with rules, guidelines and other administrative mechanisms to achieve different goals. They may be legally binding or voluntary and they may be fixed or changeable:

- *Regulations and Standards:* Specify abatement technologies (technology standard) or minimum requirements for pollution output (performance standard) to reduce emissions.
- *Tradable Permits:* Also are known as marketable permits or cap-and-trade systems. This instrument establishes a limit on aggregate emissions by specified sources, requires each source to hold permits equal to its actual emissions, and allows permits to be traded.
- *Voluntary Agreements:* An agreement between a government authority and one or more private parties to achieve environmental objectives or to improve environmental performance beyond compliance to

regulated obligations. Not all are truly “voluntary” – some include rewards and/or penalties associated with joining or with achieving commitments.

- *Taxes and Charges:* A levy imposed on each unit of undesirable activity by a source.
- *Financial Incentives:* Direct payments, tax reductions, price supports, or the equivalent from a government to an entity for implementing a practice or performing a specified action.
- *Information Instruments:* Required public disclosure of environmentally related information, generally by industry to consumers. Includes labelling programs and rating and certification.
- *Research and Development (R&D):* Direct government spending and investment to generate innovation on mitigation, or physical and social infrastructure to reduce emissions. Includes prizes and incentives for technological advances.
- *Non-Climate Policies:* Other policies not specifically directed at emissions reduction but that may have significant climate-related effects. These include: policies on poverty, land use and land use change, energy supply and security; international trade, air pollution, structural reforms; and population policies. These policies could offer an opportunity to assess and develop synergistic sustainable development strategies.

Evaluating policy options presents many challenges, since the policy making process of most governments involves complex choices involving many stakeholders.

These include the potential regulated industry, suppliers, producers of complementary products, labor organizations, consumer groups and environmental organizations. The choice and design of virtually any instrument has the potential to benefit some and to harm others. For example, standards set at a high level may be achievable by large firms, but not by small or new firms entering the market. Voluntary measures, often favored by industry because of their flexibility and potentially lower costs, are in many cases opposed by environment groups because of their lack of accountability and enforcement.

In formulating or further enhancing a domestic climate policy program, a combination of policy instruments may work better than a single instrument.

Also, the design of instruments may need to consider how they interact with existing institutions and regulations in other sectors of society. When comparing instruments, adjusting for different levels of stringency is important. For all instruments, stringency may be set at different levels. Over time, all instruments need to be monitored, adjusted and enforced. Also, an instrument that works well in one country may not work well in another country with different economic circumstances, social norms and institutions.

In terms of the policy making process for mitigation policies and measures, an essential first step may entail enhancing awareness within ministries and across the government to ensure consistency and synergies in policy making and implementation. Each country has a policy making process that, regardless of the form of government, is complex and unique. It is often the case that while individuals may be aware of the benefits of actions that have both local and climate change benefits, that awareness is not always extended to the whole set of governmental decision makers.

Second, information may be insufficient for adequate policy design, for example – developing marginal abatement cost curves. Trying to assess the benefits of a policy and the costs of inaction may be hindered or impeded by fragmentary information. Overcoming this barrier may require competing for budgetary resources with other programs, and national priorities or finding funding from other sources and governments.

Third, national capacity to elaborate scenarios – economic, energy and climate – and to model future trends and the evolution of key variables, is sometimes limited in developing countries. This can impair the quality of decision making, or reducing the scope of policy options being considered. At worst, that capacity may be missing and the necessary analysis that informs policy design may consequently be missing.

While these constraints are inherent to policy making in developing countries, it is recognized that climate change intensifies the effect of such constraints because it creates new challenges. Climate change adds an additional dimension to efforts to promote sustainable development. On one hand, because resources otherwise needed to alleviate poverty or enhance income distribu-

tion, among other goals may need to be channelled to address climate change impacts or to facilitate mitigation policies that may be initially be more expensive such as, the deployment of the some renewable energies technologies. On the other, uncertainty on the nature, intensity, frequency and timing of impacts may artificially enlarge the magnitude of resources needed to tackle the problems of adaptation thereby creating additional financial constraints and diminishing economic efficiency. Finding synergies between sustainable development goals and responses to climate change is therefore important.

Case studies

The case studies provided in this paper offer some insights into the approaches used by developing country governments and the constraints they face. Several of them exemplify situations where explicit multiple policies were used successfully to achieve national objectives. For example, in promoting energy efficiency programs, China has used regulations, financial incentives, R&D and information instruments to achieve its objective. Kenya, over a long period and with support from others, has used R&D, financial incentives and information instruments to develop and disseminate improved cooking stoves, while India has used a combination of instruments to encourage the deployment of wind power. Several of the case studies relied almost solely on financial incentives, e.g., the promotion of wind power in Argentina and natural gas vehicles in Bolivia. Only one of the case studies, i.e., the case of an energy efficiency labelling program in Brazil, contains an example of a voluntary agreement with industry.

Summary of “Adaptation to climate change: The new challenge for development in the developing world”

by Dr. E. Lisa F. Schipper, Stockholm Environment Institute; Maria Paz Cigarán, Libélula Communication, Environment and Development, Peru; and Dr. Merylyn McKenzie Hedger, Climate Change Institute of Development Studies at the University of Sussex.

Developing country policy makers will need to reflect on their national positions on the key issue of adaptation, as important decisions will be taken in the run-up to COP 15 in late 2009. The Bali Action Plan identified the need for action on adaptation, particularly for enhanced action on the provision of financial resources, investment and technology to support action on adaptation.

Adaptation to climate change is a complex and multi-faceted topic that presents a number of challenges, particularly for the developing world. Climate change impacts are already affecting developing countries, particularly the poor and most vulnerable, because they have fewer social, technological, and financial resources for adaptation. Millions of people, particularly those in developing countries, face shortages of water and food and greater risks to health. Adaptation measures that reduce vulnerability to climate change are critical, especially in countries where the risks are “here and now”. Climate change also affects the sustainable development of countries, as well as their abilities to achieve the UN Millennium Development Goals (MDG) by 2015.

The approximate costs of adaptation are high by all estimates. The UNFCCC Secretariat has estimated that in 2030 developing countries will require \$28-67 billion to enable adaptation to climate change. Although the figure is large in absolute terms, this corresponds to 0.2-0.8% of global investment flows, or just 0.06-0.21% of projected global GDP in 2030. According to the World Bank, incremental costs to adapt to projected climate change in developing countries are likely to be of the order of \$10-40 billion per year. While there are difficulties and uncertainties in calculating an exact figure, one fact remains clear: the amount needed to adapt to climate change will be considerable and far exceed what is currently available through existing UNFCCC funds and other sources.

An important challenge in considering adaptation is defining and understanding what is meant by the term “adaptation”. Adaptation is currently the topic of numerous studies that offer a range of definitions. The IPCC offers a starting point by providing a broad definition of adaptation: adjustment in natural or human systems to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Adaptation therefore involves a process of sustainable and permanent adjustment in response to new and changing environmental circumstances. Given its far-reaching nature, it is nonetheless a difficult topic to define, particularly in operational and financial terms. However, some key points may provide a helpful framework:

- *Adaptation is not a “stand alone” issue.* It has clear synergies with important issues such as economic development, poverty reduction and disaster management strategies. A sustainable development path is vital for an adaptation process to succeed.
- *Adaptation will need to be integrated into all development planning.* This includes the national and international levels. Successful adaptation measures will require long-term thinking and explicit consideration of climate change risks at the regional (cross-national), national, sub-national and local levels.
- *Adaptation will also require the capacity for both short- and long-term planning.* Strategies will be needed to address long-term climate change impacts, such as those predicted by the IPCC. At the same time, strategies for shorter-term adjustments may also be necessary, such as those prepared for shorter-term climate variability.
- *Adaptation will require substantial funding.* All indicative estimates available suggest that the costs of adapting to climate change in the developing world are in the order of tens of billions. However, there are many difficulties and limitations in estimating the exact costs of adapting under various scenarios, as well as the ability of countries to self-finance adaptation.

In the UN climate negotiations, recognition of the need for all countries to take action on adaptation has

grown over time, as the impacts of climate change have become increasingly evident. The international effort to date has delivered considerable information, resources and capacity building. However, progress on adaptation has also suffered from some of the ambiguities in the regime itself. Adaptation is not defined explicitly in the Convention, but is referenced only in the overall context of climate change. How adaptation is defined in operational terms will have significant political and financial implications. It could affect level of financing to be expected in the light of the commitments under the Convention. Much of the negotiations on adaptation have therefore focused on finance and there has been lack of agreement on how it should be addressed.

While all countries recognize that developed countries should fulfil their commitments under the Convention and provide finance, technology and capacity building support to developing countries, progress on these issues has been slow and unsatisfactory for many developing countries. Many have expressed frustration at the slow progress on the funding mechanisms. Indeed, it took about three years for current funds to be made operational following their establishment in Marrakesh in 2001. Many developing country concerns regarding finance to adaptation relate to:

- The relatively small amount of funds currently available to address adaptation under the Convention and, if the current replenishment trend continues, that these would not sufficiently address their needs.
- The experiences of developing countries in accessing and receiving support through existing funds, owing both to the complex design of the funds and to problems of implementation of the guidance.
- The recognition that additional financial flows will be needed to cope with adaptation needs.

At the national level, governmental institutions (ministries, regional governments and agencies), private entities and non-governmental organizations (NGOs) will need to consider integrating – or more broadly integrating – climate change into their planning and budgeting in all levels of decision making, and coordinate their actions among themselves. Many developing countries already have adaptation efforts underway. Most

developing countries that are a Party to the UNFCCC have already developed their first national communication and, in case of an LDC, a National Adaptation Plan of Action (NAPA). Some are already developing their second national communication, which will have information about measures to facilitate adequate adaptation to climate change.

Successfully adapting to climate change at the national level will likely require a set of conditions and elements at the national level. Some possible elements for a strategy include:

- Adequate institutional arrangements, including systematic planning capacity in a cooperative institutional setting consistent policies and measures and regulatory frameworks;
- Strong coordination of ongoing activities on a sub-national level, which could include activities that are driven by NGOs, research institutions, the private sector and by local and sub-national governments;
- Scientific and technical capacities to understand the problem and its effects at the national and sub-national level, model its long-term impacts, and elaborate responses and adaptive strategies to the level of implementation;
- Program and project preparation capacities;
- Citizen awareness and participation that sustain and prioritize climate change actions.

Summary of “Negotiations on additional investment and financial flows to address climate change in developing countries”

by Erik Haites, Margaree Consultants, Inc.

Finance has been identified as a key issue for the discussion on a post-2012 climate change agreement.

For future long-term cooperation to address climate change, developing country Parties will need considerable financial assistance for mitigation, adaptation and technology cooperation. They will therefore need to assess the current arrangements for financial assistance under the Convention and its Kyoto Protocol, as well as options in the current negotiations on additional international investment and financial flows to address climate change.

The exact amount of investment and financial flows needed is not known, but it could amount to tens of billions of dollars per year. Addressing climate change will require significant shifts and an overall net increase in global investment and financial flows. While the changes appear large in absolute terms, they are small relative to total investment. **Approximately half of the shifts and net increase will need to occur in developing countries.** Mitigation investments in developing countries are more cost-effective, resulting in larger emission reductions per dollar invested. Furthermore, developing countries are estimated to suffer more damage as a percentage of their Gross Domestic Product (GDP) than developed countries. Indeed, many studies conclude that developing countries, especially the poorest and those most vulnerable to the adverse impacts of climate change, will need considerable international financial support for mitigation and adaptation.

The Convention and its the Kyoto Protocol already foresee financial assistance from developed country Parties to developing country Parties and contain a number of provisions to address this issue. This assistance may be through bilateral, multilateral or regional channels or through a financial mechanism defined in the Convention. The Global Environment Facility (GEF) has been designated as an operating entity of the financial mechanism of the Convention on an on-going basis, subject to review every four years. Developed countries must also provide information on their bilateral and multilateral assistance in their national communications. The Kyoto Protocol created the CDM to

assist developing countries in achieving sustainable development and to assist developed countries in meeting their emissions limitation commitments. A small share of credits issued for most projects under the CDM is contributed to the Adaptation Fund, which aims to assist developing country Parties that are particularly vulnerable to the adverse impacts of climate change to meet the costs of adaptation.

In the current negotiating processes under the Convention and Kyoto Protocol, a number of options to enhance international investment and financial flows to developing countries have been suggested or proposed:

- Some options seek to **increase the scale of contributions** by developed countries to existing mechanisms under the Convention and Kyoto Protocol.
- Others seek **additional contributions by developed countries** toward new bilateral and multilateral funds.
- Some proposals would be funded by **defined contributions from developed countries**, notably proposals for a Convention adaptation fund, technology fund and insurance mechanism, as well as for an “umbrella” financial mechanism under the Convention.
- Others are based on **contributions from developed and developing countries**, while some would raise funds based on **more stringent commitments by developed countries**.
- Parties are also considering numerous **proposals that would draw from other sources**. These include an extension of the 2% levy on CDM to other market mechanisms under the Kyoto Protocol, an international air travel adaptation levy, an international maritime emission reduction scheme, access to renewable energy programs in developed countries and debt-for-clean-energy swaps.

Ensuring adequate, predictable and sustainable financial resources for mitigation, adaptation and technology cooperation as an essential component of a post-2012 agreement to address climate change will require reaching agreement on a mix of investment and financial flows, including:

- **Increased funding for the financial mechanism of the Convention.** The fourth review of the financial mechanism will inform the fifth replenishment of the GEF. Those funds will be disbursed over four years beginning in 2011.

- **More stringent commitments for developed countries under the Kyoto Protocol to generate additional demand for credits from the CDM and possibly other mechanisms.** Changes to the eligible project types and crediting mechanisms may be required to increase the supply of credits.

- **New sources of funds for mitigation, adaptation and technology cooperation.** Several options for new funds on the scale needed are available. They need to be assessed in terms of their political acceptability and their ability to provide predictable financial and investment flows on a sustained basis.

Raising substantial additional funds for mitigation, adaptation, and technology cooperation will give rise to **important governance and delivery issues** that will need to be addressed if the funds are to be used effectively.

- **Governance:** At present the Convention funds are managed by the GEF with guidance from the COP. Operation of the GEF is directed by the GEF

Council, which has different representation and rules of procedure than the COP. The Adaptation Fund has its own Board elected by, under the authority of, and accountable to the supreme decision making body under the Kyoto Protocol. Many new proposals involve the creation of new funds for specific types of mitigation actions, adaptation needs, and technology development and transfer. Governance issues apply both to the funds collected and to the manner in which those funds are disbursed. Governance issues include accountability to the COP, balanced representation of all Parties, transparency, and ease of access to the funding.

- **Effective disbursement:** Disbursement of substantially larger amounts for mitigation, adaptation and technology cooperation will raise important delivery issues, including:
 - o The share of the available funds to be allocated for mitigation, adaptation and technology cooperation;
 - o Whether the funds are distributed by country or project type;
 - o Whether funds are distributed for individual projects (like the GEF) or for “national programs”; and
 - o Whether, or under what conditions, funds can be provided through “direct access”.

Summary of “The Mitigation Technology Challenge: Considerations for National Policy Makers to Address Climate Change”

by Martina Chidiak and Dennis Tirpak

Reducing greenhouse gas emissions to levels that will prevent dangerous anthropogenic interference with the climate system presents a major technological challenge.

The good news from the IPCC is that many mitigation scenarios for the medium term (i.e., until 2030) suggest that there is considerable economic potential for reducing GHG emissions at costs ranging from negative to about \$100 per ton of CO₂. However, to stabilize GHG emissions, for example, at current levels by 2030 as a first step, additional mobilization of investment and finance flows in the order of \$200 billion (mostly aimed at the energy supply and transportation sectors) would be needed. These additional flows are large relative to the funds currently available, but low as compared to global GDP and investment.

A mix of existing and new technologies and practices will be necessary to achieve the relevant mitigation levels predicted in the IPCC stabilization scenarios.

While there is considerable economic potential for reducing GHG emissions, the costs of different mitigation options (technologies) vary considerably. There is also a large potential for no-cost mitigation, mostly related to improving energy efficiency in buildings, which imply negative costs (i.e., net benefits) if implemented, but require specific action and policies to deal with implementation barriers.

Many existing and emerging technologies can help achieve a low carbon future and other goals. Each is at a different stage of the research, development, demonstration and deployment cycle (RDD&D). They are not being developed and diffused at the rate required because of a number of technological, financial, commercial and regulatory barriers. Nonetheless, recent evidence indicates that, due to policies in some countries, investment in clean energy technologies is growing and that new financial products and markets are being developed worldwide. Some key technologies include:

- *Advanced fossil fuel power generation:* The efficiency of coal-fired power plants averaged about 35% from 1992 to 2005 globally, but the best operating plants

can achieve 47%. The efficiency of most plants is therefore well below the potential offered by state-of-the-art technologies. Retrofitting existing plants or installing new generation technology can achieve improved efficiencies.

- *Biomass and bioenergy:* Biomass – i.e., organic material grown and collected for energy use – is a source of renewable fuel that can be converted to provide heat, electricity and transport fuels. The scope for biomass to make a large contribution to global energy demand is dependent on its sustainable production, improved efficiencies in the supply chain, and new thermo-chemical and bio-chemical conversion processes.
- *Wind power:* Wind power has grown rapidly since the 1990s. Global installed capacity reached new heights in 2007 with more than 40 countries having wind farms. In 2007, global capacity increased by 40%. The outlook is for continued double digit growth.
- *Buildings and appliances:* Residential, commercial and public buildings encompass a wide array of technologies in the building envelope, including: insulation, space heating and cooling systems, water heating systems, lighting, appliances and consumer products. Buildings are, however, often refurbished – heating and cooling systems are often changed after 15-20 years. Choosing the best available technology at the time of renovation therefore is important to long-term energy demand.
- *Electricity transmission and distribution technologies:* Much of the electricity that is produced is never used. Transmission and distribution losses account to 8.8% of the electricity produced worldwide. Developing countries often have short falls in electricity production that are met by curtailing electricity to different regions at certain times of the day. There are several technological options available or under development to improve efficiencies of the grid.

Given the urgency of the climate change problem, policy makers in developing countries need to consider how they will contribute to reducing the rate of growth of GHG emissions in their countries. This involves consideration of their unique circumstances and special

technology needs, and ways to encourage innovation and the diffusion of the technologies using both public and private finances. They also need to consider how the international community could help their countries through a “full package” approach, consisting of equipment, software, enhanced human capacities, regulatory and institutional support and financial mechanisms designed for each element.

Under the UNFCCC, Parties are currently discussing ways to enhance innovation and expand the deployment, transfer and commercialization of new technologies, particularly in developing countries. For some technology-related issues, the ongoing international debate reflects a growing international consensus, while others remain highly controversial.

- **A growing consensus is being reached on important issues**, such as the key technologies needed to achieve low-cost mitigation (in particular for developing countries and in the energy sector), the main (information and incentive) barriers, the need to stimulate international technology cooperation and the existence of a substantial financing gap that needs to be filled.
- **Other issues remain controversial**, for example: how quickly a low carbon energy world can be achieved, the policy approach necessary to accelerate technology development and deployment (climate policies alone or additional technology policy instruments), and ways to achieve a significant shift in investments to sustainable technologies in an efficient manner.
- There is also debate on **the role of intellectual property rights (IPRs)** for the development and deployment of climate-friendly technologies (new international mechanisms to purchase IPRs for key technologies and licensing policies or IPRs and long lived patents for innovators to provide sufficient incentives).

- In addition, there is debate on **the form that international RDD&D cooperation** should take (should this be decided in the framework of the UNFCCC) and the role and ultimate scope of carbon markets and the CDM for technology transfer.

Parties have put forward a number of “proposals” in their recent submissions, which policy makers will need to consider in the light of their country’s experience and specific circumstances.

Some useful criteria could help guide this effort. For expanding technology research and promoting innovation, does the proposal ultimately encourage or discourage institutions from undertaking R&D on technologies of importance to the country, and the requirements needed to take advantage of the new proposal.

For problems relating to the deployment, commercialization and transfer of technology:

- *Do these problems warrant an international mechanism (and its associated bureaucracy) or would they be more appropriately addressed on a case-by-case basis?*
- *Can the “proposal” be implemented to the benefit of all or only a few countries?*
- *Will it result in additional investments for technology and capacity building?*

For financing aspects:

- *Is each part of the RDD&D cycle addressed appropriately by the proposal?*
- *Does it address each element of the “full package approach”?*

Finally, it is important to recall that the international community will need to determine how to monitor, report and verify any agreement to enhance RDD&D of technology.

Summary of “Key issues in negotiations on Land Use, Land Use Change and Forestry, with an emphasis on developing countries”

by Carmenza Robledo and Jürgen Blaser, *Intercooperation*

The land use sector, including forestry and agriculture, is an important source of anthropogenic GHG emissions. Land use change, mainly deforestation, contributed to about 20% of the emissions from anthropogenic sources between 1989 and 1998. When adding all emissions from the LULUCF sector the share is over 30%. In addition, the land use sector has great potential in mitigating climate change.

Accordingly, the role of LULUCF activities in the mitigation of climate change has long been recognized. The UNFCCC includes commitments relating to the sector and much of the initial discussion relating to LULUCF focused on GHG inventories. The main issues of concern were how to compile activity data (a particular difficulty for poorer countries with problems in accessing satellite imageries, inventories or historic data) and how, based on this information, to accurately estimate emissions and removals by sinks.

During the negotiations that led to the Kyoto Protocol in 1997, many countries highlighted the importance of including sinks and emissions from LULUCF in the Protocol’s commitments, subject to concerns about definitions, timing and scope. As a result, several articles of the Kyoto Protocol make provisions for the inclusion of LULUCF activities by Parties as part of their implementation efforts and contribute to the mitigation of climate change. Notably, in 2001 Parties agreed that limited LULUCF activities could be eligible for inclusion as activities under the CDM (afforestation and reforestation activities – known as A/R CDM).

A proposal on “reducing emissions from deforestation in developing countries and approaches to stimulate action” (REDD) was first considered by the COP in 2005. Since early 2006, discussions under the UNFCCC process have focused on: the identification of drivers for deforestation; scientific, technical and methodological issues relating to estimating and monitoring emissions from deforestation; and costs and technical barriers for the implementation of activities to reduce deforestation. Parties have also been considering a range of policy approaches and positive incentives and deliberated

the advantages and disadvantages of various financing options.

At COP 13, the Bali Action Plan was adopted, which states that: “Policy approaches and positive incentives on issues relating to reducing emissions from deforestation and forest degradation in developing countries; and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries”. Also at COP 13, another major decision to stimulate action was adopted, which provides a mandate for several elements and actions, including further strengthening ongoing efforts and support for capacity-building, technical assistance and transfer of technology. In 2008, a program of work is being undertaken on methodological issues, such as finding ways to measure forest degradation.

Negotiating LULUCF in the framework of the UNFCCC and its Kyoto Protocol has been demonstrated to be very difficult for both Annex I (developed) and non-Annex I (developing) Parties. The fact that the contribution of LULUCF to Annex I Parties’ reduction commitments was agreed after the establishment of Kyoto targets constituted a major difficulty for using the whole potential of LULUCF as a means for mitigating climate change. That happened mainly because LULUCF was seen during the previous negotiations as a way to offset emissions, i.e., to avoid changing energy and consumption paths of the major emitters.

Based on the first experiences with LULUCF, stakeholders directly involved in the implementation of LULUCF activities expressed a desire for simpler or more cost-effective ways to support the overall objective of the Convention through forestry activities. Some developed countries want more flexibility to achieve their targets, while some developing countries would prefer larger markets for CDM or other credits. For other developing countries, the concern is creating appropriate incentives.

There are a number of technical and methodological issues that have evolved with the negotiations. Technical and methodological issues for carbon accounting have been developed to accurately quantify the mitigation potential of a particular LULUCF activity. Technical and methodological issues relate mainly to how to define a baseline or a reference scenario, how to treat leakage (sometimes called “displacement of emissions”), permanence (carbon in reservoirs can be emitted at any time, e.g., a forest could burn, making emission reductions

non-permanent) and additionality (what additional emissions reductions came about because of the project), and how to monitor and report emission reductions or carbon sinks. These technical and methodological issues might need – in general terms – to be reassessed and complemented according to the LULUCF activities that become an eligible in a post-2012 agreement. In particular, there is the possibility that REDD and/or forest restoration becomes eligible.

LULUCF will therefore play a key role in any post-2012 international climate change regime emerging from the current negotiating processes under the United Nations. Currently there are three major negotiation processes under the UNFCCC: the AWG-KP (Kyoto Protocol), the AWG-LCA (UNFCCC discussion on the Bali Action Plan) and the ongoing discussions on REDD by one of the subsidiary bodies.

In the majority of the submissions for the first meeting of the AWG-LCA, LULUCF is mentioned as an important option for mitigating climate change in developing countries. A major issue for discussion focuses on which activities to include. In the submissions, the following activities were mentioned: REDD, forest conservation, sustainable forest management and enhancements of sinks. Some Parties also mentioned afforestation and reforestation as well as forest management. In the discussions on REDD, there have been a number of submissions containing proposals on financing mechanisms.

CLIMATE CHANGE MITIGATION NEGOTIATIONS, WITH AN EMPHASIS ON OPTIONS FOR DEVELOPING COUNTRIES

HARALD WINKLER
ENERGY RESEARCH CENTRE
UNIVERSITY OF CAPE TOWN

CONTENTS

Acronyms	27
Units and Measures	27
1 Introduction	28
1.1 Background to the climate negotiations	28
1.2 The Bali Action Plan	29
2 Scientific basis for mitigation and development	31
3 Background concepts in proposals for mitigation	33
4 Overview of options for mitigation in developing countries	39
4.1 Different approaches	39
4.2 More detailed description of selected approaches	41
4.2.1 Kyoto-style fixed targets	41
4.2.2 Per capita	42
4.2.3 Brazilian Proposal	43
4.2.4 Emissions intensity	44
4.2.5 SD-PAMs: Sustainable development policies and measures	44
4.2.6 Evolution of the Clean Development Mechanism (CDM)	45
4.2.7 Global Triptych	46
4.2.8 Sectoral approaches	46
4.2.9 Conclusions	47
5 Measurable, reportable and verifiable	48
5.1 MRV mitigation action by developing countries	48
5.1.1 Measurable	48
5.1.2 Reportable	49
5.1.3 Verifiable	49
5.2 MRV for means of implementation	50
5.2.1 Making finance MRV	50
5.2.2 MRV technology	52
5.3 MRV for developed countries	52
6 Conclusions	54
Bibliography	55
Further reading	55
References	55

Acknowledgements

UNDP and the author gratefully acknowledge the constructive suggestions made for this paper by the UNFCCC secretariat and UNDP staff members, as well as Hernan Carlino, Erik Haites, Dennis Tirpak, Chad Carpenter, Susanne Olbrisch and Naira Aslanyan.

1 INTRODUCTION

Climate change is one of the greatest threats to our planet and its people. Reducing emissions of greenhouse gases (GHG) is called mitigation. Responding to the impacts of climate change is called adaptation. A certain amount of adaptation will be necessary, no matter what we do. But, there will come a point where it will not be possible to adapt our way out of the problem.

Mitigation has been at the heart of the climate negotiations from the outset. As the next round of negotiations focuses on what developing countries might do on mitigation, the topic remains highly relevant.

The remainder of this introduction briefly sketches the history of the climate negotiations, ending with the most recent agreements in Bali. The paper then turns to the scientific basis of the work on mitigation. Section 3 introduces background concepts for proposals on mitigation, leading into the next section, which identifies not only different schools of thought but a number of specific proposals as well. The “hot” topic of how mitigation actions can be made ‘measurable, reportable and verifiable’ (MRV) is examined in section 5, before concluding with some questions for discussion. Information on the terminology used in this paper can be obtained from the glossary in Annex 4.

1.1 Background to the climate negotiations

In Rio de Janeiro in 1992¹, the United Nations Framework Convention on Climate Change (UNFCCC) was negotiated, including its ultimate objective and the principles on which climate action is to be based. For developing countries, it is important to underscore that Article 2, the objective of the Convention, not only refers to stabilization of atmospheric concentrations in the atmosphere, but also refers to doing this in a way that allows sustainable development to proceed – ecologically (“ecosystems adapt”), socially (“food security”) and economic development.

The Convention sets a framework for future action, it outlines the ‘rules of the game’ to enable the international community to agree on future action as the science improves or new tools and technologies become available. New information indeed became available through the Second Assessment Report from the Intergovernmental Panel on Climate Change (IPCC) in 1995, informing the negotiation of the Berlin Mandate which in turn led to the Kyoto Protocol.

In Kyoto in 1997,² based on the principle of equity and common but differentiated responsibilities and respective capabilities, it was agreed that Annex I Parties would take the leaders through quantified emission limitation and reduction objectives (QELROs) (UNFCCC 1997). For Annex I Parties, policies and measures (PAMs) are a means to achieve QELROs³. Progress is to be reported by means of annual inventories and national communications⁴.

In Kyoto, non-Annex I (NAI) Parties continued with qualitative mitigation measures⁵, without quantifying the outcome. Parties considered this appropriate, given that development would imply increasing emissions. There is no mandatory requirement for particular PAMs, so that these could in future be a possible form of commitment in themselves. Reporting for NAI Parties includes national inventories, as well as “a general description of steps taken or envisaged”⁶ and in practice includes a section on mitigation program.

There was agreement in 1992, that Annex II Parties would make available the “full agreed incremental costs” for NAI Parties to implement their commitments, including those to mitigation, as well as assist with technology transfer⁷. By Montréal in 2005⁸, the Kyoto Protocol had entered into force, and Parties agreed to launch a two-track approach. The Kyoto track set up an Ad-hoc Working Group on further commitments of Annex I Parties (AWG-KP) to negotiate commitments for Annex I Parties for subsequent commitment periods, as mandated by Article 3.9 of the Protocol. The Convention

track was not a formal negotiation process, but initiated a discussion in four workshops over two years. Given that major developed countries had not ratified the Protocol, action for mitigation by such Parties has had to be considered under the Convention track rather than the Protocol track, i.e., the AWG-KP. (For an overview regarding Conference of the Parties (COP) decisions relevant to mitigation, please refer to Annex 1).

1.2 The Bali Action Plan

In Bali,⁹ the attempt was to retain the Annex I/non-Annex I balance of mitigation commitments, but also to increase the sense of urgency on both sides. The balance was outlined in **paragraphs (b)(i) and (b)(ii)**:

- “(b) Enhanced national/international action on mitigation of climate change, including, inter alia, consideration of:
- (i) Measurable, reportable and verifiable nationally appropriate mitigation commitments or actions, including QELROs, by all developed country Parties, while ensuring the comparability of efforts among them, taking into account differences in their national circumstances;
 - (ii) Nationally appropriate mitigation actions by developing country Parties in the context of sustainable development, supported and enabled by technology, financing and capacity-building, in a measurable, reportable and verifiable manner;”

One priority for developing countries in Bali was that all developed countries, including the US, take on QELROs. This was included only as an option in the final text, but comparability of efforts was introduced in (b)(i). Raising the level of effort for developed countries includes both broader participation, (i.e., including Annex I Parties that have not ratified the Protocol), but also, in the AWG-KP, more stringent efforts by Kyoto ratifiers in the second commitment period. In respect of the latter, the range of -25% to -40% from 1990 levels by 2020 is the key

benchmark being negotiated. This range has not, to date, been agreed in the Ad Hoc Working Group on Long-term Cooperative Action under the Convention (AWG-LCA).

In paragraph (b)(ii), the same language of MRV applies to mitigation actions by developing countries, but also to support through finance, technology and capacity-building. While there will always be different interpretations of agreed text, the Chair of the Group of 77 and China (G77) made clear in his interpretive statement in the final plenary that MRV applied to both mitigation and support¹⁰. Most legal interpretations confirm that the comma prior to the last clause in (b)(ii) has the effect of applying it to the entire paragraph.

This short paragraph, then, reflects two very significant shifts. Firstly, developing countries have agreed to negotiate MRV mitigation action. In other words, developing countries are now willing to negotiate ‘quantifiable’ mitigation actions, or to use the exact words “measurable, reportable and verifiable”. Not only can the emissions implications of actions be measured, they could also be reported to the international community and be capable of verification.

Secondly, technology transfer and financial resources by developed countries need to pass the test of being verifiable, too. This similarly is a significant departure from the past, when much financing was through voluntary contributions to funds and the quantum of technology transferred was not measurable. In future, finance and technology will be subject to MRV.

The Bali Action Plan in these key paragraphs refers to developed countries and developing countries, rather than Annex I and NAI Parties. This opens the possibility of defining what is meant by the new categories. The main implication is that some developed countries deal with mitigation under the AWG-KP, but all developed countries also address mitigation “commitments or actions, including QELROs” in (b)(i). It is the only place where mitigation can be discussed for those Annex I Parties that have not ratified the Protocol. No further distinction is made among developing countries in the Bali Action Plan, so that all G77 members would understand their mitigation actions to be dealt with under (b)(ii).

¹ United Nations Conference on Environment and Development (UNCED), Rio de Janeiro, 3-14 June 1992.

² The third Conference of the Parties to the UNFCCC (COP 3) was held in Kyoto, Japan from 1 - 11 December 1997.

³ Indeed, PAMs are the first item listed in Protocol Article 2.1(a).

⁴ Reporting for Annex I in terms of Protocol Articles 5, 7 and 8 and FCCC Article 12.2.

⁵ FCCC Article 4.1b mitigation programs for all Parties.

⁶ FCCC Article 12.1 on reporting by all Parties, including developing countries, governs inter alia NAI inventories and national communications.

⁷ FCCC Articles 4.3, 4.5 and 4.7 on financial and technology transfer, and both (4.7).

⁸ COP 11 and the first Conference of the Parties serving as the meeting of the Parties (COP/MOP 1) were held from 28 November to 9 December 2005 in Montréal, Canada.

⁹ COP 13 and COP/MOP 3 were held from 3 - 14 December 2007 in Bali, Indonesia.

¹⁰ The Chair (Pakistan) in the final plenary in Bali indicated all the group was “asking for is that we are ready to have measurable, reportable, and verifiable mitigation but then that has also to qualify financing and technology.” The statement can be viewed on the UNFCCC webcast.

The balances between paragraphs b(i) and b(ii) are likely to remain central in refining the architecture of the climate regime after 2012. The negotiations on mitigation in the AWG-LCA on mitigation continue to be difficult, reflected in the work plan for 2008, which was unable to agree on workshops on mitigation issues such as MRV, comparability of effort and others. During this year, mitigation will be treated as one of the five agenda items (mitigation, adaptation, finance, technology and shared vision), with all five being considered by every meeting of the AWG-LCA in 2008.

2. SCIENTIFIC BASIS FOR MITIGATION AND DEVELOPMENT

All work under the Convention and its Protocol is done on the basis of the best available scientific information. Workshops on mitigation in the AWG-LCA are likely to happen in 2009. In the meantime, however, there is significant scientific information, in particular from the IPCC. The IPCC assesses our state of knowledge on climate change.

In 2007, the IPCC issued its Fourth Assessment Report (AR4). The science (Working Group I, abbreviated WG I) is now “unequivocal” that human activity is contributing to climate change, and the impacts (Working Group II) are already being observed in all sectors – food, water, health, agriculture, energy, etc¹¹. The contribution from Working Group III deals with mitigation (IPCC 2007b).

IPCC AR4 assessed several stabilization levels in the literature. This information provides clear information about what mitigation is needed to keep stabilization levels low and hence avoid the worst impacts of climate change (see Table 1). The impacts themselves are outlined in

Working Group II report (IPCC 2007a). If we are to avoid the worst damages and keep concentrations at the lowest level assessed (450 parts per million by volume (ppmv), which would still see climate impacts), then **what is required are absolute emission reductions by Annex I and relative emission reductions¹² for developing countries**. In fact, the pattern of action applies for 550 ppmv as well, only with less stringent requirements – but also correspondingly higher climate impacts. Only at 650 ppmv is no ‘deviation from baseline’ emissions required in developing countries – and then only up to 2020 – but there would also be more dramatic impacts. (For more details, please refer to IPCC AR4 Section 3.)

IPCC AR4 also found that “climate policy alone will not solve the climate problem” (IPCC 2007a). Development policy is at least as important. Policy on technology, industry, agriculture, energy, housing and a whole range of other areas will be important, not only climate policy conceived as environmental policy alone.

Table 1: Ranges of emission reductions required for various stabilization levels

The range of the difference between emissions in 1990 and emission allowances in 2020/2050 for various GHG concentration levels for Annex I and non-Annex I countries as a group^a.

SCENARIO CATEGORY	REGION	2020	2050
A-450	Annex I	-25% to -40%	-80% to 95%
ppmv CO ₂ -eq ^b	Non-Annex I	Substantial deviation from base Line in Latin America, Middle East, East Asia and Centrally-Planned Asia	Substantial deviation from baseline in all regions
B-550	Annex I	-10% to -30%	-40% to 90%
ppmv CO ₂ -eq	Non-Annex I	Deviation from baseline in Latin America and Middle East, East Asia	Deviation from baseline in most regions, especially in Latin America and Middle East
C-650	Annex I	0% to -25%	-30% to -80%
ppmv CO ₂ -eq	Non-Annex I	Baseline	Deviation from baseline in Latin America and Middle East, East Asia

^a The aggregate range is based on multiple approaches to apportion emissions between regions (concentration and convergence, multistage, Triptych and intensity targets, among others). Each approach makes different assumptions about the pathway, specific national efforts and other variables. Additional extreme cases – in which Annex I undertakes all reductions, or non-Annex I undertakes all reductions – are not included. The ranges presented here do not imply political feasibility, nor do the results reflect cost variances.

^b Only the studies aiming at stabilization at 450 ppmv CO₂-eq assume a (temporary) overshoot of about 50 ppmv CO₂-eq (see Den Elzen and Meinshausen, 2006).

Source: IPCC Working Group III (WG III) 2007. Chapter 13. Box 13.7.

¹¹ For more information, please refer to the paper produced for this series entitled “Adaptation to climate change: The new challenge for development in the developing world”.

¹² Absolute reductions would be lower than in a previous year, the base year, while relative reductions are typically defined to be below projected future levels. If emissions are projected to increase, a relative reduction might still see total, absolute emissions rising.

Making development more sustainable by changing development paths can thus make a significant contribution to climate goals. We should think of development paths not as mapped-out paths, but the result of many decisions by different actors in various places. To make this more concrete, WG III gives a few examples of how this might work:

- GHG emissions are influenced by, but not rigidly linked to economic growth: policy choices make a difference.
- Sectors where effective production is far below the maximum feasible production with the same amount of inputs – i.e., sectors that are far away from their production frontier – have opportunities to adopt ‘win-win-win’ policies, i.e. policies that free up resources and bolster growth, meet other sustainable development goals and also reduce GHG emissions relative to baseline.
- Sectors where production is close to the optimal given available inputs – i.e., sectors that are closer to the production frontier – also have opportunities to reduce emissions by meeting other sustainable development goals. However, the closer one gets to the production frontier, the more trade-offs are likely to appear.
- What matters is not only that a ‘good’ choice is made at a certain point in time, but also that the initial policy is sustained for a long time – sometimes several decades – to truly have effects.
- It is often not one policy decision, but an array of decisions that are necessary to influence emissions. This raises the issue of coordination between policies in several sectors, and at various scales.

Not only do development policies matter, but there is also much evidence that pursuing **local** sustainable development has co-benefits, also reducing GHG emissions. A development-oriented approach to mitigation is of particular interest for developing countries, where poverty and development are higher on the agenda than climate policy.

It also means that a much wider set of actors need to be involved in mitigation, particularly in the context of development. Within government, it would not only be environmental departments or meteorologists who would consider climate policy, but also departments of energy, forestry, housing, finance and virtually any other department, including sub-national and local governments. For mitigation, the role of the private sector will be equally important, particularly in countries where most emissions are due to industrial activity. Civil society will need to play an important role in advocating for climate policy as well.

Given all of this, the role of focal points on climate change may in future require a much greater element of coordination. Coordination will be needed to align policies across spheres of government, across sectors and across the economy and society more broadly. Coordinated work at the national level¹³ would provide a solid basis for considering the various proposals in the multilateral negotiations.

3. BACKGROUND CONCEPTS IN PROPOSALS FOR MITIGATION

As can be seen from section 1, Convention¹⁴ negotiations can result in decisions and wording that are broad and offer room for different interpretations. This section outlines key mitigation concepts and principles that must be understood in order to assess mitigation option proposals, before specific proposals are outlined in section 4.

The principles of the Convention include that **“Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and common but differentiated responsibilities and respective capabilities”**, which leads to the requirement that developed countries take the lead (Art 3.1). Further principles include:

- The specific needs and special circumstances of developing countries;
- Taking a precautionary approach (i.e. scientific uncertainty is no excuse for inaction);
- The right to promote sustainable development; and
- Sustainable economic growth¹⁵.

If one wants to quantify responsibility and capability, it matters what metric is chosen to approximate these concepts. The numerical outcome for a particular country will differ, depending on whether we consider:

- Particular gases (only CO₂ or all six Kyoto Protocol gases)¹⁶;
- Which sources of emissions (energy only, or also land use, land-use change and forestry (LULUCF));¹⁷
- Which time-frame (annual or cumulative emissions); and
- At what scale (national, or per capita emissions).

¹⁴ FCCC Article 3 contains a set of principles.

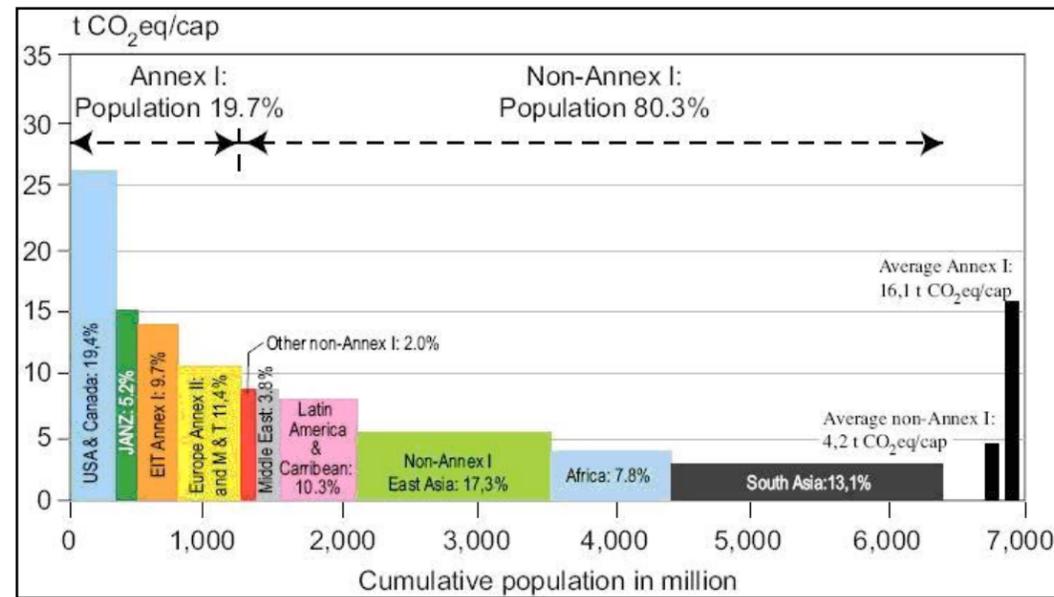
¹⁵ For the full text, see FCCC Articles 3.2, 3.3, 3.4 and 3.5.

¹⁶ The six GHGs listed in Annex A to the Kyoto Protocol are carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydro fluorocarbons (HFCs), per fluorocarbons (PFCs) and sulphur hexafluoride (SF₆).

¹⁷ Please refer to the paper produced for this series titled, *Key issues on land use, land use change and forestry (LULUCF) with an emphasis on developing country perspectives*.

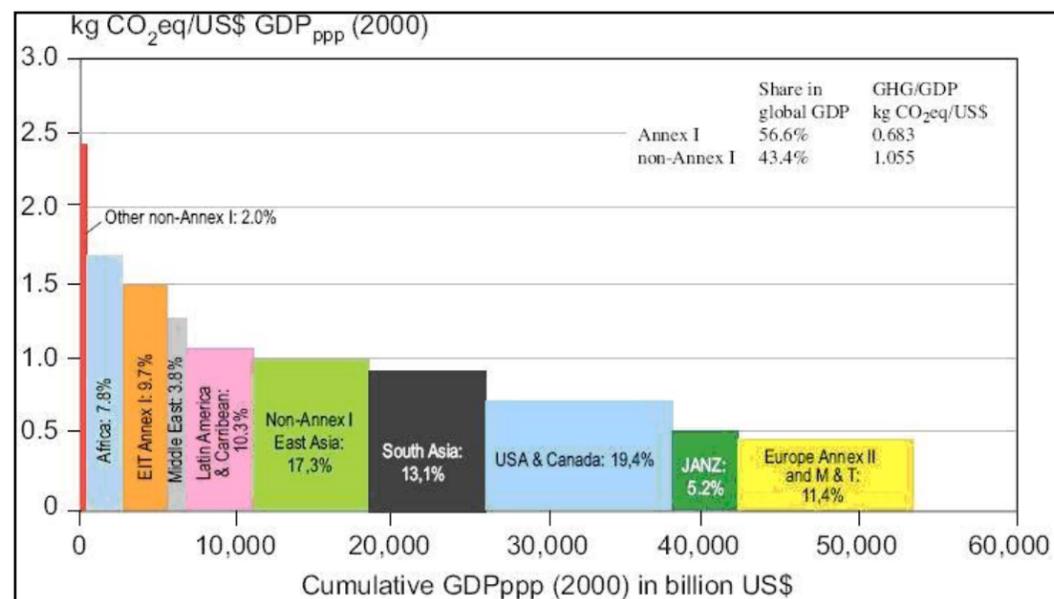
¹³ For more information, please refer to the paper in this series titled *National policies and their linkages to negotiations over a future international climate change agreement*, sections 4 and 5.

Figure 1: Annual emissions by region, per capita



Note: Year 2004 distribution of regional per capita GHG emissions (all Kyoto gases, including those from land-use) over the population of different country groupings. The percentages in the bars indicate a regions share in global GHG emissions.

Figure 2: Annual emissions by region, per \$ Gross domestic product (GDP)



Note: Year 2004 distribution of regional GHG emissions (all Kyoto gases, including those from land-use) per \$ of GDPppp (with ppp = purchasing power parity) over the GDPppp of different country groupings. The percentages in the bars indicate a regions share in global GHG emissions.

Source: IPCC 2007. Climate Change Synthesis Report

The more recent assessment of the IPCC illustrates the differences (see Figures 1 and 2). The upper graph shows the emissions per capita for different regions on the vertical axis, with the population added along the horizontal axis. On the lower graph, emissions by GDP (for the year 2004) are shown. For Africa, the bar is higher on an annual basis than a per capita basis; while for South Asia, per capita is lower. Such comparisons can be made for other regions and measures – the point is that it matters what you count. In the negotiations, countries will typically favor measures that show them in the most favorable light or support their interests.

The IPCC AR4 found that the scenarios in the Special Report on Emissions Scenarios (IPCC 2000), without any mitigation, project an increase of baseline global GHG emissions by a range of 9.7 to 36.7 GtCO₂-eq (25-90%) between 2000 and 2030. Two thirds to three quarters of this increase in energy CO₂ emissions is projected to come from NAI regions, with their average per capita energy CO₂ emissions being projected to remain substantially lower (2.8-5.1 tons of CO₂ (tCO₂)/cap) than those in Annex I regions (9.6-15.1 tCO₂/cap) by 2030.

That is as far as the best available scientific information goes. Eventually, however, the allocation of emissions and burden sharing is a deeply political matter. **There have been suggestions that, instead of leaving such allocation purely to political horse-trading, it might at least be possible to establish some analytical criteria.** Political concepts, such as responsibility and capability in FCCC Article 3.1, could be approximated by analytical measures. In that way, principles could be operationalized into key criteria that would cut across different approaches (Ott et al. 2004):

- **Responsibility has been defined in the Brazilian proposal directly in relation to the contribution to temperature increase** (see section 4.2.3 for further details). A reasonable approximation of the more complex measures of responsibility is cumulative emissions of fossil CO₂ over 1990 to 2000 as an indicator of responsibility. The relatively recent period avoids ‘punishing’ countries for historical emissions, when the consequences were less widely known. At least since the IPCC’s First Assessment Report in 1990, the implications can be said to be well-known internationally.
- **A country may have high responsibility for contributing GHG emissions, but nonetheless be**

too poor to mitigate. For this reason we include indicators reflecting capability. Emissions do not have to be linked to human development, but under given socio-economic and technological conditions, a certain level of emissions will be necessary to guarantee a decent life for poor people. We consider two indicators of capability, the human development index (HDI) and GDP per capita. Countries with higher levels of national income and a higher rank on the HDI might be expected to carry a higher burden of mitigation.

- **The potential to mitigate can be related to three factors – emissions intensity, emissions per capita and emissions growth rate.** A high value for CO₂/GDP would suggest high potential to mitigate. The more efficient an economy already is (lower CO₂ emissions per unit GDP), the less potential there is (at a given cost) to mitigate further through efficiency. However, the level of emissions per capita needs to be taken into account as well. High per capita emissions suggest unsustainable consumption patterns, which should provide potential to mitigate without endangering a basic level of development, e.g., by lifestyle changes. National circumstances such as resource endowments also influence mitigation potential. Finally, the growth rate of absolute emissions gives an idea of whether the rate of increase is still high or has already been curbed.

Of course there are many other criteria, e.g., natural resource endowments or population per square kilometer, that could be introduced, or variants to the criteria above (see the further information and readings suggested in the references and Annex 3 below).

The acceptability of the criteria may be affected by whether they apply only to developing countries or to all countries. For example criteria that apply to all countries might include a longer historical period for cumulative emissions than criteria that apply only to developing countries. As mentioned below, the appropriate weighting of the criteria depends on whether market mechanisms can be used to meet the commitments. If they can be used, then the ability to pay becomes more relevant and potential for emissions reductions becomes less important because emissions do not need to be reduced domestically.

Many of the proposals found in the literature have some basis in numerical parameters or indicators – be they top-down approaches (e.g., the Brazilian proposal based on historical cumulative emissions; or per capita approaches) or bottom-up (e.g., based on intensity). These are considered in section 4. One possible set of implications of different criteria for selected developing countries are shown in Table 2. Historical responsibility would be based

primarily on cumulative emissions; per capita might be another indicator of responsibility; ability to pay uses GDP/capita as a key measure; while emissions intensity is measured by GHG per unit of GDP. Table 2 illustrates with numerical values that it matters which indicators are used to assess responsibility, capacity and potential to mitigate in developing countries.

Table 2: Possible indicators for responsibility, capability and potential to mitigate in selected developing countries emissions by various measures¹⁸

		ARGEN-TINA	BRAZIL	CHINA	INDIA	MEXICO	SOUTH AFRICA	SOUTH KOREA	WORLD
Annual emissions	Emissions in 2004 of CO ₂ , energy, excl. LULUCF, MtCO ₂ (Mt = Megatons, 106 tons)	146	346	5,205	1,199	415	428	507	29,734
	% of world total	0.5%	1.2%	17.5%	4.0%	1.4%	1.4%	1.7%	100%
Annual emissions	Emissions in 2000, six gases, including LULUCF, MtCO ₂ -eq	347	2,222	4,915	1,861	609	420	522	41,363
	% of world total	0.8%	5.4%	11.9%	4.5%	1.5%	1.0%	1.3%	100%
Per capita allowances	Emissions per capita in 2000, six gases, including LULUCF, MtCO ₂ -eq	9.4	13.1	3.9	1.8	6.2	9.5	11.1	6.8
Per capita allowances	Emissions per capita in 2000, six gases, excluding LULUCF, MtCO ₂ -eq	7.9	5.0	3.9	1.9	5.2	9.5	11.1	5.6
Historical responsibility	Cumulative emissions 1950 - 2000, only CO ₂ (energy and LULUCF), MtCO ₂ -eq	6916	68,389	110,675	17,581	13,698	10,250	7,800	1,113,122
	% of world total	0.6%	6.1%	9.9%	1.6%	1.2%	0.9%	0.7%	100%
Ability to pay	GDP/capita, Int'l \$, ppp 2000 \$, value for 2002	10,134	7,480	4,379	2,555	8,798	9,813	17,662	7,643
Mitigation potential in terms of emissions intensity	CO ₂ /GDP, kg CO ₂ /int'l \$ GDP ppp 2000	343	263	616	399	438	787	563	521

¹⁸ Table 2: Possible Indicators for responsibility, capability and potential to mitigate in selected developing countries emissions by various measures is an updated version of a table produced in earlier work (Winkler et al. 2002b). The earlier analysis included information on emission reductions, but these depend on underlying assumptions and are not included here. Readers are referred to the earlier work.

Table 3: Emissions from developing regions by various measures

		AFRICA (SUB-SAHARAN AND NORTH) ¹⁹	NON-ANNEX I ASIA ²⁰	LATIN AMERICA AND CARIBBEAN ²¹
Cumulative emissions 1950 - 2000, only CO ₂ , only energy	MtCO ₂	21,197	157,085	33,744
	% of world total	2.7%	20.0%	4.3%
Cumulative emissions 1950 - 2000, only CO ₂ (energy and LULUCF)	MtCO ₂	61,553	321,105	138,447
	% of world total	5.6%	29.2%	12.6%
Annual emissions in 2000, only CO ₂ (energy and LULUCF)	MtCO ₂	2,277	11,758	3,681
	% of world total	7.2%	37.2%	11.7%
Annual emissions in 2000, all six gases	MtCO ₂ -eq	3,271	15,690	4,918
	% of world total	8.0%	38.1%	12.0%
Per capita emissions in 2000, all six gases	Tons CO ₂ -eq per person	4.2		
	Global average	6.8	4.5	9.6
Carbon intensity of economy in 2002	Tons of CO ₂ / mill intl \$ of GDP	469	562	354
	Global average	507		

Source: WRI 2003. *Climate Analysis Indicators Tool*.

The time-frame (annual or cumulative) matters: For South Africa, for example, the share of world emission is 1.4% by annual energy CO₂ emissions, but 0.9% by cumulative emissions; for China, the share drops from 17.5% to 9.9%. For Brazil, the inclusion of LULUCF in the consideration increases its share from 1.2% to 5.4%, reflecting the predominance of this source in the country's emissions profile. Population matters: India may have 4.0% to 4.5% of total annual world emissions (depending on gases and sources), but on a per capita basis, its emissions are well below the global average. Many other comparisons

can be drawn from Table 2 – and comparing these to other countries, including Annex I Parties. In the scope of this paper, an indication is given for a few developing countries.

To be more comprehensive, Table 3 presents various measures of emissions (annual, cumulative, per capita) for three regions of developing countries. Developing regions include only NAI Parties, which are listed in endnotes for each region. NAI Parties that are not included in any of the regions in Table 3 and Table 4: 4 are Albania, Belarus, Bosnia & Herzegovina, Cyprus, Macedonia (FYR), Malta, Moldova, Serbia & Montenegro; which together comprise

¹⁹ The region 'AFRICA' in this table includes the following non-Annex I countries: Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo, Congo, Dem. Republic, Côte d'Ivoire, Djibouti, Egypt, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Libya, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome & Principe, Senegal, Seychelles, Sierra Leone, South Africa, Sudan, Swaziland, Tanzania, Togo, Tunisia, Uganda, Zambia, Zimbabwe.

²⁰ The region 'ASIA' in this table includes the following Non-Annex I countries: Afghanistan, Armenia, Azerbaijan, Bahrain, Bangladesh, Bhutan, Brunei, Cambodia, China, Chinese Taipei, Cook Islands, Fiji, Georgia, India, Indonesia, Iran, Iraq, Israel, Jordan, Kazakhstan, Kiribati, Korea (North), Korea (South), Kuwait, Kyrgyzstan, Laos, Lebanon, Malaysia, Maldives, Mongolia, Myanmar, Nauru, Nepal, Niue, Oman, Pakistan, Palau, Papua New Guinea, Philippines, Qatar, Samoa, Saudi Arabia, Singapore, Solomon Islands, Sri Lanka, Syria, Tajikistan, Thailand, Tonga, Turkmenistan, United Arab Emirates, Uzbekistan, Vanuatu, Vietnam, Yemen.

²¹ The region 'LATIN AMERICA AND CARIBBEAN' in this table includes the following Non-Annex I countries: Antigua & Barbuda, Argentina, Bahamas, Barbados, Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominica, Dominican Republic, Ecuador, El Salvador, Grenada, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Saint Kitts & Nevis, Saint Lucia, Saint Vincent & Grenadines, Suriname, Trinidad & Tobago, Uruguay, Venezuela.

0.5 % of emissions of six gases in 2000. All countries for which no data is available in CAIT (WRI 2005, 2003) are also not included. Again, a few observations illustrate the differences made by removing the larger countries. Removing South Africa from Africa reduces Africa's share from 2.7% to 1.4%. Per capita emissions in developing Asia increase from 4.5 tons to 5.7 t CO₂-eq per person, when China, India, Indonesia and South Korea are removed. The increased level of absolute emissions is more than outweighed by not counting the large populations in those countries. Not including Brazil in the region Latin America and Caribbean increases emissions intensity from 354 to 386 t CO₂-eq/\$ of GDP, as Brazil's hydro-based electricity system is no longer taken into account.

Table 4: Emissions from developing regions by the same measures, excluding certain countries²²

		AFRICA (SUB-SAHARAN AND NORTH)	NON-ANNEX I ASIA	LATIN AMERICA AND CARIBBEAN
Cumulative emissions 1950 - 2000, only CO ₂ , only energy	MtCO ₂	10,995	55,066	16,904
	% of world total	1.4%	7.0%	2.1%
Cumulative emissions 1950 - 2000, only CO ₂ (energy and LULUCF)	MtCO ₂	51,303	104,760	56,360
	% of world total	4.7%	9.5%	5.1%
Annual emissions in 2000, only CO ₂ (energy and LULUCF)	MtCO ₂	1,926	3,998	1,489
	% of world total	6.1%	12.7%	4.7%
Annual emissions in 2000, all six gases	MtCO ₂ -eq	2,851	5,327	2,087
	% of world total	6.9%	12.9%	5.1%
Per capita emissions in 2000, all six gases	Tons CO ₂ -eq per person	3.8	5.7	8.6
	Global average	6.8		
Carbon intensity of economy in 2002	Tons of CO ₂ / mill intl \$ of GDP	359	619	386
	Global average	507		

Source: WRI 2003. *Climate Analysis Indicators Tool*.

Having seen in overview some of the key parameters and how they differ depending on what indicator is used, we turn next to specific proposal for mitigation in developing countries.

²² Developing regions include the same countries as for Table 2, except that in Table 4, the following countries are excluded: South Africa from AFRICA; Brazil and Mexico from LATIN AMERICAN AND CARIBBEAN; and China, India, Indonesia and South Korea from NON-ANNEX I ASIA.

4. OVERVIEW OF OPTIONS FOR MITIGATION IN DEVELOPING COUNTRIES

4.1 Different approaches

A wide variety of approaches under the mitigation building block for the architecture of the climate regime up to and beyond 2012 have been proposed. Some of these include:

- Extending fixed targets Kyoto-style;
- Universal carbon taxes;
- Allocations of emissions per capita (Aslam 2002; Meyer 2000; Gupta & Bhandari 1999);
- The Brazilian proposal which allocates emissions allowances in relation to the contribution to change in temperature (Brazil 1997; La Rovere et al. 2002; Pinguelli Rosa & Kahn Ribeiro 2001; UNFCCC 2002);
- Common but differentiated convergence (Höhne et al. 2006a);
- Emissions intensity (Herzog et al. 2006; Kim & Baumert 2002; Chung 2007);
- Sector-based Clean Development Mechanism (CDM) (Samaniego & Figueres 2002; Sterk & Wittneben 2006); technology agreements (Edmonds & Wise 1998);
- Various sectoral approaches (Ward 2006; Schmidt et al. 2006; Ellis & Baron 2005);
- Triptych approach extended to the global context (Groenenberg et al. 2001; Den Elzen et al. 2007);
- Converging markets (Tangen & Hasselknippe 2004; Victor et al. 2005);
- Safety valve approaches (Philibert 2002); greenhouse development rights (Baer et al. 2007); and,
- Sustainable development policies and measures (SD-PAMs) (Winkler et al. 2002a; Winkler et al. 2007).

The preceding list does not necessarily cover all proposals put forward in the burgeoning literature. The literature includes many more, as well as an evaluation of several proposals focusing specifically on adequacy and equity (Baer & Athanasiou 2007). There have been processes bringing together perspectives from North and South, including the South-North Dialogue (Ott et al. 2004); an on-going future action dialogue among selected negotiators (CCAP 2007) and the Sao Paulo Proposal (BASIC Project 2006). IPCC AR4 assessed the proposals, and Table 13.2 provides probably the most authoritative

overview of recent proposals for international climate agreements, at least up to the cut-off date for literature assessed (mid-2006). The table is reproduced in Annex 3.

Relatively few of these proposals originate from developing countries, and a smaller sub-set of those have come from developing country Parties. The Brazilian Proposal stands out as a major exception to this rule, having been formally tabled prior to Kyoto (Brazil 1997). At the time, it took a scientific approach to burden-sharing among Annex I Parties, calculating the contribution to temperature increase and hence responsibility for mitigation. By focusing on responsibility, the Brazilian proposal had a strong basis of equity. It also has a strong scientific basis, since the key factor determining temperature change is cumulative emissions, rather than annual ones.

To understand the multiplicity of proposals, two things may be helpful. Firstly, it may be helpful to consider the broader, underlying approaches within a simpler conceptual framework. This is done in the rest of this section. The second part is to elaborate at least some of the proposals in a little more detail, which is considered in section 4.2 below.

Table 5: Summary of approaches/schools of thought

	ATMOSPHERE FIRST	EQUITY FIRST	DEVELOPMENT FIRST	TECHNOLOGY FIRST
Objective	Stabilizing GHG concentrations	Ensuring fairness of allocation of mitigation burdens (historic contributions)	Making development more sustainable	Development and transfer of low carbon technologies
Stringency	Agreement on "safe" GHG concentration level or global GHG reduction targets & timeframes	Agreement on "safe" GHG concentration level	Not a distinctive feature	Set in terms of technology goal or budgetary contribution to RD&D
Quantified GHG related commitments	- Carbon budget is back calculated & allocated among countries based on current & future emissions reduction potential - Carbon markets vital incentives to join the regime - "Trigger" for participation at various stages	- Carbon budget is allocated among countries according to historical responsibility - "Trigger" for participation, but usually later than atmosphere first - Carbon markets vital with large flows to developing countries	Not the focus, contribution depends on number and ambition of SD policies implemented - Not only carbon markets	No quantified commitments, hence limited or no carbon markets
Coverage	All GHGs including LULUCF and int. transport 80% of global emissions. Minimum inclusion of 20-30 main emitters	All GHGs including LULUCF and int. transport. Inclusion of all countries	Unlikely to cover all gases and sectors	Several technology agreements to cover all sectors. Unlikely to cover all gases and sectors
Policies and measures	(SD-)PAMs for countries before the trigger for e.g, deforestation and low carbon energy & transportation	(SD-)PAMs for countries before the trigger for e.g, deforestation and low carbon energy & transportation	Richer countries would pay the cost of implementing SD PAMs in developing countries: e.g., enforcing the efficiency standards List of good/best practice policies could serve as information	(Coordinated) energy efficiency standards and renewable energy targets
Technology R&D Demonstration Deployment Transfer	Not a distinctive feature	No obligation for additional technology transfer	Provision of finances and technology for developing countries	Cooperation to increase development, transfer & deployment among technologically advanced countries
Adaptation Human health Ecosystems Agriculture/forestry Water supply Coastal zones Infrastructure Extreme events	Funded from levy on market mechanisms Not distinctive as focus on prevention	Compensation of damage costs paid according to historical responsibility	Funded also through SD-PAMs	Not a distinctive feature
Response measures	Funded from levy on market mechanisms Not distinctive as focus on prevention	Historically larger emitters to assist losers adjust to the transition	Tailor made SD-PAMs allow for diversification	Efforts could be geared towards technology that is contributing to diversification
Participation and compliance	Main 20-30 emitters must be included early on or at the outset of the agreement	Normative definition of historical responsibility for the trigger	High participation, high degree of international coordination and information exchange	Several technology agreements with different participation

Note: Bold indicates a distinctive feature of an approach

Source: DEAT & DEFRA 2007. Scenarios for future international climate change policy

There are various ways of thinking about the different types of architecture that are represented in the diversity of proposals, introduced above and elaborated in section 4.2 below. A paper (prepared jointly by the United Kingdom and South Africa) was presented at an informal Ministerial discussion in Sweden (DEAT & DEFRA 2007) and identified the following four schools of thought or approaches (see Table 5 for an overview):

- Atmosphere first;
- Equity first;
- Development first;
- Technology first.

In reviewing a range of proposals, the Working Group III SPM of AR4 concluded that there was high agreement and much evidence "that successful agreements are environmentally effective, cost-effective, incorporate distributional considerations and equity, and are institutionally feasible" (IPCC 2007c). Thus some criteria can be established to evaluate different schools of thought on the architecture of the climate regime.

It is unlikely that any "pure" approach would be adopted in its entirety. Just as there is no single, definitive list of elements, though, there is not a single conception of a balanced package. Indeed, it seems highly unlikely that any single package proposed by anyone would be adopted "as is" by everyone. Rather, it is more helpful to think of several packages along a theoretical continuum.

Negotiators will need to merge packages while carefully balancing key elements and interest. So the focus turns to a continuum of packages that might be capable of consensus – or to use another phrase, that are in the political contract zone. After Bali, the core elements or building blocks of a package deal have emerged. The balance between adaptation and mitigation is clearly reflected. Deeper cuts from all developed countries and actions by developing countries are part of the agenda, as is comparable effort. And the importance of the means of implementation, notably finance and technology, is encoded in the Bali Action Plan.²³ On the road from Bali to Copenhagen, the details of the four building blocks and the shared vision will have to be elaborated. In those negotiations, specific approaches to the future of the climate regime may become important.

4.2 More detailed description of selected approaches

A wide variety of approaches to future commitments have been proposed – most of them informally or in the academic literature, with only few having been officially endorsed. This section does not summarize every approach, but concentrates on selected types of approaches. This short document does not allow all approaches to be elaborated; the reader is referred to surveys of approaches in the further reading (see bibliography below).

Different people will categorize various proposals in different ways. The proposals described in this short paper are selected to illustrate different the different schools of thought. The approach of putting the 'atmosphere first' could be represented by extending Kyoto targets to a broader set of countries (see section 4.2.1). Putting equity first can mean several things, at least two of which – equal entitlements for each person and historical responsibility – are reflected in per capita approaches and the Brazilian proposal (4.2.2 and 4.2.3).

Others argue that the right to (sustainable) development is also a matter of equity. And indeed, equity relates not only to mitigation, but also to adaptation, finance and technology. Specific approaches that put development first would include GDP as a measure of development in intensity targets (4.2.4), explicitly start from sustainable development policies (4.2.5) or build on the development aspects of the CDM (4.2.6). Sectoral approaches are linked to putting technology first, while the Global Triptych approach disaggregates standards for just three sectors (4.2.7 and 4.2.7).

4.2.1 Kyoto-style fixed targets

Kyoto-style fixed targets take the form of an agreed percentage reduction against annual emissions in a base year, 1990. An absolute number of tons of CO₂ to be reduced is calculated. By starting from the countries' own emissions, the approach 'grandfathers' existing differences between countries in emissions. The challenge for many Annex I Parties lies more in returning to base year level of emissions, rather than the reduction negotiated. In numerical terms, the growth of emissions since 1990 is

²³ Decision 1/CP.13, the Bali Action Plan.

often larger than the percentage inscribed in Annex B of the Protocol.

Mechanisms exist in the Convention and Protocol to bring more countries into Annex I by voluntary commitments from the Parties or a COP decision to amend Annex I (Depledge 2002). These could be used to broaden the set of countries taking on this type of target. The approach has the attraction of directly building on known institutions and frameworks, including the CDM, other flexible mechanisms and the reporting and monitoring system.

Type of mitigation commitment:	Allowance calculated as reduction (less than 100%) or limit (greater than 100%) on emissions in base year, yielding tons of CO ₂ allowance. Flexible mechanisms can be used
Participation:	All countries who agree to commitments inscribed in Annex B of the Kyoto Protocol
Institutional requirements:	Institutional architecture exists, but new countries would have to set up institutions for monitoring, reporting and verification under Protocol Articles 5, 7 and 8. Internationally, a sufficient number of Parties must ratify the amendment
Legal nature (voluntary/binding):	Binding, once the Party has agreed to make a commitment and it is ratified
Accountability procedures:	Compliance provisions of the Kyoto Protocol
Sensitivity to national circumstances:	Limited, although differences in percentages possible
Timing:	Commitment periods, first one is five years, future ones may be longer

Questions:

- Would your country be ready to take on this type of mitigation commitment? What are the implications of such an approach for your country?
- Does the institutional capacity exist in your country to implement this approach?
- Can one say that Kyoto-style absolute targets are ‘harder’ than other types of mitigation commitments?
- Would ‘growth caps’ (i.e., Kyoto-style targets), but with generous increases of emissions above base year levels, be an acceptable mitigation commitment for developing countries?

4.2.2 Per capita

Per capita entitlements takes as its starting point the equal right of each person to use the atmosphere as a global commons. In a pure per capita approach, there is no reference to current emissions levels, but simply a global budget allocated equally to countries based on population. The Centre for Science and Environment has promoted per capita approaches from an early stage, (Agarwal & Narain 1991) and particularly includes an allowance for basic sustainable emission rights (Agarwal 2000). The targets of absolute emissions in tons of CO₂ thus differ radically from Kyoto-style targets.

Emissions allowances are tradable in most per capita proposals, resulting in large benefits for populous nations with low per-capita emissions. It is worth noting that India and China stated at COP-8 in New Delhi that they would not consider any other approach than one based on per capita (Vajpayee 2002). The approach is less attractive to less populous nations, who would argue that there is more than one dimension to equity.

Per capita approaches are favored by some developing countries. While there is an extensive literature formulating climate regimes based on this principle, Parties have tended to focus on the underlying principle, the negotiations have not yet formally considered an architecture based on per capita emissions. For example, the Indian Prime Minister indicated at COP 8 in Delhi that “we do not believe that the ethos of democracy can support any norm other than equal per capita rights to global environmental resources” (Vajpayee 2002). The essential equity-based argument is that each person should have the same right to use the absorptive capacity of the atmosphere.

Other variations of the per capita approach start from current levels, but require convergence on equal per capita emissions over a period of time (e.g., Meyer 2000). This convergence happens in the context of overall contraction of global emissions, with a global emission budget set to achieve a particular atmospheric concentration of GHGs. The combination of contraction and convergence results in trajectories of emissions, giving absolute numbers of emission allowances over a period of time, e.g., up to 2100.

A variant is “Common but Differentiated Convergence” (Höhne et al. 2006a), the key modification being a later convergence for developing countries. Annex I allowances converge to a low level, but NAI emissions only start later,

when their per capita emission are a certain percentage above the global average. Before then, developing countries can take voluntary actions.

Type of mitigation commitment:	Each country receives entitlement, i.e., tons of CO ₂ allowance, rather than a specified reduction. Entitlements are tradable
Participation:	Potentially all countries
Institutional requirements:	Would depend on the design of the regime; likely that nation-States would still receive allowances on behalf of the population
Legal nature (voluntary/binding):	Could be either
Accountability procedures:	Consequences of exceeding per capita allowances would need to be defined
Sensitivity to national circumstances:	Sensitive to population, but not other differences, e.g., re-source endowments
Timing:	Long-term goal; per capita emissions converge over time

Questions:

- Is per capita a useful principle for defining equity? What other dimensions of equity are there?
- Would your country be ready to take on mitigation commitments on a per capita basis? What are the implications of such an approach for your country?
- Does the institutional capacity exist in your country to implement this approach?

4.2.3 Brazilian Proposal

The Brazilian proposal (Brazil 1997) bases its burden-sharing approach on historical responsibility for change in temperature to individual countries. The original Brazilian proposal attributed responsibility among Annex I countries for an overall reduction of 30% below 1990 levels by 2020. While the detailed derivation of emission reductions based on this system goes beyond the scope of this paper, a key difference to most other approaches is the use of cumulative historical emissions rather than current annual emissions (La Rovere et al. 2002).

As with other approaches, the detailed parameters used will matter – they will define the stringency of the mitigation action for specific countries. For the Brazilian proposal, of particular significance are the gases and sectors (forestry) chosen, the end date for analysis, and the

representation of atmospheric chemistry in the model. The approach requires significant data, and this may limit applicability.

The approach has since been extended to a global scheme involving developing countries as well (e.g., UNFCCC 2002; Pinguelli Rosa & Kahn Ribeiro 2001). The proposal is the only approach for a future climate regime officially proposed to UNFCCC Parties.

Type of mitigation commitment:	Emission reductions based on historical responsibility for existing temperature change
Participation:	Initially only Annex I, but potentially all countries
Institutional requirements:	Data requirements, see text
Legal nature (voluntary/binding):	Could be either
Accountability procedures:	Would need to be defined; original suggestion was to contribute to the Clean Development Fund
Sensitivity to national circumstances:	Historical responsibility would account for some; but not explicitly adjusted for
Timing:	Long-term, taking into account effect of GHGs in atmosphere over long time

Questions:

- Is the data available in your country to calculate historical responsibility? Does the institutional capacity exist in your country to implement this approach?
- Is historical responsibility a useful criterion to inform mitigation commitments?
- When should we begin counting historical cumulative emissions? 1990? 1950? 1860?

4.2.4 Emissions intensity

Emissions intensity requires reductions of emissions relative to economic output (GHG/GDP). The approach therefore allows growth in emissions if there is economic growth. To account for different national circumstances, commitments could be formulated as a percentage decrease from each country’s own emissions intensity. Emissions intensity goals would be harder to meet if economic growth remains lower than expected, given the reduced capacity. If successful, reduced intensities should assist in decoupling emissions from economic growth. The approach is often considered ‘softer’ than absolute targets since it quantifies emissions in relative terms, but this cannot be known without the stringency of both approaches (KEI 2002; Ellerman & Wing 2003; Kim & Baumert 2002). A recent review of intensity targets has been conducted (Herzog et al. 2006).

Type of mitigation commitment:	Reduction is emissions per unit of economic outputs (t CO ₂ /\$ GDP)
Participation:	Most suitable for developing countries, as it accounts for economic development (GDP). Also adopted nationally by some developed countries
Institutional requirements:	Requires assessment of GDP, as well as emissions
Legal nature (voluntary/binding):	Could be either
Accountability procedures:	Compliance could be established if intensity target is missed. Variant: a weaker compliance target and a stronger selling target
Sensitivity to national circumstances:	Sensitive to change in GDP; does not explicitly adjust for other circumstances
Timing:	Could be voluntary for developing countries initially, becoming binding at a later date

Questions:

- Would your country be ready to take on an intensity target?
- Does the institutional capacity exist in your country to implement this approach?
- Given that emissions grow if GDP increases, is this approach acceptable for both developed and developing countries?
- How might GDP in developing countries be measured, reported and verified?

4.2.5 SD-PAMs: Sustainable development policies and measures

Some countries frame the concern about equity in terms of per capita emissions (see 4.2.2 above); others argue that consideration of historical responsibility is a basis for a fair deal (see 4.2.3), while for others again, the dimension of equity relates to development. This approach draws on Article 2, in particular that climate protection should occur in a manner that “enable[s] economic development to proceed in a sustainable manner”.

More broadly, it argues that sustainable development in developing countries, including its ecological and social dimensions, are indispensable for an equitable solution, given that developed countries went through their process of industrialization without carbon constraints. In earlier debates under the Convention, the Republic of South Africa (RSA) put forward the approach of sustainable development policies and measures (RSA 2006b).

SD-PAMs suggest that developing countries themselves identify more sustainable development paths and commit to implementing these with financial support (RSA 2006a; Winkler et al. 2002a). A similar motivation is expressed in ‘human development goals with low emissions’ (Pan 2002). A more elaborate discussion of national policies may be found in the paper by Tirpak, et. al.: “National policies and their linkages to negotiations over a future international climate change agreement”, which has been produced part of this series.

The approach starts by considering a country’s own long-term development objectives. Next, policies and measures are identified that would make the development path more sustainable. These SD-PAMs aim to encompass large-scale policies and measures, not only projects as in the CDM. Each country would define what it means by making development more sustainable, but when registering SD-PAMs, the international community would have to accept that the policy constitutes sustainable development.

Funding for SD-PAMs could build on existing commitments in Convention Article 4.1(b) and Kyoto Protocol Article 10, but since they are development oriented, they could also mobilize domestic and international development finance. Both climate and non-climate funding can be mobilized to implement SD-PAMs.

Progress in achieving both the local sustainable development benefits and climate co-benefits might be monitored through national institutions, but could also be reviewed

internationally. Recent work has identified four broad methodologies for quantifying the benefits (Winkler et al. 2008). A potential weakness of SD-PAMs is that the environmental outcome is uncertain – it depends entirely on the number and extent of policies implemented.

Type of mitigation commitment:	Pledge to implement sustainable development policies, and to report on them under the UNFCCC. Quantifies GHG reductions as co-benefits of actions motivated by local sustainable development. Useful interim step
Participation:	Developing countries only
Institutional requirements:	Builds on national development capacity. In the multi-lateral system would require a COP decision and at least a register of SD-PAMs, possibly a new Annex to the Convention.
Legal nature (voluntary/binding):	Voluntary
Accountability procedures:	Methodologies to quantify both the emission reductions and local sustainable development benefits would need to be developed. Not subject to compliance
Sensitivity to national circumstances:	Built in, as countries set their own development objectives
Timing:	Could be implemented in short-term; might continue in long-term for Least Developed Countries

Questions:

- Would your country be ready to pledge the implementation of SD-PAMs?
- Should funding for SD-PAMs be limited to public investment, or should they be linked to the carbon markets?
- How would we know whether implemented SD-PAMs reduce emissions, sufficiently?
- How would we know whether emission reductions are attributable to the implemented policy?

4.2.6 Evolution of the Clean Development Mechanism (CDM)

A major way in which developing countries are already engaging in mitigation is through the CDM. The CDM is a project-based mechanism, and particularly, the one which allows cooperative action between countries that have a cap on emissions and those that do not. As for other market mechanism, this shifts the focus from where

mitigation takes place to who pays for mitigation. Extending the CDM is not a commitment to reduce emissions domestically, but it could be an important form of nationally appropriate mitigation action in developing countries. The CDM is evolving beyond a strict project basis to programmatic CDM. Programmatic CDM is in principle agreed, and adjusted PDDs and other mechanisms are being put into place. So the extension of the CDM from projects to programs is highly likely.

CDM could also be extended to sectors. The sectoral CDM approach suggests a direct scaling up extended to particular economic sectors, or geographic sectors (e.g., cities)(Samaniego & Figueres 2002; Sterk & Wittneben 2006). It could extend the project-based mechanism of the CDM to national sectors, e.g., cement or power. Of all the approaches discussed above, it builds most directly on the CDM. It would extend the current architecture of the CDM to allow coverage of an entire sector.

Finally, “policy CDM” is a possibility. In many respects, policy CDM would be similar to SD-PAMs – except that the former would be financed from the carbon market, while the latter relies on public funding and investments.

Type of mitigation commitment:	No new commitment, but extension of CDM architecture to enhance mitigation action in developing countries
Participation:	Developing countries
Institutional requirements:	Use established CDM institutions, scaling up to programmatic and possibly sector level
Legal nature (voluntary/binding):	Voluntary, between project participants. Parties to Kyoto Protocol only
Accountability procedures:	Validation, monitoring and verification procedures at project level. Not subject to compliance at national level
Sensitivity to national circumstances:	Countries choose which projects to approve and that these contribute to sustainable development
Timing:	Immediate. CDM not available to Parties who take on Kyoto targets

Questions:

- Would your country be ready to extend the CDM to other scales?
- Does the institutional capacity exist in your country to implement this approach?
- In which dimensions might CDM best evolve – programs, sectors, policy? Or some combination thereof?

4.2.7 Global Triptych

The Triptych approach focuses on three sectors – electricity generation, energy-intensive industries and “domestic sectors” (including residential and transportation). Triptych was originally used to share the burden of the Kyoto targets within the European Union (EU) “bubble” (Phylipsen et al. 1998). Analysis has considered extending this sectoral approach to all countries (Groenenberg et al. 2001).

Apart from taking a sectoral approach, Triptych also takes into account the technological opportunities available in various sectors. For domestic sectors, convergence to equal per capita emissions is assumed, while for energy-intensive industries, rates of efficiency improvement are set. The sectoral targets are added up to constitute a national target. The calculations involved are complex and not easily communicated. Targets eventually set are defined in absolute national emissions, but can vary from significant reductions (-30%) to ‘growth caps’ (+200%). The Triptych approach has more recently been examined a method for allocating future GHG emission reductions among countries under a post-2012 climate regime (Den Elzen et al. 2008). Emission allowances are decomposed according to sectors and explicit allowance is made for delayed participation by developing countries.

Type of mitigation commitment:	National emissions target, ranging from reductions to growth caps. Based on sectoral and technological possibilities
Participation:	Potentially all countries, or for technologies in one of the three sectors
Institutional requirements:	Establishment of sectoral benchmarks or other means to promote best available technologies
Legal nature (voluntary/binding):	Voluntary at multi-lateral level; could become binding for sector
Accountability procedures:	Would depend on sectors
Sensitivity to national circumstances:	Could define technological criteria to account for structural differences
Timing:	Short- to medium-term

Questions:

- How important are the three sectors in Triptych in terms of your country’s emissions?
- Would your country be ready to take on a Global Triptych approach?
- Does the institutional capacity exist in the three sectors in your country to implement this approach?

4.2.8 Sectoral Approaches

The Bali Action Plan includes as one option in the mitigation building block “cooperative sectoral approaches and sector-specific actions, in order to enhance implementation of Article 4, paragraph 1(c), of the Convention”.²⁴ People mean many different things by ‘sectoral approaches’ (Akimoto et al. 2008; Den Elzen et al. 2008; Höhne et al. 2006c; Ward 2006; Ellis & Baron 2005; Bosi & Ellis 2005; Schmidt et al. 2006), including sectoral CDM; benchmarks across trans-national sectors; technology transfer in specific sectors; the sector-based Triptych approach, and sectoral crediting mechanisms. The UNFCCC Secretariat was given a mandate in June 2008 to prepare a paper to better define this term.

Given the various types of sectoral approaches, two distinctions may help clarify:

- Is the proposal to implement at the domestic, national level only, or transnational?
- Is the focus on a new agreement, or the efforts that Parties make?

Different ends of the spectrum would then be domestic sectoral efforts and transnational sectoral agreements.

In terms of the Bali Action Plan, domestic sectoral efforts would be closer to nationally appropriate mitigation actions, while transnational sectoral agreements probably amount to mitigation commitments – at least for the sectors concerned. Whatever one’s interpretation, it is clear that sectoral approaches are closely related to technology in the Bali Action Plan.²⁵

Developing countries have expressed concern about transnational sectoral agreements, as introducing commitments without recognizing the principles of equity and CBDR&RC. For Annex I countries, policies and measures

(many of which are implemented at the sectoral level) are intended by the Kyoto Protocol achieve national caps or QELROs.²⁶ However, there appears to be more agreement that – whatever the multi-lateral agreement – sectoral efforts are important in implementation at the national level. Framed appropriately, sectoral approaches may be helpful as one tool for mitigation.

A recent version may be of particular interest to developing countries may be sectoral crediting baselines (Ward et al. 2008). This particular variant would be implemented domestically in developing countries, with ‘no lose’ meaning that the exceeding a specified benchmark entitles a country to trade surplus emission reductions, but there is no penalty for not achieving any sectoral standard, but an incentive to exceed the benchmark. Beyond the advantage of “no lose”, this variant may be attractive due to its focus on incentives and being voluntary.

Type of mitigation commitment:	Various – technology benchmarks, crediting baselines, dual markets, industry initiatives
Participation:	Sectors in all participating countries. Not economy-wide
Institutional requirements:	Involvement of multiple sectors, possibly organizations working in sectors internationally
Legal nature (voluntary/binding):	Sectoral efforts would be voluntary (or in pursuit of a separately set binding target); transnational sectoral agreements could be binding
Accountability procedures:	Sector-specific
Sensitivity to national circumstances:	Countries could select in which sectors to participate. However, may imply global standards in certain sectors
Timing:	Medium-term

Questions:

- Which sectors are the major sources of emissions in your country? Would your country be ready to take on transnational sectoral agreement in these sectors?
- What are the implications of such an approach for your country?
- Does the institutional capacity exist in these sectors to implement this approach?
- Which variant of sectoral approaches has the most potential to assist the negotiations?
- How could the multi-lateral system assist countries and industries with sectoral efforts?

4.2.9 Conclusions

In this short paper, it is not possible to describe all proposals. Given the different schools of thought, some examples of proposals that put atmosphere, equity, development and technology first, respectively, have been examined. In considering these proposals, decision-makers in developing countries will need to consider the implications for their country. Discussing the questions posed for each approach may also lead to the formulation of new proposals, combining elements of the existing proposals – maybe even entirely new ones. For a summary of options to address mitigation actions, see Annex 2.

Most, but not all of the approaches described here relate to mitigation commitments. Particularly for those aimed at developing countries only (e.g., SD-PAMs or CDM), they focus on nationally appropriate mitigation actions, consistent with para b(ii) of the Bali Action Plan. It should be noted that Annex II Parties also have commitments relating to funding and possibly technology cooperation. Approaches that make use of market mechanisms allow Parties to pay for mitigation elsewhere, in which case domestic emission reduction potential becomes a less important consideration and ability to pay becomes a more important consideration for equity.

In this respect, the question of how both mitigation actions and support can be made MRV is highly relevant. The paper considers MRV in the following section.

²⁴ Sectoral approaches in para 1.b (IV) of decision 1/CP.13.

²⁵ Para b (iv): “Cooperative sectoral approaches and sector-specific actions, in order to enhance implementation of Article 4, paragraph 1(c), of the Convention”. Article 4.1 refers to “development, application and diffusion, including transfer, of technologies”.

²⁶ Indeed, PAMs are the first item listed in Protocol Article 2.1(a).

5. MEASURABLE, REPORTABLE AND VERIFIABLE

MRV mitigation actions are a key component in the Bali Action Plan, and likely to be central to the negotiations about the future of the climate regime. MRV is pertinent in quantifying mitigation actions, and the old balance between commitments/QELROs and qualitative actions. It is now also being applied to the means of implementation, technology and finance. And, it is central to the balance between action on climate change and support.

Three questions will need to be addressed in negotiating paragraphs 1(b)(i) and (b)(ii) of the Bali Action Plan:

- How measurable, reportable and verifiable mitigation commitments by all developed countries should best be made comparable?
- What does measurable, reportable and verifiable mean in relation to support by developed countries on technology, finance and capacity-building for developing countries?
- What does measurable, reportable and verifiable mean in relation to nationally appropriate mitigation actions by developing countries?

While there are two sub-paragraphs, there are three key questions – because the MRV in paragraph (b)(ii) is understood to apply both to mitigation and the support. The remainder of this section considers each of these components in turn.

5.1 MRV mitigation action by developing countries

MRV applies to both nationally appropriate mitigation actions and to the provision of technology, financing and capacity-building. With the debate around MRV being politically charged, a way of making some progress may be to focus on details – clearly defining what is meant by measurable, reportable and verifiable.

5.1.1 Measurable

Measurement is a fundamental starting point for any kind of mitigation action. Considering measurement in a practical way needs to ask what can be measurable. For

example, promoting renewables may require national legislation, regulations, zoning laws, scoping studies, contracts, investment packages, construction, etc. These different efforts can be measured, but in the end, it is the outcome, in terms of electricity produced and emission reduction, that needs to be measured.

Methodologies are available to quantify or measure the benefits of various bottom-up approaches, using case studies and national modelling; others such as allocation models or comparative analysis are more suitable to top-down approaches (Winkler et al. 2008). It would greatly assist developing countries to quantify both the local sustainable development benefits and the climate co-benefits of particular policies and measures. Methodologies could be further elaborated by a group of experts.

All countries are committed to develop, periodically update, publish and make available to the COP inventories of GHG emissions and removals by sinks.²⁷ It is difficult to imagine a system of measurement that would not draw on this fundamental data – the status of emissions in a country. The unit of measurement clearly should be tons of CO₂-equivalent.

A key question will be how developing countries should report on inventories? Perhaps the periodicity could be less often than for Annex I, but establishing trends will be important in the long run.

Inventories measure emissions, not reductions. If developing countries implement unilateral mitigation actions (e.g., CDM, but also other policies and measures, or investment in cleaner technologies), how would one assess reductions?

Changes in inventories would reflect not only mitigation supported with multi-lateral support, but also unilateral action. MRV would require separate tracking of domestically-financed and internationally-supported action. Changes in inventories would reflect reductions only if all actions are considered. The question of whether such inventories would be reviewed must be addressed under verification.

Another option might be ‘national inventories with footnotes’. The idea of the footnotes is to provide a place for describing action for emission reductions. They would allow developing countries to report a little more on their actions, and thus gain recognition for action taken.

Perhaps inventories for developing countries could start in sectors where there is the best information. This would allow for the required human and institutional capacity to be developed, improving coverage over time.

To measure “deviations from baseline” and recognize relative emission reductions, one effectively needs to establish national baselines. The experience gained from the CDM with project baselines provides a valuable basis for moving to larger scales. Already, the CDM is evolving to include programs, and the discussions for the period after 2012 may include further evolution, possibly to a sectoral level. The CDM experience indicates we will have to consider whether national baselines include provision for suppressed demand²⁸ and exclude national policies or not? The long-term goal in this context would be to work MRV of actions towards MRV based on inventories for all.

Questions:

- What practical experience exists in your country to measure emissions, and the activities leading to emissions?
- What institutions are needed for effective measurement?

5.1.2 Reportable

All Parties have existing reporting commitments under the Convention.²⁹ Rather than adding new provisions on reporting, use of the existing provisions could be enhanced through new and improved procedures. A simple extension of existing reporting requirement might be to have more regular reporting of GHG inventories by developing countries. This could still be less frequent than the annual reporting by Annex I Parties, for example every two or three years.

National communications provide an obvious avenue for reporting, but arguably an already overloaded one. A separate format for reporting might be considered. For SD-PAMs, for example, there have been suggestions to establish a new register to give recognition to mitigation actions by developing countries, voluntarily pledged. A new procedure could be developed to report on the

implementation of SD-PAMs. Such a procedure might be elaborated by a group of experts.

Reporting would ideally include both unilateral mitigation actions and those implemented with international support (MRV finance and technology). The purpose may differ, with unilateral action reported to provide recognition of action by developing countries and a comprehensive picture of the actions by a country, while international support action would be reported to enable verification.

Questions:

- Should reporting by developing countries continue to be done mainly through national communications? If not, what are the alternatives? If yes, what needs to be improved?
- Should developing countries report on a regular basis on their national inventories?

5.1.3 Verifiable

The general questions about verification are what can be verified, how and by whom. If emission reductions are to be real, long-term and measurable, then verification is critical.

Making mitigation actions by developing countries verifiable will probably pose the biggest challenges. Should the verification be done domestically or internationally? Are some combinations of the two possible and useful?

Under any arrangement, the domestic institutional capacity in developing countries to undertake both measurement and verification will be significant. For example, we should build on national capacity to measure and verify energy efficiency savings (examples from India, South Africa, other countries). The difference between theoretical and actual savings in electricity is examined carefully and reported to national utilities or others sponsoring part of the investment. Converting energy savings to MRV emissions savings essentially only requires an emissions factor – and an effective standard has been established for grid-electricity factors, for example, in the CDM (ACM 0002).

²⁷ FCCC Article 4.1(a).

²⁸ Suppressed demand is found in situation of poverty. If a mitigation project delivers a service where there previously was none, the relevant baseline might be the service delivered with conventional technology, not the actual situation of any service at all. For example, if solar water heaters were installed, one can compare this to electric water heaters, rather than no hot water at all.

²⁹ FCCC Article 12.1.

More broadly, the experience gained with CDM verifying emission reductions in developing countries can be a building block for MRV. Countries have built set up designated national authorities with experience in approving mitigation projects and considering their implications for sustainable development. The process of validation – and the institutional capacity embodied in designated operational entities – could be built upon for verification beyond the project level.

Institutional capacity is probably a better guarantor that climate-friendly policies would be implemented in developing countries than any international agreement. Another important factor is broad public support within the country. The international review process to make mitigation actions verifiable should build on these dimensions. For internationally supported mitigation action, reporting on how funds have been spent is standard practice.

If mitigation actions in developing countries are supported only by national finance and do not involve technology transfer, then why would they need to be verifiable internationally? The balance struck in Bali around b(ii) was that these two matters would go together, and so the scope of mitigation actions subject to MRV could be limited to those that receive international support. This will probably have to be left to the developing country concerned.

One option to address the issue of verification of mitigation actions by developing countries: actions with international financial support would be verified internationally (e.g., using mechanisms under the carbon market, or reporting on public funds spent), but unilateral mitigation actions would be verified domestically (e.g., unsubsidized energy efficiency measures), but then reported in one reporting format/instrument under Convention.

Another option to consider might be verification by peer-review. Verification could start with national institutions, and verification by other developing countries might be more acceptable. Models of peer-review mechanisms, for example in the African Union or the WTO, might provide useful lessons. Such an approach would make reviews of developing country reporting distinct from in-depth reviews of Annex I national communications.

In the longer-term, what is needed is to work towards a system where all emissions and all emission reductions are measured, reported and verified. Since we are working on

“long-term cooperation action”, we should begin with that end in mind.

Questions:

- How can we work towards a system where all emission reductions by developing countries are verifiable? How might a system evolve over time?
- What elements from national and international experience with verification and validation might be useful building blocks?

5.2 MRV for means of implementation

As outlined in section 1.2, applying MRV to the means of implementation (technology and finance) is critical to the balance of the Bali Action Plan. Developing countries expect developed countries to fulfil their commitments on “measurable, reportable, and verifiable” support on technology, financing, and capacity building.

5.2.1 Making finance MRV

The starting point for finance, like all things, is the Convention in which Annex II Parties (i.e., Annex I Parties that also have commitments to assist developing country Parties with funding and technology) agreed to provide “adequate and predictable” financial resources for agreed full incremental cost of mitigation, adaptation and reporting (Article 4.3); to support adaptation in most vulnerable countries (Article 4.4) and technology transfer, including promoting and financing technology transfer, facilitating access to technology, support for the building of internal technology related capacity (Article 4.5).

Unsurprisingly, “finance” is a critical building block in the Bali Action Plan. There would be very little of any of the other building blocks – mitigation, adaptation, technology – without finance. The problem is how to ensure that the financial flows actually occur. This is in part a question of scaling up, but centrally also of operationalising MRV of finance.

What is apparent is that the current scale of funding of several orders of magnitude below what is required and will be required in future. Adaptation funding of \$28-\$67 billion per year in developing countries will be needed by 2030. Investment in mitigation of \$200-\$210 billion per year is needed by 2030. Where might such funds come from?

The simplest solution may be a mandatory formula for collecting money. One option already proposed in the AWG-LCA is that developed countries set aside 0.5% of GDP to support climate change in developing countries.

Yet there is a range of potential sources that might provide the financial flows to meet an agreed target. The UNFCCC Secretariat provided a range of illustrative options in a paper on finance and investment flows (see also the companion paper on investment and financial flows *Negotiations on additional investment and financial flows to address climate change in developing countries* by Erik Haites).

Variants of some of the options in Table 6 below are being considered, for example auctioning of allowances. The European Commission is proposing to amend the Emissions Trading Directive, increasing auctioning of allowances, which would generate €50 billion in 2020,

and would put at least 20% into renewables and efficiency (e.g., through the Global Efficiency and Renewable Energy Fund, GEREFF) and reducing emissions from deforestation in developing countries (REDD), i.e., in developing countries.

The Liebermann-Warner bill before the US Congress (S. 2191) includes provisions to auction 2.5% of allowances for use in forestry. If EPA estimates of slightly over \$100 billion are correct, this can potentially generate \$2.8 billion in 2020, and another 1.8% of auctioning revenues in domestic cap-and-trade for international adaptation and security, yielding an estimated \$2 billion in 2020. The bill has not passed, but may be reintroduced in future.

What would be measurable in each of these options would be € or \$ – the unit for MRV of finance would be money.

Table 6: Illustrative options for raising additional revenue for addressing climate change

OPTION	REVENUE	NOTES
Application of a levy similar to the 2% share of proceeds from the CDM to international transfers of ERUs, AAUs and RMUs	\$10 to \$50 million	Annual average for 2008 to 2012
	Depends on size of carbon markets post-2012	Any estimate for post 2012 requires assumptions about future commitments
Auction of allowances for international aviation and marine emissions	\$10 to \$25 billion	Annual average for aviation rises from 2010 to 2030
	\$10 to \$15 billion	Annual average for marine transport rises from 2010 to 2030
International air travel levy	\$10 to \$15 billion	Based on charge of \$6.50 per passenger per flight
Funds to invest foreign exchange reserves	Fund of up to \$200 billion	Voluntary allocation of up to 5% of foreign exchange reserves to a fund to invest in mitigation projects determined by the investors to diversify foreign exchange reserve investments
Access to renewables programs in developed countries	\$500 million	Eligible renewables projects in developing countries could earn certificates that could be used toward compliance with obligations under renewables programs in developed countries to a specified maximum, such as 5%
Debt-for-efficiency swap	Further research needed	Creditors negotiate an agreement that cancels a portion of the non-performing foreign debt outstanding in exchange for a commitment by the debtor government to invest the cancelled amount in clean energy projects domestically
Tobin tax	\$15 to \$20 billion	A tax of 0.01% on wholesale currency transactions to raise revenue for Convention purposes
Donated special drawing rights	\$18 billion initially	Special drawing rights are a form of intergovernmental currency provided by the IMF to serve as a supplemental form of liquidity for its member countries. Some special drawing rights issued could be donated to raise revenue for Convention purposes

Note: CDM = Clean Development Mechanism, ERU = Emission reduction unit, AAU = Assigned amount unit, RMU = Removal unit, IMF = International Monetary Fund

Source: UNFCCC 2007. *Report on the analysis of existing and potential investment and financial flows relevant to the development of an effective and appropriate international response to climate change.*

Reporting may be specific, depending on the source of the funding. Markets – be they carbon or other markets – tend to track financial flows anyway, although robust market rules need to be established. A key question is how to track scaled-up public investment. As with mitigation in developing countries, the most difficult area is probably **verification**. Who verifies financial flows? Particularly if funds were collected at the national level, how would they be made subject to international scrutiny?

These questions raise issues of governance of the scaled-up funding that is clearly needed. The guiding principle should be equal partnership between donors and recipients, but also more specific principles recently negotiated, including one-country-one-vote; transparency; learning by doing approach; full costs of projects; and no duplication with other sources. The ideal would be to use the funding structures established under the UNFCCC and Kyoto Protocol, e.g., the Adaptation Fund.

5.2.2 MRV Technology

Measurable, reportable and verifiable transfer of technology is the second part of the means of implementation of mitigation actions in developing countries.

The simplest solution may be to apply MRV to the funding for technology. It may be necessary to distinguish different kinds of financial support, depending on broadly-defined lifestages of technologies:

- Funding for wider deployment of existing technology;
- Venture capital to commercialize emerging technology;
- Public and private investment in long-term R&D of new technology.

What needs to be measured on technology is thus broader than technology transfer (if the movement of technology that is higher cost than the commercial standard practice, and also lower-emitting). It also encompasses the diffusion of technology through commercialization, as well as long-term R&D. What is “MRV-able” is not a question of transfer alone, but of generating new technologies as well.

However the technology discussion is defined, an institutional mechanism is likely to be needed to deal with technology issues, and to address MRV. For the purpose of measuring, reporting and verifying technology transfer, indicators will assist. Work in the Subsidiary Bodies on

Implementation and Scientific and Technological Advice (SBI and SBSTA) on performance indicators should help to address the issue of **measurement**.

Indicators would also provide a useful format for **reporting**. What needs to be **verified** is the actual transfer of technology, not just long-term R&D. Useful information on technology and climate change is provided in the companion paper *The Mitigation Technology challenge: Considerations for National Governments and an International Agreement* by Martina Chidiak and Dennis Tirpak. Measurement would also need to include technology transfer under the CDM.

In all cases, the funding for technology would be measurable, reportable and verifiable. But at the multilateral level, investment in technology transfer does not earn carbon credits (unless we want to re-open the supplementarity debate).

The more difficult issue is how to quantify technology support where it is not financial. Important aspects relating to technology transfer, such as preferential access, collaborative R&D in the form of human resources, building local institutional capacity to apply technology are some of the less tangible forms of support.

5.3 MRV for developed countries

Having considered MRV for developing countries, both for mitigation actions (section 5.1) and for the support (5.2), we now turn to MRV for developed countries. Since the paper is aimed at developing country decision-makers, this complex matter is treated only briefly.

Mitigation commitments by developed countries are negotiated in the AWG-KP and in the AWG-LCA in terms of para 1.b(i). The further commitments for Annex I Parties under the Protocol would be measured, reported and verified according to Articles 5, 7 and 8. To ensure comparability of effort with mitigation commitments or actions, including QELROs, by developed country Parties under the Convention, the same procedures for MRV would be simplest.

What might action be compared to? If a developed country adopted “mitigation commitments or actions, including QELROs” under paragraph b(i), to what should that be compared? In the two-track negotiations, one suggestion is to compare to the Protocol track, that is, the negotiations under the AWG-KP. These negotiations have been under way since 2006. Negotiations have been

formalized in a work plan, with the major steps being (a) analysis of mitigation potentials and ranges of emission reduction objectives of Annex I Parties; (b) analysis of possible means to achieve mitigation objectives; and (c) consideration of further commitments by Annex I Parties, and at this stage is still focused on the means.³⁰ What provided a possible option for comparability is a range of -25% to -40% from 1990 levels by 2020 for Annex I Parties as a group.³¹ How such a range would be compared to efforts under the Convention will need further work in the AWG-LCA.

Improvements on this system are of course possible. **Measurement** of comparability of efforts would be simplest when comparing QELROs, based on the compliance system. Another option would be to consider the outcomes, in particular that the range of emission reductions for Annex I Parties is -25% to -40% from 1990 levels by 2020.

For **reporting**, the basis will remain Annex I national communications.³² Improvements on the procedures for reporting could help to promote best practice.

Procedures for **verification** could reinforce existing work on measurement (incl. IPCC,³³ ISO, WRI/WBCSD,³⁴ etc.), with a focus on measurement at the facility level & local capacity building for implementation of IPCC methodologies for national inventory reporting.

³⁰ FCCC/KP/AWG/2006/4, the report of the AWG-KP on its 2nd session.

³¹ “At the first part of its fourth session, the AWG recognized that the contribution of Working Group III to the AR4 indicates that achieving the lowest levels assessed by the IPCC to date and its corresponding potential damage limitation would require Annex I Parties as a group to reduce emissions in a range of 25–40 per cent below 1990 levels by 2020, through means that may be available to these Parties to reach their emission reduction targets.” See document FCCC/KP/AWG//2007/5 for the complete text.

³² KP Art 5, 7 and 8 and FCCC Article 12.2 (a) and (b).

³³ IPCC 2006. IPCC guidelines for national GHG inventories. Prepared by the National Greenhouse Gas Inventories Program. Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (Eds). by E H S, B L, M K, N T and T K (Eds) Kanagawa, Japan, Institute for Global Environmental Strategies. <http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.htm>.

³⁴ WRI & WBCSD 2007. The Greenhouse Gas Protocol: A corporate accounting and reporting standard. Revised edition. Washington, World Business Council for Sustainable Development & World Resources Institute. <http://www.ghgprotocol.org>.

6. CONCLUSIONS

The challenges on the road from Bali to Copenhagen are many. Mitigation, in balance with adaptation, is a major one. Equity and common but differentiated responsibilities will need to be central, but more urgent action is needed by all countries.

What is common is that both developed and developing countries take MRV mitigation action. For developed countries, these are commitments to absolute emission reductions, and achieving a QELRO is the key metric of effort. For developing countries, mitigation actions need to be developed in a bottom-up manner to achieve reductions relative to baseline emissions. And they are supported by technology and finance.

A range of specific proposals has been outlined in this document. Developing country negotiators will need to carefully consider the implications of different approaches for their respective countries. Detailed questions have already been posed for each of the specific approaches elaborated in several places in sections 4 and 5. Some broader, more general questions that may bear reflection include:

- What are the dimensions of equity and how should they be brought to bear on this discussion? What approaches are seen to be fair? And why?
- Which of the “schools of thought” makes most sense from your perspective? Would you put atmosphere, equity, development or technology first? Or is it a combination?
- What nationally appropriate mitigation actions, in the context of sustainable development, would have most support in your country?
- How can the co-benefits of making development more sustainable be harnessed in the multi-lateral climate system?
- What positive incentives can be put in place to stimulate action by developing countries? How can we ensure that financial flows address both mitigation and adaptation needs in developing countries, and assist them to achieve their national development goals?
- How can the multilateral system provide benefits and promote the national goals of developing countries, with co-benefits for climate change mitigation?
- Can the scale and direction of action required to develop and diffuse mitigation technologies, especially in the energy sector, be realistically expected in the absence of a carbon constraint?

- What further analysis would be needed to support your country in taking nationally appropriate mitigation actions?

BIBLIOGRAPHY

Further reading

Surveys of approaches: For further information on approaches to future commitments, see the Pew Centre (Bodansky et al. 2004) is recommended, containing a one-page summary of over 40 proposals. Baumert et al (2002) provide a more in-depth analysis of most of the major approaches, and an excellent introductory chapter outlining ‘architectural elements’ required of any proposal. For more summaries on types of commitments for post-2012 (Höhne & Lahme 2005), and Boeters et al (2007) and a web-based resource, www.fiacc.net.

Criteria: A useful summary of factors underpinning action is available in Höhne et al. (2006d).

Many specific approaches are in the references cited in this document, see references below.

References

- Agarwal, A 2000. Making the Kyoto Protocol work: ecological and economic effectiveness, and equity in the climate regime. New Delhi, Centre for Science and Environment.
- Agarwal, A & Narain, S 1991. Global Warming in an Unequal World, a case of environmental colonialism. Delhi, India, Centre for Science and Environment (CSE).
- Akimoto, K, Sano, F, Oda, J, Homma, T, Rout, U K & Tomoda, T 2008. Global emission reduction toward low-carbon society by sectoral intensity target scheme. Kyoto, Research Institute of Innovative Technology for the Earth (RITE).
- Aslam, M A 2002. Equal per capita entitlements: A key to global participation on climate change? in K Baumert, O Blanchard, S Llosa and J F Perkaus (Eds). Building on the Kyoto Protocol: Options for protecting the climate. Washington DC, World Resources Institute: 175-202.
- Baer, P & Athanasiou, T 2007. Frameworks & proposals: A brief, adequacy and equity-based evaluation of some prominent climate policy frameworks and proposals. Global Issues Papers no. 30, June. Berlin, Heinrich Böll Stiftung.
- Baer, P, Athanasiou, T & Kartha, S 2007. The greenhouse development rights framework: Rationales, mechanisms, and initial calculations. Berkeley, EcoEquity & Christian Aid. www.ecoequity.org/docs/TheGDRs-Framework.pdf. Access 23 April 2007.
- Baer, P, Harte, J, Haya, B, Herzog, A V, Holdren, J, Hulman, N E, Kammen, D M, Norgaard, R B & Raymond, L 2000. Equity and Greenhouse Gas Responsibility. Science 289 (2287.12 Discussion paper 2003-2:). 1 August 2003.
- BASIC Project 2006. The Sao Paulo proposal for an agreement on future international climate policy. www.basic-project.net Accessed on 12 May 2008.
- Baumert, K, Blanchard, O, Llosa, S & Perkaus, J F (Eds) 2002. Building on the Kyoto Protocol: Options for protecting the climate. Washington DC, World Resources Institute. http://climate.wri.org/pubs_pdf.cfm?PubID=3762. Access July 2008.
- Bodansky, D, Chou, S & Jorge-Tresolini, C 2004. International climate efforts beyond 2012. Arlington, Pew Center on Global Climate Change. www.pewclimate.org/international/about. Accessed on 3 May 2008.
- Bode, S 2004. Equal Emissions per capita over time. European Environment 14 (5): 300-316.
- Boeters, S, Den Elzen, M, Manders, A J G, Veenendaal, P J J & Verweij, G 2007. Post-2012 Climate Policy Scenarios. MNP Report 500114006/2007. Bilthoven, Netherlands Environmental Assessment Agency (MNP).
- Bosi, M & Ellis, J 2005. Exploring options for sectoral crediting mechanisms. Paris, Organisation for Economic Co-operation and Development & International Energy Agency.
- Brazil 1997. Proposed elements of a protocol to the U FCCC, presented by Brazil in response to the Berlin mandate, FCCC/AGBM/1997/MISC.1/Add.3. Bonn, UNFCCC.
- CAN, C A N 2003. Preventing dangerous climate change. Milan, Italy, Climate Action Network. <http://www.climnet.org>. Access July 2008.
- CCAP (Center for Clean Air Policy) 2007. A post-2012 package: Developing country climate change strategy. DRAFT July 16. Washington, D. C.
- Chung, R K 2007. A CER discounting scheme could save climate change regime after 2012. Climate Policy 7 (2): 171-176. <http://www.earthscanjournals.com/cp/007/02/default.htm>. Access 13 November 2007.
- Claussen, E & McNeilly, L 1998. Equity and Global Climate Change, The Complex Elements of Global

- Fairness. PEW Centre on Global Climate Change, Arlington.
- DEAT & DEFRA (Department of Food and Rural Affairs, UK & Department of Environmental Affairs & Tourism, SA) 2007. Scenarios for future international climate change policy: Discussion paper presented at the Midnight Sun Dialogue on Climate Change, Riksgården, Sweden, 11 – 14 June 2007.
- Den Elzen, M, Höhne, N, Lucas, P L, Moltmann, S & Kuramochi, T 2007. The Triptych approach revisited: A staged sectoral approach for climate mitigation. MNP Report 500114008/2007. Bilthoven, Netherlands Environmental Assessment Agency (MNP).
- Den Elzen, M, Höhne, N & Moltmann, S 2008. The Triptych approach revisited: A staged sectoral approach for climate mitigation *Climate Policy* 36 (3): 1107-1124.
- Depledge, J 2002. Continuing Kyoto: Extending absolute emission caps to developing countries. in K Baumert, O Blanchard, S Llosa and J F Perkaus (Eds). *Building on the Kyoto Protocol: Options for protecting the climate*. Washington DC, World Resources Institute: 31-60.
- Edmonds, J & Wise, M 1998. Building backstop technologies and policies to implement the Framework Convention on Climate Change. Washington DC, Pacific Northwest National Laboratory.
- Ellerman, A D & Wing, I S 2003. Absolute versus intensity based emission caps. *Climate Policy* 3 (S2): S7-S20.
- Ellis, J & Baron, R 2005. Sectoral crediting mechanisms: An initial assessment of electricity and aluminium. COM/ENV/EPOC/IEA/SLT(2005)8. Paris, International Energy Agency & Organisation for Economic Co-operation and Development.
- GCI 2005. GCI Briefing: Contraction & Convergence. Global Commons Institute. April, 2006.
- Groenenberg, H, Phylipsen, D & Blok, K 2001. Differentiating the burden world-wide: Global burden differentiation of GHG emissions reductions based on the Triptych approach - a preliminary assessment. *Energy Policy* 29: 1007-1030.
- Gupta, S & Bhandari, P M 1999. An effective allocation criterion for CO₂ emissions. *Energy Policy* (27): 727-736.
- Herzog, T, Baumert, K & Pershing, J 2006. Target: Intensity. An analysis of greenhouse gas intensity targets Washington DC, World Resources Institute. www.wri.org/publication/target-intensity. Accessed 8 May 2008.
- Höhne, N, Den Elzen, M & Weiss, M 2006a. Common but differentiated commitments (CDC): a new conceptual approach to long-term climate policy. *Climate Policy* 6 (2): 181-200.
- Höhne, N, den Elzen, M G J & Weiss, M 2006b. Common but differentiated convergence (CDC), a new conceptual approach to long-term climate policy. *Climate Policy* (accepted).
- Höhne, N & Lahme, E 2005. Types of future commitments under the UNFCCC and the Kyoto Protocol post-2012. Gland, Switzerland, Worldwide Fund for Nature.
- Höhne, N, Moltmann, S, Lahme, E, Worrell, E & Graus, W 2006c. CO₂ emission reduction potential under a sectoral approach post 2012. For the Netherlands Environmental Assessment Agency (MNP), No. DM70210. Cologne, Ecofys.
- Höhne, N, Phylipsen, D & Moltmann, S 2006d. Factors underpinning future action. Cologne, Ecofys. http://www.fiacc.net/data/Factors_underpinning_future_action.pdf. Access July 2008.
- IPCC (Intergovernmental Panel on Climate Change) 2000. Special Report on Emissions Scenarios. A special report of Working Group III of the IPCC. Cambridge University Press.
- IPCC 2007a. *Climate Change 2007: Climate Change Impacts, Adaptation and Vulnerability*. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Geneva.
- IPCC 2007b. *Climate Change 2007: Mitigation of Climate Change*. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Geneva.
- IPCC 2007c. *Climate Change 2007: Mitigation of Climate Change*. Summary for policy makers. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Geneva.
- KEI (Korea Environment Institute) 2002. Expert meeting on climate change and sustainable development. Seoul, Korea.
- Kim, Y-G & Baumert, K 2002. Reducing uncertainty through dual-intensity targets. in K Baumert, O

- Blanchard, S Llosa and J F Perkaus (Eds). *Building on the Kyoto Protocol: Options for protecting the climate*. Washington DC, World Resources Institute: 109-134.
- La Rovere, E L, Valente de Macedo, L & Baumert, K 2002. The Brazilian Proposal on relative responsibility for global warming. in K Baumert, O Blanchard, S Llosa and J F Perkaus (Eds). *Building on the Kyoto Protocol: Options for protecting the climate*. Washington DC, World Resources Institute: 157-174.
- Meyer, A 2000. *Contraction & convergence: The global solution to climate change*. Bristol, Green Books & Schumacher Society.
- Müller, B 1999. *Justice in Global Warming Negotiations - How to achieve a procedurally fair compromise*. Oxford, Oxford Institute for Energy Studies.
- Ott, H E, Winkler, H, Brouns, B, Kartha, S, Mace, M, Huq, S, Kameyama, Y, Sari, A P, Pan, J, Sokona, Y, Bhandari, P M, Kassenberg, A, La Rovere, E L & Rahman, A 2004. South-North dialogue on equity in the greenhouse. A proposal for an adequate and equitable global climate agreement. S. Eschborn, Gesellschaft für Technische Zusammenarbeit. www.south-north-dialogue.net. Access July 2008.
- Pan, J 2002. Understanding human development potentials and demands for greenhouse gas emissions: with empirical analysis using time series and cross-sectional data. Beijing, Chinese Academy of Social Sciences.
- Philibert, C 2002. Fixed targets versus more flexible architecture. Revised draft note. OECD / IEA project for the Annex I Expert Group on the UNFCCC. Paris, Organisation for Economic Co-operation and Development/International Energy Agency.
- Phylipsen, D, Bode, J W, Blok, K, Merkus, H & Metz, B 1998. A Triptych approach to burden differentiation: GHG emissions in the European bubble. *Energy Policy* 26 (12): 929-943.
- Pinguelli Rosa, L & Kahn Ribeiro, S 2001. The present, past, and future contributions to global warming of CO₂ emissions from fuels: A key for negotiation in the climate convention. *Climatic Change* 48 (289-308).
- Rose, A, Stevens, B, Edmonds, J & Wise, M 1998. International Equity and differentiation in Global Warming policy. *Environmental & Resource Economics* 12 (1): 25-51.
- RSA 2006a. Dialogue working paper 18: Submission from South Africa: Sustainable Development Policies and Measures. Pretoria, Department of Environmental Affairs & Tourism.
- RSA 2006b. Sustainable Development Policies and Measures: A strategic approach for enhancing the climate regime post-2012. Presented at the 2nd Workshop of the Dialogue on long-term cooperative action to address climate change by enhancing implementation of the Convention, Nairobi, Kenya. 15-16 November Pretoria, Department of Environmental Affairs & Tourism.
- Samaniego, J & Figueres, C 2002. Evolving to a sector-based Clean Development Mechanism. in K Baumert, O Blanchard, S Llosa and J F Perkaus (Eds). *Building on the Kyoto Protocol: Options for protecting the climate*. Washington DC, World Resources Institute: 89-108.
- Sathaye, J, Najam, A, Cocklin, C, Heller, T, Lecocq, F, Llanes-Regueiro, J, Pan, J, Petschel-Held, G, Rayner, S, Robinson, J, Schaeffer, R, Sokona, Y, Swart, R & Winkler, H 2007. Sustainable development and mitigation. Chapter 12. in B Metz, O D Davidson, P Bosch, R Dave and L M Meyer (Eds). *Climate Change 2007: Mitigation, Contribution of Working Group III to the IPCC Fourth Assessment Report*, Cambridge University Press.
- Schmidt, J, Helme, N, Lee, J & Houdashelt, M 2006. Sector based approach to the post-2012 climate change policy architecture. Washington DC, Center for Clean Air Policy.
- Stavins, R N 2001. Economic Analysis of Global Climate Change Policy: A Primer. in E Claussen, V A Cochran and D P Davis (Eds). *Climate Change: Science, Strategies, and Solutions*. Boston. Brill 18 Discussion paper 2003-2: draft ver. 1 August 2003 Publishing.
- Sterk, W & Wittneben, B 2006. Enhancing the Clean Development Mechanism through sectoral approaches: Definitions, applications and ways forward. *International Environmental Agreements: Politics, Law and Economics* 6: 271 – 287.
- Tangen, K & Hasselknippe, H 2004. Converging markets. Paper under the FNI / CRIEPI / HWWA / CASS post-2012 policy scenarios project. Polhøgda, Fridtjof Nansen Institute. http://www.fni.no/post2012/040121_Market%20convergence%20scenario.pdf. Access August 2007.
- Tangen, K & Hasselknippe, H 2005. Converging

- Markets. International Environmental Agreements: Politics, Law and Economics. 5: 47-64.
- UNFCCC (United Nations Framework Convention on Climate Change) 1997. Kyoto Protocol to the United Nations Framework Convention on Climate Change. Bonn, UNFCCC Secretariat. <http://unfccc.int/resource/convkp.html>. Access July 2008.
- UNFCCC (United Nations Framework Convention on Climate Change) 2002. Scientific and methodological assessment of contributions to climate change. Report of the expert meeting. Note by the secretariat. FCCC/SBSTA/2002/INF.14 (related to proposal by Brazil). New Delhi.
- UNFCCC (United Nations Framework Convention on Climate Change) 2007. Report on the analysis of existing and potential investment and financial flows relevant to the development of an effective and appropriate international response to climate change. Dialogue working paper 8. Bonn. http://unfccc.int/files/cooperation_and_support/financial_mechanism/financial_mechanism_gef/application/pdf/dialogue_working_paper_8.pdf. Access August 2007.
- USEPA 2002. International analysis of methane and nitrous oxide abatement opportunities: Report to Energy Modelling Forum, Working Group 21. Washington, D.C., USA, United States Environmental Protection Agency.
- Vajpayee, S A B 2002. Speech of India's Prime Minister at the High Level Segment of the Eighth Session of Conference of the Parties to the UN Framework Convention on Climate Change. 30 October. New Delhi. http://unfccc.int/cop8/latest/ind_pm3010.pdf. Access 2008.
- Victor, D G, House, J & Joy, S 2005. A Madisonian approach to climate policy Science 309: 1820-1821.
- Ward, M 2006. Climate policy solutions: A sectoral approach. Wellington, Global Climate Change Consultancy.
- Ward, M, Hagemann, M, Höhne, N, Jung, M, O'Sullivan, R, Streck, C & Winkler, H 2008. The role of sector no-lose targets in scaling up finance for climate change mitigation activities in developing countries. Prepared for the International Climate Division, Department of Environment, Food and Rural Affairs (DEFRA), United Kingdom. Auckland, GtripleC, ClimateFocus, Ecofys.
- Wicke, L 2005. Beyond Kyoto - A New Global Climate Certificate System. Heidelberg, Germany, Springer Verlag.
- Winkler, H, Höhne, N & Den Elzen, M 2008 Methods for quantifying the benefits of sustainable development policies and measures (SD-PAMs). Climate Policy 8 (2): 119-134.
- Winkler, H, Howells, M & Baumert, K 2007. Sustainable development policies and measures: institutional issues and electrical efficiency in South Africa. Climate Policy 7 (3): 212-229.
- Winkler, H, Spalding-Fecher, R, Mwakasonda, S & Davidson, O 2002a. Sustainable development policies and measures: starting from development to tackle climate change. in K Baumert, O Blanchard, S Llosa and J F Perkaus (Eds). Building on the Kyoto Protocol: Options for protecting the climate. Washington DC, World Resources Institute: 61-87.
- Winkler, H, Spalding-Fecher, R & Tyani, L 2002b. Comparing developing countries under potential carbon allocation schemes. Climate Policy 2 (4): 303-318.
- WRI (World Resources Institute) 2003. Climate Analysis Indicators Tool (CAIT). Washington DC. <http://cait.wri.org>. Access July 2008.
- WRI (World Resources Institute) 2005. Climate Analysis Indicators Tool (CAIT), version 3.0. Washington DC. <http://cait.wri.org/>. Access July 2008.

ANNEXES

Annex 1. COP decisions related to mitigation

SESSION	DECISIONS	PROVISIONS
COP 1 (Berlin, 1995)	Decision 2/CP.1	Review of first communications from the Parties included in Annex I to the Convention
	Decision 4/CP.1	Methodological issues
	Decision 5/CP.1	Activities implemented jointly under the pilot phase
COP 2 (Geneva, 1996)	Decision 9/CP.2	Communications from Parties included in Annex I to the Convention: guidelines, schedule and process for consideration
	Other action taken by the COP	The Geneva Ministerial Declaration
COP 3 (Kyoto, 1997)	Decision 1/CP.3	Adoption of the Kyoto Protocol to the United Nations Framework Convention on Climate Change
	Decision 9/CP.3	Development and transfer of technologies
	Decision 13/CP.3	Division of labor between the SBI and SBSTA
COP 4 (Buenos Aires, 1998)	Decision 1/CP.4	The Buenos Aires Plan of Action
	Decision 4/CP.4	Development and transfer of technologies
	Decision 11/CP.4	National communications from Parties included in Annex I to the Convention
COP 6 (The Hague, 2000)	Decision 1/CP.6	Implementation of the Buenos Aires Plan of Action
COP 6 part II (Bonn 2001)	Decision 5/CP.6	The Bonn Agreements on the implementation of the Buenos Aires Plan of Action
COP 7 (Marrakech, 2001)	Decision 2/CP.7	Capacity building in developing countries (non-Annex I Parties)
	Decision 4/CP.7	Development and transfer of technologies (decisions 4/CP.4 and 9/CP.5)
COP 8 (New Delhi, 2002)	Decision 1/CP.8	Delhi Ministerial Declaration on Climate Change and Sustainable Development
	Decision 2/CP.8	Fourth compilation and synthesis of initial national communications from Parties not included in Annex I to the Convention
	Decision 3/CP.8	Consultative Group of Experts on National Communications from Parties not included in Annex I to the Convention
COP 9 (Milan, 2003)	Decision 2/CP.9	Compilation and synthesis of initial national communications
	Decision 10/CP.9	Scientific, technical and socio-economic aspects of impacts of, and vulnerability and adaptation to, climate change, and scientific, technical and socio-economic aspects of mitigation
COP 10 (Buenos Aires, 2004)	Decision 7/CP.10	Status of, and ways to enhance, implementation of the New Delhi work program on Article 6 of the Convention
COP 11 (Montreal, 2005)	Decision 12/CP.11	Program budget for the biennium 2006-2007

Annex 2. Summary of options for addressing mitigation actions in a future regime

PROPOSED OPTIONS FOR MITIGATION	TYPE OF MITIGATION COMMITMENT	PARTICIPATION	INSTITUTIONAL REQUIREMENTS	LEGAL NATURE (VOLUNTARY / BINDING)	ACCOUNTABILITY PROCEDURES	SENSITIVITY TO NATIONAL CIRCUMSTANCES	TIMING
Fixed targets Kyoto-style	Allowance calculated as reduction (less than 100%) or limit (greater than 100%) on emissions in base year, yielding tons of CO ₂ allowance. Flexible mechanisms can be used.	All countries who agree to commitments inscribed in Annex B of the Kyoto Protocol.	Institutional architecture exists, but new countries would have to set up institutions for monitoring, reporting and verification under Protocol Articles 5, 7 and 8. Internationally, a sufficient number of Parties must ratify the amendment.	Binding, once the Party has agreed to make a commitment and it is ratified.	Compliance provisions of the Kyoto Protocol.	Limited, although differences in percentages possible.	Commitment periods, first one is five years, future ones may be longer.
Per capita	Each country receives entitlement, i.e. tons of CO ₂ allowance, rather than a specified reduction. Entitlements are tradable.	Potentially all countries.	Would depend on the design of the regime; likely that nation-States would still receive allowances on behalf of the population.	Could be either.	Consequences of exceeding per capita allowances would need to be defined.	Sensitive to population differences, e.g. resource endowments.	Long-term goal; per capita emissions converge over time.
Brazilian proposal	Emission reductions based on historical responsibility for existing temperature change	Initially only Annex I, but potentially all countries.	Data requirements, see text.	Could be either.	Would need to be defined; original suggestion was to contribute to the Clean Development Fund.	Historical responsibility would account for some; but not explicitly adjusted for.	Long-term, taking into account effect of GHGs in atmosphere over long time.
Emissions intensity	Reduction is emissions per unit of economic outputs (t CO ₂ / \$ GDP).	Most suitable for developing countries, as it accounts for economic development (GDP). Also adopted nationally by some developed countries.	Requires assessment of GDP, as well as emissions.	Could be either.	Compliance could be established if intensity target is missed. Variant: a weaker compliance target and a stronger selling target.	Sensitive to change in GDP; does not explicitly adjust for other circumstances.	Could be voluntary for developing countries initially, becoming binding at a later date.
SD-PAMs: Sustainable development policies and measures	Pledge to implement sustainable development policies, and to report on them under the UNFCCC. Quantifies GHG reductions as co-benefits of actions motivated by local sustainable development. Useful interim step.	Developing countries only.	Builds on national development capacity, in the multi-lateral system would require a COP decision and at least a register of SD-PAMs, possibly a new Annex to the Convention.	Voluntary.	Methodologies to quantify both the emission reductions and local sustainable development benefits would need to be developed. Not subject to compliance.	Built in, as countries set their own development objectives.	Could be implemented in short-term; might continue in long-term for Least Developed Countries.

PROPOSED OPTIONS FOR MITIGATION	TYPE OF MITIGATION COMMITMENT	PARTICIPATION	INSTITUTIONAL REQUIREMENTS	LEGAL NATURE (VOLUNTARY / BINDING)	ACCOUNTABILITY PROCEDURES	SENSITIVITY TO NATIONAL CIRCUMSTANCES	TIMING
Evolution of CDM	No new commitment, but extension of CDM architecture to enhance mitigation action in developing countries.	Developing countries.	Use established CDM institutions, scaling up to programmatic and possibly sector level.	Voluntary, between project participants. Parties to Kyoto Protocol only.	Validation, monitoring and verification procedures at project level. Not subject to compliance at national level.	Countries choose which projects to approve and that these contribute to sustainable development.	Immediate. CDM not available to Parties who take on Kyoto targets.
Global Triptych	National emissions target, ranging from reductions to growth caps. Based on sectoral and technological possibilities.	Potentially all countries, or for technologies in one of the three sectors.	Establishment of sectoral benchmarks or other means to promote best available technologies.	Voluntary at multi-lateral level; could become binding for sectors	Would depend on sectors.	Could define technological criteria to account for structural differences.	Short- to medium-term.
Sectoral approaches	Various – technology benchmarks, crediting baselines, dual markets, industry initiatives.	Sectors in all participating countries. Not economy-wide.	Involvement of multiple sectors, possibly organizations working in sectors internationally.	Sectoral efforts would be voluntary (or in pursuit of a separately set binding target); transnational sectoral agreements could be binding.	Sector specific.	Countries could select in which sectors to participate. However, may imply global standards in certain sectors.	Medium-term.

Annex 3. Overview of recent proposals in IPCC AR 4

Chapter 13 of Working Group III contribution to the IPCC's AR4 deals with "Policies, Instruments and Co-operative Arrangements". A useful table from that chapter is reproduced below, summarising recent proposals for international climate agreements.

NAME (REFERENCE)	DESCRIPTION
National emission targets and emission trading	
Staged systems	
Multistage with differentiated reductions: Gupta, 1998; Berk and den Elzen, 2001; Blanchard et al., 2003; Criqui et al., 2003; Gupta, 2003a; Höhne et al., 2003; Höhne et al., 2005; Michaelowa et al., 2005b; den Elzen and Meinshausen, 2006, den Elzen et al., 2006a	Countries participate in the system with different stages and stage-specific types of targets; countries transition between stages as a function of indicators; proposal specify stringency of the different stages
Differentiating groups of countries: (USEPA 2002; CAN 2003; Ott et al. 2004; Claussen & McNeilly 1998)	Countries participate in the system with different stages and stage-specific types of targets
Converging markets: (Tangen & Hasselknippe 2005)	Scenario with regional emission trading systems converging to a full global post 2012 market system
Three-part policy architecture: (Stavins 2001)	All nations with income above agreed threshold take on different targets (fixed or growth); long-term targets (flexible but stringent); short-term (firm, but moderate); and market-based policy instruments, e.g., emissions trading.
Allocation methods	
Equal per capita allocation: (Agarwal & Narain 1991; Wicke 2005; Baer et al. 2000)	All countries are allocated emission entitlements based on their population
Contraction and convergence (GCI 2005)	Agreement on a global emission path that leads to an agreed long-term stabilization level for GHG concentrations ('Contraction'). Emission targets for all individual countries set so per-capita emissions converge ('Convergence')
Basic needs or survival emissions: Aslam, 2002; Pan, 2005 Gupta and Bhandari, 1999	Emission entitlements based on an assessment of emissions to satisfy basic human needs
Adjusted per capita allocation: Gupta and Bhandari, 1999	Allocation of equal per capita emissions with adjustments using emissions per GDP relative to Annex I average
Equal per capita emissions over time: (Bode 2004)	Allocation based on (1) converging per capita emissions and (2) average per capita emissions for the convergence period that are equal for all countries
Common but differentiated convergence: (Höhne et al. 2006b)	Annex I countries' per capita emissions converge to low levels within a fixed period. Non-Annex I countries converge to the same level in the same timeframe, but starting when their per capita emissions reach an agreed percentage of the global average. Other countries voluntarily take on "no lose" targets
Grandfathering: (Rose et al. 1998)	Reduction obligations based on current emissions
Global preference score compromise: (Müller 1999)	Countries voice preference for either per capita allocation or allocation based on current national emissions

NAME (REFERENCE)	DESCRIPTION
Historical responsibility – the Brazilian proposal: UNFCCC, 1997b; Rose et al., 1998; Meira Filho and Gonzales Miguez, 2000; Pinguelli Rosa et al., 2001; den Elzen and Schaeffer, 2002; La Rovere et al., 2002; Andronova and Schlesinger, 2004; Pinguelli et al., 2004; Trudinger and Enting, 2005; den Elzen and Lucas, 2005, den Elzen et al., 2005c; Höhne and Blok, 2005; Rive et al., 2006	Reduction obligations between countries are differentiated in proportion to those countries' relative share of responsibility for climate change – i.e. their contribution to the increase of global-average surface temperature over a certain period of time
Ability to pay: Jacoby et al., 1998; Lecoq and Crassous, 2003	Participation above welfare threshold. Emission reductions as a function of ability to pay (welfare)
Equal mitigation costs: Rose et al., 1998; Babiker and Eckhaus, 2002	Reduction obligations between countries are differentiated so that all participating countries have the same welfare loss
Triptych: Blok et al., 1997; den Elzen and Berk, 2004; Höhne et al., 2005	National emission targets based on sectoral considerations: Electricity production and industrial production grow with equal efficiency improvements across all countries. "Domestic" sectors converge to an equal per-capita level. National sectoral aggregate levels are then adopted
Multi-sector convergence: Sijm et al., 2001	Per-capita emission allowances of seven sectors converge to equal levels based on reduction opportunities in these sectors. Countries participate only when they exceed per capita threshold
Multi-criteria: Ringius et al., 1998; Helm and Simonis, 2001; Ringius et al., 2002	Emission reduction obligations based on a formula that includes several variables, such as population, GDP and others
Alternative types of emission targets for some countries	
Dynamic targets: Hargrave et al., 1998; Lutter, 2000; Müller et al., 2001; Bouille and Girardin, 2002; Chan-Woo, 2002; Lisowski, 2002; Ellerman and Wing, 2003; Höhne et al., 2003; Müller and Müller-Fürstenberger, 2003; Jotzo and Pezzey, 2005; Philibert, 2005b; Pizer, 2005b; Kolstad, 2006	Targets are expressed as dynamic variables – including as a function of the GDP ("intensity targets") or variables of physical production (e.g. emissions per tonne of steel produced)
Dual targets, target range or target corridor: Philibert and Pershing, 2001; Kim and Baumert, 2002	Two emission targets are defined: (1) a lower "selling target" that allows allowance sales if national emissions fall below a certain level; (2) a higher "buying target" that requires the purchase of allowances if a certain level is exceeded
Dual intensity targets: Kim and Baumert, 2002	A combination of intensity targets and dual targets
"No lose", "non-binding", one-way targets: Philibert, 2000	Emission rights can be sold if the target is reached, while no additional emission rights would have to be bought if target is not met. Allocations are made at a BAU level or at a level below BAU. Structure offers incentives to participate for countries not prepared to take on full commitments but still interested in joining the global trading regime
Growth targets, headroom allowances, premium allocation: Frankel, 1999; Stewart and Wiener, 2001; Viguier, 2004	Participation of major developing countries is encouraged by unambitious allocations relative to their likely BAU emissions. To ensure benefit to the atmosphere, a fraction of each permit sold can be banked and definitely removed
Action targets: Goldberg and Baumert, 2004	A commitment to reduce GHG emission levels below projected emissions by an agreed date through "actions" taken domestically, or through the purchases of allowances
Flexible binding targets: Murase, 2005	A framework for reaching emission targets modelled after the WTO/GATT (World Trade Organization/General Agreement on Tariffs and Trade) scheme for tariff and non-tariff barriers; targets negotiated through rounds of negotiations

NAME (REFERENCE)	DESCRIPTION
Modifications to the emission trading system or alternative emission trading systems	
Price cap, safety valve or hybrid trading system: Pizer, 1999; Pizer, 2002; Jacoby and Ellerman, 2004	Hybrid between a tax and emission trading: after the initial allocation, an unlimited amount of additional allowances are sold at a fixed price
Buyer liability: Victor, 2001b	If the seller of a permit did not reduce its emissions as promised, the buyer could not claim the emission credit. Enforcement is more reliable as buyers deal with developed countries with more robust legal procedures
Domestic hybrid trading schemes: McKibbin and Wilcoxon, 1997; McKibbin and Wilcoxon, 2002	Two kinds of emissions permits valid only within the country of origin. (1) long-term permits entitle the permit owner to emit 1 tC every year for a long period; permits are distributed once. (2) Annual permits allow 1 tC to be emitted in a single year. An unlimited number of these permits are given out at a fixed price (price cap). Compliance is based on either unit
Allowance purchase fund: Bradford, 2004	Countries contribute to an international fund that buys/retires emission reduction units. Countries can sell reductions below their BAU levels
Long-term permits: Peck and Teisberg, 2003	Long-term permits could be used once at any time between 2010 and 2070. Depending on the time of emission they are depreciated 1% annually for atmospheric decay of CO ₂ . The permit would allow the emission of 1 tC in 2070, 1.01 tC in 2069 and 1.0160 (1.71) tons in 2010
Sectoral approaches	
Sector Clean Development Mechanism, sector Crediting Mechanism : Philibert and Pershing, 2001; Samaniego and Figueres, 2002; Bosi and Ellis, 2005; Ellis and Baron, 2005; Sterk and Wittneben, 2005	Sectoral crediting schemes based on emission reductions below a baseline. Excess allowances can be sold
Sector pledge approach: Schmidt et al., 2006	Annex I countries have emission targets, with the ten highest-emitting developing countries pledging to meet voluntary, "no-lose" GHG emissions targets in the electricity and major industrial sectors. Targets are differentiated, based upon national circumstances, and sector-specific energy-intensity benchmarks are developed by experts and supported through a Technology Finance and Assistance Package
Caps for multinational cooperation: Sussman et al., 2004	A cap/and trade system associated with the operations of associated enterprises in developing and developed countries
Carbon stock protocol: WBGU, 2003	A protocol for the protection of carbon stocks based on a worldwide system of "non-utilization obligations" to share the costs of the non-degrading use of carbon stocks among all states
"Non-binding" targets for tropical deforestation: Persson and Azar, 2004	Non-binding commitments for emissions from deforestation under which reduced rates of deforestation could generate emissions allowances
Policies and measures	
Carbon emission tax: Cooper, 1998; Nordhaus, 1998; Cooper, 2001; Nordhaus, 2001; Newell and Pizer, 2003	All countries agree to a common, international GHG emission tax; several of the proposals suggest beginning with a carbon tax limited to emissions from fossil fuel combustion
Dual track: Kameyama, 2003	Countries choose either non-legally binding emission targets based on a list of policies and measures or legally-binding emission caps allowing international emissions trading
Climate "Marshall Plan": Schelling, 1997, 2002	Financial contributions from developed countries support climate friendly development; similar in scale and oversight to the Marshall Plan

NAME (REFERENCE)	DESCRIPTION
Technology	
Technology research and development: Edmonds and Wise, 1999; Barrett, 2003	Enhanced coordinated technology research and development
Energy efficiency standards: Barrett, 2003; Ninomiya, 2003	International agreement on energy efficiency standards for energy-intensive industries
Backstop technology protocol: Edmonds and Wise, 1998	New power plants installed after 2020 must be carbon neutral. New synthetic fuels plants must capture CO ₂ . Non-Annex I countries participate upon reaching Annex I average GDP in 2020
Technology prizes for climate change mitigation: Newell and Wilson, 2005	Incentive or inducement prizes targeted at applied research, development and demonstration
Development-oriented actions	
Sustainable development policies and measures: Winkler et al., 2002b; Baumert et al., 2005b	Countries integrate policies and measures to reduce GHG emissions into development plans (e.g. developing rural electrification programs based on renewable energy, or mass transit systems in place of individual cars)
Human development goals with low emissions: Pan, 2005	Elements include: identification of development goals/basic human needs; voluntary commitments to low carbon paths via no-regret emission reductions in developing countries conditional to financing and obligatory discouragement of luxurious emissions; reviews of goals and commitments; an international tax on carbon
Adaptation	
UNFCCC impact response instrument: Müller, 2002	A new "impact response instrument" under the auspices of the UNFCCC for disaster relief, rehabilitation and recovery
Insurance for adaptation; funded by emission trading surcharge: Jaeger, 2003	A portion of the receipts from sales of emissions permits would be used to finance insurance pools
Financing	
Greening investment flows: Sussman and Helme, 2004	Investments through Export Credit Agencies are conditional on projects that are "climate friendly"
Quantitative finance commitments: Das-gupta and Kelkar, 2003	Annex I countries take on quantitative financial commitments – e.g. expressed as a percentage of the GDP – in addition to emission reduction targets
Negotiation process and treaty structure	
Bottom-up or multi-facet approach, pledge (with review) and review: Reinstein, 2004; Yamaguchi and Sekine, 2006	Each country creates its own initial proposal relating to what it might be able to commit to. Individual actions accumulate one by one. The collective effect of proposals is periodically reviewed for adequacy and – if necessary – additional rounds of proposals are undertaken
Portfolio approach: Benedick, 2001	A portfolio including: emission reduction policies, government research/development, technology standards and technology transfer
A flexible framework: PEW, 2005	A portfolio including: aspirational long-term goals, adaptation, targets, trading, policies, and technology cooperation
Orchestra of treaties: Sugiyama et al., 2003	A system of separate treaties among like-minded countries (emission markets, zero emission technology, climate-wise development) and among all parties to UNFCCC (monitoring, information, funding)
Case study approach: Hahn, 1998	Multiple case studies of coordinated measures, emissions tax, tradable emission permits and a hybrid system in industrialized countries to learn by doing

a There is some potential conflict with the terminology here: "non-binding" targets may be interpreted by some as restricting the capacity of countries to trade as they do not necessarily set up caps that impose prices and thus established tradable commodities.

Source: Earlier overviews by Bodansky, 2004; Kameyama, 2004; Philibert, 2005a

Annex 4. Glossary

TERM	DEFINITION
Adaptation	Adjustment in natural or human systems to a new or changing environment. Adaptation to climate change refers to adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation.
Ad hoc Working Group on further commitments of Annex I Parties under the Kyoto Protocol (AWG-KP)	Article 3, paragraph 9 of the Kyoto Protocol provides that the COP acting as the Meeting of the Parties (CMP) shall initiate consideration of future commitments for Annex I Parties at least seven years before the end of the first commitment period. Pursuant to that provision the CMP at its first session held at Montreal from 28 November to 10 December 2005, established the Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol (AWG-KP).
Ad Hoc Working Group on Long-term Cooperative Action under the Convention (AWG-LCA)	At its thirteenth session, the COP, by its decision 1/CP.13, launched a comprehensive process to enable the full, effective and sustained implementation of the Convention through long-term cooperative action, now, up to and beyond 2012, in order to reach an agreed outcome and adopt a decision at its fifteenth session. It decided that the process shall be conducted under a subsidiary body under the Convention, the Ad Hoc Working Group on Long-term Cooperative Action under the Convention (AWG-LCA), that shall complete its work in 2009 and present the outcome of its work to the COP for adoption at its fifteenth session.
Bali Action Plan	The United Nations Climate Change Conference in Bali The conference culminated in the adoption of the Bali Road Map, which consists of a number of forward-looking decisions that represent the various tracks that are essential to reaching a secure climate future. The Bali Road Map includes the Bali Action Plan, which charts the course for a new negotiating process designed to tackle climate change, with the aim of completing this by 2009. It also includes the AWG-KP negotiations and their 2009 deadline, the launch of the Adaptation Fund, the scope and content of the Article 9 review of the Kyoto Protocol, as well as decisions on technology transfer and on reducing emissions from deforestation.
Baseline	The baseline (or reference) is any datum against which change is measured. It might be a "current baseline," in which case it represents observable, present-day conditions. It might also be a "future baseline," which is a projected future set of conditions excluding the driving factor of interest. Alternative interpretations of the reference conditions can give rise to multiple baselines.
Berlin Mandate	An agreement reached in 1995 in Berlin, Germany, at the first COP to the Climate Convention, in which the industrialized countries first agreed to take on targets and timetables for quantified reductions and limitations on GHG emissions.
Capacity building	Increasing skilled personnel and technical and institutional abilities.
Clean Development Mechanism (CDM)	Defined in Article 12 of the Kyoto Protocol, the CDM is intended to meet two objectives: (1) to assist parties not included in Annex I in achieving sustainable development and in contributing to the ultimate objective of the convention; and (2) to assist parties included in Annex I in achieving compliance with their quantified emission limitation and reduction commitments. Certified Emission Reduction Units from CDM projects undertaken in Non-Annex I countries that limit or reduce GHG emissions, when certified by operational entities designated by COP Meeting of the Parties, can be accrued to the investor (government or industry) from parties in Annex B. A share of the proceeds from certified project activities is used to cover administrative expenses as well as to assist developing country parties that are particularly vulnerable to the adverse effects of climate change to meet the costs of adaptation.
Climate	Climate in a narrow sense is usually defined as the 'average weather', or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years. These quantities are most often surface variables such as temperature, precipitation, and wind. Climate in a wider sense is the state, including a statistical description, of the climate system. The classical period of time is 30 years, as defined by the World Meteorological Organization (WMO).
Climate change	Climate change refers to a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/ or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land use. Note that UNFCCC, in its Article 1, defines "climate change" as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods". The UNFCCC thus makes a distinction between "climate change" attributable to human activities altering the atmospheric composition, and "climate variability" attributable to natural causes.

TERM	DEFINITION
Deforestation	Conversion of forest to non-forest. For a discussion of the term forest and related terms such as afforestation, reforestation, and deforestation, see the IPCC Special Report on Land Use, Land-Use Change, and Forestry (IPCC, 2000).
Emission	In the climate change context, emissions refer to the release of GHG and/or their precursors and aerosols into the atmosphere over a specified area and period of time.
Energy efficiency	Ratio of energy output of a conversion process or of a system to its energy input.
Energy intensity	Energy intensity is the ratio of energy consumption to economic or physical output. At the national level, energy intensity is the ratio of total domestic primary energy consumption or final energy consumption to Gross Domestic Product or physical output.
Global Efficiency and Renewable Energy Fund (established by the EU) (GEREF)	Adopted by the European Union (EU) as a new fund for the promotion of investments in renewable energy technologies.
Greenhouse gas (GHG)	A gas that absorbs radiation at specific wavelengths within the spectrum of radiation (infrared radiation) emitted by the Earth's surface and by clouds. The gas in turn emits infrared radiation from a level where the temperature is colder than the surface. The net effect is a local trapping of part of the absorbed energy and a tendency to warm the planetary surface. Water vapor (H ₂ O), carbon dioxide (CO ₂), nitrous oxide (N ₂ O), methane (CH ₄) and ozone (O ₃) are the primary GHG in the Earth's atmosphere.
International Energy Agency (IEA)	Paris-based energy forum established in 1974. It is linked with the Organisation for Economic Cooperation and Development to enable member countries to take joint measures to meet oil supply emergencies, to share energy information, to coordinate their energy policies, and to cooperate in the development of rational energy programs.
Intergovernmental Panel on Climate Change (IPCC)	Established in 1988 by the World Meteorological Organization and the UN Environment Program, the IPCC surveys world-wide scientific and technical literature and publishes assessment reports that are widely recognized as the most credible existing sources of information on climate change. The IPCC also works on methodologies and responds to specific requests from the Convention's subsidiary bodies. The IPCC is independent of the Convention.
Land use, land use change and forestry (LULUCF)	A GHG inventory sector that covers emissions and removals of GHG resulting from direct human-induced land use, land-use change and forestry activities.
Mitigation	An anthropogenic intervention to reduce the sources or enhance the sinks of GHG.
Quantified emission limitation and reduction objectives, established under the Kyoto Protocol (QELROs)	Legally binding targets and timetables under the Kyoto Protocol for the limitation or reduction of greenhouse-gas emissions by developed countries.
Renewables, Renewable Energy	Energy sources that are, within a short time frame relative to the Earth's natural cycles, sustainable, and include non-carbon technologies such as solar energy, hydropower, and wind, as well as carbon-neutral technologies such as biomass.
Resource	Resources are those occurrences with less certain geological and/or economic characteristics, but which are considered potentially recoverable with foreseeable technological and economic developments.
Sink	Any process, activity or mechanism that removes a GHG, an aerosol, or a precursor of a GHG or aerosol from the atmosphere.
Source	Any process, activity, or mechanism that releases a GHG, an aerosol, or a precursor of a GHG or aerosol into the atmosphere.
Special Report on Emission Scenarios (of the IPCC) (SRES)	The storylines and associated population, GDP and emissions scenarios associated with the Special Report on Emissions Scenarios (SRES) (Nakićenović et al., 2000), and the resulting climate change and sea-level rise scenarios. Four families of socio-economic scenario (A1, A2, B1 and B2) represent different world futures in two distinct dimensions: a focus on economic versus environmental concerns, and global versus regional development patterns.
Sustainable development	Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.
Sustainable development policies and measures (SD-PAMs)	Sustainable Development Policies and Measures. An approach to climate protection that builds on sustainable development priorities.
United Nations Framework Convention on Climate Change (the Convention) (UNFCCC)	The Convention was adopted on 9 May 1992, in New York, and signed at the 1992 Earth Summit in Rio de Janeiro by more than 150 countries and the European Community. Its ultimate objective is the 'stabilization of GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system'. It contains commitments for all Parties. Under the Convention, Parties included in Annex I aim to return GHG emissions not controlled by the Montreal Protocol to 1990 levels by the year 2000. The Convention entered in force in March 1994.

NATIONAL POLICIES AND THEIR LINKAGES TO NEGOTIATIONS OVER A FUTURE INTERNATIONAL CLIMATE CHANGE AGREEMENT

DENNIS TIRPAK
IN COLLABORATION WITH
SUJATA GUPTA, DANIEL PERCZYK,
AND MASSAMBA THIOYE

Acknowledgements

UNDP and the authors gratefully acknowledge the constructive suggestions by the UNFCCC secretariat and UNDP staff members, as well as Eric Martinot, Hernan Carlino, Erik Haites, Harald Winkler, Chad Carpenter, Naira Aslanyan and Susanne Olbrisch.

CONTENTS

Acronyms	73
Units and Measures	73
1. Introduction	74
2. Types of policies, measures and instruments	75
3. Evaluating and selecting policy instruments	76
4. National climate and related policy instruments	78
4.1 Regulations and standards	78
4.2 Taxes and charges	79
4.3 Financial incentives	80
4.4 Voluntary agreements	82
4.5 Information instruments	83
4.6 Tradable permits	83
4.7 Research and development	85
4.8 Climate change policies and other national priorities	86
4.8.1. National policy interactions/ linkages and packages	86
4.8.2. Institutions	87
5. Assessing policy instruments	89
6. Relationship of national policies to a future international climate change agreement	91
7. The policy making process	93
References	94
Annexes	95
Annex 1. Asia	95
1.1 Renewable/wind policy in India	95
1.1.1. Background	95
1.1.2. Objective of the policy	95
1.1.3. What policy instruments were used/had to be passed to achieve the objective?	95
1.1.4. Key factors needed to make something happen	96
1.1.5. What has happened as a result of the policy and instruments that were introduced?	96
1.1.6. List of relevant laws, regulations and rules	96
1.2 Energy efficiency policies in China	97
1.2.1. Background	97
1.2.2. Objective of the policy	98
1.2.3. What policy instruments were used/had to be passed to achieve the objective?	98
1.2.4. What has happened as a result of the policy and instruments that were introduced?	99
1.2.5. Key factors needed to make something happen	99
1.2.6. List of relevant laws, regulations and rules	100
Annex 2. South America	104
2.1 Natural gas for vehicles in Bolivia	104
2.1.1. Background	104
2.1.2. Objective of the policy	104
2.1.3. What policy instruments were used/had to be passed to achieve the objective?	104
2.1.4. Key factors needed to make something happen	105
2.1.5. What has happened as a result of the policy and instruments that were introduced?	105
2.1.6. List of relevant laws, regulations and rules	105

2.2 Wind power in Argentina	105
2.2.1. Background	105
2.2.2. Objective of the policy	106
2.2.3. What policy instruments were used/had to be passed to achieve the objective?	106
2.2.4. Key factors needed to make something happen	106
2.2.5. What has happened as a result of the policy and instruments that were introduced?	107
2.2.6. List of relevant laws, regulations and rules	107
2.3 An energy efficiency labelling program in Brazil	107
2.3.1. Background	107
2.3.2. Objective of the policy	108
2.3.3. What policy instruments were used/had to be passed to achieve the objective?	108
2.3.4. Key factors needed to make something happen	108
2.3.5. What has happened as a result of the policy and instruments that were introduced?	108
2.3.6. List of relevant laws, regulations and rules	109
Annex 3. Africa	110
3.1. Efficient stoves dissemination policy in Kenya	110
3.1.1. Background	110
3.1.2. Objective of the policy	110
3.1.3. What policy instruments were used to achieve the objective?	110
3.1.4. Key factors needed to make something happen	111
3.1.5. What has happened as a result of the policy and instruments that were introduced?	111
3.1.6. List of relevant laws, regulations and rules	111
3.2 Promotion of energy efficient lighting as part of Senegal's rural electrification	111
3.2.1. Background	111
3.2.2. Objectives of the policy	112
3.2.3. What policy instruments were used/had to be passed to achieve the objective?	112
3.2.4. Key factors needed to make something happen	112
3.2.5. What has happened as a result of the policy and instruments that were introduced?	113
3.2.6. List of relevant laws, regulations and rules	113
3.3 Renewable energy development policy in Senegal	113
3.3.1. Background	113
3.3.2. Objective of the policy	113
3.3.3. What policy instruments were used to achieve the objective?	113
3.3.4. Key factors needed to make something happen	114
3.3.5. What has happened as a result of the policy and instruments that were introduced?	114
3.3.6. List of relevant laws, regulations and rules	115
Annex 4. Glossary	116
Boxes	
Box 1: Definitions of selected greenhouse gas abatement policy instruments	75
Box 2: Examples of standards, regulations, rules and financial incentives used in some countries to promote the deployment of renewable technologies	86
Tables	
Table 1: Examples of renewable energy promotion policies in selected developing countries	87
Table 2: National environmental policy instruments and evaluative criteria	89
Table 3: Relation between NGV price (in std m ³) and gasoline (in liter) at retail level	104
Table 4: Production of electricity in Argentina (GWh/year)	106
Table 5: The value of hydro-electrical production in Brazil, per year	107

Acronyms

ADB	Asian Development Bank	PBE	Brazilian Labelling Program
Annex I	Annex to the Convention listing industrialized and transitioning countries	PFCs	Perfluorocarbons
Annex II	Annex to the Convention, listing mostly OECD countries with additional commitments to assist developing countries with funding and technology transfer	PPP	Public/private partnership
Annex B	Developed Country Parties to the Kyoto Protocol	PROCEL	National Electricity Conservation Program
ASER	Senegalese Rural Electrification Agency	SELO PROCEL	Sub-program of the National Electricity Conservation Program
AWG-KP	Ad Hoc Working Group on further commitments of Annex I Parties under the Kyoto Protocol	SENELEC	National Electricity Company of Senegal
CDM	Clean Development Mechanism	PV	Photovoltaic
CH ₄	Methane	R&D	Research and development
CMP	Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol	RD&D	Research, development and demonstration
CNG	Compressed natural gas	SDPAMs	Sustainable development policies and measures
CO ₂	Carbon dioxide	SENELEC	Senegal National Electricity Company
ENRE	National Electricity Regulatory Board of Brazil	SERCs	State Electricity Regulatory Commission
ESCOs	Energy Service Companies	SEPA	State Environmental Protection Agency
ETS	Emissions Trading Scheme	SF ₆	Sulphur hexafluoride
EU	European Union	TSP	Total suspended particulates
GDP	Gross domestic product	UNDP	United Nations Development Programme
GHG	Greenhouses gas	UNEP	United Nations Environment Programme
H ₂ O	Water vapor	UNFCCC	United Nations Framework Convention on Climate Change (the Convention)
HFCs	Hydrofluorocarbons	WG I	Working Group I (of the IPCC, see above), assesses the literature on the physical science basis of climate change
IEA	International Energy Agency	WG II	Working Group II (of the IPCC, see above), assesses the literature on the impacts, vulnerability and adaptation to climate change
INMETRO	National Institute of Metrology, Standardization and Industrial Quality of Brazil	WG III	Working Group III (of the IPCC, see above), assesses the literature on the mitigation of climate change, i.e., reducing GHG emissions
IPCC	Intergovernmental Panel on Climate Change		
KCI	Kenya Ceramic Jiko	Units and measures	
KP	Kyoto Protocol	GW	Gigawatts (power measurement) = 10 ⁹ Watts
LPG	Liquefied petroleum gas	GWh	Gigawatt hours
MDIC	Ministry of Development, Industry and Foreign Trade of Brazil	K euros	K = 1,000 euros
MNES	Ministry of Non-Conventional Energy Sources	kW	Kilowatts (power measurement) = 1,000 Watts
MNRE	Ministry of New and Renewable Energy	kWh	Kilowatt-hours
N ₂ O	Nitrous oxide	MW	Megawatts (power measurement) = 10 ⁶ Watts
NDRC	National Development and Reform Commission	MWh	Megawatt-hours
NGO	Non Governmental Organization	W	Watt = 1 joule of energy per second
NGV	Natural gas for vehicles		
O ₃	Ozone		
OECD	Organization for Economic Co-operation and Development		

1. INTRODUCTION

There is a rich array of policy instruments being used by developing countries to achieve national objectives, such as, improving local air pollution and reducing poverty. Most of these policies also reduce emissions of greenhouse gases (GHGs). This paper reviews all policy instruments; in particular, the most commonly used policies in developing countries.

Based on the case studies in this paper, these policies are: *regulations, financial incentives, research and development and information instruments*. Financial incentives are indeed the one policy option used in all but one of the cases. As might be expected, large countries such as China and India use a complex set of policies to achieve objectives, while smaller countries tend to have more focused objectives and less complicated policies. Non-climate change policies in developing countries can have a significant effect on GHG emissions. Therefore, any consideration of ways to limit emissions needs to include such policies. A number of factors, including political will, adequate financing, institutional capacity and information, appear to affect the extent to which developing countries are implementing policies that limit the growth of GHG emissions.

The main purpose of this paper is to help policy makers, particularly those in developing countries, think about the national policy instruments needed to contribute to the fight against climate change, how such needs can be articulated in order to seek internal and external financial resources and how these needs may be reflected in negotiations of a future climate change agreement. This paper is an input to a series of workshops which the United Nations Development Programme (UNDP) will organize in developing countries with the aim of improving their capacity to respond to climate change.

The paper gives greater weight to instruments and experience with the renewable energy and energy efficiency sub-sectors, but inferences can be drawn for other sectors. It has borrowed heavily from the Intergovernmental Panel on Climate Change (IPCC) Working Group III (WG III) Chapter 13¹, but has been supplemented with case studies

that focus on the experiences of developing countries, which for the most part have been implemented for non-climate change reasons. Policies that have been in place for more than a decade are contrasted with cases that are still in the experimental stage. Both success stories and failures are included as they provide lessons for others to consider. Questions are included in different parts of the document to help the reader reflect on the circumstances in his/her country. A final section provides insights about the linkage of national policies to the current negotiations over a future climate change agreement.

The responsibilities of all countries to develop national policies are well grounded in the United Nations Framework Convention on Climate Change (UNFCCC). Article 4 of the UNFCCC commits all Parties, taking into account their common but differentiated responsibilities and their specific national and regional priorities, objectives and circumstances, to formulate, implement, publish and regularly update national and, where appropriate, regional programs containing measures to mitigate climate change by addressing anthropogenic emissions of GHGs by sources and removals by sinks. Articles 4.3 and 4.5 of the Convention call for developed countries to provide new and additional financial resources to meet the agreed costs of developing countries in complying with their obligations under the UNFCCC. This includes implementing measures to mitigate climate change by addressing anthropogenic emissions by sources, such as fossil fuel combustion and removals by sinks (UNFCCC 1992).

In addition, Article 11.5 stipulates that developing countries may avail themselves of financial resources related to the implementation of the Convention through bilateral, regional and other multilateral channels. The Kyoto Protocol (KP) also sets up a new mechanism, the Clean Development Mechanism (CDM), under Article 12 that is to help developing country Parties achieve their sustainable development objectives and developed country (Annex B) Parties comply with their qualified emission limitations and reduction commitments under the Protocol (UNFCCC 1998).

2. TYPES OF POLICIES, MEASURES AND INSTRUMENTS

A variety of policies, measures, and instruments are available to national governments to limit the emission of greenhouse gases. These include: regulations and standards, taxes and charges, tradable permits, voluntary agreements, informational instruments, subsidies and incentives, research and development, and trade and development assistance. Box 1 provides a brief definition of

each instrument. Depending on the legal frameworks available to countries, these may be implemented nationally, regionally or locally. They may be supplemented with rules, guidelines and other administrative mechanisms to achieve different goals. They may be legally binding or voluntary and they may be fixed or changeable.

Box 1: Definitions of selected greenhouse gas abatement policy instruments

Regulations and Standards:	Specify abatement technologies (technology standard) or minimum requirements for pollution output (performance standard) to reduce emissions.
Taxes and Charges:	A levy imposed on each unit of undesirable activity by a source.
Tradable Permits:	Also known as marketable permits or cap-and-trade systems. This instrument establishes a limit on aggregate emissions by specified sources, requires each source to hold permits equal to its actual emissions, and allows permits to be traded among sources.
Voluntary Agreements:	An agreement between a government authority and one or more private parties to achieve environmental objectives or to improve environmental performance beyond compliance to regulated obligations. Not all voluntary agreements are truly voluntary; some include rewards and/or penalties associated with joining or achieving commitments ² .
Financial Incentives:	Direct payments, tax reductions, price supports, or the equivalent from a government to an entity for implementing a practice or performing a specified action.
Information Instruments:	Required public disclosure of environmentally related information, generally by industry to consumers. Includes labelling programs and rating and certification.
Research and Development (R&D):	Direct government spending and investment to generate innovation on mitigation, or physical and social infrastructure to reduce emissions. Includes prizes and incentives for technological advances.
Non-Climate Policies:	Other policies not specifically directed at emissions reduction but that may have significant climate-related effects.

Note: Instruments are defined above that directly control GHG emissions. Instruments may also be used to manage activities that indirectly lead to GHG emissions, such as energy consumption.

Questions:

- Which policy instruments have been used in your country to achieve environmental, energy, or related objectives? Have they been successful?
- What are the three most important reasons for their success and failure?
- In your opinion, what would it take to ensure more widespread success?

¹ Gupta, S., D. A. Tirpak, N. Burger, J. Gupta, N. Höhne, A. I. Boncheva, G. M. Kanoan, C. Kolstad, J. A. Kruger, A. Michaelowa, S. Murase, J. Pershing, T. Sajjo, A. Sari, 2007: Policies, Instruments and Co-operative Arrangements. In *Climate change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [B. Metz, O. R. Davidson, P. R. Bosch, R. Dave, L. A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

² Voluntary Agreements should not be confused with voluntary actions which are undertaken by sub-national governments, corporations, NGOs and others independent of national government authorities.

3. EVALUATING AND SELECTING POLICY INSTRUMENTS

The policy-making process of most governments involves complex choices involving many stakeholders. These include the potential regulated industry, suppliers, producers of complementary products, labor organizations, consumer groups and environmental organizations. The choice and design of virtually any instrument has the potential to benefit some and to harm others. For example, standards set at a high level may be achievable by large firms, but not by small or new firms entering the market. Voluntary measures, often favored by industry because of their flexibility and potentially lower costs, are in many cases opposed by environmental groups because of their lack of accountability and enforcement.

In formulating a domestic climate policy program, a combination of policy instruments may work better than relying on a single instrument. Also, the design of instruments may need to consider how they interact with existing institutions and regulations in other sectors of society. When comparing instruments, adjusting for different levels of stringency is important. For all the instruments discussed in this paper stringency may be set at different levels. Over time, all instruments need to be monitored, adjusted and enforced. Furthermore, an instrument that works well in one country may not work well in another country with different economic circumstances, social norms and institutions.

The IPCC identifies four principal criteria by which environmental policy instruments can be evaluated:

- **Environmental effectiveness:** the extent to which a policy meets its intended environmental objective or realizes positive environmental outcomes. The main goal of environmental policy instruments is to reduce the negative impacts of human action on the environment. Policies that achieve specific environmental quality goals better than alternatives can be said to have a higher degree of environmental effectiveness. The environmental effectiveness of policies depends on design, implementation, participation, stringency and compliance. While climate protection may be the main goal, any given policy may have other environmental and societal benefits.
- **Cost-effectiveness:** the extent to which the policy can achieve its objectives at minimum cost to society. There are many components of cost, including the direct costs of administering and implementing the policy, as well as indirect social costs, which are more

difficult to measure. Cost-effectiveness can be enhanced by limiting the creation of new institutions and keeping implementation procedures as simple as possible while preserving the integrity of the approach.

- **Distributional considerations:** the extent to which a policy is perceived to be fair and equitable and whether it has distributional consequences. Policies rarely apportion environmental benefits and costs evenly across stakeholders. Even if a policy meets an environmental goal at least cost, it may face political opposition if it disproportionately impacts, or benefits certain groups, within a society or across generations. However, equity and fairness may be perceived differently, depending on the cultural background of the observer.
- **Institutional feasibility:** the extent to which a policy instrument is likely to be viewed as legitimate, gain acceptance, and be adopted and implemented. Environmental policies that are well adapted to existing institutional constraints have a high degree of institutional feasibility; however, institutional realities can constrain environmental policy decisions. Policies that are not acceptable to a wide range of stakeholders and supported by institutions, notably the legal system may not prove successful. Other important considerations include human capital, bureaucratic infrastructure as well as the dominant culture and traditions. The decision-making style of each nation is therefore a function of its unique political heritage.

Governments often use other evaluation criteria, such as “Does it meet our sustainable development strategy?”, “Will it help to reduce poverty?” and “Will it help to provide new jobs or stimulate a new industry?”. Most of such criteria can fit into one of the above four criteria. These criteria can be used in advance to select a policy or afterwards to evaluate the results of a policy.

The case studies in the Annexes provide some insights into the approaches used by governments and the constraints they face, but they do not pretend to assess the criteria that shaped government decisions. However, several of the case studies exemplify situations where explicit multiple policies were (and are being) used successfully to achieve national objectives. For example, in promoting energy efficiency programs China has used regulations, financial incentives, R&D, and information instruments to achieve its objectives. Kenya, over a long

period, with support from others, has used R&D, financial incentives and information instruments to develop and disseminate improved cook stoves, and India has used a combination of instruments to encourage the deployment of wind power. Several of the case studies relied almost solely on financial incentives, e.g., the promotion of wind power in Argentina and natural gas vehicles in Bolivia. Only one of the case studies, i.e., the case of the energy efficiency labelling program in Brazil, contains an example of a voluntary agreement with industry. (For additional information on the interaction of policies see Section 5.8.)

Questions:

- How are policy decisions made in your country?
- What decision criteria are used and how are they weighted?
- How could the policy-making process be improved and what technical and financial support would be needed to make that happen?
- What institutional arrangements would help to improve policy design and decision making related to climate change?

4. NATIONAL CLIMATE AND RELATED POLICY INSTRUMENTS

Addressing climate change requires actions that range from purely technological (such as fuel switching) to purely behavioral (such as reducing vehicle kilometres travelled) and mixes of technological and behavioral actions. Triggering the implementation of such actions usually requires the adoption of some form of policy instruments which are considered below.

4.1 Regulations and standards

Regulatory standards are the most common form of environmental regulation, covering a wide variety of approaches. A regulatory standard specifies with some precision the action that a firm or individual must take to achieve environmental objectives. This could include specifying technologies or products to use or not use, general standards of performance, as well as dictates on acceptable and unacceptable behavior. The primary advantage of a regulatory standard is that it may be tailored to an industry or firm, taking into account the specific circumstances of that industry or firm. There is also a more direct connection between the regulatory requirement and the environmental outcome. This can provide some degree of certainty.

Two broad classes of regulatory standards are technology and performance standards. **Technology standards** mandate specific pollution abatement technologies or production methods, while **performance standards** mandate specific environmental outcomes per unit of product.

For example, a technology standard might mandate specific carbon dioxide (CO₂) capture and storage methods on a power plant. Technology standards involve the regulator stipulating the specific technology or equipment that the polluter must use. Technology standards are best used when there are few options open to the polluter for controlling emissions and thus the regulator is able to specify the technological steps that a firm should take to control pollution. The information needs for technology standards are high: the regulator must have good information on the abatement costs and options open to each firm. Losses in cost effectiveness arise when regulators are less well informed. Technology standards may be applied uniformly to a variety of firms, rather than tailoring the standard to the circumstances of

the firm. This raises costs without improving environmental effectiveness and is one of the main drawbacks to regulatory standards.

A performance standard would limit emissions to a certain number of grams of CO₂ per kWh of electricity generated or require, for example, refrigerators to operate at a specified level of efficiency. A technology-forcing standard would involve setting the refrigerator efficiency requirement slightly beyond technological feasibility, but announcing that the efficiency requirement will not go into effect until a number of years after announcement. Performance standards often provide more flexibility than technology standards. Costs can generally be lower whenever a firm is given some discretion in how it meets an environmental target. Performance standards expand compliance options beyond a single mandated technology and may include process changes, reducing output, changes in fuels or other inputs, and selecting alternative technologies. Despite this increased flexibility, performance standards also require well-informed and responsive regulators.

One problem with regulatory standards is that they do not give polluters incentives to develop more effective technologies. Moreover, firms may be discouraged from finding more effective technologies out of fear that standards will be subsequently tightened. Finally, although it may be possible to force some technological change through technology mandates, it is difficult for regulators because they often do not have access to corporate data to determine the amount of change that is possible at a reasonable economic cost. This raises the possibility of either costly, overly stringent requirements or weak, unambitious requirements.

Although relatively few regulatory standards have been adopted solely to reduce GHG emissions, standards have been adopted that reduce these gases as a co-benefit. For example, there has been extensive use of standards to increase energy efficiency in over 50 nations (IPCC 2001b). Energy efficiency applications include fuel economy standards for automobiles, appliance standards, and building codes³. Standards to reduce methane and other emissions from solid waste landfills have been adopted in Europe, the United States, and other countries. These standards are often driven by multiple factors,

including the reduction of volatile organic compound emissions, improved safety by reducing the potential for explosions, and reduced odours for local communities.

In many cases, countries simply pass laws that mandate industry to do certain things.⁴ For example, targets for future shares or amounts of renewables exist in 58 countries, of which 13 are developing countries. Thirty-six countries have developed feed-in tariff policies; 44 countries, states and provinces have enacted renewable performance standards; and mandates for blending bio-fuels have been enacted in 11 developing countries in Latin America and Asia (UNEP 2007).

Whether regulatory standards or economic instruments are preferable for developing countries is a matter of some discussion. One common view is that technology standards may be more appropriate for building initial capacity for emissions reduction because economic incentive programs require more specific and greater institutional capacity, have more stringent monitoring requirements, and may require fully developed market economies to be effective (IPCC 2001). Some authors suggest that a transitional strategy is appropriate for developing countries, whereby technology standards are introduced first, followed by performance standards and then experimentation with economic instruments.

The case studies in the Annexes demonstrate the complex array of approaches used by developing country governments. In some cases, laws stipulate both the goal and the means to achieve the goal. In other cases, government ministries are empowered to implement the law by designing and issuing regulations. Interestingly, all of the case studies used some form of financial incentives to motivate industry or consumers to change behavior. Where incentives have been poorly designed – either because of limited information and/or when they have not been evaluated/revised – the results have been poor. It is difficult to draw conclusions about whether countries with fully developed market economies are better or worse in employing financial instruments or regulations as both situations are represented by the cases.

Questions:

- Does your country have regulations or standards to promote energy efficiency or renewable energy?
- In the case of renewable energy, what combination of national, state and local laws would be required?
- Do your country's investment policies encourage or limit investments in renewable energy or energy efficiency measures?
- What specifically has to change or what new actions are needed to promote energy efficiency or renewables?
- What type of assistance would be necessary to expand or introduce energy efficiency measures and renewable energy?

4.2 Taxes and charges

Taxes are usually imposed by governments to raise revenue for the common good or to discourage the consumption of things that are perceived to be bad or lead to long-term societal costs. An emission tax on GHG emissions requires individual emitters to pay a fee, charge, or tax⁵ for every tonne of GHG released into the atmosphere. An emitter must pay this per-unit tax or fee regardless of how much of an emission reduction it undertakes. Each emitter weighs the cost of emissions control against the cost of emitting and paying the tax; in the end, polluters undertake emission reductions that are cheaper than paying the tax, but do not undertake those that are more expensive (IPCC 2001, Section 6.2.2.2). Taxes and charges are commonly leveled on commodities that are closely related to emissions, such as energy or road use.

Taxes and fees levied on imports and exports can also affect emissions by limiting the availability of GHG friendly products and equipment in different countries. Trade ministers from a number of countries met for the first time in Bali in 2007 to discuss what could be done to support the UNFCCC thorough efforts to remove import duties that restrict the flow of goods that could reduce GHG emissions.

³ See China case study (Annex 1.2) for examples.

⁴ China, in an attempt to mitigate GHG emissions, has set mandatory quantified targets for 2010 (See Annex 1.2 for additional details): reduce the consumption of energy for every 10,000-yuan of gross domestic product from 1.22 tons of standard coal equivalent in 2005 to below one ton – a reduction of 20%; raise the share of renewable energy in the primary energy supply to 10% (from 7% in 2005); extract 10 billion m³ of coal-bed methane; cap nitrous oxide emissions from industrial processes at the 2005 level; increase the forest coverage rate to 20%; and increase the carbon sink by 50 million tons over the 2005 level.

⁵ No distinction is made here among the terms taxes, fees, and charges. In actuality, the revenue from taxes may go into the general government coffers whereas the revenue from fees or charges may be earmarked for specific purposes.

An **emissions tax** provides some assurance regarding the marginal cost of pollution control, but it does not ensure a particular level of emissions. Over time, an emissions tax needs to be adjusted for changes in circumstances, like an international treaty, inflation, technological progress, and new emissions sources. Fixed emissions charges in the transition economies of Eastern Europe, for example, have been significantly eroded by the high inflation of the past decade. Innovation and invention generally has the opposite effect, reducing the cost of emissions reductions and increasing the level of reductions made. If the tax is intended to achieve a given overall emissions limit, the tax rate will need to be increased to offset the impact of new sources.

Most **environmentally related taxes** with implications for GHG emissions in OECD countries are levied on energy products (150 taxes) and on motor vehicles (125 taxes), rather than on CO₂ emission directly. There is also a significant number of waste-related taxes in many countries (about 50 taxes in all), levied either on particular products that can cause particular problems for waste management (about 35 taxes), or on various forms of final waste disposal, i.e., on incineration and/or land-filling (15 taxes in all).

A very significant share of all the revenues from environmentally related taxes arises from taxes on motor fuels. Such taxes were introduced many decades ago, primarily as a means to raise revenue or to pay for road construction programs. Regardless of that, they do impact car users face, and thus they do have environmental and social impacts. They may affect the size of the cars and how extensively they are used by consumers, but may have disproportionately negative financial impacts on some drivers, such as, those in rural areas and with low incomes who depend on cars to travel to work. In some countries, subsidized gasoline and diesel encourage consumer's choice of cars and driving habits, often to the detriment of the environment. One example of the use of a tax is that of Bolivia, which has a policy of maintaining a fixed differential price (based on tax reduction) between gasoline and natural gas for vehicles (NGV). Since 1992 the NGV price has been linked to the price of gasoline at around 50% of the retail price as a means to encourage consumers to modify their vehicles to use natural gas. (See Annex 2.1 for more details.)

There is some experience with **CO₂ taxes** in a number of OECD countries, e.g., Norway and the United Kingdom.

To implement a domestic emissions tax, governments must consider a number of issues, such as the level the tax should be set, particularly in the case of pre-existing taxes (e.g., taxes which already exist on energy) or other distortions (e.g., subsidies to certain industries or fuels). Consideration must also be given to how the tax is used, i.e., whether it goes directly into general government coffers, is used to offset other taxes (i.e., the double-dividend effect), is transferred across national boundaries to an international body, is earmarked for specific abatement projects like renewable energy, or is allocated to those most adversely impacted by either the costs of emission reduction or damage from climate change. Another important issue is the point at which the tax is levied. A tax on gasoline may be levied at the pump and collected directly from consumers or it may be levied on wholesale gasoline production and collected from oil companies. Emissions or energy taxes often fall disproportionately on the poor, creating negative distributional consequences. In developing countries, institutions may be insufficiently developed for collection of emission fees from a wide variety of dispersed sources. (See, for example, the discussion of institutions in China in Annex 1, Section 1.2.)

Questions:

- Does your country have a tax on energy, including gasoline? Why was it established? Has it been changed since it was introduced? How is it collected and what use is made of the revenue?
- Does your country have a tax on cars or tolls on roads? Why was it established and how was the tax determined?
- What information and assistance would be required if your country wanted to establish a tax on energy or products that use energy?

4.3 Financial incentives

Direct and indirect subsidies can be important environmental policy instruments, but they have strong market implications and may increase or decrease emissions, depending on their nature. Financial incentives to reduce emissions can take different forms ranging from support for R&D, investment tax credits, low interest loans, rebate programs and price supports, e.g., feed-in tariffs for renewable electricity. Subsidies that increase emissions typically involve support for fossil fuel production and consumption. They tend to expand the subsidized industry, relative

to the non-subsidy case. If the subsidized industry is a source of greenhouse gas emissions, subsidies may result in higher emissions. Subsidies to the fossil fuel sector result in over-use of these fuels with resulting higher emissions; subsidies to agriculture can result in expansion of agriculture into marginal lands and corresponding increases in emissions. Conversely, incentives to encourage the diffusion of new technologies, such as for renewables or nuclear power, may promote emissions reductions.

One of the significant advantages of subsidies is that they have politically positive distributional consequences (see, for example, the case of Senegal in Annex 3, Section 3.2, which is subsidizing the distribution of compact fluorescent lights in rural villages). The costs of subsidies are often spread broadly through an economy whereas the benefits are more concentrated. This means that subsidies may be easier to implement politically than many other forms of regulatory instruments. However, subsidies do tend to take on a life of their own, making it difficult to eliminate or reduce them, should that be desired.

One of the most effective incentives for fostering GHG reductions are the **price supports associated with production of renewable electricity**⁶. These price supports tend to be set at attractive levels and have resulted in significant expansion of renewable energy in OECD countries. They require electric power producers to purchase such electricity at favorable prices. In Europe, specific prices have been set at which utilities must purchase renewable electricity—these are referred to as **“feed-in tariffs”**⁷. These tariffs have been effective at promoting the development of renewable sources of electricity, expansion of the industry and creation of new jobs. As long as renewables remain a relatively small portion of overall electricity production, consumers see only a small increase in their electricity rates as in the case of Germany. Incentives, therefore, have attractive properties in terms of environmental effectiveness, distributional implications and institutional feasibility.

In India (see the case study in Annex 1.1), incentives

provided by the government include:

- 80% accelerated depreciation of project costs for wind power projects (in the initial stages 100% accelerated depreciation was allowed);
- Concessions or full exemption on customs duties of certain imported components of wind turbines;
- Tax holiday for a maximum of 10 consecutive years within 15 years of commissioning; and
- Concessional loans available through Government-owned agencies.

The Indian Electricity Act, 2003 requires all state-level energy regulatory commissions to ensure that electricity distributors procure a specified minimum percentage of power generation from renewable energy sources. The result of these and other measures has enabled India to develop an industry that competes with the largest companies in the world. The main problem with some financial incentives is cost-effectiveness as there are often energy efficiency savings available at a far lower cost to society. Also, if the feed-in tariff (or subsidy) is set too low by a national law as described in the case study of wind power in Argentina (See Annex 2, Section 2.2), it will be ineffective instrument for encouraging the installation of wind turbines.

The level of subsidies in developing and transition economy countries is generally considered to be higher than in member countries of the Organisation for Economic Co-operation and Development (OECD). One example is low domestic energy prices that are intended to benefit the poor, but which often benefit high users of energy. The result is increased consumption and delayed investments in energy efficient technologies. In India kerosene and LPG subsidies are generally intended to shift consumption from biomass to modern fuels, reduce deforestation and to improve indoor air quality, particularly in poor rural areas. In reality, these subsidies are largely used by higher expenditure groups in urban areas, thus having little effect on the use of biomass. In the

⁶ Based on personal communications from the UNEP office in Paris, the renewable industry is estimated to have grown to \$150 billion in 2007, largely as a result of regulatory and financial measures in some countries.

⁷ The “Feed-in Law” in Germany permits customers to receive preferential tariffs for solar generated electricity depending on the nature and size of the installation. Under the new tariff structure introduced in 2004, the base level of compensation for ground-mounted systems can be up to 45.7 euro cents/kWh. Photovoltaic (PV) installations on buildings receive higher rates of up to 57.4 euro cents/kWh. In May 2008, the government agreed that subsidies for roof top solar PV systems will be reduced annually by 8% from 2009 to 2010 and then by 9% annually from 2011 onwards. Currently these subsidies are subject to reductions of 5% per year.

Dominican Republic subsidies intended for cooking gas go in practice to owners of cars that run on natural gas.⁸

More recently, high global oil prices have led some countries to reconsider their national energy policies, including the subsidies for gasoline. Some developed countries have faced strikes by truckers and other groups calling for governments to reduce taxes or compensate high consumption groups. Some developing countries who are attempting to reduce subsidies for gasoline have also faced protests. Attempts to remove/increase subsidies need to be done cautiously, in the absence of substitutes and a long-term energy plan.

Questions:

- Are fossil fuels subsidized in your country?
- Have attempts been made to reduce subsidies and what was the result? What lessons might be applied from this experience?
- Would information on the experience of others be helpful to your government?
- Does your government provide any financial incentives to promote renewable energy? What form of financial incentives would be most likely to succeed? What would your government need to make a program of financial incentives a success?

4.4 Voluntary Agreements

Voluntary agreements are agreements between a government authority and one or more private parties to achieve environmental objectives or to improve environmental performance beyond compliance to regulated obligations. They tend to be popular with industry and can be used when other instruments face strong political opposition. Voluntary agreements can take on many forms with varying levels of stringency and while all voluntary agreements are “voluntary”, some may involve incentives (rewards or penalties) for participation. Firms may agree to direct emissions reductions or to indirect reductions through changes in product design.

The benefits of voluntary agreements for individual companies and for society may be significant. Firms may enjoy lower legal costs, can enhance their reputation, and may improve their relationships with society and shareholders. Societies gain to the extent that firms translate

goals into concrete business practices and persuade other firms to follow their example. Often, negotiations to develop Voluntary agreements raise awareness of climate change issues and potential mitigative actions within industry to establish a dialog between industry and government, and help to move industries towards best practices.

There are widely differing views as to the environmental effectiveness of voluntary agreements. Some governments, as well as industry, believe voluntary agreements are effective in reducing GHG emissions. Agreements in the Netherlands have resulted in improvements in energy efficiency beyond what would have occurred in the absence of such agreements; that is on average, between a quarter and a half of the energy savings in the Dutch manufacturing industry can be attributed to the policy mix of the agreements and supporting measures.

Others are more sceptical about the efficacy of voluntary agreements in reducing emissions. Independent assessments of voluntary agreements, while acknowledging that there have been absolute emission improvements brought about by investments in cleaner technologies, indicate that there is little improvement over business-as-usual scenarios, as these investments would have probably happened anyway.

The best voluntary agreements include a clear goal and baseline scenario; third party participation in the design of the agreement; description of the parties and their obligations; a defined relationship with the legal and regulatory framework; formal provision for monitoring, reporting, and independent verification of results at the plant level; a clear statement of the responsibilities expected to be self-financed by industry; commitments in terms of individual companies, rather than as sectoral commitments; and references to sanctions or incentives in the case of non-compliance. While imposing lower costs on industry they require dedicated government resources to be effective. It is the case that voluntary agreements fit into the cultural traditions of some countries better than others. Japan, for instance, has a history of cooperation between government and industry which facilitates the operation of “voluntary” programs.

The Brazilian labelling program (PBE) described in Annex 2, Section 2.3 represents both a voluntary agreement

and an information instrument. It aims to provide information to consumers to facilitate optimizing consumption of electricity in domestic appliances, choose more efficient appliances in terms of energy consumption and improve use of those appliances allowing the saving of energy costs. Participation in the program is voluntary and testing of the appliances is only on products made by manufacturers and facilities that are willing to participate in the PBE. On the basis of the outcome of the tests made a scale was created to classify appliances and those tests are repeated periodically to update the scale. Those appliances that are tested and labelled showing the best performance in their class may also receive an energy efficiency endorsement (SELO PROCEL), given to the best products on the basis of specific energy consumption. The SELO PROCEL program also contributed for the implementation of the PBE by creating measurement infrastructure.

The Brazilian program contained a number of elements listed above for a good voluntary agreement, i.e., there was an adequate regulatory framework, appropriate institutional arrangements between governmental institutions and the companies, economic and technical resources, including investment in laboratories to measure performance and compliance with required standards and a dissemination plan and capacity building.

Questions:

- Would voluntary agreements fit with the current policy environment in your country and be a means of educating industry about climate change and opportunities for energy efficiency?
- If so, which industry is likely to be a test case for a voluntary agreement? What would be the main elements of such an agreement?
- What would it take to launch and maintain such an activity in your country?

4.5 Information instruments

There is an array of instruments (television, newspapers, internet, workshops and educational forums) that can inform the public about climate change, the local benefits of different actions and possible ways they can help to reduce emissions. More specific information instruments – such as public disclosure requirements and awareness/education campaigns – may help consumers to make choices that may lead to improved environmental quality or reductions in energy use. Examples of information instruments

include labelling programs for consumer products, information disclosure programs for firms, or public awareness campaigns. Some of the most frequently used instruments are labels denoting the automobile gas consumption and labels denoting the consumption of energy and its cost for different electrical appliances.

Information instruments can be used to improve the effectiveness of other instruments. They are popular with industry because they do not impose penalties for environmentally harmful behavior per se. They may also be less expensive than other instruments. However, it is difficult to measure the environmental effectiveness or cost effectiveness of information instruments (*See the case studies on Brazil, Kenya and China in the Annexes for examples of how different countries are using information instruments.*).

Questions:

- Have information instruments been used in your country to educate and inform the public about the environmental consequences or energy consumption and costs?
- Do you think a labelling program for some sectors would be useful in your country?
- What assistance would you need to make that happen?

4.6 Tradable permits

Tradable permit systems have been or are being implemented in a number of OECD countries. This paper does not go into depth with regard to such systems because relatively few developing countries are currently contemplating such an instrument. However, if such systems allow for the introduction of emission offsets, such as those from CDM projects in developing countries, their design features may be of interest to developing countries.

Briefly, a number of analyses as documented in IPCC 2007 have found that economy-wide approaches are superior to sectoral coverage because they equalize marginal costs across the entire economy. They find significant cost savings to an economy-wide program when compared to a sectoral program coupled with non-market-based policies in the United States and the European Union.

Permits may be allocated directly to emitters, such as energy-using industrial facilities (**downstream**) or to producers or processors of fuels (**upstream**), or to some combination of the two (a **“hybrid system”**). There are

⁸ According to Marino Inchaustegui, the former Finance Minister of Dominican Republic.

two basic options for the initial distribution of permits: free distribution of permits to existing polluters or auctions. Auctions provide a source of revenue that could potentially address inequities brought about by a carbon policy, creating equal opportunity for new entrants, and avoiding the potential for “windfall profits” that might accrue to emissions sources if allowances are allocated at no charge. Government revenues from auctions may be used to address equity issues through reductions in taxes or other distributions to poor households. Recently, Germany has indicated that it will use a portion of its auction proceeds to fund adaptation projects in developing countries.

Although a tradable permits approach can ensure that a certain quantity of emissions will be reduced, it does not provide certainty of price. **Price uncertainty** may be addressed by a “price cap” or “safety valve” mechanism, which guarantees that the government will sell additional permits if the market price of allowances hits a certain price. The reasoning is that GHGs are of concern as they accumulate over an extended period in the atmosphere. There may therefore be less concern about short-term increases in CO₂ as long as the overall trajectory of CO₂ emissions is downward over an extended period. While no current emissions trading scheme (ETS) has initiated a price cap, such an approach could have long-term implications for the price of emission offsets. (For a more expansive consideration of emission trading systems, including different types of targets, banking and borrowing provisions, enforcement requirements and the European Union’s ETS, see the IPCC 2007 report.)

There have been several experiments with tradable permits for conventional pollution control in developing countries and economies in transition. For example, there was an experiment with tradable permits for total suspended particulates in Santiago, Chile, which revealed that the permit market was underdeveloped due to high transaction costs, uncertainty, and poor enforcement, but that such a system improved documentation of historic emissions inventories and increased flexibility to address changing market conditions. Several analysts have suggested that strengthening the monitoring and enforcement capacity that would be required to imple-

ment conventional pollution trading programs in most developing countries.

The tradable permit systems developed or under construction in OECD countries all permit some form of offsets for credits generated through either domestic projects or the international mechanisms such as CDM of the Kyoto Protocol. Under the CDM, more than 3,000 projects are in the pipeline of which 1,090 are registered.⁹ However, there is an uneven distribution of CDM projects by type, gas and country as documented in IPCC 2007. Ellis and Kamel (2007) have identified a number of barriers to CDM projects, including:

- *National-level barriers not related specifically to the CDM*, such as the policy or legislative framework within which a CDM project operates, e.g., electricity-related regulations that constrain generation by independent power producers;
- *National-level CDM-related barriers* such as institutional capability/effectiveness or lack of awareness about CDM potential. For example, delays in host country approval of CDM projects can dampen interest in CDM project development;
- *Project-related issues* including availability (or not) of underlying project finance, or other country or project-related risks that render the performance of the project uncertain;
- *International-level barriers* such as constraints on project eligibility (e.g., on land use and forestry projects), available guidance and decisions (e.g., with respect to the inclusion of carbon capture and storage projects).

Barriers to CDM development can arise at different parts of the CDM project cycle. The relative importance of particular barriers varies between countries as well as over time. A combination of factors is needed to drive growth in a country’s CDM activity. This includes the presence of attractive CDM opportunities, a positive investment climate, and an enabling policy and legislative framework (in general, as well as CDM-specific). Some barriers to CDM development can be reduced relatively simply and cheaply. These include CDM-specific actions such as establishing a simple, timely and transparent CDM project approval process and a clear policy on

CDM-relevant issues such as ownership of CDM credits or the national-level eligibility of certain project types. Other, more general, actions can also help to reduce barriers. These include reducing participation/ownership restrictions on foreign investment and ownership in sectors liable to CDM investments.

Questions:

- Does your country have a clear legal framework and process for CDM projects?
- If your country has not been able to develop a CDM project, what are the main domestic issues that need to be clarified?
- Are there specific ‘immediate’ actions that the CDM Executive Board could take to facilitate the development of CDM projects in your country?
- What additional steps might be addressed through the negotiations to facilitate the development of projects?

4.7 Research and development

The need for R&D in changing the trajectory of the energy emissions is unquestionable. The IPCC (2007) notes that the range of stabilization levels assessed can be achieved by deployment of a portfolio of technologies that are currently available and those that are expected to be commercialized in coming decades. However, it also notes that investments in and world-wide deployment of **low-GHG emission technologies**, as well as technology improvements through public and private research, development & demonstration (RD&D) would be required for achieving stabilization targets as well as cost reduction. The lower the stabilization levels are, especially those of 550 ppm CO₂-eq or lower, the greater the need for more efficient RD&D efforts and investment in new technologies during the next few decades will be. For some high risk technologies government support will clearly be needed.

Governments in OECD countries, which account for most energy research, use a number of tools to support R&D, such as grants, contracts, tax credits and allowances, and public/private partnerships. Total public funding for energy technologies in IEA countries in the period 1987-2002 was \$291 billion, with 50% allocated to nuclear fission and fusion, 12.3% to fossil fuels and 7.7% to renewable energy technologies. Funding has dropped after the initial interest created through the oil shock in the 1970s and has stayed constant, even after the

UNFCCC was ratified. The capacity of developing countries to pursue R&D programs in the main depends on the size of their economies and status of their institutions, but is generally more limited.

Many countries pursue technological R&D as a national policy to foster the development of innovative technologies or help domestic industries to be competitive. Countries chose to cooperate with each other in order to share costs, spread risks, avoid duplication, access facilities, enhance domestic capabilities, support specific economic and political objectives, harmonize standards, accelerate market learning and create goodwill. Cooperation, however, may increase transaction costs, require extensive coordination, raise concerns over intellectual property rights (IPRs) and foreclose other technology pathways. It may also be a path to reducing tension over IPRs if developing countries participate from the beginning as equal partners in an R&D program.

Analysts have examined several policy options to promote renewables. They indicate that research subsidies are an expensive way to achieve emission reductions, in the absence of higher prices. A specific example arises from the Danish experience with wind technologies. In that case, despite significant support for wind energy R&D during the 1980s, wind power only boomed in Denmark when favorable feed-in tariffs were introduced, procedures for construction were simplified and priority was given for green electricity. Others have found that the ability to raise capital and take risks has played a much larger role in the recent expansion of the photovoltaic industry than other factors such as learning by experience.

Questions:

- Does your government support any R&D programs that aim to develop or deploy GHG mitigation technologies? If so, what sectors or technologies are of particular interest?
- What means does it use to share information and results with other governments?
- What would be necessary to enable your government to participate in a cooperative international program?

⁹ As of June 24, 2008. See: www.unfccc.int.

4.8 Non-climate change policies and other national priorities

A number of non-climate national priorities and policies can have an important influence on GHG emissions. These include: policies that focus on poverty, land use and land use change, energy supply and security; international trade, air pollution, structural reforms, and population policies. These non-climate policies could offer countries an opportunity to assess and develop synergistic sustainable development strategies at a time of limited financial and human resources in developing countries.

For example, **poverty** reduces the resilience of vulnerable populations and makes them more at risk to the potential impacts of climate change, but it also leads communities to take measures that may increase emissions. If poverty can be reduced without raising emissions, a strategy to reduce poverty will be seen as a way to reduce emissions as well as enhance resilience. Typical areas of synergy included small-scale renewables and community forestry. The case study of efficient cook stoves in Kenya (*Annex 3.1*) is an example of how the climate may benefit from efforts to improve the lives of the poor, reduce local air pollution, and reduce wood consumption.

Land use policies (or lack thereof), whether terrestrial (agriculture, forestry, nature), aquatic (wetlands) or urban, can lead to enhanced emissions. Policies that aim to integrate climate change concerns with those of local people may yield major synergies. For example, within the Netherlands, a major program is currently underway to understand how spatial planning and climate change policy can be effectively linked. Regional (acid rain abatement), local and indoor air pollution policies can also have climate change co-benefits.

Consumption of natural resources is ultimately one of the major drivers of global emissions. The global population and income levels affect the consumption of natural resources, particularly energy, food and fiber, and hence can also affect GHG emissions. Consumption patterns vary significantly between developed and developing countries. The IPCC 2007 notes that changes in lifestyle and behavior patterns can contribute to climate change mitigation across all sectors and lifestyles and that consumption patterns that emphasize resource conservation can contribute to developing a low-carbon economy that is both equitable and sustainable. It further notes, among several examples that management practices,

education and training programs, and industrial management tools can affect consumption patterns.

4.8.1. National policy interactions/linkages and packages

Single instruments are unlikely to be sufficient for many environmental problems, including climate change mitigation; rather it is likely to take a portfolio of policies (*see IPCC, 2001*). However, the application of two or more overlapping instruments could diminish economic efficiency while increasing administrative costs. In practice, however, there are market failures that make a mix of instruments desirable. We note for example, that the rapid increase in renewable investments has come about largely because of a combination of regulations and financial incentives shown in Box 2. Also to be noted, the lists in Box 2 contain a combination of regulations, standards, and rules at different levels of government. Vertical policy integration is an important requirement to overcome many implementation barriers as demonstrated by the developing countries with multiple policies in Table 1 and by the case studies.

Box 2: Examples of standards, regulations, rules and financial incentives used in some countries to promote the deployment of renewable technologies

Regulations, standards and rules:
Renewable Performance Standards
Performance standards for new facilities
Green power purchasing requirements
Interconnection standards
Net metering rules
Generation disclosure rules
Contractor licensing
Equipment certification
(Solar) access laws/guidelines/zoning codes/building permits
Financial incentives:
Feed in tariffs
Rebates
Grant programs
Loan programs
Bonds
Production incentives
Government purchasing programs
Equity investments, including venture capital
Insurance programs

Source: Adapted from DSIRE website <http://dsireusa.org/Index.cfm?EE=0&RE=1>

Table 1: Examples of renewable energy promotion policies in selected developing countries

Country	Feed-in tariff	Renewable portfolio standard	Capital subsidies, grants, or rebates	Investment excise, or other tax credits	Sales tax, energy tax, or VAT reduction	Tradable renewable energy certificates	Energy production payments or tax credits	Net metering	Public investment, loans, or financing	Public competitive bidding
Argentina			X				X			
Brazil	X								X	
China	X		X	X	X				X	X
Guatemala				X						
India	(*)	(*)	X	X	X				X	X
Indonesia	X									
Mexico								X	X	
Morocco										
Nicaragua	X			X						
Philippines				X	X				X	
Sri Lanka	X									
Thailand	X	X	X					X		
Turkey	X		X							
Vietnam										

Source: Erik Martinot

There are several requirements for applying an environmentally and economically effective instrument mix. First, there is a need to have a good understanding of the environmental issues to be addressed. In practice, many environmental issues can be complex. A tax can affect the total demand for a product and the choice between different product varieties, but is less suited to address, for example, how a given product is used and when it is used. Hence, other instruments could be needed. A second requirement is to have a good understanding of the links with other policy areas. In addition to coordinating different environmental policies, co-ordination with other related policies and consistency among policy goals is needed. A third requirement is to have a good understanding of the interactions between the different instruments in the mix. In this regard, depending on their designs, modelling tools can provide some insights into policy interactions. Finally, the exchange of information among ministries is essential to the implementation of good policies. (*See IPCC 2007 for a more elaborate discussion of when a combination of policies may be desirable.*)

4.8.2. Institutions

A number of the case studies in the Annexes point to the need for well-functioning institutions and/or, when none are present, for reforms. Such was the case of Senegal, which, when faced with the need to provide greater access to electricity for the poor, passed new laws that liberalized the electricity sector, set up a commission to develop regulations, created the Senegalese Rural Electrification Agency dedicated to the implementation of the rural electrification policy, and allowed the creation of Public/Private Partnerships. Other countries such as China, with its heavily centralized institutions, are reorganizing, downsizing, and decentralizing over-burdened institutions. In China's case, the institutional capacities at the provincial and county level are very weak. China recognizes this issue. To strengthen the system, the energy bureau within the National Development and Reform Commission was upgraded to a State Bureau of Energy in March 2008.

The lessons from these and other case studies is that if national policies are to be well designed and implemented

effectively, strong institutions are needed. The cases demonstrate that there are still substantive needs for institutional capacity building at both central and local levels in most developing countries for the smooth implementation of policies.

Questions:

- Can you identify the non-climate national policies that are likely to have the greatest impact on GHG emissions in your country?
- Is there a way to quantify the effects of a possible change in policy over the next 10-20 years? What would it take to implement such a policy?
- Given your knowledge of the policies in your country and reflecting on the case studies in the Annexes, what additional local, state or national policies, institutions, financing and/or other arrangements are needed to promote renewable/energy efficiency in your country?

5. ASSESSING POLICY INSTRUMENTS

Evaluating instruments based on the criteria we have discussed is challenging for two reasons. First, practitioners must be able to compare potential instruments based on each of the evaluative criteria. However, in many cases it can be difficult to rank instruments in an objective manner. For example, ranking environmental policy instruments based on their technology-stimulating effects is particularly difficult, as is assessing distributional considerations in some cases. Second, policy makers must

determine how much weight to assign each of the evaluative criteria. Consider two instruments that are equally environmentally effective and both institutionally feasible, but one has unfavorable distributional implications while the other is less cost-effective. To choose one instrument over the other one must assess the relative importance of distribution vs. cost-effectiveness. Determining these weights is a subjective question, left to policy makers to decide.

Table 2: National environmental policy instruments and evaluative criteria

CRITERIA				
Instrument	Environmental effectiveness	Cost-effectiveness	Meets distributional considerations	Institutional feasibility
Regulations and Standards	Emissions level set directly, though subject to exceptions. Depends on deferrals and compliance.	Depends on design, uniform application often leads to higher overall compliance costs.	Depends on level playing field. Small/new actors may be disadvantaged.	Depends on technical capacity. Popular with regulators, in countries with weak functioning markets.
Taxes and Charges	Depends on ability to set tax at a level that induces behavioral change.	Better with broad application. Higher administrative costs where institutions are weak.	Regressive. Can be ameliorated with revenue recycling.	Often politically unpopular. May be difficult to enforce with underdeveloped institutions.
Tradable Permits	Depends on emissions cap, participation and compliance.	Decreases with limited participation and fewer sectors.	Depends on initial permit allocation. May pose difficulties for small emitters.	Requires well functioning markets and complementary institutions.
Voluntary Agreements	Depends on program design, including clear targets, a baseline scenario, third party involvement in design and review, and monitoring provisions.	Depends on flexibility and extent of government incentives, rewards and penalties.	Benefits accrue only to participants.	Often politically popular. Requires significant number of administrative staff.
Subsidies and Other Incentives	Depends on program design. Less certain than regulations/standards.	Depends on level and program design. Can be market distorting.	Benefits selected participants, possibly some that do not need it.	Popular with recipients; potential resistance from vested interests. Can be difficult to phase out.
Research and Development	Depends on consistent funding, when technologies are developed, and policies for diffusion. May have high benefits in long-term.	Depends on program design and the degree of risk.	Benefits initially selected participants. Potentially easy for funds to be misallocated.	Requires many separate decisions. Depends on research capacity and long-term funding.
Information Policies	Depends on how consumers use the information. Most effective in combination with other policies.	Potentially low cost, but depends on program design.	May be less effective for groups (e.g., low-income) that lack access to information.	Depends on cooperation from special interest groups.

Note: Evaluations are predicated on assumptions that instruments are representative of best practice rather than theoretically perfect. This assessment is based primarily on experiences and literature from developed countries, as peer reviewed articles on the effectiveness of instruments in other countries was limited. Applicability in specific countries, sectors and circumstances – particularly developing countries and economies in transition – may differ greatly. Environmental and cost effectiveness may be enhanced when instruments are strategically combined and adapted to local circumstances.

Source: IPCC 2007

Nevertheless, it is possible to make general statements about each instrument according to the criteria we have selected. For instance, it is generally believed that market-based instruments will be more cost effective than regulations and standards. However, this belief implicitly assumes that a country has well-functioning institutions, the lack of which can make market-based instrument more costly to implement. Table 2 (*previous page*), taken from the IPCC 2007, summarizes the seven climate-related instruments presented in this chapter for each of the four criteria.

6. RELATIONSHIP OF NATIONAL POLICIES TO A FUTURE INTERNATIONAL CLIMATE CHANGE AGREEMENT

The reasons for an international agreement are well covered in the IPCC 2001 and 2007, in particular, the global nature of the problem and the fact that no single country has more than approximately 20% of global emissions. This means that successful solutions will need to engage multiple countries. Similarly, the fact that no one sector is responsible for more than about 25% of global emissions (the largest sector is that of electricity generation and heat production at 24% of the global, six-gas total) implies that no single sector will be uniquely required to act.

Recent literature has noted the limitations of existing international agreements to address climate change. In fact, there are no authoritative assessments of the UNFCCC or its Kyoto Protocol that assert that these agreements have succeeded – or will succeed without changes – in fully solving the climate problem. As its name implies, the UNFCCC was designed as a broad framework and the Kyoto Protocol's first commitment period for 2008 to 2012 only as a first detailed step. Both the Convention and the Kyoto Protocol include provisions for further steps as necessary.

A number of limitations and gaps in existing agreements are cited, namely:

- The lack of an explicit long-term goal means countries do not have a clear direction for national and international policy¹⁰;
- The targets are not sufficiently stringent;
- The agreements do not engage an adequate complement of developed and developing countries;
- The agreements are too expensive;
- The agreements do not have adequately robust compliance provisions; and
- The agreements do not adequately promote the development and/or transfer of technology.

To address these limitations in the post 2012 period, Parties to the UNFCCC and to the Kyoto Protocol met in Bali, Indonesia, from December 3 to 14, 2007. Negotia-

tors agreed on a two year process to finalize a post 2012 regime by December, 2009¹¹. The key elements are contained in UNFCCC decision 1/CP.13 on the Bali Action Plan, adopted by consensus on December 15 (UNFCCC 2007).

The Bali Plan of Action seems to provide an opportunity to foster a global response to climate change. The Plan retains distinctions between the responsibilities of developed and developing countries with respect to their mitigation actions¹². Actions by developed countries may include measurable, reportable and verifiable nationally appropriate mitigation commitments, or actions including quantified emission limitation and reduction objectives, while ensuring the comparability of efforts among them, taking into account differences in their national circumstances; while those of developing countries are to include nationally appropriate mitigation actions in the context of sustainable development, supported and enabled by technology, financing and capacity-building, in a measurable, reportable and verifiable manner.¹³

Each of the **Bali Action Plan building blocks** (i.e., mitigation, adaptation, technology transfer, and financing) will represent a special challenge for the negotiators over the next several years, but finding a means to reduce the level and growth rates of emissions and to improve the cost-effectiveness of, and generate sufficient, predictable and sustainable financial resources for mitigation will be a particularly crucial task.

An analysis of the financial resources and investment that would be required for mitigation and adaptation undertaken by the UNFCCC secretariat indicates that significant changes in the existing patterns of public and private investment and financial flows will be required (UNFCCC 2007b). Additional investment and financial flows in 2030 to address climate change amounts to 0.3-0.5% of global domestic product and 1.1-1.7% of global investment. This is a small amount in overall global GDP, but large compared to the currently available public

¹⁰ The IPCC report notes that under regime designs for low and medium concentration stabilization levels, i.e. 450 ppm CO₂-eq, GHG emissions from developed countries would need to be reduced substantially during this century, i.e. 25 to 40% by 2020 and that, substantial deviation from baseline would be required in Latin America, Middle East, East Asia and Centrally-Planned Asia by 2020.

¹¹ This process will build on the work of the Ad Hoc Working Group on Further Commitments of Annex I Parties under the Kyoto Protocol (AWG-KP) and a "Dialogue" to consider long-term cooperation under the Convention as initiated at COP11 in Montreal in December 2005. The main purpose of both processes was to exchange information and ideas regarding a follow-up to the Kyoto Protocol.

¹² See the paper by Harald Winkler that is part of this series titled *Climate change mitigation negotiations, with an emphasis on options for developing countries*.

¹³ See decision 1/CP.13 for full text (UNFCCC, 2007a).

and private financial resources for climate change. Total investment in new physical assets is projected to triple between 2000 and 2030. Due to rapid economic growth, a large share of these investments will occur in developing countries using internally generated funds, through foreign direct investment, the carbon market and through other financial mechanisms related to the Convention. As with any such global analysis, the circumstances of any individual country will differ.¹⁴

There is little doubt that additional investments are needed. Yet, a dilemma that has faced climate change negotiations since 1992 has been how to separate out development needs from the extra cost of addressing climate change. What should the international community pay for versus developing countries because it is in their national development and economic interest? One way to overcome this dilemma is for developing country negotiators to articulate how they will contribute to the global effort by changing the trajectory of their emissions as noted in IPCC 2007 through the adoption/modification of national policies, if additional technological and financial assistance is forth coming. Moreover, careful consideration of the state of national policies in developing countries would seem to be a useful step even without any consideration of how such information might be applied in the context of the negotiations.

Finally, one additional concept needs consideration, that is, the concept of sustainable development policies and measures (SD-PAMs) as a contribution to the global effort. The basic idea behind this concept is that in many cases addressing the sustainable development goals of developing countries may also be the most effective way of stimulating reductions in greenhouse gas emissions. In most cases, these SD-PAMs do not need to be based on emission limits or on a carbon price. They can be aimed directly and wholly at meeting the sustainable development goals of the host country. Critics have noted the difficulty of quantifying the benefits of such actions, however, if the link between the two can be made clearer, a hurdle in the negotiations may be overcome.¹⁵

¹⁴ See the paper by Erik Haites that is part of this series titled *Negotiations on additional investment and financial flows to address climate change in developing countries* for additional details on investment needs and options to increase funding to developing countries.

¹⁵ See the paper by Harald Winkler that is part of this series titled *Climate change mitigation negotiations, with an emphasis on options for developing countries* for more details.

7. THE POLICY MAKING PROCESS

Each country has a policy making process, that regardless of the form government, is complex and unique. It is often the case that while individuals may be aware of the benefits of actions that have both local and climate change benefits, that awareness is not always extended to the whole set of governmental decision makers. Hence, in terms of mitigation policies and measures, an essential first step may entail enhancing awareness within ministries and across the government to ensure consistency and synergies in policy making and implementation.

Secondly, even if a problem is recognized, information may be insufficient for adequate policy design, for example developing marginal abatement cost curves. Trying to assess the benefits of a policy and the costs of inaction may be hindered or impeded by fragmentary information. Overcoming this barrier may require competing for budgetary resources with other programs, and national priorities or finding funding from other sources and governments.

Third, national capacity to elaborate scenarios – economic, energy and climate, and to model future trends and the evolution of key variables, is sometimes limited in developing countries. This can impair the quality of decision making, or reducing the scope of policy options being considered. At worst, that capacity may be missing and the necessary analysis that informs policy design may consequently be missing.

While acknowledging that these constraints are inherent to policy making in developing countries, it is recognized that climate change intensifies the effect of such constraints as it creates new challenges. Climate change adds an additional dimension to efforts to promote sustainable development. On the one hand, because resources otherwise needed to alleviate poverty or enhance income distribution, among other goals may need to be channelled to address climate change impacts or to facilitate mitigation policies that may be initially be more expensive such as, the deployment of the some renewable energies technologies. On the other hand, uncertainty on the nature, intensity, frequency and timing of impacts may artificially enlarge the magnitude of resources needed to tackle the problems of adaptation thereby creating additional financial constraints and diminishing economic efficiency. Finding synergies between sustainable development goals and responses to climate change is therefore important.

More broadly, there are dynamic tensions in developing

countries between economic growth, development, environmental preservation, poverty alleviation, or energy security, among other critical goals. In that regard mitigation policies might be seen as improving the overall efficiency and security of an economy, e.g., by reducing the need for imported oil. However, this is not always the case as they may be viewed as an unnecessary diversion of key resources.

Questions:

- Are the institutional arrangements and policy making processes in your country adequate in the short term (the next couple of years) to tackle the broad set of issues that need to be addressed?
- How can the constraints noted above be measured and needs quantified in order to justify funding and capacity building?
- What are the effects of these constraints when defining national positions at the negotiations?
- What are the effects of those constraints in terms of prioritization of sectors/planning/policy development/opportunities?
- What can you personally do to overcome them?

REFERENCES

- Ellis J. and S. Kamel 2007. Overcoming Barriers to Clean Development Mechanism Projects, OECD, COM/ENV/EPOC/IEA/SLT(2007)3, Paris.
- IPCC 2001. Climate Change 2001: Mitigation, Contribution of Working Group III to the Third Assessment Report of the Intergovernmental Panel on Climate Change, [Bert Metz, Ogunlade Davidson, Rob Swart and Jiahua Pan (Eds.)], Cambridge University Press, United Kingdom and New York, NY, USA.
- IPCC 2007. Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [B. Metz, O. R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
- UNEP 2007. Global Trends in Sustainable energy Investment 2007, UNEP, Paris 2007.
- UNFCCC, 1992. United Nations Framework Convention on Climate Change. <http://unfccc.int/resource/docs/convkp/conveng.pdf>
- UNFCCC, 1998. Kyoto Protocol to the United Nations Framework Convention on Climate Change. <http://unfccc.int/resource/docs/convkp/kpeng.pdf>
- UNFCCC, 2007. Bali Action Plan. Decision adopted by COP 13 and CMP 3. December 2007. http://unfccc.int/files/meetings/cop_13/application/pdf/cp_bali_action.pdf.
- UNFCCC, 2007b. Investment and Financial Flows to Address Climate Change. http://unfccc.int/cooperation_and_support/financial_mechanism/items/4053.php.

Internet websites with information on national policies

- International Energy Agency
http://www.iea.org/textbase/pm/index_effi.asp
- World Resources Institute
<http://cait.wri.org/sdpams/search.php>

ANNEXES

ANNEX 1. ASIA

1.1 Renewable/wind policy in India

1.1.1. Background

India is endowed with abundant renewable energy sources – solar, wind, biomass, and small hydroelectric – and the government is working proactively to develop them. Under the “Power for All by 2012” initiative, the government has envisaged universal electricity supply by 2012. So far only 56% of the households have access to electricity.

India is the third largest electricity consumer in Asia behind China and Japan. As of 31 December 2006, installed power generation capacity in India was 127,753 MW. Thermal power plants, mostly coal-fired, provide 66% of the installed capacity. Hydropower accounts for 26% of the capacity, with gas and oil fired thermal plants, renewable energy plants, and nuclear plants providing the remaining 8%.¹⁶

As the Indian power sector has grown, India has become increasingly dependent on fossil fuels. With continued and sustained hikes in oil and gas prices in recent years, as well as the expected fossil fuel shortages in the future, the security of energy supply in India has generated increasing concern. The environmental concern over excess use of fossil fuels is also on the rise. In this context, India urgently needs to explore sustainable energy development, and the government has been working proactively to promote the use of renewable energy sources.

Among the renewable power resources available in India, wind energy is a promising source for further development. India has over 45,000 MW of gross potential and 13,000 MW of technical potential for wind power. As of September 2007, India had over 7,200 MW of installed wind power capacity, ranking the country fourth in the world after Germany, United States, and Spain. While the 10th Five Year Plan (2002-2007) targeted a 2,200 MW increase of installed wind power capacity, over 5,400 MW was actually installed.¹⁷

The government has provided support measures to increase renewable energy contributions in the country.

It has also issued policy guidelines for the state governments to establish and maintain state-specific policies to promote renewable power projects. The promotional measures available to renewable energy projects comprise a wide range of fiscal and financial incentives, including soft loans, concessional customs duties, exemption from excise duty, tax holidays, and accelerated depreciation benefits.

1.1.2. Objective of the policy

To support the development of renewable energy, the government has stipulated a national objective of achieving 10% of the capacity additions for the period 2002-2012 from renewable energy sources.

1.1.3. What policy instruments were used/had to be passed to achieve the objective?

The government is proactively encouraging development of renewable energy sources. The government's efforts to promote renewable energy started in the early 1980s after the first and second global oil price shocks. The government created the Commission for Additional Sources of Energy in 1981 and Department of Non-Conventional Energy Sources in 1982. The Department of Non-Conventional Energy Sources was transformed into the Ministry of Non-Conventional Energy Sources (MNES) in 1992, and then was renamed the Ministry of New and Renewable Energy (MNRE) in 2006. The National Electricity Policy, issued by the Ministry of Power in 2005, contains a major thrust toward the development of renewable energy sources. MNRE is the nodal ministry in the government for all matters relating to new and renewable energy. Its main functions include:

- Policymaking and planning;
- Program formulation and implementation;
- Research and development;
- Technology development and commercialization;
- Promotion of demonstration and pilot projects; and
- Implementation of fiscal and financial incentives.

The MNES (now MNRE) established the Centre for Wind Energy Technologies at Chennai as an autonomous R&D institution of the government and as a technical

¹⁶ Ministry of Power. 2007. Report of the Working Group on Power for Eleventh Plan (2007–2012). New Delhi.

¹⁷ Ministry of New and Renewable Energy Annual Report 2006–2007. New Delhi.

focal point for India's wind power development. The centre provides developers with technical services, including wind resource assessment for project sites, testing and certification services for equipment, and training and capacity-building services. Technological advancements are gradually increasing the commercial viability of wind power projects.

Fiscal and financial incentives provided by the national and state governments have traditionally driven the development of wind power projects in India. The incentives being provided by the government include:

- 80% accelerated depreciation of project costs for wind power projects (in the initial stages 100% accelerated depreciation was allowed);
- Concessions or full exemption on customs duties of certain imported components of wind turbines;
- Tax holiday for a maximum of 10 consecutive years within 15 years of commissioning, which is available for infrastructure projects;
- Concessional loans available through Government-owned agencies, including Indian Renewable Energy Development Agency Limited, Power Finance Corporation Limited, and Rural Electrification Corporation Limited.

The Electricity Act, 2003 requires all state-level energy regulatory commissions to ensure that electricity distributors procure a specified minimum percentage of power generation from renewable energy sources. The midterm appraisal of the 10th Five Year Plan by Planning Commission included the following recommendations for the renewable energy sector:

- Explore alternative subsidy structures that encourage utilities to integrate wind, small hydroelectric, cogeneration, etc., into their systems;
- Phase out capital subsidies linked to the creation of renewable capacity in favor of subsidies linked to renewable energy generated;
- State electricity regulatory commissions should mandate the purchase of energy from renewable sources, as per the provisions of the Electricity Act;
- Improve coordination and synergize the programs of MNRE with similar programs of other central ministries and state governments.

1.1.4. Key factors needed to make something happen

Several factors supported the development of the

wind-based electricity generation in India. On the technical side, the government undertook extensive wind mapping studies in the mid-80s. Besides providing policy support it also established the India Renewable Energy Development Agency to channel concessional finance into renewable energy projects. Wind energy projects capitalized on this facility in a significant manner. The government further set up the Centre for Wind Energy Technologies to cover R&D, technology upgrading, testing, certification and standardization in association with the wind turbine industry. The technological support and the fast growth in the sector as a result of the various policies encouraged local industry to collaborate with foreign firms and establish local manufacturing capacity.

1.1.5. What has happened as a result of the policy and instruments that were introduced?

The policies and instruments and their constant adaptation and modification have resulted in the commercialization of the wind electricity technology in the country. At present, wind turbines of 1 MW and above are being manufactured in India. A major evolution in the policy was a shift in focus from "capacity additions" to "generation based incentives". The initial growth in capacity was followed by a lull in capacity additions. However, international policy instruments like the CDM added fillip to the growth in wind based power generation in India. The sector continues to benefit from the national and state level policies for promoting renewables. For example, innovative business models are being developed where firms with technical capability develop projects that are sold to the private investors. The technical firms continue to operate and maintain the wind farms through a maintenance contract.

1.1.6. List of relevant laws, regulations and rules

Electricity Act 2003

Section 86. (1): "The State Commission shall discharge the following functions... (e): promote cogeneration and generation of electricity from renewable sources of energy by providing suitable measures for connectivity with the grid and sale of electricity to any person, and also specify, for purchase of electricity from such sources, a percentage of the total consumption of electricity in the area of a distribution licensee".

National Electricity Policy 2005

The National Electricity Policy 2005 stipulates that the share of electricity from non-conventional sources would need to be progressively increased; with purchase by distribution companies through a competitive bidding process. Considering that it will take some time before non-conventional technologies compete, in terms of cost, with conventional sources, the state commission may determine an appropriate deferential in prices to promote these technologies.

Tariff Policy 2006

The Tariff Policy announced in January 2006 has the following provisions:

- Pursuant to provisions of Section 86 (1) (e) of the Act, the Appropriate Commission shall fix a minimum percentage for purchase of energy from such sources taking into account availability of such resources in the region and its impact on retail tariffs. Such percentages for purchase of energy should be made applicable for the tariffs to be determined by the State Electricity Regulatory Commission (SERC) latest by April 1, 2006.
- It will take some time before non-conventional technologies can compete with conventional sources in terms of cost of electricity. Therefore, procurement by distribution companies shall be done at preferential tariffs determined by the Appropriate Commission.
- Such procurement by Distribution Licensees for future requirements shall be done, as far as possible, through competitive bidding process under Section 63 of the Act within suppliers offering energy from same type of non-conventional sources. In the long-term, these technologies would need to compete with other sources in terms of full costs.
- The Central Commission should lay down guidelines within three months for pricing non-firm power, especially from non-conventional sources, to be followed in cases where such procurement is not through competitive bidding.

National Rural Electrification Policies, 2006

- Goals include provision of access to electricity to all households by 2009, quality and reliable power supply at reasonable rates, and minimum lifeline consumption of 1 unit/household/day as a merit good by 2012.
- For villages/habitations where grid connectivity would

not be feasible or not cost effective, off-grid solutions based on stand-alone systems may be taken up for supply of electricity. Where these also are not feasible and if only alternative is to use isolated lighting technologies like solar PV, these may be adopted. However, such remote villages may not be designated as electrified.

- State government should, within six months, prepare and notify a rural electrification plan, which should map and detail the electrification delivery mechanism. The plan may be linked to and integrated with district development plans. The plan should also be intimated to the appropriate commission.
- Gramapanchayat shall issue the first certificate at the time of the village becoming eligible for declaration as electrified. Subsequently, the Gramapanchayat shall certify and confirm the electrified status of the village as on 31 March each year.

1.2 Energy efficiency policies in China

1.2.1. Background

China has the largest population in the world and is amongst the highest rate of economic growth. However, many of its people live in poverty. The government's objective is to lift its people out of poverty through continued economic development. China is the second largest consumer of energy in the world and its future growth will increase its energy requirements significantly making it the largest energy consumer by 2015.

China's relative dearth of high-quality energy resources hinders its supply capability. Its imbalanced distribution makes it difficult to secure a continued and steady supply; and the pattern of economic growth, irrational energy structure, unsatisfactory energy technology and relatively poor management have resulted in higher energy consumption per-unit GDP for the major energy-consuming products. Constrained supply is, thus, further intensified by high energy intensity. Consequently, meeting increasing energy demand just by increasing energy supply has its limitations and it is well recognized that action to lower energy intensity is essential.

In recent years, a host of programs have been formulated to address the problem of low energy efficiencies, including: 10 energy conservations, top 1,000 energy-using enterprises, retirement of inefficient power-generation

stations and industrial plants, power generation dispatch scheduling based on energy efficiency, demand-side energy efficiency management, clean coal initiative, use of coal-bed methane and waste coal, green light stimulation, energy efficiency in transportation, urban and rural environment management, and energy-efficient labelling and certification. (See 1.2.6 for more details.)

1.2.2. Objective of the policy

China has set itself the goal of quadrupling its GDP by 2020 (from 2000) while only doubling its energy consumption. Although as a non-Annex I country China is not obliged to commit itself to binding quantified emission reduction during the first period of the Kyoto Protocol (2008–2012), in an attempt to mitigate GHG emissions, the national climate change program has set the following mandatory quantified targets for 2010:

- Reduce the consumption of energy for every 10,000-yuan of gross domestic product from 1.22 tons of standard coal equivalent in 2005 to below one ton – a reduction of 20%;
- Raise the share of renewable energy in the primary energy supply to 10% (from 7% in 2005);
- Extract 10 billion m³ of coal-bed methane;
- Cap nitrous oxide emissions from industrial processes at the 2005 level;
- Increase the forest coverage rate to 20%;
- Increase the carbon sink by 50 million tons over the 2005 level.

1.2.3. What policy instruments were used/had to be passed to achieve the objective?

In the early 80s, China adopted the principle of “promoting both development and conservation, but conservation first,” making energy and resource conservation a priority in energy and industrial policy. In the late 80s, China began paying more attention to growth patterns and economic structural adjustment with an eye to reducing the consumption of energy and other resources, promoting cleaner production, and reducing industrial pollution. A series of industrial policies were instituted with the goal of accelerating the growth of tertiary industry (normally low energy intensity), improving energy efficiency in secondary industry, and discouraging quick expansion of energy-intensive industries. Since then, the State Council and relevant ministries have issued a series of energy and resource conservation rules.

A three-tier energy and resource conservation management system has been set up at the central, local, industrial and enterprise levels. It has also established standards, labelling, and certification of energy efficiency, and included “energy efficiency” in procurement requirements. In 1997, the Energy Conservation Law was issued in support of these efforts. The law was amended in 2007 to strengthen its provisions. Some policies and measures undertaken are listed in the last section.

At the turn of the 21st century, China responded to the stresses on natural resources with a “green strategy,” which sought to:

- Improve overall planning for regional economic development, especially with respect to the efficient use of land, water, and energy resources and local environmental absorption capacity;
- Improve technologies and management practices thereby promoting efficient resource use;
- Replace or retrofit old equipment so as to attain higher energy and resource efficiency;
- Explore new sources for resource substitution (e.g., clean and renewable energy, energy-efficient construction materials).

In May 1996, the State Planning Commission, the State Economic and Trade Commission, and the State Science and Technology Commission jointly formulated the Policy Outlines for Energy Conservation Technologies in China, which provided targets for energy saving by the various sectors of the economy. They recommended 106 energy-saving technologies for large-scale adoption, and introduced policies that promoted market development for technological services on energy conservation, restructuring of corporate energy management systems, and privatization of energy utilities.

In November 2006, the Ministry of Finance increased export taxes on energy-intensive industries. This included a 15% export tax on copper, nickel, aluminium, and other metals, a 10% tax on steel primary products, and a 5% tax on petroleum, coal and coke. Simultaneously, import tariffs on 26 energy and resource products, including coal, petroleum, aluminium, have been cut from their current levels of 3–6% to 0–3%. These tax changes aim to discourage the export of energy-intensive products and to conserve energy. They were triggered when elevated international prices started stimulating large investments in energy-intensive industries, particularly copper, aluminium, and steel.

China recognizes that only with improved energy technologies can it achieve its targets for development and economic growth while avoiding energy shortages and coping with global climate change. In 2006, the Outline of National Medium- and Long-term Science and Technology Development Plan (2006–2020) were issued. The latter identified innovation as a new national “strategy” for which China will:

- Invest more than 2.5% of its GDP in R&D;
- Ensure that the contribution of science and technology to economic development exceeds 60%; and
- Reduce its dependence on foreign technologies to under 30%.

1.2.4. What has happened as a result of the policy and instruments that were introduced?

Energy intensity has started to decline recently, although less than the annual target of 4%. This was mainly the result of aggressive adjustments made to the structure of the economy, increases in productivity, technological progress, and more efficient ways of using energy.

From 1991 to 2005, China had an annual GDP growth rate of 10.2%, supported by an annual energy consumption growth rate of 5.6%. This resulted in an energy consumption elasticity of 0.55. Other examples of energy efficiency measures include the following. By December 2007, China had shut down 553 small (average capacity 23 MW) and inefficient power generation units, totalling 14.38 GW and 43.8% more than the 2007 target. Electricity generation from the old units has been replaced by larger and more efficient units. New energy efficiency labels, similar to the US ENERGY STAR program, were introduced to encourage consumers to use the more energy efficient appliances. *More examples are listed in Section 1.2.6.*

1.2.5. Key factors needed to make something happen

China has achieved significant improvement in its energy intensity and energy efficiency. However, it is below the stated and ambitious target and there is scope for further improvement in the following areas:

- **Consistency.** Many policies and regulations are developed over several stages, by various government agencies, for different purposes, and with targeted focuses. They may not necessarily consistent with each other. For example, the policy of promoting high efficiency technologies but at the same time reduced

dependence on foreign technologies.

- **Coordination.** Fiscal, financial, and environmental policies are formulated by the Ministry of Finance, Central Bank, and State Environmental Protection Agency (SEPA), respectively. Energy sector operations and large project approvals are controlled by the National Development and Reform Commission (NDRC). Relevant line ministries (e.g., Ministry of Construction, Ministry of Science and Technologies, Ministry of Agriculture) have been playing their own roles. Apparently, coordination among these government agencies needs to be further strengthened.
- **Institutional Arrangements.** The central government has been reorganized and downsized and implementation for energy development and conservation has been decentralized and assigned to various agencies, many of which are claiming to be over-burdened. The institutional capacities at the provincial and county level are very weak. China recognizes this issue and to strengthen the system the energy bureau within NDRC was upgraded to a State Bureau of Energy in March 2008. But there are still substantive needs for institutional capacity building at both central and local levels for the smooth implementation of these policies.
- **Implementation Procedures.** Many policies in China have focused on laying out broad guidelines and overall targets. Implementation procedures need to be worked out in detail in order to carry out these policies. For example, the procedure to measure and monitor energy savings and pollution reduction needs to be systematically established to ensure actual award of fiscal incentives (e.g., subsidies, tax privileges, and allowances for accelerated depreciation). Energy efficiency standards and labelling systems need to be put in place to phase out energy-inefficient appliances. Approximately 2 billion m² of floor area is being constructed annually in China, accounting for half of the world’s total. Based on this trend, China will build another 20-30 billion m² of floor space between now and 2020. Despite the issuance of a number of building standards and regulation, so far, among the existing 40 billion m² of buildings, only 4% have been considered for energy efficiency improvements, mainly by adopting energy-efficient heating and cooling systems. There is a need for stronger enforcement of existing law, rules and regulations.

• **Support to Market Mechanism Development.**

Currently, most policies in China are implemented through administrative means (e.g., allocating energy conservation requirements to provinces and large industrial enterprises, linking results of energy conservation to the performance evaluation of local officials). Insufficient efforts have been put to inducing enterprises to voluntarily participate in energy conservation and pollution control (that would also enhance long-term competitiveness and profitability), to encourage local financial institutions and banks to invest in energy conservation (even though many energy conservation projects have high returns and relatively short pay-back periods), and to boost development of domestic energy service companies.

1.2.6. List of relevant laws, regulations and rules

Mandatory Reduction of Energy Intensity

The 11th Five-Year Development Plan (2006-10) includes a major program to improve energy efficiency nationwide, including a goal of reducing the energy intensity to 20% below 2005 levels by 2010. This energy intensity reduction target is part of a broader goal of quadrupling per-capita GDP while only doubling energy consumption between 2000 and 2020. The government has allocated the reduction target to provinces and industrial sectors.¹⁸ Energy efficiency improvement is now among the most important criteria used to evaluate the performance of local officials. Progress to date has been slower than the expected annual reduction of 4%.

Ten Energy Conservation Programs

In 2004, the NDRC launched the Medium and Long-term Plan of Energy Conservation, which covers two phases: 2005–2010 and 2010–2020. In this plan, detailed energy conservation targets and implementation plans were set up. Key actions and comprehensive policy measures were put forward. The following ten key programs for energy conservation were stipulated in the plan:

- **Upgrade Coal-Burning Industrial Boilers (kilns).** China has about 500,000 medium- and small-sized boilers, which on an average have an actual efficiency

around 65%. Three measures are planned to raise the efficiency by 5 and 2 percentage points respectively:

- i. Use quality coal;
 - ii. Renovate boilers and kilns employing advanced techniques, like circulating fluidized bed and pulverized coal firing; and
 - iii. Establish a scientific management and operation system.
- **District Co-generation.** Combined heat and power systems, can raise efficiency by 30% over that of separated generation. Centralized heat supply is 50% more efficient than small boilers. In the 11th five-year period, the focus will be on the heat load and measures to be taken, which will include:
 - o Installing high efficiency 300 MW cogeneration units;
 - o Constructing back-pressure units;
 - o Developing centralized heat supply for areas where heat demand is small and mainly for warming;
 - o Developing combined heat and electricity supply systems in medium-sized and small cities;
 - o Transforming existing coal-burning small boilers for decentralized heat supply.

The goal is to cover 40% of urban centralized heat supply systems by 2010.

- **Residual Heat and Pressure Utilization.** Iron and steel enterprises will apply coke dry quenching and power generation from the waste energy from blast furnaces, renovate all blast furnace gas power generation, and implement converter gas recovery.
- **Petroleum Conservation and Substitution.** Specific steps include: replacing fuel oil (light oil) with clean coal, petroleum coke, and natural gas in the power, petroleum and petrochemical, metallurgy, and construction material industries and in transport; accelerate the development of the west-east power transmission to replace small oil-burning units; implement policies and regulations on fuel use and petroleum conservation measures; implement the policy for clean automobiles; promote hybrid vehicles; popularize compressed natural gas buses and taxis in cities and speed up the promotion of methanol and

alcohol as fuels; step up coal-liquefaction projects; and develop alternative fuels.

- **Energy Conservation for Electrical Motor Systems.** Currently, 420 million-kW electrical motors, which consume 60% of the total electricity, operate at an efficiency which is 10-30% lower than that in other countries. In the 11th 5-year period, the country will popularize high efficiency electrical motors and those that use rare earth permanent magnets, launch systematic renovation to and operation of high-efficiency wind turbines, pumps and compressors and promote variable speed motors and automated system control.
- **Energy System Optimization.** Optimization of energy systems in major industries (mainly metallurgical, petrochemicals, and chemicals) will be launched.
- **Energy Conservation for Buildings.** The country will adopt strict standards that save energy by 50% in residential buildings and public structures, speed up the reform in heat-supply system, and tighten efforts in promoting building energy efficiency technology and related products.
- **Green Lighting.** Thirteen percent of the total power use of the country is in lighting. 70% to 80% of power can be saved by replacing ordinary incandescent lamp with high-efficiency energy-saving fluorescent lamp and an additional 20-30% can be saved by replacing traditional electromagnetic ballast with electronic ballast. Ninety percent of power use in traffic lights can be saved by replacing incandescent lamps with light emitting diodes.
- **Energy Conservation in Governmental Agencies.** Energy consumption in government and public institutions is increasing rapidly and expenditure on energy is relatively high. Energy efficiency measures include: reconstruction and renovation of the buildings, heating, air-conditioning, and lighting systems according to building energy efficiency standards, procurement of high-efficiency products, and purchase of fuel efficient business vehicles.
- **Energy Conservation Monitoring and Technical Services System.** Establish and improve the capability of the energy-saving monitoring centers in provinces and in major energy-consuming industries through

upgrading monitoring equipment, strengthening personnel training, and popularizing contractual energy management. These centers would provide a package of services including diagnosis, design, financing, renovation, operation, and management for enterprises, governmental organs, and schools.

1,000 Enterprise Programs

In 2006, NDRC launched a major program to improve energy efficiency in the 1,000 largest energy-consuming enterprises,¹⁹ which in 2004, accounted for 33% of the total and 47% of the industrial energy use. Each enterprise under the “1,000 Enterprise Program,” signed an energy conservation agreement with the local government outlining its 2010 energy-saving target. The enterprise will be monitored and supervised on its energy use. Advanced domestic and international standards are used to set the targets for the energy intensity for products produced. Incentives will be offered to encourage enterprises to exceed their targets. Overall and individual targets for the 1,000 enterprises were established in 2006.

Retiring Inefficient Power Plants

In early 2007, the State Council issued an order to retire 50 GW of small, inefficient power plants, amounting to 8% of China's total generating capacity. Large and more efficient coal-fired generation units can be constructed only when the smaller and older ones are fully decommissioned. Certain compensations (up to 3 years' economic benefits) could be provided to smooth and accelerate the closure processes. By 2010, approximately 40 GW of coal-fired and 10 GW of fuel oil-fired capacities will be retired before the completion of their design life. In addition, all coal-fired plants of less than 50 MW capacity and 50-100 MW capacity plants that have been in operation for more than 20 years will be retired by 2010. Generators with unit coal consumption 10% above the provincial average or 15% above the national average are also targeted for closure.

Energy Efficient Power Generation Dispatch Scheduling

The current power generation scheduling and dispatch system allows about the same utilization hours to large-efficient plants and to small but less efficient coal-fired

¹⁸ ADB is providing advisory technical assistance to NDRC for the exploration of innovative mechanisms that promote energy improvement, as a part of a regional project TA-6392-REG. Supporting the Implementation of the Energy Efficiency Initiative in Developing Member Countries.

¹⁹ <http://www.iea.org/textbase/pm/?mode=pm&id=3542&action=detail>.

power generation units, resulting in a large waste of energy. Since the newly installed 300 MW or more coal-based power plants have a designed efficiency close to the international standards, their utilization has to be maximized to reduce coal consumption. NDRC has taken the initiative to implement a new energy-efficient and environment-friendly dispatch system²⁰ that maximizes the use of renewable energy, gives priority to nuclear energy, and ranks coal-fired units according to their marginal fuel consumption. When fully implemented, it will significantly reduce coal consumption and GHG emissions from the rapidly expanding power sector. The implementation guidelines for the new dispatch system were approved in August 2007. Five provinces, namely, Guangdong, Guizhou, Henan, Jiangsu, and Sichuan, have been selected to test the new system.

Closing Inefficient Industrial Plants

NDRC announced in early 2007 that it would close many inefficient industrial plants manufacturing a range of products, including cement, aluminum, ferroalloy, coke, calcium carbide, cement, and steel.

- All cement plants with an annual capacity of less than 200,000 tons are to be closed by the end of 2008, with 250 Mt of outdated cement capacity to be eliminated by 2010.
- In the steel sector, outdated pig iron capacity is to be reduced by 100 Mt, and steel capacity by 55 Mt by 2010.

NDRC has set reduction quotas at the provincial and regional levels, and provincial officials are required to sign agreements with the central government holding them accountable for their targets. Potential disciplinary action is possible for provincial officials failing to comply.

Promoting End-Use Energy Efficiency

The 1997 Energy Conservation Law initiated a range of programs to increase energy efficiency in buildings, industries, and consumer goods. China has established efficiency standards for many energy-consuming appliances and is adopting building energy standards in regions with high heating and cooling demands. China also promotes end-use energy efficiency improvement²¹

through government procurement policy. In 2004, the Ministry of Finance, in coordination with NDRC, modified the National Procurement Policy to include the preferential purchase of labelled energy efficient products in public procurement. The program started in 2005 and by the end of 2006 it was rolled out to all levels of government: central, provincial, and local. The State Council ordered in June 2007 that air-conditioning units in most office buildings be set no cooler than 26°C.

Phasing Out Incandescent Bulbs

In 1996, the China Green Lights Program was launched to raise the awareness of available energy efficient lighting technologies. The program has contributed to the increase in production and use of these efficient lighting technologies. By 2017, China will have phased out incandescent bulbs through a program initiated through the Global Environment Facility.

Energy Efficiency in Transportation

The transportation sector is currently not a big consumer of energy in China, but takes an increasingly large share in the longer term. The increase in vehicles has doubled oil consumption in the last 20 years, turning China from a net oil exporting country into a large oil importing country. Measures for improving energy efficiency and reducing emissions in the transport sector include:

- **Investing in Energy-efficient Transportation Infrastructure.** China has implemented a massive plan to build and renovate high-speed railway systems that will be more energy efficient, less polluting, less vulnerable to extreme weather events, and likely to replace many passenger and cargo vehicles on roads.
- **Requiring High Fuel Economy Standards.** China's fuel economy standards are more stringent than those in Australia, Canada, and the US, including California (but less stringent than those in the European Union and Japan). The vehicle standards will be implemented in two phases (2005–6 and 2008–9) for all classes of vehicles.
- **Encouraging Use of Public Transport.** The Ministry of Construction held a “no car day” on 22 September 2007 to encourage people to travel by public transport.

ation. In urban areas, light rails and subways are being constructed and tariffs are subsidized to popularize mass transport systems.

- **Use of Alternative Fuels.** Twenty percent ethanol has been introduced in six provinces.
- **Developing New Transport Technologies.** An automobile emission tax is under consideration, which will fund the development of cleaner transport technologies.

Efficiency in Urban Housing and District Heating

China has realized that adoption of energy-efficient technologies in buildings is a promising path to ease expanding energy shortages and reduce GHG emissions. It began investigating energy efficiency in buildings in early 1980s. A number of standards, regulations, related incentives, and administrative rules have been issued. The 11th Five-Year Development Plan calls for energy savings of 50% for new buildings nationwide and up to 65% for buildings in four large municipalities (Beijing, Shanghai, Tianjin, and Chongqing). In early 2006, the government issued the Designing Standard for Energy Conservation in Civil Building to encourage contractors to use energy-efficient materials and adopt energy-saving technologies for heating, cooling, ventilating, and lighting in public buildings.

²⁰ ADB is providing advisory technical assistance to NDRC concerning the structuring and implementation of the proposed energy-efficient generation scheduling and dispatch system.

²¹ ADB is working on two loan operations, in Guangdong and Shandong, to assist China in improving demand-side energy efficiency.

ANNEX 2. SOUTH AMERICA

2.1 Natural gas for vehicles in Bolivia

2.1.1. Background

During the past decade, Bolivia has experienced major increases in its gas reserves, production, and exports. In recent years, this process has been followed by a rise in world energy prices of natural gas, as well as, more recently, by a sharp increase in the government's tax take from the hydrocarbons sector. This combination of factors has transformed the Bolivian natural gas sector so that it now constitutes not only the main component of country's exports (43% of total exports in 2006) but also is a large source of revenues for the government (about 27% of total revenues in 2006).

The hydrocarbons sector has thus become increasingly important. In terms of contribution to growth, the key economic sectors in Bolivia since 1990 have been manufacturing, agriculture, and transport and communication.

Despite those positive trends, Bolivia still has an unbalanced availability of fossil fuels. While the country has important reserves of natural gas, 30% of the diesel consumed is imported. Being one of the countries with a lower GDP per capita in South America and currently having per capita income of less than a quarter of the average for the rest of Latin America, the reduction of imports by replacement with local production has been a priority for all Bolivian governments. Furthermore, the aim is to have increased gasoline domestic surplus in order to export gasoline, as value per energy unit traded is far higher (two or three times) for liquid fuels than for natural gas.

The replacement of gasoline by compressed natural gas is a very well known technology in the region. Two neighboring countries (Argentina and Brazil) have the largest NGV fleets in the world (more than 1.3 million cars in each country).

Bolivia is now benefiting from the replacement of gasoline by compressed natural gas in two ways: reducing fuel imports while consuming a fuel that the country is abundantly endowed with and in addition reducing pollution.

There are many actors in the NGV chain: government, dispensing stations, distributors, producers and transporters of natural gas, small facilities to convert vehicles, and consumers.

The Ministry of Energy and Hydrocarbons is the key actor responsible for policy making and implementation while the Superintendencia de Hidrocarburos regulates NGV dispensing stations and replacement facilities.

2.1.2. Objective of the policy

The objective of the policy was to foster the substitution of liquid fuels in mobile applications with natural gas. The only instrument used by government was to fix a different tax and a different price for NGV and for gasoline in 1992. Since that time, there has been no change in the policy or the tax. The policy did not include a quantitative objective, as it was not completely clear in the beginning how ambitious the target could be in terms of effective replacement.

2.1.3. What policy instruments were used/had to be passed to achieve the objective?

The policy was based on a fixed differential price (based on tax reduction) between the gasoline and the NGV. Since 1992, the NGV price has been linked to the price of gasoline at around 50% of the retail price.

There are technical rules that govern how the producers of natural gas, replacement facilities and distributors operate, fixing parameters as pressure level, and standards for security in NGV stations and cars (mainly for the cylinders) and measuring.

Table 3: Relation between NGV price (in std m³) and gasoline (in liter) at retail level

1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.49	0.44	0.44	0.44

Source: Ministry of Energy and Hydrocarbons

2.1.4. Key factors needed to make something happen

- The difference between NGV and gasoline price is the only incentive car owners have to adapt their cars to NGV. A sustained (through years) difference provides a clear signal to car owners and also to NGV stations owners and requires a delicate balance between demand (cars adapted) and supply (NGV stations).
- An NGV business requires a significant investment in the station. Natural gas is compressed at 250 bars. The difference between the NGV price (paid by cars) and natural gas cost (paid by stations) should be high enough to recover the investment.
- The repayment period of a car conversion is in the order of eight months. Even with this short period, as car owners don't have access to financial institutions (banks, credit cards), a specific credit line should be provided.

On top of that, an additional creative scheme of incentives for adapting cars to consume NGV was implemented by the private sector. Since 2001, an association between private companies including Transredes (gas distribution company), Sergas (distribution) dispensing stations and replacement facilities, under the name Feria del Gas, reimburses up to 80% of the cost of replacement to end users, in kind (NGV). There are no credit or government incentives for distributors. The only government intervention is related to the tax and the price of NGV and gasoline.

2.1.5. What has happened as a result of the policy and instruments that were introduced?

- The volume of NGV sold today is equivalent to 40% of the volume of gasoline sold;
- Approximately 90.000 vehicles were converted out of a total fleet of 550.000 vehicles;
- In the short term replacement is mainly from gasoline to NGV, but when consumers buy new vehicles they change from diesel to NGV (e.g., taxi fleet in Santa Cruz which was 95% diesel and is now 95% gasoline converted to NGV). The owner of the car covers the conversion costs.

2.1.6. List of relevant laws, regulations and rules

[Ley Nacional de Hidrocarburos, Resolución 120/1992 del Ministerio de Energía \(National Hydrocarbons Law, Resolution 120/1992 of the Department of Energy\)](#)

- Established the objective of the policy: substitution of liquid fuels by natural gas in mobile applications;
- Approved the rules for NGV stations, including the differential price between NGV and gasoline.

[National Law N° 3058](#)

In 2005, the oil and gas institutional framework was completely changed, moving to a system with a high level of government intervention. The general policy indicates that hydrocarbons should be used to promote comprehensive, sustainable and equitable development, ensuring the supply of hydrocarbons to the domestic market, encouraging the expansion of consumption in all sectors of society, developing industrialization in the national territory and promoting the export of surplus in a position favoring the interests of the state. It also has a specific prescription for NGV pertaining to tax exemptions (custom duties and value added) for imports of materials and equipment for the NGV sector.

2.2 Wind power in Argentina

2.2.1. Background

The demand for electricity in Argentina has grown constantly over the last decade despite the economic downturn of the late 1990s as shown in Table 4. The cost of electricity in Argentina, however, is difficult to estimate. Government intervention is extensive: fixing the price of natural gas to producers, importing natural gas and liquid fuels, and finally fixing different rules for electricity prices. There are two price levels. In the first level the price is determined by the cost of the most expensive unit dispatched using natural gas. Hydro, nuclear, wind and thermal units using natural gas are included in this level. The second level applies to units using liquid fuels.

As a result of these government interventions, the price of electricity is low, and as a consequence private investment in generation is small. The production of natural gas is declining. On the other hand, the consumption of gas has grown at 5% per year since 2003. The situation is further complicated because gas supplies from neighboring countries are unstable due to the political issues.

Table 4: Relation between NGV price (in std m³) and gasoline (in liter) at retail level

1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
69.892	72.998	74.137	80.710	88.943	90.088	84.420	91.996	100.261	105.750

Source: Secretariat of Energy

Wind power resources

Argentina has large wind resources. According to the Centro Regional de Energía Eólica (CREE), which has extensively researched wind resources and made inventories at the regional and national level, the technical potential of wind power resources can be estimated at around 500.000 MW.

Some regions, mainly the Patagonia, in the southern part of the country, are among the best locations in the world for wind power production. Data available from existing power units operating in Comodoro Rivadavia (Chubut Province) show that average wind speeds are higher than 11 m/s, and load factors are in the order of 40%.

The national grid

The information provided by the Secretariat of Energy, indicates that total installed power in Argentina was 25,678 MW in 2006. Hydropower represents 39% of the total installed capacity, while thermal facilities (fossil fuel fired) contribute 57% and nuclear approximately 4%. Installed wind power capacity is 27 MW (0.1% of the total).

Relevant institutions

Policies and regulations are determined by the Secretariat of Energy. Ente Nacional Regulador de la Electricidad (ENRE) is in charge of enforcing the regulations and of the supervision of the electric market. CAMMESA is responsible for decisions on the dispatch of the system, determines wholesale prices and administers transactions in the electric markets.

2.2.2. Objective of the policy

The objective of the national policy, enacted through the National Law 25019 (1998), is to promote the installation of additional wind power generation capacity. No quantitative objective (in absolute terms or as a proportion of the total capacity) has been fixed.

2.2.3. What policy instruments were used/had to be passed to achieve the objective?

The above-mentioned law declared that the generation of electricity from wind or solar resources is in the national interest, and established subsidies and specific tax conditions for these activities. The law did not include quantitative targets to be achieved through the application of the new framework.

Further, the National Law 26190 (2006) confirmed the objective of the previous law, expanded its applicability to other renewable sources (e.g., small hydro, landfill gas, biogas, biomass, geothermal) and updated the value of the subsidies. The National Law 26190 established that by 2016, eight percent of the electricity national consumption should be produced from renewable resources.

2.2.4. Key factors needed to make something happen

In this case, four factors can be identified as barriers for the development of a successful wind power program in Argentina:

- Information on resource availability;
- Long term capital recovery;
- Cost of production; and
- Tax framework instability.

The first barrier is related to the nature of the resource itself: renewable and difficult to quantify (high unpredictability). The law should have made provisions to promote research in order to quantify the availability and determine the characteristics of wind resources in Argentina.

The second barrier is common to all renewable energy projects. When compared to fossil fuel power generation projects, capital costs are higher while variable costs are very low. Hence, renewable energy projects in Argentina face constraints, particularly in access to project finance. The period required to recover the investment is higher in renewable projects compared to the period required in fossil fuel projects.

Wind power electricity production costs in 1998 had (and still have) higher costs than the wholesale price of electricity in the national market. The difference was

around \$0.03/kWh. The value of subsidies fixed in the National Law 25019 was \$0.01/kWh, only around a third of the differential cost. The situation was not improved by the National Law 26190 in 2006. Although the value of the subsidies was increased to \$0.015/kWh, the actual value was equivalent to only \$0.005/kWh due to the devaluation of the Argentine peso – that is, less than before the adjustment.

The last barrier is related to the second one, as due to longer capital recovery, these types of projects are highly vulnerable to a changing tax and fiscal environment. Both laws granted 15 years of fiscal stability for wind energy projects.

It should be noted that importing the equipment is not a barrier. Duties are not too high, maximum levels are in the order of 15%.

2.2.5. What has happened as a result of the policy and instruments that were introduced?

There is a fundamental inconsistency between the policy and its implementation. As a result, the policy is not effective. The wind power installed capacity increased from 12 MW (1997) to 28 MW (1998). The instruments provided by the law provided non-effective solutions for two of the barriers, while not considering other ones. It is clear that the subsidies provided are not enough to cover the difference between wind power production costs and the market price. It could be concluded that there is no consistency between the objective enunciated and the instruments provided.

2.2.6. List of relevant laws, regulations and rules

National Law 25019

Declares that the generation of electricity from wind or solar resources is in the national interest and provides tax benefits: value-added tax on capital investment could be deferred up to 15 years and 15 years of fiscal stability. It also establishes subsidies: a value of \$0.01/kWh produced for 15 years. The resources for the subsidies are obtained from a specific charge in the electricity tariff.

National Law and 26190

This law declares that the generation of electricity from renewable sources, and also the research and manufacturing of renewable energy equipment, is in the national interest. It establishes a quantitative objective: by 2016,

eight percent of the electricity national consumption should be produced from renewable resources. Renewable energy sources included in the law regime are defined as: wind power, solar energy, geothermic energy, hydropower (less than 30 MW), tidal power, biomass, landfill gas and biogas. It provides tax benefits for a 10-year period on value added and income taxes. It also established subsidies: for all renewable sources (but solar), a value of \$0.005/kWh produced for 15 years. For solar, the value is \$0.3/kWh. The procedure to obtain the resources for the subsidies fixed in the Law 25019 is maintained.

2.3 An energy efficiency labelling program in Brazil

2.3.1. Background

Brazil, with its 190 million inhabitants, has the largest population in Latin America. The country has very important renewable resources, and has been implementing policies in order to increase the participation of renewables in the energy matrix.

The country had limited oil production and reserves in the past. The impact of fuel imports on domestic prices – due to fuel price increases – and trade balances led the country to implement a very extensive bio-ethanol program and to consolidate an electric system based on hydropower in the beginning of the 80s. As a result, the Brazilian energy system is currently one of the most efficient in the world in terms of CO₂ emissions per unit of energy supplied.

Brazil is also one of the largest producers of hydroelectricity in the world: in 2006, Brazil was the third world producer (after China and Canada), with 11.5% of total world hydro-electrical production. Table 5 provides the value of hydro-electrical production in Brazil, per year (1965-2005) in Terawatt hours.

Table 5: The value of hydro-electrical production in Brazil, per year, 1965-2005

1965	1975	1985	1995	2005
24.0	72.3	178.4	253.9	337.5

Source: British Petroleum Statistical Review of World Energy 2007

In 2005, hydroelectricity was 85% of total electricity production. However, due to its characteristics the system became vulnerable to natural events (e.g., droughts). The crises suffered in 2001 and 2002, when the government had to implement very stringent water rationing schemes, is an example of how vulnerable the system is to climate conditions.

Since the early 80s, the Brazilian government has implemented different energy efficiency programs.

The institutions involved in those programs were:

- Eletrobrás (government is the major share owner);
- INMETRO (National Institute of Metrology, Standardization and Industrial Quality, within the Ministry of Development, Industry and Foreign Trade).

2.3.2. Objective of the policy

The purpose of PROCEL, the National Electricity Conservation Program, was to integrate the energy conservation actions in the country.

The PROCEL Label (a subprogram of PROCEL) was created in order to indicate to consumers the equipment and appliances available in the domestic market that have the highest rates of energy efficiency in each category. The scheme stimulates the production and marketing of more efficient products, in terms of energy efficiency, reducing environmental impacts in Brazil.

2.3.3. What policy instruments were used/had to be passed to achieve the objective?

In 1984, on the basis of a protocol (a voluntary agreement) between the government (MDIC) and the Brazilian Electrical and Electronics Industry Association (ABINEE), the Brazilian Labeling Program (PBE) was created. The program is coordinated by INMETRO. PBE aims to provide information to consumers to facilitate optimization of consumption of electricity in domestic appliances; choose more efficient appliances in terms of energy consumption; and improve use of those appliances allowing the saving of energy costs. Participation in the program is voluntary and testing of the appliances is made only on those products made by those manufacturers and facilities that are willing to participate. On the basis of the outcome of the tests, a scale was created to classify appliances. The tests are repeated periodically to update the scale.

PROCEL, now coordinated by ELETROBRÁS, was created in 1985. PROCEL includes several subprograms of

electric energy efficiency: Evaluation of Energy Efficiency Measures, Energy Efficiency in Buildings, Energy Efficiency in Public Facilities, Municipal Energy Management, Industrial Energy Efficiency, Energy Efficiency in Public Lighting, and Energy Efficiency in Environmental Sanitation.

The SELO PROCEL subprogram was created in 1993 and, along with the PBE, is responsible for significant results obtained. Appliances that are tested and labelled showing the best performance in their class can receive an energy efficiency endorsement (SELO PROCEL), given to the best products with respect to specific energy consumption. The SELO PROCEL program also contributed to the implementation of the PBE by creating measurement infrastructure.

Finally in 2001, an important milestone was the Law N° 10.295. The law establishes “maximum levels of specific energy consumption or minimum levels of energy efficiency of machines and energy-consuming devices produced and sold in Brazil”. Performance levels have been defined for electric engines and fluorescent lamps. There are advanced proposals for other devices. The law defines compulsory performance levels. Therefore, it is different from the labelling programs (PBE and SELO PROCEL) which are voluntary.

2.3.4. Key factors needed to make something happen

The success of the program was due to a combination of elements that included:

- An adequate regulatory framework;
- Appropriate institutional arrangements:
 - Between governmental institutions and entities (INMETRO, Eletrobras, others);
 - Between the government and industry, which were based on voluntary agreements;
- Economic and technical resources, including investment in laboratories to measure performance and compliance with required standards;
- Dissemination and capacity building.

2.3.5. What has happened as a result of the policy and instruments that were introduced?

The outcomes of the implementation of the PROCEL Label in 2006 were:

- Savings of 2,900 GWh of energy consumption;
- Savings in domestic appliances including also domestic lighting, air conditioning, refrigerators, electric engines and solar energy equipment.

2.3.6. List of relevant laws, regulations and rules

[Resolution N° 1877, 1985. Creation of the PROCEL](#)

[Decree December 8, 1993. Creation of the Energy Label and Award.](#)

This decree established the Green Label of Energy Efficiency, aiming to identify the equipment that achieves optimal levels of energy efficiency.

[Law N° 10.295, 2001 National Policy of Rational Use of Energy](#)

Established maximum levels of specific consumption of energy, or minimum energy efficiency, for machinery and consumer appliances, energy manufactured or marketed in the country, based on technical indicators relevant. Levels will be established based on values that are technically and economically feasible.

ANNEX 3. AFRICA

3.1. Efficient stoves dissemination policy in Kenya

3.1.1. Background

Sub-Saharan Africa countries, except South Africa, still depend heavily on wood to meet their basic energy needs. The share of fuel wood is estimated to be 61%-86% of primary energy consumption, with a major part (74%-97%) consumed by households. Fuel wood is also used to a significant extent in many of these countries in cottage industries such as bread baking, metal smelting operations, and brick kilns. The management of fuel wood resources and demand is a major issue to be accounted for in energy policies and strategies in Africa.

Furthermore, fuel wood production has been identified as one of the causes of forest degradation and deforestation in many African nations, in particular in regions surrounding large towns (e.g., N'Djamena in Chad). Indeed, the most important share of total wood removal is due to fuel wood consumption, which represents around 92% of total African wood consumption, and contributes to GHG emissions. Fuel wood use is therefore a major local and global environmental issue in Africa, and should be fully integrated into forestry management and environmental protection policies.

In Kenya, wood fuel is the dominant primary energy source for most households and small industrial establishments. This was confirmed by a 2000 energy survey, which indicated that biomass accounted for more than 68% of Kenya's total direct primary energy consumption. The survey also revealed that 89% of rural households relied on fuel wood, while 82% of the urban households relied on charcoal for their energy needs.

In most Sub-Saharan Africa countries, women devote most of their time to fuel wood gathering and cooking tasks. Children in rural area are also involved in fuel wood gathering tasks that can take most of their time, depending on the region. In Kenya, a lot of effort has gone into the promotion of fast-growing energy trees for the supply of fuel wood. In 2000, 84% of the fuel wood consumed in rural households was supplied from these farms, as opposed to 47% in the 80s. In 2007, 85% of the households could access fuel wood at close proximity to their homes – within a 4km radius. However, as a consequence of continuous urbanization, a change in the

use of wood for fuel wood and charcoal is taking place. Charcoal will play a more important role in the achievement of the sustainable development objectives of the country.

In this context, a demand-side, energy-efficiency program was needed to reduce the negative impact of the growing charcoal demand.

Sessional Paper No. 4 of 2004 on Energy in Kenya, which constitutes the government policy on energy, recognizes that fuel wood will continue to be a primary source of energy for years to come. As a consequence, it lays out strategies and policies for biomass development and exploitation, including the promotion of energy-efficient stoves and study and research for additional efficiency improvement of the stoves.

3.1.2. Objective of the policy

The policy aims to promote the dissemination of energy-efficient stoves, mainly through R&D activities that increase the efficiency of stoves and lower their price, thereby facilitating access to urban and rural poor populations. The aim is to increase the adoption of charcoal stoves from 47% to 100% by 2020.

3.1.3. What policy instruments were used to achieve the objective?

R&D activities are the main policy instruments used for the promotion of high-quality, energy-efficient and low-cost stoves. The research activities also encompass the development of appropriate distribution strategies for the stoves. Indeed, the Kenyan Ceramic Efficient Stove is the result of research on stove design, materials, and production processes for the purpose of increasing quality and decreasing costs. The program was initiated in the 70s and continued through the 80s with support from GTZ of Germany.

In Kenya, commercial energy-efficient stove production and dissemination is not directly subsidized. Initially, stoves were expensive (~\$15/stove) and quality assurance and control was not established for the production process. As a consequence, the stoves were not attractive to the poorer part of the population. The studies and research initiated since the early 80s, the experience accumulated by the manufacturers, and the competition that has been generated have led to innovations in materials and production processes and, ultimately, to better quality stoves, more choices, and lower costs.

While the program of energy efficient stoves diffusion has been implemented without direct subsidies, other forms of soft subsidies have been provided. Free training sessions have been provided and research results transferred without fees payment to producers by a number of organizations. Loans with low interest rates have been provided for the acquisition of efficient equipment for stove production and design and to implement communication schemes to raise awareness about stove performance by Winrock International²². This support was needed to facilitate the dissemination of the new technology to the portion of the population with low incomes.

3.1.4. Key factors needed to make something happen

The Minister for Energy is empowered under section 103 of the Energy Act N°12 of 2006 to promote the development of renewable energy technologies, including biomass, biodiesel, charcoal, fuel wood, biogas, solar, and wind. This includes providing an enabling framework for the efficient and sustainable production, distribution, and marketing of renewable energy technologies. The Ministry undertook a study of wood fuel in 2000 and plans to undertake another study in 2009/10 to determine the impact of the policy measures implemented over the last 10 years in redressing the balance between supply and demand for fuel wood.

In addition, the inadequate data on the development of markets for efficient stoves will be addressed by doing surveys. Also, the legal and regulatory framework for wood fuel development and an effective mechanism for coordination of different stakeholders, as identified in an Integrated Assessment of the Energy Policy study²³ that was requested by the Kenyan Ministry of Planning and National Development in Household Energy Sector, will be addressed. The assessment identifies gaps in the energy policy for the household sector and provides recommendations, but it does not formulate clear actions relating to the recommendations.

3.1.5. What has happened as a result of the policy and instruments that were introduced?

The Kenyan efficient stove can now be purchased in a variety of sizes and styles. Prices have decreased to roughly \$1-\$3²⁴. This has opened the market for these stoves. More than 13,000 energy efficient stoves are sold each month in Kenya and there are more than 700,000 energy efficient stoves in use in the country.

As a consequence, there are now more than 200 businesses of different sizes, legal entities, or informal sectors that are involved in this production activity. The Kenyan ceramic efficient stove is used in more than 50% of the households in urban area, and more than 15% in rural area.

The charcoal savings of the energy-efficient stoves reduce the energy-related expenditures of users that are generally low income populations.

3.1.6. List of relevant laws, regulations and rules

Parliament passed the Energy Act No.12 in 2006. Section 6 (p) of this Act gives power to the Energy Regulatory Commission. Under the Act, the Commission is empowered to make proposals to the Minister on regulations that are necessary for the energy sector, particularly for charcoal.

3.2 Promotion of energy efficient lighting as part of Senegal's rural electrification

3.2.1. Background

In sub-Saharan Africa, access to modern energy in rural areas remains a complex issue with multiple constraints in relation to the low income of the populations, the dispersion of the habitat, and increases in international energy prices. This situation is particularly exacerbated for the countries that don't have energy resources. The electricity sector conforms to this general rule. With 35.5% of the population electrified in 2002, Africa has the lowest rate

²² Household Energy for Improved Health and Livelihoods: Winrock International. See: <http://www.winrock.org/publications.asp>.

²³ Kenya: Integrated Assessment of the Energy Policy, UNEP, August, 2006.

²⁴ Walubengo, D., 1995: Commercialization of improved stoves: the case of the Kenya Ceramic Jiko (KCI). In Stove Images: a Documentation of Improved and Traditional Stoves in Africa.

of electrification of the world under development.²⁵ If only sub-Saharan Africa is accounted for, households that have access to electricity are limited to 23.6%. However, the disparities are even more marked within the sub-Saharan Africa countries, between urban and rural areas, where the latter areas have a rate of electrification that is generally lower than 5%.

In Senegal, the situation that preceded the reform of the energy sector was characterized by:

- Weak rate of rural electrification: 5% in 1998;
- Single player: the government which subsidizes access to electricity;
- Single technical solution of the national operator: connection to the grid;
- Weak commercial interest for the national operator in a tariff context whereby subsidies did not allow the real costs of electricity to be reflected, particularly in rural areas.

At the end of the 90s, catalyzed by the emergence of the fight against poverty and concerns of the international community, new laws with important changes were passed which promoted in-depth reforms of the energy sector. The new laws liberalized the electricity sector, set up a commission to develop regulations, and created the Senegalese Rural Electrification Agency (ASER), dedicated to the implementation of rural electrification policy.

In this new environment, an energy efficiency program has emerged as an important part of the rural electrification strategy of the Senegalese government. It aims to promote the use of energy-efficient devices as compact fluorescent light bulbs to displace incandescent light bulbs in newly electrified households in rural areas. It will be undertaken within a nation-wide rural electrification plan implemented under the supervision of ASER. ASER coordinates and monitors the implementation of the national rural electrification plan which includes a Public/Private Partnership scheme. For the purpose of the plan, the Senegalese territory has been divided in 12 geographical concessions. Each concession will be granted to investors/operators through an international competitive bidding process. Standardized contracts have been drawn up by ASER to provide a framework for the activities of the concessionaires. The concessionaire will purchase and

install the compact fluorescent light bulbs, which will be subsidized by ASER.

3.2.2. Objectives of the policy

The demand-side energy efficiency measures aim to reduce energy consumption in newly electrified households in rural areas, for the same service provided by electricity operators. This will lead to an increase of the access of rural population to electricity. The objective is to increase electricity access in Senegalese rural areas from 16% to 50% by 2012.

3.2.3. What policy instruments were used/had to be passed to achieve the objective?

An in-depth change has occurred compared to the traditional tariff models. A new tariff system has been introduced for low-energy consumers based on a fixed price authorized by the Commission of Regulation. Low-energy consumers are the ones that consume electricity mainly through lighting and use a radio as their only appliance. Indeed, for these consumers, the tariff is fixed and based on whether or not they use a radio and on the number of lighting points in the household. Instead of the energy consumed, these clients will pay for a level of service. This promotes the implementation of demand-side, energy-efficiency measures.

3.2.4. Key factors needed to make something happen

The main factor influencing the success of this program is the guarantee that the use of the compact fluorescent light bulbs will be sustainable. For this purpose, power limitation devices calibrated according to the level of service purchased will be installed. The client is discouraged from using incandescent light bulbs or adding other appliances. The electricity operator has the obligation to provide a compact fluorescent light bulb on request to the client after the recovery of the old one.

A local network of distributors is needed to collect, install, and replace the compact fluorescent light bulbs. The light bulbs that are to be installed should be of good quality. A Terms of Reference is to be elaborated for the compact fluorescent light bulbs, with very precise characteristics concerning the life time and the capability to operate in an environment with fluctuating voltage.

Local stakeholders consultations are to be carried out to enhance the awareness of the rural population concerned by the project. Their commitment is needed for the success of the project.

3.2.5. What has happened as a result of the policy and instruments that were introduced?

This demand-side, energy-efficiency program will facilitate the implementation of the rural electrification program. It will allow more people to be connected to the grid while reducing the need for additional new electricity supplies. One contract has been already signed by an electricity operator for the electrification of the concession of Saint-Louis/Dagana/Podor. Through this contract, the electricity operator is committed to electrify 16,400 households corresponding to 114,600 compact fluorescent light bulbs. If the rural electrification agency continues to subsidize the installation of the internal equipment as planned, it is foreseen that this program will be a success. Other operators have showed interest in signing for the other concessions. The fact that the purchase of the compact fluorescent light bulbs is subsidized by ASER reduces the electricity operator's investment and has helped to reduce the investment risk for the electricity operator.

3.2.6. List of relevant laws, regulations and rules

The ASER is an autonomous public entity created in 1998 under Senegal's Electricity Reform Law 98-29 to provide technical and financial assistance for rural electrification in Senegal.

3.3 Renewable energy development policy in Senegal

3.3.1. Background

While almost 100% of modern energy generated in Senegal is fossil fuel based, the country is not endowed with conventional energy resources. The import of fossil fuel for modern energy production has had a very negative effect on the availability of hard currency and on national export earnings. This reliance also increases the vulnerability of the country to fuel price increases. As a result, a diversification in modern energy generation is now the key goal of the Senegalese energy strategy.

In Senegal, actual electricity demand growth has been estimated to be higher than 7% per year. The government

aims to increase access in rural areas from its current value of 16% to 50% by 2012, as access to modern energy is seen as a human right by the Senegalese population. This will lead to a very significant increase in demand for electricity, which the government will have difficulties satisfying.

Senegal has a vast potential to generate electricity from renewable sources. There is substantial wind energy potential in the northern coastal areas and significant solar energy and biomass potential. This suggests the need to develop renewable energy as these resources are locally available, secure, and not exposed to exogenous disruptions or higher prices. However, the success of this option depends to a large extent on a policy framework with all the instruments necessary to achieve its objectives. A national renewable energy policy was needed in Senegal to ensure that national energy resources are adequately tapped. In particular, an optimized energy system cascade – in which renewable energy and fossil fuel energy are integrated and utilized efficiently to satisfy the most appropriate demands – was needed to provide the modern energy needed for the country development.

3.3.2. Objective of the policy

The objective of the policy is to strengthen the electricity market and increase access to modern energy, while protecting the global environment and diversifying the sources for electricity generation through the development of public and private investment in electricity production from renewable sources. For that purpose, an attractive regulatory framework has been set up and implemented.

3.3.3. What policy instruments were used to achieve the objective?

The existing laws relating to the purchase and cost of renewable energy in the electricity sector (the 98-29 law of 14 April 1998 and the 2002-01 of 10 January 2002) were updated. The updated law obligates the grid operator – that is, the national electricity company owned by the state – to buy and pay for electricity produced from renewable sources. It guarantees the purchase of electricity from independent power producers using renewable sources and establishes a national system of subsidies to cover the cost differences among different regions. The subsidy does not vary with different renewable sources. The grid is the property of the state. The updated law also established a Ministry for Bio-fuels and Renewable Energy, which is responsible for its implementation.

²⁵ African Bank of Development and the Center of Development of OECD, Economic Outlooks in Africa, 2005-2006.

The elaboration of a law on the purchase and cost of renewable energy is the instrument used by the Senegalese government for the development of renewable energy and its use for electricity sector development. A legal framework consisting of laws and regulations will permit different stakeholders to play their role in a sound and attractive environment. This law defines the obligation of companies that operate the electricity grid to purchase and to pay for electricity produced from renewable sources. It applies to the following renewable sources:

- Micro and mini hydroelectric power plants;
- Wind farms;
- Solar based electricity generation;
- Waste heat recovery; and
- Renewable biomass based electricity generation.

3.3.4. Key factors needed to make something happen

The use of renewable resources is, in most cases, not cost competitive when compared to conventional fossil-based energy generation. There is therefore a need for the Senegalese government to create an attractive environment through the introduction of fiscal and financial support mechanisms within this legal and regulatory framework to allow renewable energy technologies to compete with fossil-based technologies.

For the development and deployment of solar PV in rural electrification projects, an assessment of the most suitable technology for a given region, accounting for the notion of subsidiarity, is required. This means that in times of scarce electricity, the most suitable option to satisfy a given energy need should be based on both economical criteria and the availability of the supply. For example, in times of high demand, the satisfaction of energy demand for lighting by low power consumers in villages should be met by off grid sources of electricity, while the needs of industry should be met by the grid as their requirements cannot easily be met by solar PV. This is the first step of an integration that will satisfy each type of demand with the type of sources of quality just required.

The law must be properly enforced so that investors can be confident that they can earn a return on their investment. For that purpose, the Regulatory Commission for Electricity is to be strengthened and supported.

A holistic approach is to be used for policy definition and implementation. Otherwise, if one key factor for the achievement of the policy objective is not accounted for, even if important measures are taken, the result can be

mitigated. The key factors and stakeholders needed to ensure implementation must be identified for each step of the process.

To expand the program beyond its current scope, CDM revenues could be used as an incentive to increase the attractiveness of projects using renewable sources of electricity. However, there are still some barriers (e.g., non involvement of the local financial institutions in the CDM capacity building process, the lack of official data publicly available for demonstration projects, and the eligibility assessments of CDM projects) that prevent CDM development in Senegal.

3.3.5. What has happened as a result of the policy and instruments that were introduced?

There are two projects under development as a result of the law. The first is a project to generate electricity using typha biomass, an invasive water plant that is abundant in the Senegal River. This plant colonizes the flood plains, reduces the available cropland in the irrigated areas, impedes river traffic, and provides habitat for carnivorous birds. So, this project will also contribute to sustainable development because the plant must be harvested, thereby providing jobs for local people. In the first phase, the investors aim to implement a 12 MW power plant and add two 12 MW plants in a second phase. The feasibility studies have been done and if the project proponents finalize the contract with the electricity company, the project will be launched.

The second is the development of a wind farm project at Saint-Louis, on the north coastal area of Senegal. The region of Saint-Louis, with a subsidy from the Midi Pyrenees region and the Agence Française de Développement, the French bilateral cooperation agency, is undertaking preliminary studies for a 50 MW wind park. This project will be carried out in two phases: a first pilot of 15MW and a complementary phase of 35MW. The estimated cost of the first phase is about 16,500 K Euros. The annual net producible electricity will be 28,775 MWh. Training will be provided for the operation and the maintenance of the wind park as part of the project activity.

The Saint-Louis region has clearly stated its interest in this wind park. A contract providing a long-term concession of the land to accommodate this park has been signed. The government of Senegal, through the Ministry for Energy, is very interested in implementing the project,

which is highly ranked on the list of projects for energy production by the ministry. The project was presented by the national private sector at the employers' national council workshop as an example of a renewable energy project that can be implemented in a short term. A draft contract for the sale of electricity was proposed by SENELEC, the Senegal National Electricity Company.

There was a legal barrier to the implementation of this project that needed to be clarified. The consortium of companies behind this project originally wanted the electricity for their own use and to pay the electricity company fees for the transport of the electricity in its lines. The concept of self-production does not exist in the laws and regulations in force in Senegal. The project was thus perceived to be selling energy to the companies in the consortium, whereas the electricity company SENELEC has the monopoly for the sale and the distribution – a monopoly which it does not plan to reassign to self producers. The new approach of the independent power producers, in the context of the new regulatory framework for renewable energy production and sale, seems to be more appropriate for SENELEC and will remove the barrier to the implementation of this project. The companies have to sell their entire production to the grid and purchase electricity from the grid.

3.3.6. List of relevant laws, regulations and rules

[*The 98-29 law of 14 April 1998.*](#)

[*The 2002-01 of 10 January 2002.*](#)

Only one law is for the time being identified as instrument for the achievement of this policy. It is the law on the purchase and cost of renewable energy.

Annex 4. Glossary

TERM	DEFINITION
Abatement	Refers to reducing the degree or intensity of greenhouse gas emissions.
Adaptation	Adjustment in natural or human systems to a new or changing environment. Adaptation to climate change refers to adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation.
Anthropogenic emissions	Emissions of greenhouse gases, greenhouse gas precursors, and aerosols associated with human activities. These include burning of fossil fuels for energy, deforestation, and land-use changes that result in net increase in emissions.
Ad Hoc Working Group on Further Commitments of Annex I Parties under the Kyoto Protocol (AWG-KP)	Article 3, paragraph 9 of the Kyoto Protocol provides that the CMP shall initiate consideration of future commitments for Annex I Parties at least seven years before the end of the first commitment period. Pursuant to that provision the CMP at its first session held at Montreal from 28 November to 10 December 2005, established the Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol (AWG-KP).
Bali Action Plan	The United Nations climate change conference in Bali culminated in the adoption of the Bali Road Map, which consists of a number of forward-looking decisions that represent the various tracks that are essential to reaching a secure climate future. The Bali Road Map includes the Bali Action Plan, which charts the course for a new negotiating process designed to tackle climate change, with the aim of completing this by 2009. It also includes the AWG-KP negotiations and their 2009 deadline, the launch of the Adaptation Fund, the scope and content of the Article 9 review of the Kyoto Protocol, as well as decisions on technology transfer and on reducing emissions from deforestation.
Biomass fuels or biofuels	A fuel produced from dry organic matter or combustible oils produced by plants. These fuels are considered renewable as long as the vegetation producing them is maintained or replanted, such as firewood, alcohol fermented from sugar, and combustible oils extracted from soy beans. Their use in place of fossil fuels cuts greenhouse gas emissions because the plants that are the fuel sources capture carbon dioxide from the atmosphere.
Capacity building	Increasing skilled personnel and technical and institutional abilities.
Clean Development Mechanism (CDM)	Defined in Article 12 of the Kyoto Protocol, the CDM is intended to meet two objectives: (1) to assist parties not included in Annex I in achieving sustainable development and in contributing to the ultimate objective of the convention; and (2) to assist parties included in Annex I in achieving compliance with their quantified emission limitation and reduction commitments. Certified Emission Reduction Units from CDM projects undertaken in Non-Annex I countries that limit or reduce GHG emissions, when certified by operational entities designated by COP Meeting of the Parties, can be accrued to the investor (government or industry) from parties in Annex B. A share of the proceeds from certified project activities is used to cover administrative expenses as well as to assist developing country parties that are particularly vulnerable to the adverse effects of climate change to meet the costs of adaptation.
Climate	Climate in a narrow sense is usually defined as the 'average weather', or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years. These quantities are most often surface variables such as temperature, precipitation, and wind. Climate in a wider sense is the state, including a statistical description, of the climate system. The classic period of time is 30 years, as defined by the World Meteorological Organization (WMO).

TERM	DEFINITION
Climate change	Climate change refers to a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/ or the variability of its properties and that persists for an extended period – typically, decades or longer. Climate change may be due to natural internal processes or external forcings or to persistent anthropogenic changes in the composition of the atmosphere or in land use. Note that UNFCCC, in its Article 1, defines “climate change” as “a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods”. The UNFCCC thus makes a distinction between “climate change” attributable to human activities altering the atmospheric composition, and “climate variability” attributable to natural causes.
Co-generation	The use of waste heat from electric generation, such as exhaust from gas turbines, for either industrial purposes or district heating.
Deforestation	Conversion of forest to non-forest. For a discussion of the term forest and related terms such as afforestation, reforestation, and deforestation, see the IPCC Special Report on Land Use, Land-Use Change, and Forestry (IPCC, 2000).
Demand-side management	Policies and programs designed for a specific purpose to influence consumer demand for goods and/or services. In the energy sector, for instance, it refers to policies and programs designed to reduce consumer demand for electricity and other energy sources. It helps to reduce greenhouse gas emissions.
Emission	In the climate change context, emissions refer to the release of greenhouse gases and/or their precursors and aerosols into the atmosphere over a specified area and period of time.
Energy efficiency	Ratio of energy output of a conversion process or of a system to its energy input.
Fossil fuels	Carbon-based fuels from fossil carbon deposits, including coal, oil, and natural gas.
Greenhouse gas (GHG)	A gas that absorbs radiation at specific wavelengths within the spectrum of radiation (infrared radiation) emitted by the Earth's surface and by clouds. The gas in turn emits infrared radiation from a level where the temperature is colder than the surface. The net effect is a local trapping of part of the absorbed energy and a tendency to warm the planetary surface. Water vapor (H ₂ O), carbon dioxide (CO ₂), nitrous oxide (N ₂ O), methane (CH ₄) and ozone (O ₃) are the primary GHGs in the Earth's atmosphere.
Intergovernmental Panel on Climate Change (IPCC)	Established in 1988 by the World Meteorological Organization and the UN Environment Program, the IPCC surveys world-wide scientific and technical literature and publishes assessment reports that are widely recognized as the most credible existing sources of information on climate change. The IPCC also works on methodologies and responds to specific requests from the Convention's subsidiary bodies. The IPCC is independent of the Convention.
Mitigation	An anthropogenic intervention to reduce the sources or enhance the sinks of greenhouse gases.
Renewables/renewable energy	Energy sources that are, within a short time frame relative to the Earth's natural cycles, sustainable, and include non-carbon technologies such as solar energy, hydropower, and wind, as well as carbon-neutral technologies such as biomass.
Research, development, and demonstration (RD&D)	Scientific and/or technical research and development of new production processes or products, coupled with analysis and measures that provide information to potential users regarding the application of the new product or process; demonstration tests; and feasibility of applying these products processes via pilot plants and other pre-commercial applications.
Renewable energy	Energy sources that are, within a short time frame relative to the Earth's natural cycles, sustainable, and include non-carbon technologies such as solar energy, hydropower, and wind, as well as carbon-neutral technologies such as biomass.
Resources	Resources are those occurrences with less certain geological and/or economic characteristics, but which are considered potentially recoverable with foreseeable technological and economic developments.

TERM	DEFINITION
Sink	Any process, activity or mechanism that removes a greenhouse gas, an aerosol, or a precursor of a greenhouse gas or aerosol from the atmosphere.
Source	Any process, activity, or mechanism that releases a greenhouse gas, an aerosol, or a precursor of a greenhouse gas or aerosol into the atmosphere.
Subsidy	Direct payment from the government to an entity, or a tax reduction to that entity, for implementing a practice the government wishes to encourage. Greenhouse gas emissions can be reduced by lowering existing subsidies that have the effect of raising emissions, such as subsidies to fossil-fuel use, or by providing subsidies for practices that reduce emissions or enhance sinks (e.g., for insulation of buildings or planting trees).
Sustainable development	Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.
Voluntary measures	Measures to reduce greenhouse gas emissions that are adopted by firms or other actors in the absence of government mandates. Voluntary measures help make climate-friendly products or processes more readily available or encourage consumers to incorporate environmental values in their market choices.
United Nations Framework Convention on Climate Change (the Convention) (UNFCCC)	The Convention was adopted on 9 May 1992, in New York, and signed at the 1992 Earth Summit in Rio de Janeiro by more than 150 countries and the European Community. Its ultimate objective is the 'stabilization of GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system'. It contains commitments for all Parties. Under the Convention, Parties included in Annex I aim to return greenhouse gas emissions not controlled by the Montreal Protocol to 1990 levels by 2000. The Convention entered in force in March 1994.

Sources: IPCC and UNFCCC glossaries, available at <http://www.ipcc.ch/glossary/index.htm> and http://unfccc.int/essential_background/glossary/items/3666.php.

ADAPTATION TO CLIMATE CHANGE: THE NEW CHALLENGE FOR DEVELOPMENT IN THE DEVELOPING WORLD

DR. E. LISA F. SCHIPPER

STOCKHOLM ENVIRONMENT INSTITUTE

MARIA PAZ CIGARÁN

LIBÉLULA COMMUNICATION, ENVIRONMENT AND DEVELOPMENT, PERU

DR. MERYLYN MCKENZIE HEDGER

INSTITUTE OF DEVELOPMENT STUDIES AT THE UNIVERSITY OF SUSSEX

CONTENTS

Acronyms	123
1. Introduction	124
2. What is adaptation?	126
2.1 Adaptation and development	126
2.2 Adaptation and disaster risk reduction	127
2.3 Adaptation and climate data	127
2.4 Adaptation and finance	127
3. Adaptation in the UN climate negotiations	130
3.1 Milestones in the process	130
3.1.1 Initial discussions	130
3.1.2 COP 7 (2001)	133
3.1.3 UNFCCC Expert Group Contributing to Adaptation	133
3.1.4 COP 10 (2004), COP 11 (2005) and COP 12 (2006)	134
3.1.5 COP 13 (2007) and the Bali Action Plan	134
3.2 Negotiations on adaptation: the contours of the debate	135
4. The adaptation challenge at the national level	138
4.1 Approaching adaptation at national level	138
4.2 Take stock of the progress made in your country	139
4.3 Identify adaptation options, set priorities, do adaptation planning and introduce it as part of your national policy framework and planning	139
4.4 Institutional arrangements needed to plan and implement adaptation: What roles should the different stakeholders have? How would you ensure public, private and social participation?	145
4.5 The need to catalyze investments: The role of public and private entities	146
4.6 Determine resources needed to implement adaptation	146
4.7 Technology: a means for adaptation	147
4.8 New and strengthened scientific and technical capabilities	148
4.9 Supporting institutions for the implementation of adaptation	148
4.10 Public awareness and participation	148
5. Conclusions: key messages and points for further reflection	150
References	152
Recommendations for further reading	152

Acknowledgements

UNDP and the author gratefully acknowledge the constructive suggestions made for this paper by the UNFCCC secretariat, UN/ISDR and UNDP staff members, as well as Hernan Carlino, Chad Carpenter, Susanne Olbrisch and Naira Aslanyan.

This paper relies heavily on the recent paper, "Impacts, Vulnerabilities and Adaptation in Developing Countries," by the UNFCCC Secretariat.

Annexes	154
Annex 1: Impacts and vulnerability	154
Annex 2: Decisions on adaptation under the UNFCCC and the Kyoto Protocol	156
Annex 3: Information resources guide	158
Boxes	
Box 1: Overview of developed and developing country positions and views on adaptation	136
Box 2: Examples of adaptation measures	138
Box 3: Adaptation options under the UNFCCC	144
Box 4: Adaptation technology for coastal areas: protect, retreat, accommodate	147
Figures	
Figure 1: Development of financial instruments for adaptation under the UNFCCC and the GEF	131
Figure 2: Activities involved in formulating an adaptation strategy	143
Tables	
Table 1: Funding sources for adaptation under the Convention and Kyoto Protocol	133
Table 2: Expert groups relating to adaptation	133
Table 3: Assessments needed as a base to identify adaptation options	141
Table 4: Potential roles and responsibilities of stakeholders	145

Acronyms

AAUs	Assigned Amount Units	MDGs	Millennium Development Goals
ADB	Asia Development Bank	NAPAs	National Adaptation Programs of Action
AfDB	African Development Bank	NGO	Non-Governmental Organization
ALM	Adaptation Learning Mechanism	NWP	Nairobi Work Programme
Annex I	Annex to the Convention listing industrialized and transitioning countries	ODA	Overseas Development Assistance
Annex II	Annex to the Convention, listing mostly OECD countries, with additional commitments to assist developing countries with funding and technology transfer	REDD	Reducing Emissions from Deforestation and Forest Degradation
AOSIS	Alliance of Small Island States	SBI	Subsidiary Body for Implementation
APF	Adaptation Policy Framework	SBSTA	Subsidiary Body for Scientific and Technological Advice
AR4	Fourth Assessment Report (of the IPCC, see below)	SCCF	Special Climate Change Fund
AWG-LCA	Ad hoc Working Group on Long-Term Cooperative Action under the Convention	SIDS	Small Island Developing States
BAP	Bali Action Plan	SNC	Second National Communication
CBA	Cost Benefit Analysis	SPA	Strategic Priority for Adaptation
CDM	Clean Development Mechanism	UKCIP	UK Climate Impacts Programme
CEA	Cost Effectiveness Analysis	UNDP	United Nations Development Programme
CEC	Commission of the European Countries	UNGA	United Nations General Assembly
CGE	Consultative Group of Experts on National Communications from Parties not included in Annex I	UNFCCC	United Nations Framework Convention on Climate Change (the Convention)
COP	Conference of Parties (to the UNFCCC)		
CMP	Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol		
CRMA	Climate Risk Management and Adaptation		
DEFRA	Department of Environment, Food and Rural Affairs of the UK		
EC	European Commission		
EGTT	Expert Group on Technology Transfer		
ETF	Environmental Transformation Fund		
EU	European Union		
FDI	Foreign direct investment		
GDP	Gross domestic product		
GEF	Global Environment Facility		
GIS	Geographic Information System		
HDR	Human Development Report		
IATAL	International Air Travel Adaptation Levy		
ICAO	International Civil Aviation Organisation		
IPCC	Intergovernmental Panel on Climate Change		
LDC	Least Developed Countries		
LDCF	Least Developed Countries Fund		
LEG	Least Developed Countries Expert Group		
MCA	Multi-Criteria Analysis		
MDBs	Multilateral Development Banks		

1 INTRODUCTION

The global climate is changing: the impacts associated with the accumulation of greenhouse gases in the atmosphere from human activities—changes in mean temperature, shifts in seasons and an increasing intensity of extreme weather events—are already occurring and will worsen in the future. Millions of people, particularly those in developing countries, face shortages of water and food and greater risks to health. Adaptation measures that reduce vulnerability to climate change are critical, especially in many countries where the risks are here and now.

The Intergovernmental Panel on Climate Change (IPCC) predicts serious effects of climate change across sectors and scales. By 2020, up to 250 million people in Africa could be exposed to greater risk of water stress. Other impacts include an increased risk of floods as glaciers retreat, sea level rise inundating coasts worldwide and completely inundating some small island States, and an increased severity and frequency of tropical cyclones (IPCC 2007). In 2007, the IPCC concluded that the unavoidable impacts and changes resulting from climate change will go beyond current coping capacity, and society and ecosystems will have to implement adaptation measures.

The approximate costs of adaptation are high by all estimates. The UN Climate Change secretariat has estimated that by 2030 developing countries will require \$28–67 billion to enable adaptation to climate change.¹ This corresponds to 0.2–0.8% of global investment flows, or just 0.06–0.21% of projected global GDP in 2030. Incremental costs to adapt to projected climate change in developing countries are likely to be of the order of \$10–40 billion per year (World Bank 2006). In addition, the Stern Review on the Economics of Climate Change estimates that if no action is taken to mitigate climate change, overall damage costs will be equivalent to losing at least 5% of global GDP each year, with higher losses in most developing countries (Stern, 2007). Current global funding for adaptation is a fraction of the amount needed.

Adaptation to climate change is a complex and multi-faceted topic that presents a number of challenges, particularly for the developing world. Climate

change impacts are already affecting developing countries, particularly the poor and most vulnerable, because they have fewer social, technological and financial resources for adaptation. Climate change also affects the sustainable development of countries, as well as their abilities to achieve the United Nations Millennium Development Goals (MDG) by 2015. The 2007/8 Human Development Report (HDR) warned that the achievements of a number of MDG targets, most notably in poverty reduction, will be compromised by five climate change-induced human development tipping points: reductions in agricultural productivity; heightened water insecurity; exposure to extreme events; collapse of ecosystems; and increased health risks (UNDP HDR, 2007).

Successful adaptation strategies require action at different levels: community, national, regional and/or international. There is growing scientific, economic, political and social consensus these adaptation measures will require long-term thinking and explicit consideration of climate change risks at the regional (cross-national), national, sub-national, and local levels. They require a combination of many components, such as an assessment of vulnerabilities to climate change, appropriate technologies, capacity assessment, local coping practices and government actions.

The many aspects of adaptation cannot be addressed in a single document. This paper will therefore limit its scope to the key aspects of these issues and provide policymakers with a starting point, including background information and questions for further reflection.

The paper focuses on:

- The contours of the adaptation issue, as well as its relationship to other important issues;
- The consideration of adaptation within the current international negotiations under the United Nations Framework Convention on Climate Change (UNFCCC), including the issues relating to adaptation finance;
- The challenge of approaching adaptation at every level in a country: community, local, regional, sectoral and national.

Issues relating to finance are crucial for addressing adaptation and this paper highlights many of the fundamental aspects. A fuller discussion of issues relating to adaptation financing is available in a separate paper produced for this series.²

¹ <http://unfccc.int/4053.php>.

² See the paper by Erik Haites in this series titled, *Negotiations on additional investment and financial flows to address climate change in developing countries*.

2. WHAT IS ADAPTATION?

Adaptation to climate change is a complex topic that presents a number of challenges. Indeed, one important challenge lies in defining adaptation and understanding the full scope of its implications. Adaptation is currently the topic of numerous studies that offer a range of definitions. The IPCC offers a starting point by providing a broad definition of adaptation: adjustment in natural or human systems to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. However, adaptation is increasingly difficult to define in practical and operational terms. To aid in this effort, some key points can be identified to provide a helpful framework for understanding the complex nature of adaptation.

Adaptation involves a process of sustainable and permanent adjustment in response to new and changing environmental circumstances. Although humanity has constantly adapted to their surroundings, planned anticipatory adaptation has only recently emerged as a response to the impacts of anthropogenic climate change around the world. Policy makers have accepted that the world is facing a real and immediate threat and adapting to the change is necessary. Adaptation has been identified as an appropriate response because it is associated with supporting development processes and can facilitate the continuation and improvement of existing livelihoods.

Climate change will affect every aspect of society, environment and economy. This means adjusting behavior, livelihoods, infrastructure, laws and policies and institutions in response to experienced or expected climatic events. These adjustments can include increasing flexibility of institutions and management systems to deal with uncertain future changes, or they can be based on experienced impacts and threats and/or predicted changes. Planned adaptation requires careful thinking about how systems will function in the short, medium and long term.

An overview of climate change impacts and vulnerability is contained in Annex 1.

2.1 Adaptation and development

Adaptation is closely linked with development and this linkage is critical to reducing vulnerability to climate change. Economic growth is essential for developing countries to improve the health, economic livelihood and quality of life of their citizens. It is also essential to increase the capacity of developing countries to

adapt to the negative impacts of climate change. However, development in line with ‘business-as-usual’ is often not sufficient to adapt to climate change. Indeed, some dimensions of development can impede the adaptation process, focusing on growth at the cost of higher exposure and sensitivity to climate change. There is also a risk that development efforts will be misaligned with future changes in climate, leading to maladaptation, i.e., a process that initially looks like a response to a hazard but ultimately exacerbates vulnerability to the hazard.

All of the development objectives that fall under the MDGs influence how vulnerable any individual, group or society is to climate change. The IPCC agrees that “sustainable development can reduce vulnerability to climate change” (IPCC, 2007). At the same time, climate change is a direct threat to sustainable development. One of the pivotal issues underlying the growing popularity of adaptation is the belief that adaptation is fundamentally linked to sustainable development and must be part of the development and planning process.

Most development processes that are sustainable and equitable will also be able to bridge the “adaptation deficit” – i.e., the gap between the adaptation that is possible without additional policy or projects and the level that is needed to avoid adverse effects of climate change (Burton, 2004). The adaptation deficit describes the additional effort needed to manage the impacts of climate change in order to make up for the failures in managing existing climate variability, emphasising the massive scale of the gap. Indeed, this “deficit” is a central element drawing together adaptation and sustainable development. Adaptation measures are concerned with human development, because factors that constrain and facilitate adaptation are often the same factors that constrain or enable human development. While some survive under difficult conditions with current weather patterns, the addition of climate change impacts may push the system over a threshold into unviable existence.

Efforts to “mainstream” adaptation can be found in national development plans (as in Bangladesh and the Caribbean), development projects (by non-governmental organizations (NGOs) and institutes carrying out action research) and in aid agencies of countries such as Denmark, the UK, Germany and Norway. This work is in early stages, with few results on which to assess levels of success. Nevertheless, even in the most climate sensitive countries, numerous other priorities remain ranked above

climate change, coupled with a general lack of clarity on how to integrate it into planning.

Another aspect of mainstreaming adaptation into development relates to different approaches to adaptation across sectors, where one sector may take an approach that is inconsistent with the approach taken in another sector. For example, if energy managers decide to build new dams for hydropower, while the agriculture managers advocate expanded irrigation downstream, there could be inconsistencies and adverse consequences for the downstream farmers, whose water supply might become more unreliable.

Lastly, it is important to understand adaptation as a process and think carefully about how it is implemented. In particular, thinking about adaptation as a process explains why measures to adapt now may need to be adjusted in the future in response to changes, including environmental, social, political and financial. Framing adaptation in this way also explains why adaptation is not a tangible outcome that can be measured exhaustively at any given time, but an evolving objective.

2.2 Adaptation and disaster risk reduction

Frequently there are conceptual and practical linkages drawn between adaptation and disaster risk reduction. It may seem obvious that these two approaches function together as part of a repertoire of risk reduction techniques. **But on the ground, the two approaches are supported by entirely different sets of institutions, individuals, methodologies and policy frameworks.** Further discrepancies range from the intellectual development of the fields to implementation of risk reduction measures, resulting in policy inconsistency, redundant investment, and competing approaches to addressing the same problems, among other things.

Recently, dialogue between the disaster risk reduction and climate change adaptation communities has focused on creating stronger linkages, putting greater effort on learning more from each other, and collaborating conceptually and practically. In part, this common interest has come from a simultaneous recognition that risk reduction requires a far more holistic approach than has been previously been applied.

This convergence in efforts recognises that neither disaster risk reduction nor climate change adaptation is about disasters or climate change only, but rather about

all of the social, physical and economic factors that influence the magnitude of and are affected by the threat. Consequently, the cycle of disaster management has been expanded to incorporate lessons from disaster impacts into planning, placing more focus on making profound changes to reduce risk, rather than focus on reconstructing the same conditions as prior to a disaster, as is often the case when disaster management is limited to humanitarian relief efforts.

2.3 Adaptation and climate data

There are many challenges to planning successful adaptation. One of these is the need for information about impacts of climate change and their secondary effects. Climate variability and change add uncertainty to decision making, but the uncertainty in these phenomena add even more complexity to the planned adaptation process.

Uncertainty dominates all of the approaches aimed at understanding the potential impacts of climate. Attempts to overcome these uncertainties mean designing adaptation strategies that would be robust against a range of future climate outcomes. However, it is difficult to imagine an adaptation option that would address extended wetter and drier conditions simultaneously – these would likely need to be addressed by different strategies. So-called ‘win-win’ or ‘no-regrets’ adaptation measures are those whose benefits outweigh their costs. These often address adaptation, while simultaneously meeting other needs. They are not in conflict with development objectives, nor do they lead to circumstances that will increase vulnerability to climate change in the short and medium term. These could potentially be designed without accurate climate information.

Climate data is not always necessary to warrant adaptation actions. For example, if model projections for the future suggest that an already observed trend will continue, detailed climate data will not be necessary to justify adaptation measures. It is important to recognise that in such cases, lack of climate data should not inhibit action.

2.4 Adaptation and finance

Adaptation will require substantial funding. As noted earlier, all indicative estimates available suggest that the costs of adapting to climate change in the developing world are in the order of tens of billions. However, there

are many difficulties and limitations in estimating the exact costs of adapting under various scenarios, as well as the ability of countries to self-finance adaptation. These include:

- (1) **Differences in adaptive capacity:** Adaptive capacity is a key limitation in estimating the costs of adaptation. Adaptive capacity is essentially the ability to adapt to stresses such as climate change. It does not predict what adaptations will happen, but gives an indication of the differing capacities of societies to adapt on their own to climate change or other stresses.
- (2) **Most adaptation measures need not be implemented solely for the purpose of adapting to climate change:** Most activities that need to be undertaken to adapt to climate change will have benefits even if the climate does not change. For example, improvements in the management of ecosystems to reduce stresses on them or water conservation measures can typically be justified without considering climate change. Climate change provides an additional reason for making such changes because benefits of the adaptations are larger when climate change is considered. Indeed, the need for these adaptations may not depend on specific greenhouse gas concentration levels and thus climate change associated with scenarios. It may well be justified to introduce water use efficiency or reduce harm to coral reefs no matter what scenario is assumed.
- (3) **The uncertainties associated with any readily available methods to estimate adaptation costs:** Most all methods for estimating adaptation costs contain a number of uncertainties. For example, the existing information for using a complete “bottom-up approach”, which involves estimating costs of specific adaptations across the world, is far from being comprehensive and complete. For other methods, uncertainties can arise because the assumptions that must be made can result in quite different estimates of magnitudes.
- (4) **The existence of an adaptation deficit:** In many places, property design and activities are insufficient-

ly adapted to current climate, including its variability and extremes. Evidence for the existence and size of the adaptation deficit can be seen in the mounting losses from extreme weather events such as floods, droughts, tropical cyclones and other storms. These losses have been mounting at a rapid rate over the last 50 years. This widespread failure to build enough weather resistance into existing and expanding human settlements is the main reason for the adaptation deficit. This topic is also considered in section 2.1 of this paper.

Beyond the difficulties in estimating the global cost of adaptation to climate change, other areas of uncertainty or lack of clarity also influence the level of financing available. For example, the absence of a universally accepted operational definition of adaptation could affect the level of financing to be expected in the light of the commitments under the UNFCCC. Questions also arise with regard to how adaptation finance should be delivered and how its effectiveness can be tracked.

In addition, questions arise with regard to how different costs will be covered under different development scenarios. While mainstreaming adaptation measures into a sustainable development policy scenario would cover some of the expected costs, some costs for adaptation may arise from measures that address adaptation alone.

Despite these difficulties and uncertainties, one fact remains clear: the amounts needed to adapt to climate change will be considerable and far exceed what is currently available through existing UNFCCC funds and other sources. There are a number of different proposals that have been recently submitted to the UNFCCC negotiating process or have been discussed in other related forums that focus on ways to increase the level of funding for adaptation. For further information on these proposals, see a separate paper on adaptation funding produced for this series.³

Questions:

- What are the key development priorities in your country; for which would adaptation be necessary? What would be the first steps to integrate adaptation into such priorities?

- In what sectors would you see possible “win-win” options that could promote adaptation while benefiting other national priorities through the same activities?
- What do you think are the key data limitations to assess vulnerability and identify adaptation options in your country?
- Are you involved in, or aware of, the Hyogo Framework for Action for building resilience to disasters?⁴ Does your country have a coordinated strategy regarding climate change and disaster risk reduction?
- What has been the experience of your country in developing and considering the funding needed for projects? What, in your view, are the important elements to consider?

³ See the paper by Erik Haites in this series titled, *Negotiations on additional investment and financial flows to address climate change in developing countries*.

⁴ Disaster risk reduction efforts are guided by the Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters to which 168 Governments agreed in Hyogo, Kobe, Japan, in 2005. The Framework aims for “the substantial reduction of disaster losses, in lives and in the social, economic and environmental assets of communities and countries.” As part of its text, governments agreed to integrate climate change adaptation and disaster risk reduction.

3. ADAPTATION IN THE UN CLIMATE NEGOTIATIONS

The UNFCCC, also referred to as the Convention, provides the basis for international action to mitigate climate change and to adapt to its impacts. The UNFCCC entered into force in 1994 and now has 191 Parties (member countries). It commits these Parties to: launch national strategies for adapting to expected impacts including the provision of financial and technological support to developing countries by developed countries and to cooperate in preparing for adaptation to the impacts of climate change. It also refers to adaptation in several of its articles.

In addition, the supreme body of the Convention, the Conference of the Parties (COP), has made several decisions over the years pertaining to adaptation. These decisions relate to support and funding by developed country Parties to assist developing countries with impact, vulnerability and adaptation assessment; capacity-building, training, education and public awareness; implementing concrete adaptation activities; promoting technology transfer; and exchanging experience through regional workshops. Adaptation is also addressed by ongoing work relating to national communications, research and systematic observation, and guidance to the Global Environment Facility (GEF).

3.1 Milestones in the process

Although early on the focus of the UNFCCC was mainly on mitigation, adaptation is now recognized as an important component of any response to climate change. The IPCC Fourth Assessment Report (AR4) in 2007 made it clear that accumulated historical emissions have already “committed” the Earth to some level of warming and that the impacts of this warming are already being felt. Accordingly, efforts to understand how adaptive capacity might be enhanced and how adaptation is supported have increased exponentially in the last few years.

3.1.1 Initial discussions

When the UNFCCC was adopted at Rio in 1992, only the First Assessment Report of the IPCC had been completed and although the nature of the climate change problem was well defined, there were many uncertainties. While it was known that human activities had been substantially increasing the atmospheric concentration of greenhouse gases, all the consequent impacts were to be seen and addressed in the future. The focus of the Convention was on reducing emissions of greenhouse gases (in industrialized countries), with the aim of reducing the cause of the problem so its effects could be minimized and easily managed. Capacity to adapt was considered to be inherent in ecosystems and society, therefore not requiring explicit policy.⁵ Furthermore, adaptation was seen at the time as a defeatist recourse that reflected a failure to meet the mitigation challenge.

UNFCCC Parties, at the first session of the Conference of the Parties (COP 1) in 1995, agreed to create an ad hoc group⁶ to address mitigation and negotiate what ultimately became the Kyoto Protocol. Adaptation was considered to be a lower and longer-term priority and early discussions on the topic took place in the context of the negotiations on guidance to the financial mechanism of the Convention and the negotiations on guidelines and support for preparing national communications.⁷

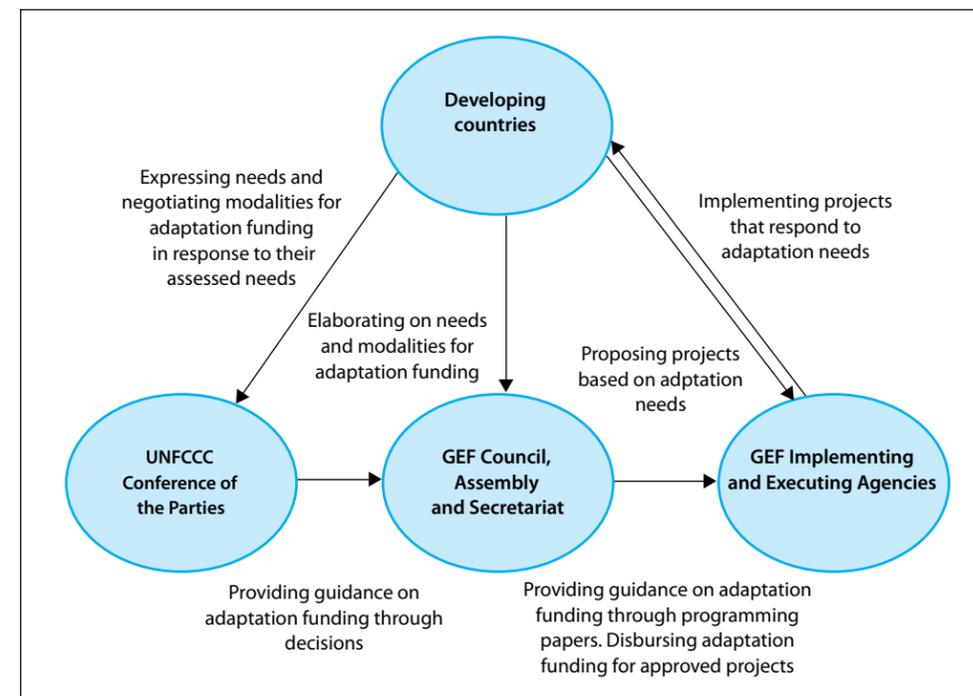
The UNFCCC commits developed countries to assist developing countries in meeting costs of adaptation to the adverse effects of climate change. This assistance is operationalized primarily through the financial mechanism of the Convention, which is currently operated by the GEF, subject to review every four years. The financial mechanism is guided by, and accountable to, the COP, which decides on its climate change policies, program priorities and eligibility criteria for funding, which is normally adopted based on advice from the Convention’s Subsidiary Body for Implementation (SBI).

Since the initial phases of the Convention, it was recognized that developing countries needed financial and technical support to assess their vulnerabilities to impacts of climate change and develop plans to adapt to these impacts during the preparation of their national communications. Parties agreed that adaptation should be implemented in the context of short, medium and long-term strategies, and set up a three-stage approach to adaptation funding in developing countries:

- Stage I and II encompass planning, vulnerability assessments, developing policy options and capacity building for adaptation; and,
- Stage III envisions actual measures to facilitate adequate adaptation.

The COP requested the GEF to provide full-cost funding for adaptation activities in the context of formulating national communications. See Figure 1 for information on the development of financial instruments for adaptation under the UNFCCC and the GEF.

Figure 1: Development of financial instruments for adaptation under the UNFCCC and the GEF



Source: Adapted from Möhner and Klein (2007).

⁵ UNGA: Paragraph 14.

⁶ This group subsequently became known as the Ad Hoc Group on the Berlin Mandate.

⁷ Parties to the Convention must submit national reports on implementation. The required contents of national communications and the timetable for submission are different for Annex I Parties (developed countries) and non-Annex I Parties (developing countries). This reference pertains to discussions on non-Annex I national communications.

3.1.2 COP 7 (2001)

At COP 7 in 2001, Parties made major strides forward on the issue of adaptation.

The COP adopted a decision dedicated to the issue of adaptation (decision 5/CP.7), which identified 14 adaptation-related activities needing support and further work. These included: enhancing technical training for integrated climate change impact, vulnerability and adaptation assessments; promoting the transfer of adaptation technologies; establishing adaptation pilot projects; and, supporting systematic observation and monitoring networks and early warning systems in developing countries.

In recognition of the special needs of the **Least Developed Countries (LDCs)**, the COP adopted a work program to address the needs of LDCs (decisions 28/CP.7 and 29/CP.7). This work program, inter alia:

- Established a process for developing **National Adaptation Programs of Action (NAPAs)**, through which LDCs identify the priority activities that respond to their urgent and immediate adaptation needs through a multi-stakeholder bottom-up assessment;
- Established the **Least Developed Countries Expert Group (LEG)** to provide advice to LDCs in preparing and implementing NAPAs.

The COP also created two special funds under the Convention to support adaptation, in order to enhance the support provided by the GEF trust fund⁸ (see Table 1):

- The **Least Developed Countries Fund (LDCF)** was established to support the above-mentioned work program, which currently assists the LDCs to carry out, inter alia, the preparation and implementation of NAPAs;
- The **Special Climate Change Fund (SCCF)** was established to finance projects relating to adaptation; technology transfer and capacity building; energy, transport, industry, agriculture, forestry and waste management; and economic diversification. This fund

should complement other funding mechanisms for the implementation of the Convention.

Parties also established the **Adaptation Fund**⁹ under the Kyoto Protocol to finance concrete adaptation projects and programs in developing countries that are Parties to the Kyoto Protocol. Unlike other funds in the Convention that rely mainly on donor contributions, this fund is to be financed with a 2% share of proceeds from clean development mechanism (CDM) project activities. However, it is also open to receiving contributions from other sources of funds. Because of its innovative means of funding, and because the Kyoto Protocol only entered into force in 2005, the Fund was only fully operationalized in 2007.

The Adaptation Fund has an innovative governance system, as it is managed by an “Adaptation Fund Board” which:

- Has government representation following UN regional distribution and a majority of developing countries;
- Is elected and directly accountable to the supreme body of the Kyoto Protocol, the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol (CMP).

The first two meetings of the Adaptation Fund Board were held in Bonn in March and June 2008. The members elected a chair and a vice-chair for 2008–2009. The Board agreed on: the role and responsibilities of the Adaptation Fund Secretariat,¹⁰ the 2008 work plan and budget, and draft legal arrangements for the Adaptation Fund Secretariat. The Board began, but did not complete, the rules of procedure of the Board, provisional operational policies and guidelines for Parties to access resources from the Fund, legal status of the Fund, monetization of CERs, the role and responsibilities of the Trustee, and the responsibilities of implementing and executing entities.¹¹ In summary, the Adaptation Fund is just becoming operational.

Further information on the Adaptation Fund, as well as other funds, is available in a separate paper produced for this series, *Negotiations on additional investment and financial flows to address climate change in developing countries*.

Table 1: Funding sources for adaptation under the Convention and Kyoto Protocol

FUNDS	CONVENTION/KYOTO PROTOCOL MANDATES	GOVERNANCE	CURRENT LEVEL OF FUNDS
GEF Trust Fund strategic priority for adaptation (SPA)	FCCC Art. 11: Financial Mechanism of the Convention	GEF Council	\$50 million (GEF 4, 2007–2010)
Special Climate Change Fund (SCCF)	FCCC Art. 11: Financial Mechanism of the Convention	SCCF Council (under the GEF)	\$74 million (until March 2008)
Least Developed Countries Fund (LDCF)	FCCC Art. 11: Financial Mechanism of the Convention	LDCF Council (under the GEF)	\$173 million pledged (until March 2008)
Adaptation Fund	Kyoto Protocol Art. 12.8: Clean Development Mechanism	Adaptation Fund Board (directly elected by the CMP)	Depending on quantity and price of CERs (until 2012). \$80–300 million per year

3.1.3 UNFCCC expert groups contributing to adaptation

In addition to the LEG, two other constituted expert groups under the UNFCCC also contribute to adaptation (see Table 2):

Table 2: Expert groups relating to adaptation

EXPERT GROUP	MANDATES	STATUS	FURTHER INFORMATION
Least developed countries expert group (LEG)	Advise on the preparation and implementation strategy for NAPAs	Mandate extended in 2007 for three more years. COP will review progress at COP 16 (2010)	http://unfccc.int/2666.php
Expert Group on Technology Transfer (EGTT)	Enhance the implementation of Article 4.5 of the Convention; Advance technology transfer activities under the Convention; Make recommendations to the SBSTA and the SBI	Mandate renewed in 2007 for additional 5 years. A work plan was prepared and agreed in June 2008	http://unfccc.int/1126.php
Consultative Group of Experts on National Communications from Parties not included in Annex I (CGE)	New mandate: Improve the process of the preparation of the second and subsequent national communications by providing technical advice and support	On hold – the mandate of this expert group has not been renewed since COP 13 in 2007. Its status is under negotiation	http://unfccc.int/2608.php

⁸ Information regarding the financial mechanism of the Convention, the LDCF, the SCCF and the Adaptation Fund can also be found at: <http://unfccc.int/2807.php>.

⁹ For more information on this fund please refer to: http://unfccc.int/cooperation_and_support/financial_mechanism/items/3659.php and to: <http://www.adaptation-fund.org/home.html>.

¹⁰ With the exception of one bracketed paragraph.

¹¹ Adaptation Fund Board, 2008.

- **The Consultative Group of Experts on National Communications from non-Annex I Parties (CGE)**, established at COP 5, offers technical advice and support in the area of tools, methodologies and process for vulnerability and adaptation assessments in the context of national communications; and
- **The Expert Group on Technology Transfer (EGTT)**, established at COP 7, provides an interface between planning and implementation through guidance on sources of funding and support for pilot projects in the area of the development and transfer of environmentally sound technologies for adaptation.

3.1.4 COP 10 (2004), COP 11 (2005) and COP 12 (2006)

By COP 10, Parties recognized that adaptation should be considered on a par with mitigation. By its decision 1/CP.10 (known as the Buenos Aires Programme of Work on Adaptation and Response Measures), the COP established two complementary tracks for adaptation:

- The development of a structured program of work on the scientific, technical and socio-economic aspects of vulnerability and adaptation known as the **Nairobi Work Programme on impacts, vulnerability and adaptation to climate change (NWP)**; and,
- The adoption of concrete implementation measures for furthering information and methodologies, concrete adaptation activities, technology transfer and capacity-building.

The NWP, launched in 2005, has a twofold objective:

- To assist countries, in particular developing countries, including the LDCs and small island developing States (SIDS), to improve their understanding and assessment of impacts, vulnerability and adaptation; and,
- To assist countries to make informed decisions on practical adaptation actions and measures to respond to climate change on a sound scientific, technical and socio-economic basis, taking into account current and future climate change and variability.

Initial activities were defined for the first two years. Three regional workshops and one expert meeting for SIDS were organized before COP 13 to facilitate the exchange of information and integrated assessments to assist in identifying specific adaptation needs and concerns.¹² In the first phase, these activities have enhanced capacity at international, regional, sectoral and local levels to understand and implement practical effective and high priority adaptation actions.

At the twenty-eighth session of the Convention's Subsidiary Body for Scientific and Technological Advice (SBSTA) in June 2008, Parties agreed to activities for the second phase of the NWP, to be implemented in the period leading up to the end of 2010. The program is an international framework implemented by Parties, intergovernmental organizations (IGOs), NGOs, the private sector, communities and other stakeholders. It is structured around nine areas of work, each vital to increasing the ability of countries to adapt and consistent with the action-orientated sub-themes of decision 2/CP.11.¹³

A comprehensive list of articles and decisions related to adaptation under the UNFCCC and the Kyoto Protocol is presented in Annex 2.

3.1.5 COP 13 (2007) and the Bali Action Plan

At its most recent session in Bali (COP 13), the COP adopted a decision entitled the Bali Action Plan that charts the course for a new negotiating process designed to tackle climate change, with the aim of completing this process by 2009. It also identified the need for enhanced action on adaptation. In particular, the Bali Action Plan process will address the issue of enhanced action on the provision of financial resources, investment and technology to support action on adaptation.

To conduct the process, a subsidiary body under the Convention was established called the Ad Hoc Working Group on Long-term Cooperative Action under the Convention (AWG-LCA). The AWG-LCA met for the

first time in Bangkok in April 2008. Parties agreed on a work program that structures the two-year negotiations on a long-term agreement. Given the strong interlinkages between the issues, they also agreed to discuss all five main elements – adaptation, mitigation, technology, finance and a shared vision for long-term cooperative action – in conjunction at each of the sessions in 2008. In addition, each session will address specific subjects under these elements.

At the second meeting of the AWG-LCA in June 2008, adaptation was considered at an in-session workshop on “advancing adaptation through finance and technology”. As an outcome of these discussions, issues were identified under four clusters of adaptation categories that could serve as future tracks of discussion:

- National Planning for Adaptation;
- Streamlining and scaling up financial and technological support;
- Enhancing knowledge sharing; and
- Institutional frameworks for adaptation.

At the fourth AWG-LCA meeting, which will be held in Poznan in conjunction with COP 14, a special workshop will be dedicated to risk management and risk reduction strategies, including risk sharing and mechanisms such as insurance.

3.2 Negotiations on adaptation: the contours of the debate

Recognition of the need for all countries to take action on adaptation has grown over time, as the impacts of climate change have become increasingly evident. The international effort to date has delivered considerable information, resources and capacity building. However, progress on adaptation has also suffered from some of the ambiguities in the regime itself. Adaptation is not defined explicitly in the Convention, but is referenced only in the overall context of climate change.

How adaptation is defined in operational terms will ultimately have significant political and financial implications. It could affect level of financing to be expected in the light of the commitments under the Convention. Much of the international negotiations to date on adaptation have therefore focused on finance and there has been lack of agreement on how it should be addressed (*see Box 1 next page*).

While all countries recognize that developed countries should fulfil their commitments under the Convention and provide finance, technology and capacity building support to developing countries, progress on these issues has been slow and unsatisfactory for many developing countries. Many have expressed frustration at the slow progress on the funding mechanisms. Indeed, it took about three years for funds (the SCCF, LDCF) to be made operational following their establishment in Marrakesh in 2001. Many of their concerns regarding finance to adaptation relate to:

- The relatively small amount of funds currently available to address adaptation under the Convention and, if the current replenishment trend continues, that these would not sufficiently address their needs;
- The experiences of developing countries in accessing and receiving support through existing funds, owing both to the complex design of the funds and to problems of implementation of the guidance;
- The recognition that additional financial flows will be needed to cope with adaptation needs (see also Stern (2008) and UNFCCC (2007)).

¹² Further information on these workshops can be found on the UNFCCC web site at: <http://unfccc.int/3582.php>.

¹³ The areas are: methods and tools; data and observations; climate modelling, scenarios and downscaling; climate related risks and extreme events; socio-economic information; adaptation planning and practices; research technologies for adaptation; and economic diversification. For detailed information on the NWP, see: <http://unfccc.int/3633.php>, http://www.wmo.ch/pages/prog/wcp/cca/documents/nwp_en_070523.pdf and http://unfccc.int/files/adaptation/sbsta_agenda_item_adaptation/application/pdf/ids_pledge_10dec.pdf.

Box 1: Overview of developed and developing country positions and views on adaptation

This list provides a general overview of positions and views on the issue of adaptation. There are variations and differences among the countries and groups of countries.

Common concerns

- The need for a methodological shift from climate change impacts studies to increased understanding of how to make adaptation happen
- How to examine adaptation needs and identify priorities
- The relative roles of adaptation and mitigation actions
- The lack of clarity on the relationship between climate change adaptation measures and the mainstream of development, particularly in relation to financial assistance
- What institutions and funding mechanisms are used for delivery at international and national level

Developed countries

- The need to meet obligations and provide financial assistance to cover costs of impacts caused by historically accumulated greenhouse gas stocks is generally accepted
- Issues relating to potential climate change impacts have been raised during discussions on support for in-country studies and on engaging developing countries more directly on mitigation
- The financial mechanism should deliver effectively for their taxpayers
- Overseas Development Assistance (ODA) should integrate climate change into its activities
- There should be no proliferation of new funds under the Convention
- There should be minimum conditions for accessing funding

Developing countries

- Equity and justice issues about damage of climate change to vulnerable countries due to emissions from "rich" developed countries are a primary concern
- Developed countries must deliver on their obligations under the Convention on finance, technology and capacity building
- Funding for adaptation should cover the additional costs of climate change and existing ODA commitments should not be diverted (also, no new conditionalities should be added to ODA)
- Governance of financial mechanisms should be transparent, include an equitable and balanced representation by all Parties, and operate under the authority of the CMP. It should provide "direct access" to funding and ensure that recipient countries are involved during all stages. "Predictable" sources of funding are needed, not just more funding
- Support should be provided through the UNFCCC instruments rather than through fragmented efforts outside these instruments
- New institutional arrangements should be created, such as an adaptation committee or an expert body like the one covering technology transfer (EGTT) within the Convention

In addition to the levels of funding, part of the debate on adaptation finance has focused on how it should be delivered and how its effectiveness can be tracked.

The need for concerted international action on adaptation continues to receive increased attention under the UNFCCC process. The sense of urgency is particularly true for developing countries, as demonstrated at the UNFCCC meetings in June 2008, where nine different developing countries made presentations on adaptation on behalf of themselves or regional groups (AOSIS, LDCs).

Questions

- What were the key messages of your country's delegation or Minister at COP 13 in Bali (2007)?
- What is your country's negotiating position on adaptation? Does it need changes?
- What is the position on adaptation of the regional group/constituency to which your country belongs? Do you agree with this position?
- Has your country been represented or involved in any expert groups under the Convention?
- Has your country participated in regional workshops regarding implementation of adaptation measures and/or workshops relating to the Nairobi Work Programme?
- What has been the experience of your country in receiving support from the financial mechanism for adaptation?
- What is your country's position on the guidance to the financial mechanism and/or the Adaptation Fund? What should be emphasized? What arguments could you advance to enable your country to obtain urgent funding assistance on adaptation?
- Are you aware of the guidelines for preparation of national communications with regard to vulnerability assessment and selection of adaptation options for your country? Have you been involved in preparing the national communication of your country?
- How can the Nairobi Work Programme and work being developed by experts groups under the Convention be used to support adaptation in your country?
- What adaptation-related issues do you think should be further emphasized in a future climate change regime?

4. THE ADAPTATION CHALLENGE AT THE NATIONAL LEVEL

4.1 Approaching adaptation at national level

Adapting to climate change requires adjustments at every level in a country: community, local, regional, sectoral and national. Even though the choice of adaptation interventions depends on national circumstances and internal and priorities, it should be framed by, and influence, international negotiations and efforts.

Governmental institutions (ministries, regional governments and agencies), private entities and NGOs, must consider integrating climate change in their planning and budgeting in all levels of decision making, and coordinate their actions among themselves. At a local level, communities can build their resilience by adopting appropriate technologies, making the best use of traditional knowledge and diversifying their livelihoods to deal with climate threats.

Adaptation cannot be treated as a stand-alone issue, since climate change impacts will hinder almost all efforts of development. Synergies among the multiple objectives of sustainable development, poverty reduction, disaster risk reduction and adaptation policies are essential. Local strategies also need to be implemented in synergy

with national government interventions. The design of adaptation plans and strategies is then crucial.

Climate change impacts do not happen in isolation. Sectors can be affected directly or indirectly by climate change and a change in one sector can offset the effects of climate change in another sector. Adaptation to climate change is essentially a cross-cutting issue and therefore should not be considered on a purely sectoral basis, but in a multi-sectoral and cross-sectoral way. As a first step, however, the simpler way is to analyze vulnerability and adaptation options at a national level, by sector, and then link it to other related issues (i.e., development, poverty and risk reduction). Another approach, which is particularly useful for community-level assessments, is to analyze vulnerability and adaptation options by hazard. However, one single community is sometimes threatened by more than one hazard, so a multi-hazard analysis may be needed.

Adaptation will also require the capacity for both short- and long-term planning. Strategies will be needed to address long-term climate change impacts, such as those predicted by the IPCC. At the same time, strategies for shorter-term adjustments may also be necessary, such as those prepared for shorter-term climate variability.

Box 2: Examples of adaptation measures

Sectoral adaptation measures look at actions for individual sectors that could be affected by climate change. For example, in agriculture, reduced rainfall and higher evaporation may call for the extension of irrigation; and for coastal zones, sea level rise may necessitate improved coastal protection such as reforestation. Often adaptation measures in one sector will involve a strengthening of the policy that already exists, emphasizing the importance of including long term climate change considerations along with existing local coping mechanisms and integrating them into national development plans.

Multi-sectoral adaptation options relate to the management of natural resources that span sectors, for example, integrated management of water, river basins or coastal zones.

Cross-sectoral measures also span several sectors and can include: improvements to systematic observation and communication systems; science, research and development and technological innovations such as the development of drought-resistant crop varieties or new technologies to combat saltwater intrusion; education and training to help build capacity among stakeholders; public awareness campaigns to improve stakeholder and public understanding on climate change and adaptation; strengthening or making changes in the fiscal sector such as new insurance options; and risk/disaster management measures such as emergency plans.

Source: *Climate change: impacts, vulnerabilities and adaptation in developing countries*. UNFCCC, 2007

Regardless the area, sector or institution, some basic issues need to be considered in order to effectively implement adaptation. A description of these issues is presented below.

4.2 Take stock of the progress made in your country

As a party to the UNFCCC and the Kyoto Protocol, it is very likely that some adaptation efforts are already being implemented in your country with the support in most cases of international cooperation. Most developing countries that are a Party to the UNFCCC have already developed their first national communication and, in case of an LDC, a NAPA. Some of them are already developing their second national communication (SNC), which, according to the UNFCCC guidelines,¹⁴ will have some information about measures to facilitate adequate adaptation to climate change. Some of this information could include:

- Human systems, sectors and/or areas that are vulnerable (or most critical) to climate change;
- Main limitations of the vulnerability and adaptation assessments, i.e., methodological, technical, institutional and financial limitations;
- Vulnerabilities to current climate variability and future climate changes;
- Difficulties or barriers to adaptation in critical areas or sectors; and
- Opportunities and priorities for adaptation to climate change.

Some countries have developed or are also developing adaptation projects financed by sources such as the SPA, the SCCF and other bilateral and multilateral cooperation activities.¹⁵ The UNFCCC or GEF National Focal Points¹⁶ are also a source of information on projects.

Once this basic information is in your hands, you should identify the key sectors or areas in your country, and who the main players are or should be. A workshop could be organized in order to have an exchange of

experiences, information and perceptions about the importance of climate change adaptation. The workshop should be oriented towards collecting the following information:

- What sectors or areas are most vulnerable to climate change?;
- Who are the key actors and what are they doing regarding adaptation?;
- What has been done and which needs have been already identified?;
- What is being currently implemented? Are there synergies related to what could be done in your sector/area?;
- What needs to be done to further facilitate adaptation in your sector/area?

4.3 Identify adaptation options, set priorities, do adaptation planning and introduce it as part of your national policy framework and planning.

Adaptation will need a variety of responses and extensive resources to prevent future damage. It will also need to balance tradeoffs with sustainable development and poverty reduction efforts, as well as disaster risk reduction. A cost benefit analysis of different adaptation measures responding to different threats, among other criteria, should be applied in order to decide which policies and measures to implement or modify.

Unquestionably, poverty, access to resources, health and education and all of the other development objectives that fall under the MDGs influence how vulnerable any individual is to climate change. The following issues should therefore be considered in order to establish adaptation priorities:

- What is the vulnerability to climate change of national planning instruments and processes? Is compliance of national development objectives in jeopardy due to climate change? How should strategies and plans be realigned to deal with potential climate change impacts?;

¹⁴ Decision 17/CP.8 and decision 8/CP.11 refer specifically to SNCs. See http://unfccc.int/national_reports/non-annex_i_natcom/items/2816.php. See also "Reporting on climate change. User manual for the guidelines on national communications from non-Annex I Parties", (UNFCCC 2003).

¹⁵ See Funding for adaptation at <http://unfccc.int/2807.php>.

¹⁶ See <http://maindb.unfccc.int/public/nfp.pl>.

- Do national, regional, sectoral and/or local policy frameworks identify climate change as a threat? What policy changes should be made to cope with the current and expected impacts of climate change?

What are the steps for assessing vulnerability, identifying and prioritizing adaptation options, formulating adaptation plans and introducing them into the national policy framework? The practical steps needed to carry out the main activities of the adaptation process may vary within each region, country and community. However, there are a number of structured frameworks that countries can use to guide the process.

The UNDP Adaptation Policy Framework (APF) and the guidelines such for the formulation of NAPAs can provide us with as a set of practical actions and steps to be taken in order to achieve adaptation. In addition, the UK Climate Impacts Programme (UKCIP) risk decision framework¹⁷ and the Australian government’s adaptation guide for business and government¹⁸ both contain a step-wise description of the process, detailed guidance on how to perform each step and pointers to sources of information and data underpinning the relevant steps.

This paper will focus on the APF, which contains an important principle to be considered during the process: “the adaptation strategy and the process by which it is implemented are equally important”. Adaptation should be seen as a learning process. In addition, stakeholder involvement is key to achieve mainstreaming of adaptation at different levels. One of the challenges that climate changes poses is the urgent need of designing and implementing coordinated activities among different stakeholders and levels (international, national, regional, local, communities).

1. Developing vulnerability and adaptation assessments for prioritizing adaptation policies and measures

Vulnerability and adaptation assessments are aimed at informing the development of policies that reduce the risks associated with climate change, based on tools that combine qualitative and quantitative data. They can range from simple approaches based on household survey data and in-depth interviews with stakeholders, to complex models requiring extensive data input. They are normally based on knowledge about the physical impacts of climate change, and seek to understand the social and economic dynamics of these impacts and the possible solutions. They can provide a good overview of where and how adaptation could be beneficial or necessary. Vulnerability and adaptation assessments should serve as a basis to prioritize adaptation measures and policies.

How much information do we really need? The APF identifies four key assessments that need to be carried out in order to identify adaptation options: vulnerability, current climate risks, future climate risks, and current and changing socio-economic conditions. Table 3 shows steps to be taken within these assessments:

Table 3: Assessments needed as a base to identify adaptation options

ASSESSING VULNERABILITY	ASSESSING CURRENT CLIMATE RISKS	ASSESSING FUTURE CLIMATE RISKS	ASSESSING CURRENT AND CHANGING SOCIO-ECONOMIC CONDITIONS
1. Structure the vulnerability assessment: determine and agree on definitions, frameworks and objectives	1. Build conceptual models	1. Select an approach	1. Set up study boundaries
2. Identify vulnerable groups in terms of exposure and assessment boundaries	2. Characterize climate variability, extremes and hazards	2. Gather information on future climate (IPCC Emission Scenarios and projected climate changes)	2. Develop and use indicators
3. Assess sensitivity (current vulnerability of the selected system and vulnerable Group) and adaptive capacity.	3. Do an impact assessment (by qualitative quantitative methods)	3. Conduct sensitivity experiments	3. Characterize socio-economic conditions today
4. Assess future vulnerability	4. Define risk assessment criteria	4. Select planning and policy horizons	4. Explore specific characteristics (demography, economy, use of natural resource, governance and policy, culture)
5. Link vulnerability assessment outputs with adaptation policy	5. Assess current climate risks	5. Construct climate scenarios	5. Characterize current adaptation measures
	6. Define the climate risk baseline	6. Conduct climate change risk assessments	6. Characterize changing socio-economic conditions using storylines and projections of socio-economic changes

Source: Elaboration based on the Adaptation Policy Framework, Technical Papers, UNDP

If urgent and immediate adaptation is needed, a different approach – such as the one for NAPAs – could be used. NAPAs use existing information; no new research is needed. Such an approach focuses on enhancing adaptive capacity to climate variability, which helps address the adverse effects of climate change. Existing coping strategies at the grassroots level must be taken into account and built upon to identify priority activities, rather than focusing on scenario-based modelling to assess future vulnerability and long-term policy at state level. The steps under this approach include: synthesis of available information; participatory assessment of vulnerability to current climate variability and extreme events and areas where risks would increase due to climate change; and, identification of key adaptation measures. It is important to highlight, however, that this should only be a first step in the adaptation strategy, since climate change scenarios will continue to pose challenges to vulnerable countries.

2. Identifying adaptation options to deal with vulnerabilities and increase adaptive capacity, and setting priorities

The process of identifying adaptation options should make use of different sources: scientific and technical

information (i.e., IPCC, UNFCCC); countries experiences (through, i.e., the NWP); local expertise; coping strategies; and traditional knowledge.

Once all options have been identified, a prioritization exercise should be performed (first, in cabinet, then with stakeholder involvement). It will have to be used to determine what current and future problems to solve first (i.e., on a sectoral and/or territorial level) and what adaptation options to use to deal with them. Some examples of criteria are: the level of current and future vulnerability, the percentage of population and/or poor population that will be benefit; technical and institutional feasibility; alignment with national priorities; replicability potential; sustainability; cost benefit; cost effectiveness; and, barriers to overcome.

According to the APF, four main methods should be particularly useful to the prioritization process. These are:

- Cost Benefit Analysis (CBA);
- Cost Effectiveness Analysis (CEA);
- Multi-Criteria Analysis (MCA);
- Expert judgement.

Formal methods for prioritization can most easily be applied to project-type adaptation measures. In the case of

¹⁷ “Climate adaptation: Risk, uncertainty and decision-making”, UK Climate Impacts Programme, UKCIP Technical Report, May 2003. See: http://www.ukcip.org.uk/images/stories/Pub_pdfs/Risk.pdf. An online version (adaptation wizard) is also available: http://www.ukcip.org.uk/index.php?option=com_content&task=view&id=147&Itemid=297.

¹⁸ “Climate Change Impacts & Risk Management: A Guide for Business and Government”, Australian Greenhouse Office in the Department of the Environment and Heritage, 2006. See: <http://www.climatechange.gov.au/impacts/publications/pubs/risk-management.pdf>.

cross-sectoral measures, such as institutional capacity building and legislation, it may be necessary to employ informal, qualitative and subjective methods.

3. Adaptation planning: formulating an adaptation strategy

According to the APF, the adaptation strategy consists of a plan containing the measures selected for implementation, a time frame and modalities for implementation. The five different activities involved in formulating an adaptation strategy (see Figure 2) are:

- Synthesize assessments and studies;
- Design the adaptation strategy;
- Formulate adaptation options for policies and measures;
- Prioritize and select adaptation policies and measures;
- Formulate an adaptation strategy.

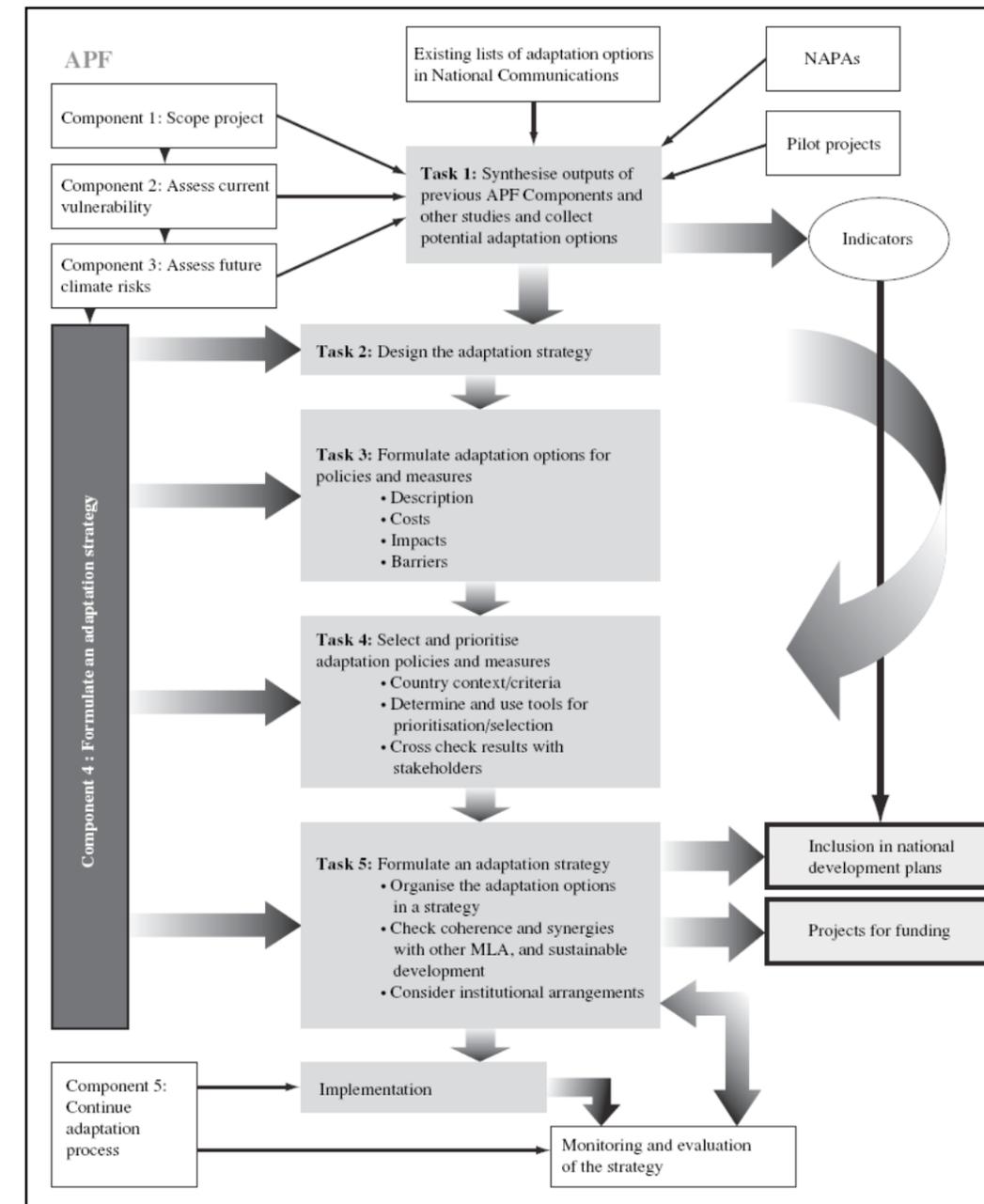
During this formulation and adoption process, it is important to include stakeholders at all levels (national to local) not only to gain public acceptance of the strategy, but also to include all traditional, local knowledge and priorities in the exercise. Also, it is important to establish and implement monitoring and evaluation mechanisms for the adaptation strategy.

4. Introducing adaptation planning as a part of national policy framework and planning: mainstreaming adaptation into development

Climate change adaptation will be cost effective if “mainstreamed” into the development processes. The APF provides basic steps for introducing adaptation planning as part of national policy framework and planning:

- Defining system boundaries and identifying entry points, this means being specific about the scale and type of intervention. Also, the entry point for the adaptation should be identified, a “top-down” approach could involve changes in policies and procedures at the strategic, programming and operational levels. For community-based actions, the entry points could be at the household level;
- Describing the socio-economic context and identifying opportunities;
- Analysing socio-economic barriers (such as legislation at national level or social institutions at a local level);
- Identifying partners and change agents.

Figure 2: Activities involved in formulating an adaptation strategy



Source: Adaptation Policy Framework, Technical Paper 8: Formulating an Adaptation Strategy, UNDP

National policies and instruments should be able to respond and anticipate the demands from local governments and communities, based on the studies and processes developed. A worthwhile exercise would be to identify whether national objectives are “vulnerable” to climate change and if so, what policies, objectives, measures and instruments should then developed or modified, and what processes and platforms should be put in place to go to its actual implementation at local levels.

One example of this is the need for an assessment of the way the national budget is allocated to poverty reduction programs. If regional vulnerability assessments to climate change are not developed, then the national budget would continue to be allocated in a traditional way, not taking into account that new threats need to be tackled to ensure sustainability of poverty investments, i.e., resources should not only be allocated to nutrition or water infrastructure;

Box 3: Adaptation options under the UNFCCC

- The Nairobi Work Programme provides information to help all countries improve their understanding and assessment of the impacts of climate change and to make informed decisions on practical adaptation actions and measures.
- The UNFCCC secretariat has developed a local coping strategies database to facilitate the transfer of long-standing coping strategies and knowledge from communities that have adapted to specific hazards or climatic conditions, to communities that may be starting to experience such conditions as a result of climate change.¹⁹
- The Adaptation Learning Mechanism (ALM), which is a knowledge sharing platform, contributes to the implementation of the Nairobi Work Programme, which aims to increase the ability of countries to adapt to climate change, with an emphasis on exchanging experience.²⁰
- Workshops covering adaptation issues have been held under different subsidiary bodies: During 2006-2007, a series of workshops and an expert meeting, mandated by decision 1/CP.10, helped facilitate information exchange and integrated assessments to assist Parties in identifying specific adaptation needs and concerns.
- The Ad Hoc Working on Long-term Cooperative Action under the Convention (AWG-LCA) also held a focused workshop on “advancing adaptation through finance and technology, including national adaptation programs of action”.
- The NAPAs provide an important way to prioritize urgent adaptation needs for LDCs. They are developed based on existing information and community-level input to identify adaptation projects required in order to enable these countries to cope with the immediate impacts of climate change.

but to economic diversification of agricultural communities (very vulnerable to climate change) that would make communities able to respond properly to climate change.

Another example is analyzing the Macroeconomic Framework Objectives, i.e., GDP growth. If it is not recognized that climate change poses new threats, then measures to prevent losses will not be prioritized, such as: implementing or strengthening hydrometeorological and ocean observation systems; developing climate change scenarios to guide investments and poverty strategies; implementing guidelines for climate proofing public investments; and, creating capacities in local governments to deal with the new challenges of climate change.

Box 3 provides information on a number of platforms and options under the UNFCCC that would be useful for the process.

¹⁹ See <http://maindb.unfccc.int/public/adaptation>.

²⁰ For more information on the ALM, see: <http://www.adaptationlearning.net/>.

4.4 Institutional arrangements needed to plan and implement adaptation: What roles should the different stakeholders have? How would you ensure public, private and social participation?

Due to the cross cutting nature of the issue, there is a need for stakeholder engagement in the development of adaptation plans or strategies. Climate change calls for wide participation, since structural changes and changes in paradigms are likely to be needed.

A wide range of sectors will need to adapt and there are considerable implications for policy development, businesses and communities. The implementation of adaptation will be carried out mainly at a local level and by public and private sector stakeholders. It is then helpful to define how the roles and responsibilities are currently seen, taking into account that they will change over time as new policies develop or are adjusted (see Table 4). It is vital to ensure wide, continuous and coordinated participation from different stakeholders.

Table 4: Potential roles and responsibilities of stakeholders²¹

INSTITUTION	POTENTIAL ROLES AND RESPONSIBILITIES
National government and its ministries: economy and finance, agriculture, health, education, housing	Leadership regulation, introducing economic instruments and setting performance management frameworks. Appropriate policies, standards, regulations and design guidance, and where necessary, appropriate funding Guidance on climate proofing to justify additional investment or ensure sustainability of investments
Local governments	Many of the changes that need to be delivered in housing, transport and other issues will depend on local authorities. They bring together economic, social and environmental concerns and they have the potential to link their own actions with others through community strategies.
Private sector	There will be a variety of roles depending on the organization, its size and its purpose. However the key issues concerning climate adaptation that need to be considered by all include: • Awareness raising within the organization • Preparing for the loss and opportunities • Using the available tools to investigate the impacts • Contribute to sustainable investments and development gaps
Scientific and academic organizations	• Provide policy oriented research • Information for decision makers
Investment promotion agencies	• Ensure climate proof investments and promote investments to bridge development gaps
Poverty reduction agencies	• Address climate change impacts as part of their priority actions
Risk reduction community	• Address climate change impacts as part of the risk

²¹ Based on “Adaptation Policy Framework”. The UK Department for Environment, Food and Rural Affairs (DEFRA), 2005.

4.5 The need to catalyze investments: the role of public and private entities

Adaptation has to be mainstreamed in investment planning, whether public or private. Feasibility studies need to include risk assessments that take into account climate change in order to promote the construction of infrastructure strong enough to cope with extreme climate variability and to face climate events such as El Niño. Besides preventing disasters, the development of community-infrastructure can also anticipate future stresses, i.e., it can help gather and store water to help reduce vulnerability and enhance the capacity to face droughts.

There is, therefore, a need to consider what governmental structure is needed to ensure that climate change is mainstreamed into development planning and poverty reduction plans. Would an inter-ministerial committee be useful to give national priority to adaptation and address its international dimension?

A large part of investments come from the private sector, and the amount of money that needs to flow in order to address adaptation strategies surpasses the capacities of governments. Governments therefore need to devise policies, incentives and regulation to turn private initiative toward strengthening adaptation. A combination of markets and public policy could refine risk sharing through: innovative insurance schemes and improved natural resource management; the creation of environmental markets and climate-proofing infrastructure; and, public-private partnerships.

Investment is required in various sectors, where funding from both public and private sources are needed.

- **In infrastructure:** Developed countries have recognized that preventing disasters is less expensive than investing in reconstruction projects. Hence, it has become an important strategy to encourage governments to invest in infrastructure. Thus, when designing new buildings, climate change considerations should be taken into account to avoid inadequate housing conditions. The development of adequate infrastructure can be an efficient way of improving disaster risk management.
- **In preventing water scarcity:** Irrigation systems need to be technified, and water must be recycled and re-used in houses, offices, cities, businesses and agricultural activities. Water also needs to be preserved.

This requires the improvement of water quality standards and the treatment of industrial grey-water before dumping to the sea, lakes and rivers. Moreover, Payment for Environmental Services schemes can be implemented in order to protect and preserve water in the upper watersheds, where reforestation projects could also be developed.

- **In agriculture:** In countries where agriculture activities are crucial and producers are working in water-stressed rain fed environments, some investment has been made to develop water harvesting systems that enable the conservation of rainfall. Additionally, research on the generation of new crop varieties is in progress in some regions, which in turn promotes improved management practices, new irrigation systems and reduced fertilizer use. Hence, investment in technology transfer is also crucial for adaptation in agriculture.

The insurance sector has a vital role to play in adaptation, since its business requires that it evolve in order to cope with the new varieties of risks that climate change poses. Currently, insurance covers around 4% of losses in the world's poorest countries, mainly because the cost of insurance products is not affordable for poor people or is not designed for covering their needs. Insurance is mainly created to provide relief after losses occur. However, insurance type approaches or credit schemes could also be designed to motivate proactive risk or vulnerability reduction efforts. Innovative risk-sharing mechanisms are needed to respond to the new challenges posed by the adverse effects of climate change, including biodiversity loss and land degradation.

4.6 Determine resources needed to implement adaptation

Developing countries need international assistance and resources to support adaptation in the context of national planning for sustainable development, capacity-building, transfer of technology and finance. Systematic planning and capacity-building are also needed to reduce the risk of disasters and increase resilience of communities to more frequent and intense extreme climate events such as hurricanes, droughts and floods. As previously mentioned, existing estimates indicate that additional funding needed for adaptation for developing countries is around tens of billions of dollars annually. At a national level, however,

much needs to be done to determine how much is required for adaptation to climate change and where these resources should be allocated.

4.7 Technology: a means for adaptation

Different forms of technology will be often employed, whether "hard" forms, such as new irrigation systems, or "soft" technologies, such as insurance schemes. Or, they could use a combination of hard and soft, as with early warning systems that combine hard measuring devices with soft knowledge and skills that can raise awareness and stimulate appropriate action (see Box 4 for more information about adaptation technologies for coastal zones).

Many of these technologies are already available and

widely used. The global climate system has always confronted human societies with extreme weather events. Thus it should be possible to adapt to some extent by modifying or extending existing technologies.

Whatever the level of technology, its application is likely to be an iterative process. Although many of these technologies are already available and in place, they often need further investment to make them more effective. Such technology transfer has mostly been for purposes of mitigation, for the energy sector and has typically involved transferring ideas or equipment from developed to developing countries. Unlike mitigation, which is a relatively new approach, adaptation is generally the continuation of an ongoing process for which many of the technologies are already being applied even in some of the LDCs.

Box 4: Adaptation technology for coastal areas: protect, retreat, accommodate

Sea-level rise, floods and storms are a threat to coastal cities, with the consequent loss of crops, lands and impose damages to human settlements. Therefore, climate change poses a big challenge to develop and developing countries that are located below sea level. Some developed countries face big challenges against the risk of abrupt sea-level rise and are already investing in the construction of appropriate infrastructure like dykes and dams. Many cities have expanded and moved to coastal areas, which means that currently there is more population exposed to the impacts of climate change. With climate change coastal areas will become more hazardous. Therefore, adaptation technologies that consider coastal areas are most necessary. There are three strategies for adaptation in this case: Protect, Retreat and Accommodate. Examples of each strategy are outlined in the table below. More importantly, information is crucial. There is a need to gather information in order to acknowledge the current conditions of the coastal areas that can be done by satellite observation complemented by human experience in the areas. Also, Geographic Information Systems (GIS), which combine data coming from different sources and presents them as maps, can be very useful. GIS applied in coastal areas can show the zones that could be impacted by overlaying scenarios of sea level rise on land elevation.

PROTECT	RETREAT	ACCOMMODATE
<ul style="list-style-type: none"> • <i>Hard Structures</i> - dykes, sea-walls, tidal barriers, detached breakwaters • <i>Soft Structures</i> - dune or wetland restoration or creation, beach nourishment • Indigenous options walls of wood, stone or coconut leaf, afforestation 	<ul style="list-style-type: none"> • Establishing set-back zones • Relocating threatened buildings • Phasing out development in exposed areas • Creating upland buffers • Rolling easements 	<ul style="list-style-type: none"> • Early warning and evacuation systems • Hazard insurance • New agricultural practices, such as using salt-resistant crops • New building codes • Improved drainage • Desalination systems

Source: UNFCCC Technologies for Adaptation to Climate Change: 2006

Moreover, adaptation, rather than being concentrated in one sector, will essentially be dispersed across all socio-economic sectors including water, health, agriculture and infrastructure, each of which presents its own challenges, and will involve stakeholders in different if overlapping groups.

Adaptation measures are also likely to be less capital intensive and more amenable to small-scale interventions. They should therefore be more flexible and adaptable to local circumstances, which means that in addition to being socially and legally acceptable they can be made reasonably cost-effective. Policymakers need to ensure that new forms of adaptation do not heighten inequality but rather contribute to a reduction in poverty.

4.8 New and strengthened scientific and technical capabilities

Information and research is needed in order to take the right decisions. Nonetheless, most countries lack information. Climate change requires adequate information development and management. And for that, policy oriented research needs to be enhanced. New and strengthened scientific and technical capabilities (hardware, software, know how) will have to be put in place to face adaptation challenges. Some of the key ones are: systematic climate, hydrological and ocean observation systems; developing climate change scenarios and downscaling them to regional and local areas; performing policy relevant vulnerability and adaptation assessments.

Vulnerability and adaptation assessments should serve as a basis to prioritize adaptation measures and policies. Some of the challenges with vulnerability assessments however are related to the lack of underlying data to identify the impacts of climate change. Generally, a limited number of hydro-meteorological stations are available in developing countries, and data have in some cases only been collected recently. Mountainous countries have an additional challenge: their topography is such that very little can be said about averaged climate data for an area, since this will include peaks of several thousand metres above sea-level down to low valleys. This means that the strengthening of Systematic Observation systems need to be a priority at a national level and investments should be strengthened to this end. This would not only generate information for better short-term weather forecasts, but would help reduce uncertainties of Global

Circulation Models that are used to develop global climate scenarios that are downscaled to national and local scales for vulnerability assessments.

4.9 Supporting institutions for the implementation of adaptation

In addition to funds generated from the international level, in terms of implementing and funding adaptation, as well as establishing regional networks and executing adaptation projects, the work of global and regional development banks and other institutions is worth highlighting. Annex 3 provides more information resources on these and other initiatives.

4.10 Public awareness and participation

Global awareness of the risks posed by climate change is rising rapidly. Nonetheless, there is still much to do, especially in developing countries, where policy makers, policy takers, and the public in general still need to understand the importance of integrating concerns of climate change into their daily operations, as well as their policies, programming and projects. Nearly all sectors of society – spanning from businesses to humanitarian aid organizations to schools – have to do their part in it in order to create awareness and make society participate in the whole process leading to adaptation to climate change. In the end, the world needs a behavioral change through education, public information campaigns and regulation. NGOs and media, with their experience in generating political incidence and participation and inclusion processes, have a big role to play in this.

Questions:

National planning

- What are key sectors/areas for which adaptation options are identified in your national communications and/or NAPA? Do these correspond to national development priorities?
- What should in your view be priority sectors/areas of action regarding adaptation?
- What are the existing national institutional frameworks for coordinating climate change in your country? Is there a specific group for coordination action and positions on adaptation? What kind of

stakeholders are involved in such institutional framework?

- What are the key stakeholders playing a role in promoting adaptation measures in your country? Which ones need to be further involved? How would you go about promoting further awareness?

Resources and funding

- What level of funding does your country need for meeting its national adaptation needs?
- To what areas and activities would these resources be allocated?
- What criteria should be used to allocate resources?
- How should adaptation options be prioritized? What criteria should be used?
- Could these criteria be also used for allocating resources through international funds?

International and national level linkages

- What kinds of networks, mechanisms and platforms at an international level would be useful for implementing adaptation at a national level?
- Do current UNFCCC instruments (i.e., National Communications, NWP) need to be adjusted?
- What should be done to place climate change at the top the international agenda?
- What policies and incentives could be put in place at national and international levels so that a substantial part of the necessary additional resources for adaptation can catalyse larger commercial flows?

5. CONCLUSIONS: KEY MESSAGES AND POINTS FOR FURTHER REFLECTION

The challenges for developing countries arising from climate change impacts and the need for adaptation are many. A number of the key challenges have been outlined in this paper and detailed questions have already been posed in several sections to provide a starting point for discussion. Developing country policymakers and negotiators may wish to consider these questions when developing and refining their adaptation policies, as well as their negotiating positions under the international climate change process. The following points and questions may also help provide a useful framework for further reflection:

What is adaptation?

An important challenge in considering adaptation is defining and understanding what is meant by the term “adaptation”. Given its far-reaching nature, it is a difficult topic to define, particularly in operational and financial terms. However, some key messages may provide a helpful framework for understanding adaptation:

- **Adaptation is not a “stand alone” issue.** It has clear synergies with important issues such as economic development, poverty reduction and disaster management strategies. A sustainable development path is vital for an adaptation process to succeed.
- **Adaptation will need to be integrated into all development planning.** This includes the national and international levels. Successful adaptation measures will require long-term thinking and explicit consideration of climate change risks at the regional (cross-national), national, sub-national and local levels.
- **Adaptation will also require the capacity for both short- and long-term planning.** Strategies will be needed to address long-term climate change impacts, such as those predicted by the IPCC. At the same time, strategies for shorter-term adjustments may also be necessary, such as those prepared for shorter-term climate variability.
- **Adaptation will require substantial funding.** All indicative estimates available suggest that the costs of adapting to climate change in the developing world are in the order of tens of billions. However, there are many difficulties and limitations in estimating the exact costs of adapting under various scenarios, as well as the ability of countries to self-finance adaptation.

Adaptation in the UN climate negotiations: possible next steps

Important decisions will be taken in the run-up to COP 15 in Copenhagen in late 2009. How could your country develop a national strategy for successfully engaging in the Bali Action Plan discussions on adaptation? Such a strategy could include:

- Understanding the issues in order to define positions and strategies, as well as background knowledge of the positions of other countries;
- Awareness of the country’s main vulnerabilities, adaptation options, priorities and needs for support, including among financing, capacity building and technology transfer;
- Awareness of national, sub-national and local experiences, processes and actors that have been dealt with adaptation to climate change; in addition to the country’s experience with the UNFCCC adaptation resources and initiatives.

When developing or refining national positions, the following questions may be helpful:

- How much will climate change impacts affect the economic growth and social development of the country and how much should the country invest to minimize those impacts?;
- What mechanisms should be put in place, nationally and internationally, to provide effective means for adaptation to climate change, including financing?;
- What adaptation-related issues should be further emphasized in a future climate change regime? Are current tools, process and platforms available through the UNFCCC enough or need to be changed in a future climate change regime?

Adaptation at the national level: possible elements

Successfully adapting to climate change at the national level will likely require a set of conditions and elements at the national level. Some possible elements for a national level strategy could include:

- Adequate institutional arrangements, including systematic planning capacity in a cooperative institutional setting consistent policies and measures and regulatory frameworks;

- Strong coordination of ongoing activities on a sub-national level, which could include activities that are driven by NGOs, research institutions, the private sector and by local and sub-national governments;
- Scientific and technical capacities to understand the problem and its effects at the national and sub-national level, model its long-term impacts, and elaborate responses and adaptive strategies to the level of implementation;
- Program and project preparation capacities;
- Citizen awareness and participation that sustain and prioritize climate change actions.

References

- Adaptation Fund Board, 2008. Report of the Second Meeting of the Adaptation Fund Board, AFB/B.2/16. The Adaptation Fund, June 19, 2008. http://www.adaptation-fund.org/images/Report_of_the_Second_Meeting_of_the_Adaptation_Fund_Board_06.19.08.pdf. Access July 2008.
- Adaptation Working Group, 2008. Submission to GLOBE Brasilia. G8+5 Legislators Forum.
- DEFRA, 2005. Adaptation Policy Framework, a consultation by the Department for Environment, Food and Rural Affairs.
- IPCC, 2007. Fourth Assessment Report. Intergovernmental Panel on Climate Change Secretariat. Geneva, Switzerland. <http://www.ipcc.ch>.
- Klein, R.J.T., S. Huq, F. Denton, T.E. Downing, R.G. Richels, J.B. Robinson, F.L. Toth (2007) 'Inter-relationships between adaptation and mitigation' Chapter 18 in M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson (eds.) *Climate Change 2007: Impacts, Adaptation and Vulnerability*. Contribution of Working Group II to the Fourth Assessment.
- Möhner, Annett/Klein, Richard J.T. (2007). The Global Environment Facility. Funding for Adaptation or Adapting to Funds?
- OECD, 2008. Economic aspects of Adaptation to Climate Change: Costs, benefits and policy instruments.
- Oxford Institute for Energy Studies, 2008. Benito Mueller. *International Adaptation Finance: The Need for an Innovative and Strategic Approach*. Report of the Intergovernmental Panel on Climate Change, Cambridge University Press: Cambridge, UK.
- Stern, Nicholas, 2007. *The Economics of Climate Change: The Stern Review*. Cambridge University Press, Cambridge, UK.
- Stern, Nicholas, 2008. Key elements of a global deal on climate change.
- UNDP, 2007. Human Development Report, 2007/2008.
- UNFCCC Secretariat, 2008. Technologies for adaptation to climate change.
- UNFCCC Secretariat, 2007. *Impacts, Vulnerabilities and Adaptation in Developing Countries*.
- UNFCCC Secretariat, 2007. Analysis of existing and potential investment and financial flows relevant to the development of an effective and appropriate international response to climate change

World Bank, 2006. *Clean Energy and Development: Towards an Investment Framework*. DC2006-0002, World Bank, Washington, DC, USA.

Further reading

Adaptation Theory and Related Concepts

- Adger, W.N., S. Agrawala, M. Mirza, C. Conde, K. O'Brien, J. Puhlin, R. Pulwarty, B. Smit, K. Takahashi (2007) 'Chapter 17: Assessment of Adaptation Practices, Options, Constraints and Capacity', IPCC Working Group II contribution to the Fourth Assessment Report, Cambridge University Press: Cambridge.
- Burton, I., B. Challenger, S. Huq, R. Klein, G. Yohe (2007) 'Chapter 18: Adaptation to Climate Change in the Context of Sustainable Development and Equity', IPCC Working Group II contribution to the Fourth Assessment Report, Cambridge University Press: Cambridge.
- Smit, B., I. Burton, R.J.T. Klein, R. Street (1999) 'The Science of Adaptation: A Framework for Assessment' *Mitigation and Adaptation Strategies for Global Change*, 4 (3-4) 199-213.

Adaptation under the UNFCCC

- Burton, I., E. Diringer, J. Smith (2006) 'Adaptation to Climate Change: International Policy Options' Pew Center on Global Climate Change Research: Arlington, VA. http://www.climate-adaptation.info/wp-content/uploads/2007/08/pew_adaptation.pdf
- Harmeling, S., C. Bals (2008) 'Adaptation to climate change—where do we go from Bali? An analysis of COP-13 and the key issues on the road to a new climate change treaty' Germanwatch: Bonn.
- Lim, B., E. Spanger-Siegfried, I. Burton, M. Malone, S. Huq (2005). "Adaptation Policy Frameworks for Climate Change: Developing Strategies, Policies and Measures". A Project by the UNDP and GEF, Cambridge University Press: New York.
- Linnerooth-Bayer, J. M.J. Mace, R. Verheyen (2003) 'Insurance-Related Actions and Risk Assessment in the Context of the UNFCCC' Paper commissioned by the UNFCCC Secretariat for the UNFCCC Workshop on Insurance-Related Actions to Address the Specific Needs and Concerns of Developing Country Parties Arising from the Adverse Effects of Climate Change and from the Impact of the Implementation of

Response Measures", 14-15 May 2003, Bonn.

Yamin, F., J. Depelgde (2004) *The International Climate Change Regime: A Guide to Rules Institutions and Procedures*, Cambridge University Press: Cambridge.

Adaptation and Development

- Agrawala, S. (ed.) (2005) 'Bridge over Troubled Waters—Linking Climate Change and Development', Organisation for Economic Cooperation and Development: Paris.
- Burton, I. (2000) 'Adaptation to Climate Change and Variability in the Context of Sustainable Development' in Gómez-Echeverri, L. (ed.) *Climate Change and Development*, Yale School of Forestry and Environmental Studies & UNDP: New Haven and New York.
- Burton, I., M. van Aalst (1999) 'Come Hell or High Water - Integrating Climate Change and Adaptation into Bank Work' World Bank Environment Department, Environment Department Papers No. 72, World Bank: Washington, D.C.
- Huq, S., A. Rahman, M. Konate, Y. Sokona and H. Reid (2003) 'Mainstreaming Adaptation to Climate Change in Least Developed Countries' IIED: London.
- Klein, R.J.T., S. Huq, J.B. Smith (2003) *Climate Change, Adaptive Capacity and Development* Imperial College Press: London.
- McGray, H., Hammill, A., Bradley, R. with Schipper, E. L., Parry, J.E. (2007) 'Weathering the Storm: Options for Framing Adaptation and Development' World Resources Institute (WRI) Report, WRI: Washington, D.C. http://pdf.wri.org/weathering_the_storm.pdf.
- Sperling, F. (ed.) (2003) 'Poverty and Climate Change: Reducing the Vulnerability of the Poor through Adaptation' Inter-agency report by the African Development Bank (AfDB), Asian Development Bank (ADB), Department for International Development (DFID, UK), Federal Ministry for Economic Cooperation and Development (BMZ, Germany), Directorate-General for Development European Commission (EC), Ministry of Foreign Affairs - Development Cooperation (DGIS, The Netherlands), Organisation for Economic Cooperation and Development (OECD), United Nations Development Programme (UNDP), United Nations Environment Programme (UNEP), and the World Bank.
- UNFCCC (2008) 'Climate Change: Impacts, Vulnerabili-

ties and Adaptation in Developing Countries' UNFCCC: Bonn.

Adaptation and disaster risk reduction

- Schipper, L., M. Pelling (2006) 'Disaster Risk, Climate Change and International Development: Scope for, and Challenges to, Integration', Special issue of *Disasters*, 30 (1): 19-38.
- Soussan, J., I. Burton (2002) 'Adapt and Thrive: Combining Adaptation to Climate Change, Disaster Mitigation, and Natural Resources Management in a New Approach to the Reduction of Vulnerability and Poverty', Paper presented at the UNDP Expert Group Meeting, "Integrating Disaster Reduction and Adaptation to Climate Change", Havana, Cuba. 17-19 June 2002, UNDP: Havana. http://www.climate-adaptation.info/wp-content/uploads/2008/05/undp_book1.pdf.
- Sperling, F., F. Szekeley (2005) 'Disaster Risk Management in a Changing Climate' World Bank: Washington DC. http://www.climate-adaptation.info/wp-content/uploads/2007/08/varg-drmcc-fns-fs_-2005-full.pdf.

Other Reports

- Climate Proofing: A Risk-Based Approach to Adaptation: by the Asian Development Bank: <http://www.adb.org/Documents/Reports/Climate-Proofing/climate-proofing.pdf>.
- Final report of workshop on Climate Change, Humanitarian Disasters, and International Development: Linking Vulnerability, Risk Reduction and Response Capacity, Oslo, April 2007: http://www.climate-adaptation.info/wp-content/uploads/2007/08/final_workshop_report_03-07-07.pdf.
- IPCC WGII Summary for Policymakers of the IPCC Fourth Assessment Report volume on Impacts, Adaptation and Vulnerability. <http://www.ipcc.ch/SPM13apr07.pdf>.
- Climate Change Adaptation, Institute for Development Studies (UK), "In Focus," Issue 2, November 2007. http://www.ids.ac.uk/UserFiles/File/publications/in_focus/InFocus2.0ClimateChangeAdaptation.pdf.

ANNEXES

Annex 1: Impacts and vulnerability

The science is now “unequivocal” that human activity is contributing to climate change (WGI, IPCC 2007) and the impacts are already being observed in all sectors – food, water, health, agriculture, and energy (WGII, IPCC 2007). The Fourth Assessment Report (AR4, 2007) of the IPCC projects a warming of about 0.2°C per decade for the next two decades, which will bring about serious economic, social and environmental problems, all of which will cause even more poverty and less development, affecting all countries but especially the developing world. Therefore, to acknowledge the current and future impacts of climate change is of primary concern for any adaptation strategy. According to the Human Development Report (UNDP, 2007-2008) based on the IPCC AR4 (2007) scenarios, climate change is already having an impact on various systems and sectors of society and will continue impacting as follows:

1. Ecosystems and biodiversity

- Climate change is already transforming ecological systems. With an increase of up to 2.5°C between 20 to 30% of species of the earth could disappear.
- Marine ecosystems are suffering due to the accumulation of carbon dioxide, which will impact fish stocks, especially upon the main coastal cities and also small island states. This will have an impact over biodiversity and ecosystem goods and services such as water and food security.

2. Agriculture and Food Security

- The African region is threatened by declining crop yields, which affects food security of a population that already suffers of malnutrition, and threatens the dependence on agriculture activity for food security.
- Precipitation, temperature and water availability for agricultural purposes will be affected by climate change. Sub-Saharan Africa will be mostly affected and food security threatened, but also other regions of the world like Latin America and certain parts of Asia. By 2080 it is projected that approximately 600 million could suffer from malnourishment.

3. Sea level rise and exposure to meteorological disasters

- Sea level could increase rapidly due to accelerated ice sheet disintegration. Global temperature rise of 3 to 4 °C could cause the permanent or transitory

displacement of 330 million people due to flooding and threaten approximately 4 million km² of land, where 5% of the world’s population is located. This will affect millions of people from developing countries and from large coastal cities of the developed countries.

- During wet seasons floods will become more intense due to the melting glaciers, putting in risk water availability of one-sixth of the world’s population, especially the South American Andean region, certain parts of China and the Indian sub-continent.

4. Human health

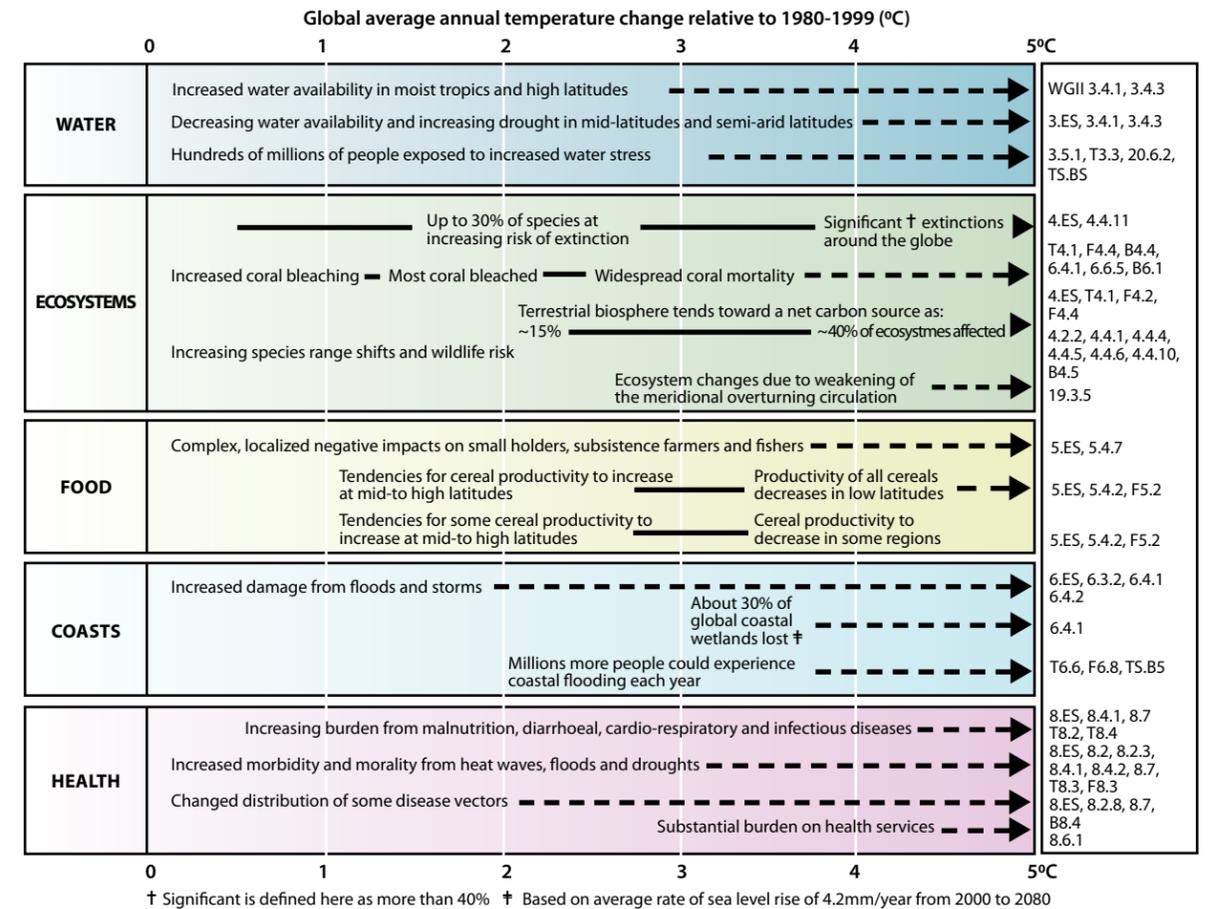
- The main impacts over health conditions will be felt especially on developing countries due to poverty conditions and limited capacity to have access to adequate public health systems.
- 200 to 400 million people could suffer malaria, which already kills around 1 million people per year. It is already possible to find cases of dengue at unusual high altitudes in Latin America and certain parts of Asia. Climate change could worsen this situation.

5. Industry, settlements and society

- Those industries, settlements and societies located in coastal and river flood plains, or in areas where extreme weather event occur, and whose economies are dependent on climate-sensitive resources, are the most vulnerable to climate change.

The consequences of climate change will become disproportionately more damaging with increased warming (Stern Review 2006). With higher temperatures (see the chart below), the chance to face abrupt and large-scale changes will be harder and this will lead to regional disruption, migration and conflict.

Examples of impacts associated with global average temperature change (Impacts will vary by extent of adaptation, rate of temperature change and socio-economic pathway)



Source: IPCC Fourth Assessment Report (2007)

The poorest countries and most vulnerable citizens will suffer the earliest and most damaging effects, even though they have contributed least to the problem and even if serious efforts to reduce emissions start immediately. Looking to the future no country, regardless it wealth or power, will be immune to the impact of global warming.

Annex 2: Decisions on adaptation under the UNFCCC and the Kyoto Protocol

COP decisions

ISSUE	DECISIONS	PROVISIONS
Nairobi Work Programme on impacts, vulnerability and adaptation to climate change	Decision 1/CP.10 Decision 2/CP.11	Buenos Aires program of work on adaptation and response measures Five-year program of work of the Subsidiary Body for Scientific and Technological Advice on impacts, vulnerability and adaptation to climate change
Non-Annex I national communications	Decision 10/CP.2 Decision 8/CP.5 Decision 31/CP.7	National communications to include information on policy frameworks for implementing adaptation measures and response strategies and technological needs related to facilitating adequate adaptation Establishment of the Consultative Group of Experts on non-Annex I national communications (CGE). CGE to link with LDC Expert Group (LEG) on adaptation issues
Annex I national communications	Decision 2/CP.1 Decision 4/CP.1 Decision 9/CP.2 Decision 4/CP.5	IPCC Technical Guidelines for Assessing Impacts and Adaptations be used for national communications National communications to include information on expected impacts of climate change, and action taken to implement Article 4.1 with regard to adaptation. Also report on meeting costs of adaptation
Technology transfer	Decision 13/CP.1 Decision 7/CP.2 Decision 9/CP.3 Decision 4/CP.4 Decision 4/CP.7 Decision 3/CP.13 Decision 4/CP.13	Development of technologies for adapting to climate change Synthesis and dissemination of information on adaptation technologies Secretariat to work on synthesis and dissemination of information, technologies and know-how relating to adaptation and to accelerate development of adaptation methodologies Tools to evaluate different adaptation strategies
Guidance to the financial mechanism (GEF)	Decision 11/CP.1 Decision 2/CP.4 Decision 6/CP.7	Definition of three stages of funding for adaptation GEF should provide funding for Stage I and II activities Establish pilot or demonstration projects on how adaptation planning and assessment can be translated into projects
Capacity building	Decision 2/CP.7 Decision 3/CP.7 Decision 5/CP.12	Capacity building for implementation of adaptation measures Capacity building for carrying out adaptation and vulnerability assessments and NAPAs
Adverse effects	Decision 3/CP.3 Decision 1/CP.4 Decision 5/CP.4 Decision 12/CP.5 Decision 5/CP.7 Decision 1/CP.10	Decision to start a process to consider Article 4.8 and 4.9 Process should identify adverse effects, impacts of the implementation of response measures, needs of developing countries arising from such impacts, and identification and consideration of actions to address these BAPA adopted to consider adverse effects, among other issues, before COP6 Program of work from COP4 to COP6 Decision to consider Article 4.8 and 4.9 at COP-6 and beyond <ul style="list-style-type: none"> • That the GEF and other bilateral and multilateral sources should fund work on vulnerability and adaptation assessments, training, capacity building, technology transfer relating to adverse effects • That adaptation fund and SCCF should fund the implementation of adaptation activities where sufficient information exists to warrant such activities • The Convention should support the NAPA process • Establishment of LDC Fund • Workshop requests
Funding under the UNFCCC	Decision 7/CP.7 Decision 27/CP.7 Decision 8/CP.8 Decision 6/CP.9 Decision 5/CP.9 Decision 1/CP.12	Establishment of SCCF to fund activities, programs and measures on adaptation Establishment of LDC Fund to fund NAPAs Guidance on LDC Fund for speedy disbursement of funds for NAPA preparation Further guidance on SCCF

ISSUE	DECISIONS	PROVISIONS
Funding under the Protocol	Decision 10/CP.7	Establishment of an Adaptation Fund to finance concrete adaptation projects and programs in developing countries that are also Parties to the Protocol Fund to be financed by share of proceeds from CDM activities
Least Developed Countries	Decision 28/CP.7 Decision 29/CP.7 Decision 9/CP.8 Decision 4/CP.10 Decision 3/CP.11 Decision 4/CP.11 Decision 8/CP.13	Guidelines for NAPA preparation Establishment of the LDC Expert Group to advise on NAPA preparation, and advise on other adaptation efforts relevant to LDCs Work of the Least Developed Countries Expert Group Extension of the mandate of the Least Developed Countries Expert Group Further guidance for the operation of the Least Developed Countries Fund
IPCC	Decision 10/CP.9 Decision 5/CP.13	The consideration of the scientific, technical and socio-economic aspects of impacts of, and vulnerability and adaptation to, climate change in the context of the IPCC TAR Fourth Assessment Report of the Intergovernmental Panel on Climate Change
Other	Decision 6/CP.1 Decision 13/CP.3 Decision 7/CP.4 Decision 11/CP.8 Decision 1/CP.11 Decision 1/CP.13	Adaptation technology to be addressed by SBSTA SBSTA, with SBI, to assess comprehensiveness and effectiveness of adaptation measures Inclusion of adaptation in work program on Kyoto Protocol, also under CDM to determine share of proceeds from CDM Delhi Work Programme on Article 6: consider linkages between implementing this and implementing P&Ms on adapting to climate change Dialogue on long-term cooperative action to address climate change by enhancing implementation of the Convention Bali Action Plan (enhanced action on adaptation)

CMP (Kyoto Protocol) decisions on issues related to adaptation

ISSUE	DECISIONS	PROVISIONS
Adaptation Fund	Decision 28/CMP.1 Decision 5/CMP.2 Decision 1/CMP.3	Initial guidance to an entity entrusted with the operation of the financial mechanism of the Convention, for the operation of the Adaptation Fund Details and guidance for the design of the Adaptation Fund Operationization of the Adaptation Fund
Second Review of the Kyoto Protocol	Decision 7/CMP.2 Decision 4/CMP.3	Review aim to further enhance the implementation of the Protocol and elaborate in particular adaptation

Annex 3: Information resources guide

Publications

- Bo Lim, et al., *Adaptation Policy Frameworks (APF) for Climate Change*, United Nations Development Programme: 2004. <http://www.undp.org/climate-change/adapt/apf.html#about>.
- Frankel-Reed, Jennifer and Nick Brooks, *Proposed Framework for Monitoring and Evaluation Framework of Adaptation to Climate Change*, United Nations Development Programme: 2008.
- Lu, Xianfu and Nick Brooks, *Quality Standards for Climate Change Adaptation*, United Nations Development Programme: 2008.
- Nick Brooks, et al., *Operational Guidance for Climate Change Adaptation: Technical Papers for Six Priority Thematic Areas*, United Nations Development Programme: 2008.
- United Nations Development Programme, *Briefing Note: Adaptation to Climate Change: Doing Development Differently*, United Nations Development Programme: 2007. http://www.undp.org/climate-change/adapt/downloads/UNDPAdaptationBrief_Nov07.pdf.
- United Nations Development Programme, *Climate Change Adaptation: Knowledge Needs Survey*, United Nations Development Programme: 2007. <http://www.energyandenvironment.undp.org/undp/index.cfm?module=Library&page=Document&DocumentID=6508>.
- United Nations Development Programme, *Climate Risk Profiles*, United Nations Development Programme: 2008.
- United Nations Development Programme, *Hot Spot Analysis from Vulnerability and Hazard Data*, United Nations Development Programme: 2007.
- United Nations Development Programme, *Human Development Report 2007/08 – Fighting Climate Change: Human Solidarity in a Divided World*, United Nations Development Programme: 2007. <http://www.energyandenvironment.undp.org/undp/index.cfm?module=Library&page=Document&DocumentID=6505>.

Websites

- *Adaptation Basics*, provides an overview of the relationship between climate change impacts and development, including impacts by sector (e.g. land degradation, health, etc.) as well as impacts affecting

the achievement of the Millennium Development Goals. <http://www.undp.org/climatechange/adapt/basics1.html>.

- *Adaptation Definitions*, highlighting commonly used terminology. <http://www.undp.org/climatechange/adapt/definitions.html>.
- *Adaptation Learning Mechanism (ALM)*, a collaborative knowledge-sharing project, offers a library of case studies and a database of adaptation profiles for individual countries. www.adaptationlearning.net.
- *Country Adaptation Profiles database*, a UNDP-developed tool hosted by the Adaptation Learning Mechanism, provides information on climate change and the national initiatives for over 140 developing countries. <http://www.adaptationlearning.net/profiles/>.
- *National Communications Support Program (NCSP)*, jointly managed by UNDP and UNEP, provides support to more than 130 developing countries as they prepare Second (or Third) National Communications to the UNFCCC. Together with the implementing agencies, the NCSP provides technical and policy guidance on vulnerability and adaptation assessment, and on linking climate risks with national development priorities. <http://ncsp.undp.org/>.
- *UNDP Environment & Energy e-Library*, a broad-themed collection of climate change, energy and environment-related literature. <http://www.energyandenvironment.undp.org/undp/index.cfm?module=Library&page=DocumentList&LibraryID=8&AreaID=440>.
- *Web-based training module on Climate Change*, a 3-hour training including three lessons: The Science of Climate Change, Global Responses to Climate Change, and Climate Change and UNDP's Development Efforts. To be released in late 2008.

Global and regional development banks

- The **World Bank** has adopted a climate risk management approach to development, which calls for development that is resilient to both present-day variability and projected climate change. The Bank is increasing collaborative efforts on adaptation with other multilateral development banks and is working with the IFC on exploring ways to involve the private sector.
- The **African Development Bank (AfDB)** has some experience in the design of specific climate risk management and adaptation (CRMA) interventions.

A CRMA approach – the most effective strategy to address climate change, according to Bank Group experts – integrates the management of current climate variability and extremes with adaptation to climate change. The strategy will review and elaborate on the adequacy of existing financing and non-financing instruments. It will also assess Bank capacity to access external finance such as UNFCCC/GEF financing and explore opportunities to establish or access new internal and external financing mechanisms.

- The **Asia Development Bank (ADB)** has been working with partners across Asia and the Pacific to build knowledge of climate change impacts and adaptation measures for almost a decade. Bolstering these efforts are long-standing programs of support for disaster preparedness and response, as well as productive relations with development partners – from government agencies, to academia, think tanks, green businesses, civil society organizations, and both bilateral and multilateral development agencies. ADB also has direct access to climate change adaptation funds administered by GEF.

NEGOTIATIONS ON ADDITIONAL INVESTMENT AND FINANCIAL FLOWS TO ADDRESS CLIMATE CHANGE IN DEVELOPING COUNTRIES

ERIK HAITES
MARGAREE CONSULTANTS, INC
TORONTO

CONTENTS

Acronyms	165
Units and measurements	165
1. Introduction	166
1.1 Purpose and scope	166
1.2 Background	166
2. Estimates of the investment and financial flows needed to address climate change	168
2.1 Mitigation	168
2.2 Adaptation	170
2.3 Sources of investment and financial flows	172
3. Existing funding mechanisms of the Convention and the Kyoto Protocol	174
3.1 Financial Mechanism under the Convention	174
3.1.1 GEF Trust Fund allocations and co-financing and allocation of GEF resources to climate change activities	174
3.1.2 Special funds	176
3.1.3 Summary	176
3.2 The Kyoto mechanisms	178
3.2.1 Distribution of CDM projects by type	178
3.2.2 Distribution of CDM Projects by Host Country	180
3.2.3 Investments and Revenues of CDM Projects	181
3.2.4 Summary	182
3.3 The Adaptation Fund	182
4. Options to enhance international investment and financial flows to developing countries	184
4.1 Introduction	184
4.2 Increasing the scale of existing mechanisms	185
4.2.1 The Convention funds	185
4.2.2 The CDM and other crediting mechanisms	185
4.2.3 The Adaptation Fund	186
4.3 Increased contributions by developed countries	187
4.3.1 New bilateral and multilateral funds	187
4.3.2 Proposals funded by defined contributions from developed countries	188
4.3.3 Proposals funded by contributions from developed and developing countries	189
4.4 More stringent commitments by developed countries	189
4.4.1 Auction of Assigned Amount Units	190
4.4.2 Nationally appropriate mitigation actions	190
4.5 Other possible sources of funds	191
4.6 Summary	194
5. Governance of international investment and financial flows	196
6. Effective disbursement of the international funds	197
7. Conclusions	199
Bibliography	201
Annexes	202
Annex 1. COP decisions	202
Annex 1.1. COP decisions related to financial mechanisms	202
Annex 1.2. COP and CMP decisions related to the Adaptation Fund	203
Annex 1.3. CMP decisions related to CDM	204
Annex 2. Glossary	205

Acknowledgements

UNDP and the author gratefully acknowledge the constructive suggestions made for this paper by the UNFCCC secretariat, UNEP, and UNDP staff members, as well as John Drexhage, Benito Müller, Hernan Carlino, Dennis Tirpak, Chad Carpenter, Susanne Olbrisch and Naira Aslanyan.

Figures

Figure 1: Distribution of CDM projects by type	179
Figure 2: Distribution of CDM projects by host country	180

Tables

Table 1: Change to the Annual Investment and Financial Flows in 2030 for Climate Change Mitigation	169
Table 2: Change to the Annual Investment and Financial Flows in 2030 for Climate Change Adaptation	171
Table 3: Sources of Investment in 2000	172
Table 4: GEF Trust Fund Allocations and Co-financing (millions of \$)	175
Table 5: Allocation of GEF Resources to Climate Change Activities (millions of \$)	175
Table 6: Summary of the Options to Enhance International Investment and Financial Flows to Developing Countries	195

Acronyms

ADB	Asian Development Bank	
Annex I	Parties included in Annex I to the United Nations Framework Convention on Climate Change. These countries have additional commitments to assist developing countries with finance and technology	
Annex II	Parties included Annex II to the United Nations Framework Convention on Climate Change	
AOSIS	Alliance of Small Island States	
CCS	CO ₂ capture and storage	
CDM	Clean Development Mechanism	
CERs	Certified emission reductions, the credits issued for emission reductions achieved by a CDM project activity (equal to one metric tonne of carbon dioxide equivalent)	
CMP	Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol	
CO ₂	Carbon dioxide	
COP	The Conference of the Parties to the United Nations Framework Convention on Climate Change. It is the supreme body of the Convention	
CTF	Clean Technology Fund	
DIVA	Dynamic Interactive Vulnerability Analysis	
DOE	Designated Operational Entity	
ERU	Emission Reduction Unit, the credits issued for emission reductions achieved by a Joint Implementation project activity (equal to one metric tonne of carbon dioxide equivalent)	
GEF	Global Environment Facility	
IATAL	International Air Travel Adaptation Levy	
IET	International Emissions Trading	
IMERS	International Maritime Emissions Reduction Scheme	
IMF	International Monetary Fund	
IMO	International Maritime Organization	
IPCC	Intergovernmental Panel on Climate Change	
JI	Joint Implementation	
LDC	Least Developed Country	
LDCF	Least Developed Countries Fund	
LULUCF	Land use, land-use change and forestry	
MDGs	Millennium Development Goals	
MOU	Memorandum of Understanding	
NAMA	Nationally Appropriate Mitigation Actions	
NAPA	National Adaptation Plans of Action	
NAI Parties	Parties to the United Nations Framework Convention on Climate Change that are not included in Annex I (developing countries)	
NGO	Non-governmental organization	
ODA	Overseas Development Assistance	
RAF	Resource Allocation Framework	
RD&D	Research, development and demonstration	
REDD	Reducing Emissions from Deforestation and Forest Degradation in Developing Countries	
RMU	Removal Unit: a type of tradable unit based on LULUCF activities such as reforestation	
SCCF	Special Climate Change Fund, a fund established under the Convention that funds adaptation and technology cooperation projects in developing countries	
SCF	Strategic Climate Fund	
SD-PAMs	Sustainable development policies and measures	
SDRs	Special Drawing Rights	
SIDS	Small Island Developing States	
UNFCCC	United Nations Framework Convention on Climate Change (the Convention)	
Units and measures		
AAUs	Assigned Amount Units (equal to one metric tonne of carbon dioxide equivalent)	
CO ₂ -eq	CO ₂ -equivalent	
CO ₂ -eq/yr	CO ₂ -equivalent per year	
Gt	Gigatons: 10 ⁹ tons, 1 billion tons	
Mt	Megatons: 10 ⁶ tons, 1 million tons	
tCO ₂	tons of CO ₂	

1. INTRODUCTION

1.1 Purpose and scope

The purpose of this paper is to help developing countries to assess options in negotiations on additional international investment and financial flows to address climate change. This paper covers:

- Estimates of the investment and financial flows needed to address climate change;
- Existing funding mechanisms of the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol;
- Options to enhance international investment and financial flows to developing countries;
- Governance of the international investment and financial flows;
- Effective disbursement of the international funds.

This paper does NOT deal with national policies relating to investment and financial flows to address climate change in developing countries – that is addressed in a separate paper produced for this series¹. In addition, separate guidelines that developing countries can use to assess their national needs are available. Information on the terminology used in this paper can be obtained from the glossary in Annex 2.

1.2 Background

The UNFCCC and the Kyoto Protocol foresee financial assistance from developed country Parties to developing country Parties. Developed country Parties (Annex II Parties) committed to provide new and additional financial resources to assist developing country Parties comply with their obligations under the Convention (Article 4.3) and the Kyoto Protocol (Article 11.2).² The financial assistance may be provided through a “financial mechanism” established by Article 11 of the Convention

or through bilateral, regional or other multilateral channels.³

The Global Environment Facility (GEF) was designated as an entity entrusted with the operation of the financial mechanism of the Convention on an interim basis in 1995.⁴ The financial mechanism is accountable to the Conference of the Parties (COP), which decides on its policies, program priorities and funding criteria. A memorandum of understanding (MOU) between the COP and the Council of the GEF was concluded in 1996.⁵ After its first review of the financial mechanism, the COP decided to grant the GEF its status on an ongoing basis, subject to review every four years.⁶

Parties have also established two special funds under the Convention managed by the GEF; the Special Climate Change Fund (SCCF) and Least Developed Countries Fund (LDCF) (see section 3.1.2).⁷

The Adaptation Fund under the Kyoto Protocol was established to assist developing country Parties to the Protocol that are particularly vulnerable to the adverse effects of climate change to meet the costs of adaptation.⁸ A “share of proceeds” consisting of 2% of the certified emission reductions (CERs) issued for most Clean Development Mechanism (CDM) projects is contributed to the Adaptation Fund. The operating entity of the Fund is the Adaptation Fund Board serviced by a secretariat and a trustee. The GEF and World Bank have been appointed the secretariat and trustee respectively on an interim basis.⁹ The Board, subject to the guidance and under the authority of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol (CMP), will develop strategic priorities, policies and guidelines, decide on projects and develop rules of procedure.

Financial support is currently being addressed in two negotiating processes. One is the **fourth review of the**

financial mechanism, which is scheduled to be completed by the COP at its 15th session (2009). The COP has adopted objectives and methodology for the review of the financial mechanism.¹⁰ The fourth review will inform the fifth replenishment of the GEF. The second process is the Ad Hoc Working Group on Long Term Cooperative Action established by the **Bali Action Plan**. Its mandate includes enhanced action on the provision of financial resources and investment to support action on mitigation and adaptation and technology cooperation. That process is also scheduled to conclude at COP-15 in 2009.

The financial component of the Bali Action Plan will consider, inter alia:

- Improved access to adequate, predictable and sustainable financial resources and the provision of new and additional funding for developing country Parties;
- Positive incentives for developing country Parties for the enhanced implementation of national mitigation strategies and adaptation action;
- Innovative means of funding to assist developing country Parties particularly vulnerable to the adverse impacts of climate change to meet the cost of adaptation;
- Incentives to implement adaptation actions on the basis of sustainable development policies;
- Mobilization of public- and private-sector funding and investment; and
- Financial and technical support for capacity building in the assessment of the costs of adaptation in developing countries.

For an overview of COP and CMP decisions, please refer to Annex 1 of this report.

¹ Please refer to the paper by Dennis Tirpak, Sujata Gupta, Daniel Perczyk, and Massamba Thiouye, *National Policies and Their Linkages to Negotiations over a Future International Climate Change Agreement*.

² Article 4.3 of the Convention states that developed country Parties shall provide new and additional financial resources to meet the agreed full costs incurred by developing country Parties to prepare national communications and to meet the agreed full incremental costs of implementing measures covered by Article 4.1. Article 4.4 stipulates that developed country Parties shall assist particularly vulnerable developing country Parties to meet the costs of adaptation and Article 4.5 commits developed country Parties to take all practicable steps to promote, facilitate and finance the transfer, or access, to environmentally sound technologies and know how.

³ Parties are required to report such financial assistance in their national communications.

⁴ Decision 9/CP.1.

⁵ Decision 12/CP.2.

⁶ Annex to decision 3/CP.4.

⁷ Decision 7/CP.7.

⁸ Article 12.8 of the Kyoto Protocol and decisions 10/CP.7 and 28/CMP.1.

⁹ Decision 1/CMP.3.

¹⁰ Decision 6/CP.13.

2. ESTIMATES OF THE INVESTMENT AND FINANCIAL FLOWS NEEDED TO ADDRESS CLIMATE CHANGE

In 2007, the UNFCCC Secretariat prepared a report on “Investment and Financial Flows to Address Climate Change”.¹¹ The report covers mitigation and adaptation in various sectors over the period to 2030. The report defines an **investment** as the initial (capital) cost of a new physical asset with a life of more than one year, such as the capital cost of a gas-fired generating unit or a water supply system. A **financial flow** is an ongoing expenditure related to climate change mitigation or adaptation that does not involve physical assets, such as research or health care. These investment and financial flows are NOT the same as the cost of addressing climate change; changes to the operating costs of investments are not considered nor are damages due to climate change estimated.

Total investment and relevant financial flows are estimated for both a reference scenario and a mitigation scenario. The scenarios are a composite of several sources covering energy-related emissions, industrial process carbon dioxide (CO₂) emissions, non-CO₂ emissions, and agriculture and forest sinks. A comparison of those scenarios indicates the investment and financial flows needed to address climate change.

Addressing climate change will require significant shifts and an overall net increase in global investment and financial flows. **While the changes appear large in absolute terms, they are small relative to total investment.** Most of the changes and additional investment are likely to be made by corporations and households, although this may require government policies and incentives. But additional public sector investment and financial flows will be required, primarily for adaptation.

Approximately half of the shifts and net increase in investment and financial flows needed to address climate change occur in developing countries. Mitigation investments in developing countries are more cost-effective; larger emission reductions per dollar invested. On average developing countries are estimated to suffer more damage as a percentage of their GDP than developed countries.

The UNFCCC report and other studies conclude that developing countries, especially the poorest and those

most vulnerable to the adverse impacts of climate change, will need international financial support for mitigation and adaptation.

The estimated investment and financial flows are distinct from development needs. The energy sector investment, for example, does not reduce the number of people without access to modern energy services. The UNFCCC analysis does not systematically address individual countries or groups of developing countries. However, the data indicate that official development assistance plays a much larger role in least developed countries (LDCs) than other developing countries.

2.1 Mitigation

Mitigation investment and financial flows depend on the scale of the emission reductions. The reference scenario used in the UNFCCC report assumes that global emissions rise from 38.87 Gigatons CO₂-equivalent (GtCO₂-eq) in 2000 to 61.52 GtCO₂-eq in 2030; about 1.5% per year.¹² Most of the growth occurs in developing countries. Under the mitigation scenario, global emissions peak in 2015 at 41.81 GtCO₂-eq and then decline to 29.11 GtCO₂-eq in 2030; 25% below 2000 emissions.

The lower emissions under the mitigation scenario are due to major changes to energy demand and supply and to shifting forests and agriculture from a source to a sink. Energy demand is estimated to be about 15% lower in 2030 due to aggressive implementation of energy efficiency measures – industry, buildings and transportation – by energy consumers and electric utilities. Electricity generating capacity is about 10% lower in 2030 and the mix of sources used is less carbon-intensive. Forests shift from an emissions source to a large sink.

The changes to the investment and financial flows in 2030 for climate change mitigation are shown in Table 1. The net change to the annual investment and financial flows in 2030 for climate change mitigation is estimated increase of \$200-\$210 billion globally, of which about \$75 billion is projected to occur in developing countries.

As discussed below, the net increase involves reduced investment for fossil fuel supply and large shifts in the investment for electricity generation.

Annual investment in **fossil fuel supply** and associated infrastructure in 2030 is almost \$60 billion lower due to the increased energy efficiency. However, global fossil fuel consumption is still about 30% higher than in 2000.

Substantial shifts in investment for electricity supply will be needed. Mitigation is projected to reduce investment for fossil-fired generation, transmission and distribution by \$156 billion in 2030. Almost all of that amount, about \$148 billion, needs to be shifted to renewables, nuclear and CO₂ capture and storage (CCS). Currently investment in the power sector is mostly domestic (about 70%), with significant international foreign direct investment and international borrowing in

some regions. Shifting domestic investments into more climate friendly alternatives may require national policies and/or financial incentives.

Increased energy efficiency requires additional investment for electrical and fossil fuel equipment in **industry and buildings**. Some CCS is also projected for the industrial sector. Improved vehicle efficiency, including hybrid vehicles, increases energy efficiency in the **transportation** sector. Actions to reduce emissions of non-CO₂ gases and from **waste** (landfills and wastewater treatment plants) require small investments. Finally, annual spending on **energy research, development and demonstration (RDD&D)** is projected to double from the current level. Currently, most research is undertaken in a few developed countries; what share of the research will be conducted in developing countries in 2030 is difficult to predict.

Table 1: Change to the annual investment and financial flows in 2030 for climate change mitigation

SECTORS	GLOBAL (BILLIONS OF \$ 2005)	SHARE OF NAI PARTIES (PERCENTAGE)
Fossil Fuel Supply	(-) 59	50 to 55%
Electricity Supply	(-) 7	50 to 55%
Fossil-fired generation, transmission and distribution	(-) 156	50 to 55%
Renewables, nuclear and carbon, capture & storage (CCS)	148	50 to 55%
Industry	36	50 to 55%
Building	51	25 to 30%
Waste	0.9	66 to 70%
Transport	88	40 to 45%
Forestry	21	Almost 100%
Agriculture	35	35 to 40%
Energy RD&D	35-45	-
Net Change	200-210	35 to 40%

Notes: NAI Parties: Parties to the United Nations Framework Convention on Climate Change that are not included in Annex I, developing countries.

RD&D: Research, development and demonstration

Source: UNFCCC 2007. *Investment and Financial Flows to Address Climate Change*, Tables IX-61, IX-62 and IX-63, pp. 173 and 174.

¹¹ UNFCCC, 2007.

¹² The reference and baseline scenarios for mitigation used by the UNFCCC correspond to scenarios from IEA World Energy Outlook (WEO) 2006; the non-CO₂ emissions projections from the United States Environmental Protection Agency (US EPA) extrapolated to 2030 (US EPA, 2006) and industrial process CO₂ emissions from the World Business Council on Sustainable Development (WBCSD) (WBCSD, 2002). For more detail, please see UNFCCC, 2007, Chapter II, p. 22 and Table 5, p. 216.

A little over half of the incremental investment for energy supply, electricity generation and industry is projected for developing countries, which reflects the relatively rapid economic growth projected for those countries and the cost-effective emission reduction opportunities available there. The shares are lower for buildings and transportation because building stocks with heating and/or cooling and vehicle fleets are concentrated in developed countries.

The **agriculture sector** offers opportunities to reduce nitrous oxide emissions from soils (fertilizer use) and manure management as well as methane emissions from animals, manure management and rice cultivation. The annual cost of such measures is estimated at \$20 billion in 2030, mostly (\$13 billion) in developing countries. Agroforestry offers the potential to increase carbon sinks; expanding agroforestry by 19 million ha/year would require an annual investment of about \$15 billion with virtually all of this potential in developing countries.

Deforestation and forest degradation currently lead to emissions of 5.8 GtCO₂ per year globally, all from developing countries. Halting those emissions would cost an estimated \$12 billion per year. In addition forest management – reducing harvest rates and harvest damage – could increase the forest carbon stock in developing countries. The estimated annual cost of such measures is \$8 billion per year. The forest carbon stock can also be increased through afforestation and reforestation of cleared land, but the potential is relatively small and the associated annual investment is less than \$0.5 billion annually.

2.2 Adaptation

The global cost of adaptation to climate change is difficult to estimate, largely because adaptation measures will be widespread and heterogeneous. More analysis of the costs of adaptation at the sectoral and regional levels is required to support the development of an effective and appropriate international response to the adverse impacts of climate change. Nevertheless it is clear that large new

and additional investment and financial flows will be needed to adapt to climate change. Based on the available literature, the UNFCCC Secretariat was able to compile partial estimates of the investment and financial flows for adaptation for agriculture, forestry and fisheries; water supply; human health; coastal protection; and infrastructure. The UNFCCC estimates are partial estimates for a limited number of sectors, so they do not represent the full incremental cost of adaptation.

Since they are drawn from available literature, the UNFCCC estimates of the investment and financial flows for adaptation in 2030 are based on a different scenario for each sector.¹³ For water supply and coastal zones, adaptation costs are the capital costs of measures designed for the projected climate over the life of the facility; 2050 and 2080 respectively.

According to the UNFCCC estimates, the incremental investment and financial flows needed to adapt to climate change in selected sectors are estimated to be \$49-\$171 billion globally in 2030 with \$28-\$67 billion of this total being needed in developing countries. Other recent estimates of adaptation costs for developing countries include: World Bank (\$9-\$41 billion),¹⁴ Oxford Institute for Energy Studies (\$2-\$17 billion),¹⁵ Oxfam (greater than \$50 billion),¹⁶ and UNDP (\$86 billion).¹⁷ While these estimates differ in terms of their scope and approach, and hence are not directly comparable, they all show that tens of billions of dollars annually will be needed by developing countries to adapt to climate change.

The estimated additional investment and financial flows needed for climate change adaptation in 2030 are shown in Table 2.

The **agriculture, forestry and fisheries** sector is estimated to need an additional investment of \$11 billion annually in new capital such as irrigation systems, equipment for new crops and fishing practices, and relocation and modification of processing facilities. An additional \$3 billion will be needed annually for research and extension activities to facilitate adaptation. About half of the total requirement will be for developing countries.

The capital cost of the **water supply**¹⁸ infrastructure needed to meet the projected population and economic growth to 2030 given the projected climate in 2050 is about \$800 billion. A little over 25% of this – \$225 billion – was estimated to be due to climate change. Spreading the capital cost over the 20-year life of the facilities leads to an annual adaptation cost of \$11 billion.¹⁹ About 85% of the additional investment would be needed in developing countries.

Table 2: Change to the annual investment and financial flows in 2030 for climate change adaptation

	GLOBAL (BILLIONS OF \$ 2005)	DEVELOPING COUNTRIES (PERCENTAGE)
Agriculture	14	50%
Water supply	11	85%
Human health	5	100%
Coastal protection	11	45%
Infrastructure	8 to 130	25 to 35%
Total	49 to 171	35 to 60%

Source: UNFCCC 2007. *Investment and Financial Flows to Address Climate Change*, Table IX-65, p. 177

For **human health** the adaptation cost is estimated as the cost of the additional cases of diarrhoeal disease, malnutrition and malaria due to climate change in developing countries. This cost is estimated at \$5 billion per year for 2030, all in developing countries.

The additional investment needed for **coastal protection** was estimated using the dynamic interactive vulnerability analysis (DIVA) model, which analyses adaptation options for more than 12,000 segments of the world's coasts. The model was run with and without sea level rise. It estimates the costs of beach nourishment, the costs of building dykes, land loss costs, number of people flooded, and losses from flooding. Only the costs of beach nourishment and dykes were counted as climate change adaptation costs. The annual investment in 2030 was estimated

at \$11 billion of which \$5 billion is in developing countries.²⁰

Infrastructure, such as buildings and roads, may be damaged due to severe weather events, flooding or other impacts of climate change. New infrastructure can be adapted to the impacts of the projected climate. To estimate the adaptation cost for new infrastructure, the share of infrastructure vulnerable to the adverse impacts of climate was estimated by region based on historical data for damages due to extreme weather events. Adapting the vulnerable new infrastructure to the potential impacts of climate change was estimated to increase the capital cost by 5-20%. The adaptation cost for new infrastructure in 2030 is estimated at \$8-\$130 billion globally, of which \$2-\$41 billion is in developing countries.

¹³ The differences in temperature, precipitation and sea level rise between a reference and mitigation scenario would be quite small in 2030.

¹⁴ World Bank, 2006, Table K.1. Current needs, based on share of investment estimated to be climate sensitive.

¹⁵ Müller and Hepburn, 2006, p. 14. Current needs, based on extrapolations of LDC NAPAs.

¹⁶ Oxfam 2007, p. 3. Current needs, based on extrapolations of NAPAs.

¹⁷ UNDP 2007. Needs in 2015.

¹⁸ The model used to develop the estimates for water supply considered changes in demand due to population and economic growth and changes in supply due to projected climate change. The estimates in the UNFCCC report includes water supply, but not water quality, flood protection, unmet irrigation needs or water distribution systems. UNFCCC 2007, Chapter 5.4.2, p. 105.

¹⁹ These estimates do not include the cost of sanitation facilities, storm water management, or flood protection. They also do not include the cost of meeting Target 10 of the Millennium Development Goals – halving the number of people without sustainable access to safe drinking water and basic sanitation by 2015 – which is estimated to require an annual expenditure of \$10 billion over that period.

²⁰ Flood and land losses are climate change damages. In practice, adaptation costs would be incurred in responding to those damages, so the adaptation costs are under estimated.

2.3 Sources of investment and financial flows

The additional investment and financial flows needed for climate change mitigation and adaptation in 2030 is \$249-\$381 billion (in 2005 \$). While that figure is large in absolute terms, it is only 1.1-1.7% of projected global investment in 2030. The sources of future investment and financial flows are not available from the economic models used. The sources of investment in 2000 are shown in Table 3.

Most investments are made by corporations (60%) with the balance being made by households (26%) and governments (14%). **Household** investments are for

vehicles, homes, farms, and small businesses and are financed by the owner.²¹ **Corporate** investments are financed by foreign direct investment (37%), domestic sources (35%) and foreign loans (28%). **Government** investments are financed mainly from domestic sources (91%) with some foreign loans (8%) and official development assistance (1%). Official development assistance for new physical assets provides 30% of the government investment in least developed countries. The significant shares of foreign direct investment (22%) and foreign debt (18%) of global investment attests to the importance of international capital markets and financial institutions to address climate change.

Table 3: Sources of investment in 2000

		AMOUNT (BILLIONS OF \$ 2000)	SHARE OF TOTAL (PERCENTAGE)
Households	Total investment	1,184	26%
Corporations	Domestic funds	1,429	21%
	Foreign direct investment	1,540	22%
	Foreign debt	1,156	17%
	Total investment	4,125	60%
Governments	Domestic funds	850	12%
	Foreign debt	71	1%
	Official development assistance	16	0
	Total investment	937	14%
Total	Domestic funds	4,093	60%
	Foreign direct investment	1,540	22%
	Foreign debt	1,226	18%
	Official development assistance	16	0
	Total investment	6,875	100%

Note: Official Development Assistance (ODA) investment only; ODA for new physical assets with a life of more than one year.

Total ODA is much larger.

Source: UNFCCC 2007. *Investment and Financial Flows to Address Climate Change*, Table III-3, p. 31.

Most of the additional investment and financing needed for climate change mitigation and adaptation is expected to be financed by corporations, although this may require government policies and incentives, e.g., electric utilities are usually government-owned or regulated private corporations. Changing the mix of generation types they build may require government policies. Facility owners should make the extra investment for energy efficiency in industry and buildings because it will yield an attractive return, but policies may be needed to address market barriers. Households will bear the higher initial cost of efficient vehicles, but policies are likely to be needed to induce manufacturers to produce more efficiency vehicles.

Governments are likely to play a larger role in providing the additional funds needed for adaptation. While most of the additional investment needed for agriculture, forestry and fisheries will be provided by households and corporations, a substantial part of the additional research and extension activity will be funded by government. Most water supply systems and coastal protection measures are funded by governments. Health care relies on a mix of public and private funding that varies widely across countries. Most infrastructure is privately owned, but government policies may be needed to ensure that new facilities are well suited to the future climate.

Questions:

- What are the major mitigation measures to reduce global greenhouse gas emissions? How will they affect future investment flows? How will investments by different types of entities – households, corporations, governments – be affected? How will investments in developing countries be affected? What role(s) will governments play?
- What types of adaptation measures will be needed to cope with the impacts of climate change? What are the estimated costs of those measures? How will investments by different types of entities be affected? What share of the adaptation investment is expected to occur in developing countries?
- What are the annual investment flows in your country? What are the main mitigation options in your country? What changes to the investment and financial flows would implementing those options entail? What are the main adaptation options in your country? What changes to investment and financial flows would implementing those options entail?

²¹ The household may borrow funds from financial institutions, but the financial institution would get the money from deposits by households and corporations. The available data do not allow the sources of domestic funding to be tracked.

3. EXISTING FUNDING MECHANISMS OF THE CONVENTION AND THE KYOTO PROTOCOL

The Convention and its Kyoto Protocol foresee financial assistance from developed country Parties to developing country Parties. This assistance may be through bilateral, multilateral or regional channels or through a financial mechanism defined in Article 11 of the Convention. The GEF has been designated as an operating entity of the financial mechanism of the Convention on an on-going basis, subject to review every four years.

Annex II Parties are expected to provide information on the bilateral and multilateral assistance they provide in their national communications. Due to gaps and inconsistencies in reporting approaches in the third and fourth national communications, it is not possible to calculate the financial assistance provided by Annex II Parties through such channels.

The Kyoto Protocol created the CDM to assist non-Annex I (NAI) Parties in achieving sustainable development and in contributing to the ultimate objective of the Convention and to assist Annex I Parties in meeting their emissions limitation commitments.²² The CDM provides financial assistance for mitigation projects in NAI Parties by issuing CERs credits for the emission reductions or removals achieved. A small share (2%) of the CERs issued for most projects is contributed to the Adaptation Fund. The Adaptation Fund will assist developing country Parties that are particularly vulnerable to the adverse impacts of climate change to meet the costs of adaptation.

3.1 Financial Mechanism under the Convention²³

The GEF receives guidance from the COP on policy, program priorities, and eligibility criteria. The COP has provided general guidance with regard to operation of the financial mechanism, and has also provided specific guidance related to:

- Support to national communications of NAI Parties;
- Capacity-building;
- Public awareness and outreach (Article 6 activities);
- Development and transfer of technologies;
- Support to adaptation;

- Support to activities referred to in Article 4, paragraph 8(h) of the Convention;
- Support to mitigation.

The GEF is replenished on a four-year cycle. The donors agree on the amount of the replenishment and the contribution of each country is then calculated using a pre-defined “basic” burden share.²⁴ In anticipation of a replenishment, the COP makes an assessment of the funds needed to assist developing countries to fulfill their commitments under the Convention over the next cycle. The fourth review of the financial mechanism started at COP 13 (December 2007) and will be completed at COP 15 (December 2009). It will provide an input to the fifth replenishment of the GEF.

3.1.1. GEF Trust Fund allocations and co-financing and allocation of GEF resources to climate change activities

The funds contributed to the GEF Trust Fund for the pilot phase and the first four replenishments are shown in Table 4. The total is over \$3.3 billion. The GEF has used these funds to support projects that have provided over \$14.3 billion of co-financing.

The allocation of GEF resources to climate change activities is shown in Table 5. Most of the resources have been allocated to long-term mitigation projects, including renewable energy, energy efficiency, and low-greenhouse gas emitting technologies.

A key feature of the GEF Trust Fund is the requirement that projects meet the agreed incremental costs for delivering global environmental benefits. Many mitigation actions are able to meet this requirement; limiting climate change is a global benefit and the incremental costs can be calculated by comparing the measure with the cost of the conventional alternative. In contrast, the benefits of adaptation measures – reduced damage due to the adverse impacts of climate change – tend to be local and the incremental costs can be difficult to estimate.

In 2005 the GEF Council adopted the resource

Table 4: GEF Trust Fund Allocations and Co-financing (millions of \$)

GEF PHASE	GEF GRANT	CO-FINANCING
Pilot phase (1991-1994)	280.60	2,402.89
GEF 1 (1995-1998)	507.00	2,322.10
GEF 2 (1999-2002)	667.20	3,403.40
GEF 3 (2003-2006)	881.80	4,609.69
GEF 4 (2007-2010)	990.00	
From which in the first half of 2007	76.35	1,651.82
Total	3,326.60	14,389.90

Source: UNFCCC 2007. *Investment and Financial Flows to Address Climate Change*, Table VII-56, p. 164.

Table 5: Allocation of GEF Resources to Climate Change Activities (millions of \$)

	PILOT PHASE	GEF 1	GEF 2	GEF 3	GEF 4	TOTAL	SHARE
OP 5: Energy efficiency	70.6	128.6	200.1	286.7	33.8	719.8	29.8%
OP 6: Renewable energy	108.8	191.3	251.8	299.2	10.0	861.1	35.7%
OP 7: Low-GHG emitting energy technologies	10.1	98.4	98.6	111.1		318.2	13.2%
OP 11: Sustainable transport			46.4	82.2	32.0	160.6	6.7%
Enabling activities	20.2	46.5	45.3	73.9		185.9	7.7%
Short term response measures	70.8	42.2	25.1	3.7		141.8	5.9%
Strategic pilot approach to adaptation				25.0		25.0	1.0%
Total	280.5	507.0	667.3	881.8	75.8	2,412.4	100.0%

Source: UNFCCC 2007. *Investment and Financial Flows to Address Climate Change*, Table VIII-58, p. 167.

allocation framework (RAF) to increase the predictability and transparency of its resource allocation.²⁵ The resources each eligible country can expect from the GEF are specified at the start of the four-year replenishment period with an update in the middle of the period. Each country receives a minimum allocation of \$1 million with a maximum allocation of 15% of the resources available. Within that range the GEF Benefits Index and the GEF Performance Index are used to determine the resources allocated to each country.²⁶

The Benefits Index measures the potential of a country to generate global environmental benefits (emission reductions) and the Performance Index measures a country's capacity, policies and practices relevant to successful implementation of GEF projects.

The COP requested the GEF to provide information on the initial application of the RAF to the allocation of resources in the fourth replenishment period and how the funding available to developing countries is likely to affect implementation of their commitments under the

²² Kyoto Protocol, Article 12, paragraph 2.

²³ Please refer to http://unfccc.int/cooperation_and_support/financial_mechanism/items/2807.php for more information.

²⁴ GEF, 2005a.

²⁵ The RAF does not change the GEF project cycle. A country still needs to work with a GEF implementing/executing agency to develop and prepare concepts for review, pipeline entry and inclusion in a work program.

²⁶ China, India and the Russian Federation are likely to receive the most under the RAF formula, followed by Brazil, Mexico and South Africa, followed by a group of countries that includes Argentina, Egypt, Indonesia, Islamic Republic of Iran, Kazakhstan, Malaysia, Pakistan, Romania, Thailand, Turkey, Ukraine and Venezuela (GEF, 2005b).

Convention.²⁷ The COP subsequently requested the GEF to report the resources available to each developing country Party through the initial implementation of the RAF including a list of climate change activities funded with these resources.²⁸

3.1.2. Special funds

The **Special Climate Change Fund (SCCF)** finances activities, programs and measures relating to climate change that are complementary to those funded by the climate change focal area of the GEF and by bilateral and multilateral funding, in the following areas:

- a) Adaptation,
- b) Transfer of technologies,
- c) Energy, transport, industry, agriculture, forestry and waste management; and,
- d) Activities to assist developing countries whose economies are highly dependent on income generated from the production, processing and export, and/or on consumption of fossil fuels and associated energy-intensive products in diversifying their economies.²⁹

As of March 2008, pledges to the SCCF totalled \$90 million of which \$74 million had been received.³⁰ Of this sum, \$60 million was pledged for the SCCF Program for Adaptation and \$14 million for the SCCF Program for Transfer of Technology. As of March 2008, nine adaptation projects had been approved with SCCF funding of \$33.5 million and another eight adaptation projects seeking grants of \$45.4 million were in the pipeline.³¹ Donors are urgently requested to make further contributions to the SCCF Program for Adaptation.

The **Least Developed Countries Fund (LDCF)** is designed to support projects addressing the urgent and immediate adaptation needs of the least developed countries (LDCs) as identified by their national adaptation plans of action (NAPAs). The LDCF contributes to the enhance-

ment of adaptive capacity to address the adverse effects of climate change.

The priority sectors that are expected to receive the most attention under the NAPA are water resources, food security and agriculture, health, disaster preparedness and risk management, infrastructure and natural resources management. Community-level adaptation may also be a crosscutting area of concern.

As of March 2008, \$173 million had been pledged and \$92 million had been paid.³² At that time 46 of 49 eligible LDCs had been allocated funds to prepare their NAPAs, of which 29 had completed their NAPA.³³ In addition, 10 NAPA implementation projects involving LDCF funding of \$29.6 million had been approved.

3.1.3 Summary

In summary, the financial mechanism of the Convention relies on voluntary contributions by Annex II Parties. There is a pre-defined “basic” burden share for the GEF Trust Fund, but not for the SCCF and LDCF. The COP provides input to the replenishment of the GEF Trust Fund through its review of the financial mechanism, but can only support appeals for contributions to the SCCF and LDCF when needed. The fourth review of the financial mechanism, which will inform the fifth replenishment of the GEF, is currently underway and is scheduled for completion at COP 15 in 2009. The SCCF needs additional contributions to support projects that have been submitted.

Most of the contributions to the GEF Trust Fund have been allocated to long-term mitigation projects. Mitigation actions can more easily meet the GEF requirement of delivering global environmental benefits. However, a small amount of money has been allocated for a **strategic pilot approach to adaptation**. The Resource Allocation Framework determines the funds available to each eligible country. A transparent allocation process may be necessary given the limited funds available, but the funds allocated

to a particular country may not be sufficient to support its commitments under the Convention such as preparation of national communications.

Most of the funding for adaptation comes from the LDCF and SCCF. The LDCF supports the immediate adaptation needs of the LDCs. The SCCF Program for Adaptation supports adaptation projects in all developing countries, including LDCs. The SCCF Program for Transfer of Technology is the only mechanism that supports technology cooperation. The COP provides regular guidance to the GEF on the allocation and use of the funds.

Questions:

- Does a defined burden share, such as that used by the GEF Trust Fund, generate larger total contributions than voluntary contributions?
- Do the current funds provide sufficient support for mitigation? Adaptation? Technology transfer?
- What share of the total cost should be covered by Convention funds in the case of mitigation actions? Adaptation measures? Technology Transfer?
- Should all bilateral and multilateral assistance for climate change by Annex II Parties go through Convention funds?

²⁷ Decision 5/CP.11.

²⁸ Decision 3/CP.12.

²⁹ GEF, 2004.

³⁰ GEF, 2008a.

³¹ GEF, 2008b.

³² GEF, 2008a.

³³ GEF, 2008b.

3.2 The Kyoto mechanisms

The Kyoto Protocol established emissions limitation commitments for developed country (Annex.B) Parties³⁴ for 2008–2012 and established three mechanisms – the CDM,³⁵ Joint Implementation (JI),³⁶ and International Emissions Trading (IET) – they can use to help meet those commitments.

Most Annex B Parties plan to use domestic emissions trading systems to regulate the emissions of fossil-fired electricity generators and large industrial emitters to help comply with their Kyoto Protocol commitments.³⁷ Those emissions trading systems are already operational in the Member States of the EU and Norway.³⁸ Participation in JI and IET is limited to Annex B Parties.

The CDM enables a project to mitigate climate change in a NAI Party to generate CERs.³⁹ Most domestic emissions trading systems allow participating firms to use CERs toward compliance.⁴⁰ Those CERs are transferred to the government and it can use them for compliance with its Kyoto Protocol commitment. Some Annex B governments also purchase CERs directly to help meet their Kyoto Protocol commitment. The CDM was launched in November 2001, the first project was registered about three years later, and the first CERs were issued in October 2005.

The CDM is supervised by the CDM Executive Board under the authority and guidance of the Conference of the Parties serving as the meeting of the Parties to the Protocol.⁴¹ A CDM project must use a methodology approved by the CDM Executive Board and be validated by an accredited designated operational entity (DOE).⁴² CERs are issued by the CDM Executive Board only after the emission reductions achieved have been verified and certified by an accredited DOE. Thus, a CDM project incurs costs (validation of the project) before it can be registered, and further costs (certification of the emission reductions) before CERs are issued.⁴³

3.2.1 Distribution of CDM projects by type

At the end of March 2008, 3188 projects were in the CDM pipeline, including 978 registered projects.⁴⁴ These projects are projected to reduce emissions by 464 million tCO₂-eq. Figure 1 shows the distribution of these projects and their projected emission reductions by project type.

Over half of the projects are renewable energy – hydro, biomass, wind, solar and geothermal – but they account for about 30% of the projected reductions. On the other hand, less than 5% of the projects involve destruction of HFCs, N₂O, coal bed methane and PFCs, but they represent over 30% of the estimated emission reductions.

³⁴ Parties included in Annex B to the Kyoto Protocol.

³⁵ Please refer to http://unfccc.int/kyoto_protocol/mechanisms/clean_development_mechanism/items/2718.php or <http://cdm.unfccc.int/index.html>.

³⁶ Please refer to http://unfccc.int/kyoto_protocol/mechanisms/joint_implementation/items/1674.php or <http://ji.unfccc.int/index.html>.

³⁷ An emissions trading system regulates total emissions by specified sources. The government sets a limit on total emissions by the sources during each compliance period and distributes emissions allowances equal to that limit. Each source must accurately measure its actual emissions during the period. At the end of a period, each source must remit allowances equal to its actual emissions to achieve compliance. With full compliance, the combined emissions of the specified sources can not exceed the overall limit. Emissions trading encourages participating sources to implement the lowest cost emission reduction measures. Some trading systems allow sources not covered by the system to earn credits for emission reductions they implement. Those credits can be used by system participants toward compliance.

³⁸ In addition, emissions trading schemes began operation in Switzerland and New Zealand in January 2008.

³⁹ Afforestation and reforestation projects under the CDM can generate temporary CERs (tCERs) or long-term CERs (lCERs), which have limited lifetimes. For ease of exposition CERs will include tCERs and lCERs unless explicitly stated otherwise.

⁴⁰ But not tCERs or lCERs.

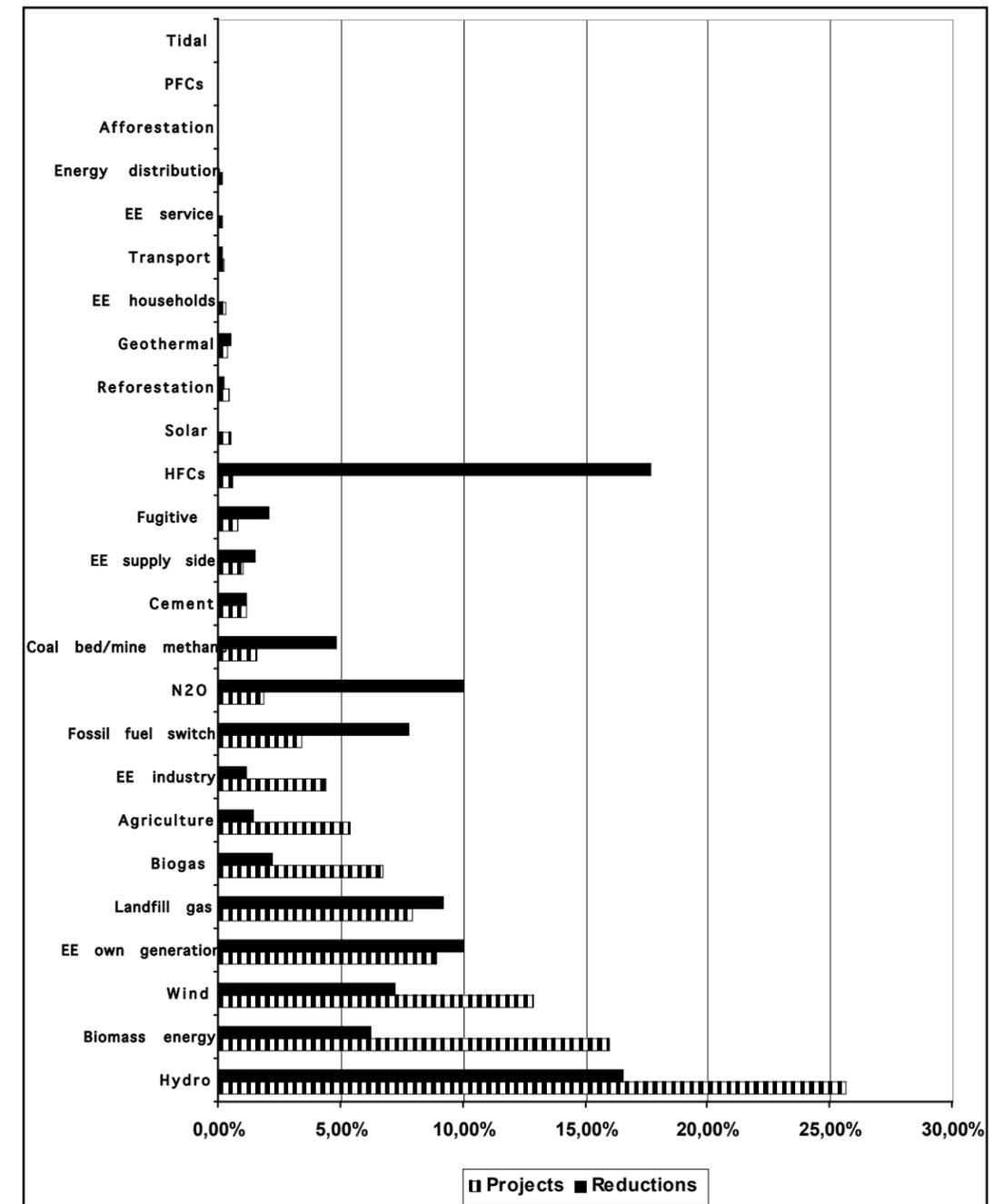
⁴¹ Annex to Decision 17/CP.7 and Decision 3/CMP.1.

⁴² DOEs are accredited by the CDM Executive Board.

⁴³ This approach to issuing CERs increases environmental integrity.

⁴⁴ Fenhann, 2008. As part of the validation process the project design document of a proposed comment must be posted for public comment. A project that has reached this stage is said to be in the CDM pipeline.

Figure 1: Distribution of CDM Projects by Type



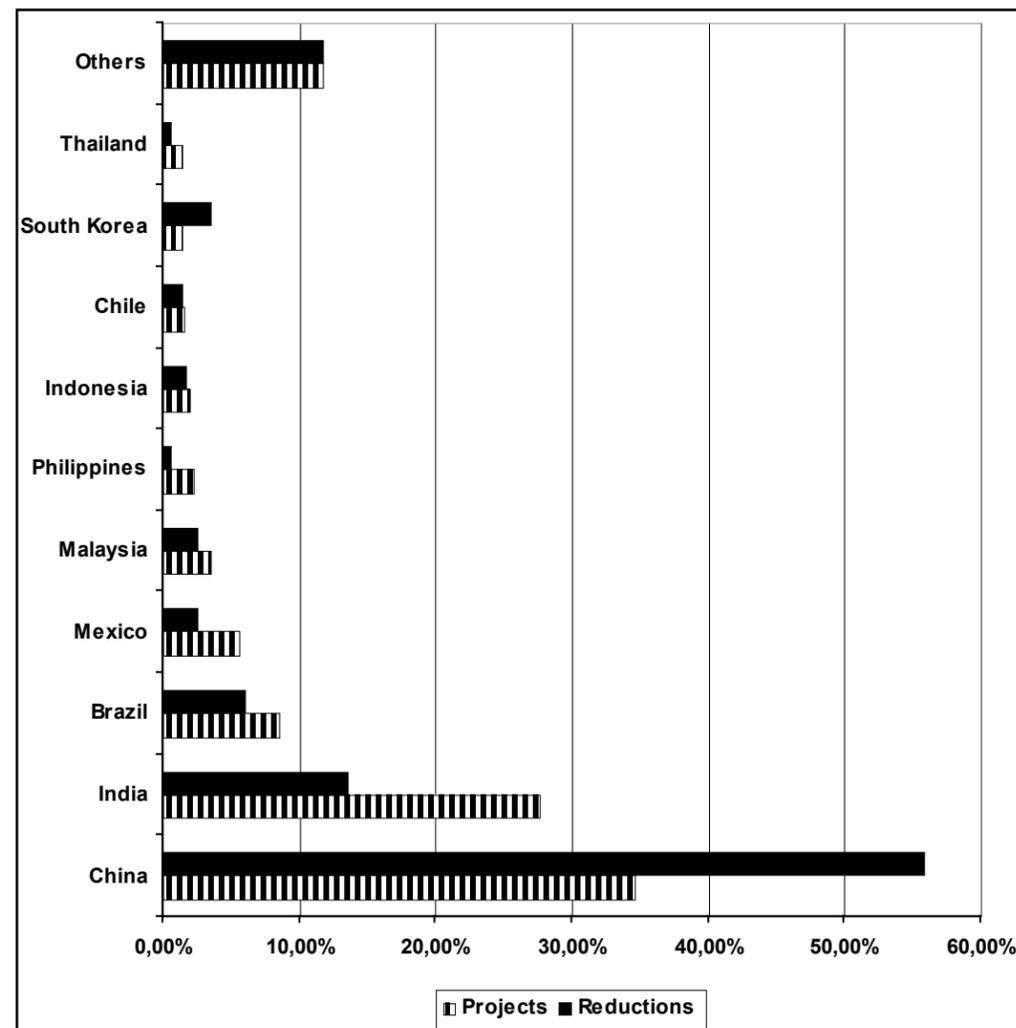
Source: Fenhann 2008. The CDM Pipeline.

3.2.2. Distribution of CDM Projects by Host Country

Sixty-eight countries have at least one CDM project in the pipeline.⁴⁵ Several countries had only one project in the pipeline at the end of March 2008 but China had over 1100 projects representing over 55% of the total projected emission reductions. Figure 2 shows other countries

hosting a relatively large share of the projects or the forecast emission reductions. The ten countries with the largest number of projects are China, India, Brazil, Mexico, Malaysia, Philippines, Indonesia, Chile, South Korea and Thailand. The projects in China and South Korea are larger than average, while those in the other countries are smaller than average.

Figure 2 Distribution of CDM Projects by Host Country



Source: Fenhann 2008. The CDM Pipeline.

⁴⁵ Fenhann, 2008.

3.2.3. Investments and Revenues of CDM Projects

To help defray the cost of implementing the CDM project, proponents often agree to sell some of the expected CERs before the project has been implemented. Capoor and Ambrosi (2008) indicate that expected CERs from projects at an early stage of regulatory and operational preparation transacted at around €8-10 during 2007, while registered projects attracted prices between €11-13. The lowest prices reflect risks that the proposed project might not be registered and might not deliver the expected emission reductions.⁴⁶ Projects demonstrating strong sustainability attributes and community benefits (such as projects certified under the Gold Standard) could fetch a €1-1.5 premium.

Capoor and Ambrosi (2008) report total sales by CDM project proponents at 551 million tCO₂-eq with a value of 2007 \$7,426 million during 2007, an average price \$13.60 (€9.90) per tCO₂-eq. As the quantity of issued CERs increased, some of those CERs were sold by the project proponents or entities that had contracted to buy them. Such “spot market” transactions yielded a price of about €16.50 per tCO₂-eq.⁴⁷ The past year witnessed a ten-fold growth of the secondary market for CERs. In this market, sellers guarantee delivery of the specified quantity of CERs by the agreed date. The guarantee is based on CERs from a designated project or portfolio of projects enhanced by credit guarantee by a highly rated bank. During 2007 secondary market transactions amounted to 240 million tCO₂-eq with a value of 2007 \$5,451 million, an average price \$22.70 (€16.70) per tCO₂-eq.

The UNFCCC estimated that over \$26.4 billion would be invested in CDM projects that entered the pipeline during 2006.⁴⁸ Over 80% of the investment was for renewable energy and energy efficiency projects. Approximately half of the total investment is capital invested in unilateral projects by host country proponents.⁴⁹ Capoor

and Ambrosi (2008) estimate that in 2007 the CDM led to investment of \$33 billion (€24 billion) for renewable energy and energy efficiency.

Although the CDM does not have an explicit technology transfer mandate, it contributes to technology transfer by financing projects that use technologies currently not available in the host countries. Roughly 39% of all CDM projects accounting for 64% of the annual emission reductions claim to involve technology transfer.⁵⁰ Technology transfer usually involves both knowledge and equipment with equipment imports accounting for most of the remaining transfer. Technology transfer is more common for larger projects and projects with foreign participants. Technology transfer is very heterogeneous across project types. The host country can have a significant impact on the prevalence of technology transfer.

The operation of the CDM responds to the number and types of projects proposed. During its short life there has always been some part of the CDM administration that has been under strain due to the large number of projects. The CDM Executive Board has tried to address the problems as they arise. In early 2008 strains include the limited capacity of accredited DOEs, the complexity of and frequent changes to the rules, and inconsistent treatment of proposed projects leading to delays and higher costs.⁵¹ Proposals to modify or abolish the additionality requirement and to move from individual projects to larger emission reduction initiatives have been floated.⁵² And expansion of the CDM to include CCS, HFC destruction at new HFCF plants and reduced deforestation and degradation in developing countries (REDD) has been suggested.

The main use of CERs is to help meet the emission reduction commitments of Annex B Parties to the Kyoto Protocol. These commitments are currently limited to the 2008-2012 period. Unless and until post-2012 commitments are agreed by developed countries, the market for

⁴⁶ In each contract the price also depends on how the risks are shared between the buyer and the seller through penalty provisions or requirements to replace CERs that could not be delivered.

⁴⁷ In a spot market the CERs are delivered to the buyer's registry account within a day or two.

⁴⁸ UNFCCC, 2007, pp. 140-141.

⁴⁹ A unilateral project is one for which the project proponent in the developing country bears all of the costs before selling the CERs.

⁵⁰ Seres, 2007.

⁵¹ Capoor and Ambrosi, 2008, pp. 5-6.

⁵² The Kyoto Protocol requires that CDM emission reductions must be “additional to any that would occur in the absence of the certified project”. The CDM Executive Board has developed a tool to help project proponents demonstrate the additionality of their projects. But assessing additionality almost always involves judgment, so this remains a controversial requirement. Defining some project types, such as wind projects, as additional or adopting defined benchmarks for the baseline emissions of specified project types have been proposed as alternatives to assessment of additionality for individual projects.

CERs generated by post-2012 emission reductions is uncertain.⁵³ The UNFCCC found that estimates of potential post-2012 demand vary widely.⁵⁴ The low estimates of demand are in the range of \$5–25 billion per year (representing purchases of 400 – 600 Megatons (Mt) CO₂ per year); roughly the same as the current market. The high estimates suggest an annual demand of the order of \$100 billion with 4,000 – 6,000.Mt CO₂-eq per year, which requires ambitious commitments by all Annex I Parties, no commitments of any type by any NAI Party, and CERs for a large fraction of the potential emission reductions from all existing and some new categories of sources.

3.2.4 Summary

In summary, the CDM has grown rapidly and is now a significant market and source of renewable energy and energy efficiency investment in developing countries. Although the number of host countries is growing, CDM activity is concentrated in a small number of countries.

The CDM was designed as a responsive mechanism that approves proposed projects individually. The Executive Board has broad powers to engage assistance as necessary and to modify its administrative procedures. The rapid growth of the number of projects has strained the operation of the CDM and this continues to be the case despite changes implemented by the Executive Board. As part of its annual guidance to the Executive Board, the COP can also change CDM procedures.

Approval on a project-by-project basis is costly and cumbersome. Numerous changes to administration of the CDM have been proposed to reduce the administrative burden for individual projects or to enable larger reductions to be approved by a single decision, sectoral CDM for example. The success of the CDM has also generated proposals to expand its scope to new categories of emission reductions.

The absence of post-2012 commitments by developed countries creates uncertainty for the CDM. The ambition of those commitments will be a major determinant of the future demand. A large post-2012 demand would require

credits to be supplied by a large fraction of the potential emission reductions from all existing and some new categories of sources. That is likely to require new mechanisms in addition to the current types of CDM projects.

Questions:

- What impact does the negotiation of a post-2012 agreement have on the CDM?
- How could the CDM be improved?

3.3 The Adaptation Fund

The Adaptation Fund was established under the Kyoto Protocol to finance concrete adaptation projects and programs in developing country Parties to the Protocol, in particular those that are particularly vulnerable to the adverse effects of climate change. The Adaptation Fund is supervised and managed by the Adaptation Fund Board under the authority and guidance of the CMP. The Adaptation Fund Board is serviced by a secretariat, the GEF, and a trustee, the World Bank – both on an interim basis.

The Adaptation Fund is financed through a share of proceeds from CDM projects and other sources of funding. The share of proceeds is 2% of CERs issued for CDM projects with exemptions for some project types.⁵⁵ The revenue received by the Adaptation Fund will depend on the quantity of CERs issued and the price of CERs. Assuming annual sales of 300–450 million CERs and a market price of €17.50 (range of €10–25), the Adaptation Fund would receive \$80–300 million per year for 2008 to 2012.⁵⁶

Post-2012 funding for the Adaptation Fund depends on the continuation of the CDM and the level of demand in the carbon market. Assuming the same price levels and a share of proceeds for adaptation of 2% continues to apply post-2012, the level of funding could be \$100–500 million per year in 2030 for low CDM demand (\$5 – 25 billion representing purchases of 400 – 600 Mt CO₂ equivalent per year (CO₂-eq/yr)) and \$1 to \$5 billion per year for high CDM demand (\$100 billion with 4,000 – 6,000 Mt CO₂-eq/yr).

The first two meetings of the Adaptation Fund Board were held in Bonn in March and June 2008. The members elected a chair and a vice-chair for 2008–2009. The Board agreed on: the role and responsibilities of the Adaptation Fund Secretariat,⁵⁷ the 2008 work plan and budget, and draft legal arrangements for the Adaptation Fund Secretariat. The Board began, but did not complete, the rules of procedure of the Board, provisional operational policies and guidelines for Parties to access resources from the Fund, legal status of the Fund, monetization of CERs, the role and responsibilities of the Trustee, and the responsibilities of implementing and executing entities.⁵⁸

In summary, the Adaptation Fund, financed by a levy of 2% of the CERs issued for most CDM projects, is just becoming operational. It could have \$80–300 million per year for adaptation projects and programs in developing countries during 2008–2012. Post-2012 the Adaptation Fund depends on the continuation of the CDM and the level of demand in the carbon market.

Questions:

- What should be the Board's priorities for disbursement of funds? How should eligible Parties access the Fund?

⁵³ Capoor and Ambrosi, 2008, p. 5.

⁵⁴ UNFCCC, 2007, Section 7.4, pp. 156–160.

⁵⁵ Article 12.8 of the Kyoto Protocol and decisions 17/CP.7 and 3/CMP.1.

⁵⁶ UNFCCC, 2007, p. 169.

⁵⁷ With the exception of one bracketed paragraph.

⁵⁸ Adaptation Fund Board, 2008.

4. OPTIONS TO ENHANCE INTERNATIONAL INVESTMENT AND FINANCIAL FLOWS TO DEVELOPING COUNTRIES

4.1 Introduction

The UNFCCC report on investment and financial flows to address climate change concluded that to meet the additional investment and financial flows would require a combination of:

- Commitments by Annex II Parties to provide additional financial assistance to developing countries under the Convention;
- Appropriate national policies to encourage private investment and domestic government investment in mitigation and adaptation measures;
- Optimal use of the funds available under the Convention and from other sources to spread the risk across public and private sources;
- Expansion of the carbon market through more stringent commitments by Annex I Parties to increase demand and possible additional mechanisms to increase supply; and
- New sources of predictable funds to provide additional external financial flows to developing countries for adaptation and mitigation.

If the funding available under the financial mechanism of the Convention remains at its current level and continues to rely mainly on voluntary contributions, it will not be sufficient to address the future financial flows estimated to be needed for mitigation and adaptation.

With appropriate policies and/or incentives, a substantial part of the additional investment and financial flows needed could be covered by the currently available sources. **National policies can assist in shifting investments and financial flows made by private and public investors into more climate-friendly alternatives and optimize the use of available funds by spreading the risk across private and public investors.**

However, **improvement in, and an optimal combination of, mechanisms**, such as the carbon markets, the financial mechanism of the Convention, ODA, national policies and, in some cases, new and additional resources, will be needed to mobilize the necessary investment and financial flows to address climate change.

The **carbon market**, which is already playing an important role in shifting private investment flows, would have to be significantly expanded to address needs for additional investment and financial flows for mitigation.

New and additional external funding for climate change mitigation and adaptation will be needed, particularly for sectors in developing countries that depend on government investment and financial flows. Several other options for generating additional funds have been suggested. Some of these options, such as auctioning a share of the assigned amount and auctioning allowances for emissions from international bunkers, could generate revenues commensurate with the additional needs.

This section summarizes options that have been proposed to enhance funding. The options are categorized as follows:

- **Increasing the Scale of Existing Mechanisms**
 - o The Convention Funds
 - o The CDM and Other Possible Crediting Mechanisms
 - o The Adaptation Fund
- **Additional Contributions by Developed Countries**
 - o New Bilateral and Multilateral Funds
 - *Cool Earth Initiative*
 - *International Climate Protection Initiative*
 - *Clean Investment Funds*
 - *Global Climate Financing Mechanism*
 - o Proposals Funded by Defined Contributions from Developed Countries
 - *Convention Adaptation Fund, Technology Fund and Insurance Mechanism*
 - *Adaptation Fund and Multilateral Technology Acquisition Fund*
 - *Mechanism for Meeting Financial Commitments under the Convention*
 - *Efficiency Penny*
 - o Proposals Funded by Contributions from Developed and Developing Countries
 - *World Climate Change Fund*
 - *Multilateral Adaptation Fund*
- **More Stringent Commitments by Developed Countries**
 - o Auction of Assigned Amount Units
 - o Nationally Appropriate Mitigation Actions
- **Other Sources of Funds**
 - o Extension of the 2% levy on CDM to other Market Mechanisms
 - o International Air Travel Adaptation Levy
 - o International Maritime Emission Reduction Scheme
 - o Auction of Allowances for International

- o Aviation and Marine Emissions
- o Funds to Invest Foreign Exchange Reserves
- o Access to Renewables Programs in Developed Countries
- o Tobin Tax
- o Donated Special Drawing Rights
- o Debt-for-clean-energy Swap

4.2 Increasing the scale of existing mechanisms

More funds could be contributed to the GEF Trust Fund, the SCCF and LDCF. And the CDM could be expanded, which would increase the support for mitigation actions in developing countries and also raise more revenue for the Adaptation Fund.

4.2.1 The Convention funds

The fourth review of the financial mechanism will inform the fifth replenishment (2011-2014) of the GEF Trust Fund. The COP has adopted objectives and methodology for the review of the financial mechanism. The COP will complete the review at its 15th session (2009). Replenishment of the GEF Trust Fund occurs on a fixed four-year cycle and follows a pre-defined "basic" burden share formula. A country that feels its share of the proposed replenishment is higher than it wishes to contribute may argue for a lower amount thus reducing the contributions by all countries.

Contributions to the SCCF and LDCF are voluntary and may occur at any time. The SCCF and LDCF have defined roles that meet specific needs of developing countries, rather than their overall mitigation and adaptation needs. The COP can only support appeals for contributions to the SCCF and LDCF when needed. The SCCF needs additional contributions to fund projects that have been submitted.

Questions:

- What are the roles of the respective funds? Are there overlaps or gaps in their roles?
- Are the replenishment methods appropriate to their roles?

4.2.2 The CDM and other crediting mechanisms

The scale of the CDM depends on commitments by developed countries, which determines the demand, and the availability of eligible, cost-effective mitigation measures in developing countries, which determines the supply. The supply can be increased by expanding the range of eligible mitigation actions, for example to include CCS, REDD, and by expanding the range of crediting approaches, for example to include sectoral CDM or sectoral crediting.

Increasing the number of countries with commitments and/or the stringency of the commitments is the only way to increase the demand. The demand can be reduced by restrictions on the use of CDM credits (CERs) for example by restrictions on the eligible countries or project types. Developed countries may also restrict the quantity or types of CERs that will be accepted. A requirement that use of the market mechanisms be supplemental to domestic action by developed countries may also reduce the demand for CERs.

Due to the uncertainties affecting the potential supply and demand, estimates of the potential scale of the CDM span a wide range. The UNFCCC reported that the post-2012 market is likely to be between \$25 and \$100 billion per year.⁵⁹

Despite the uncertainty, it appears the CDM could supply a substantial part of the funding needed for mitigation measures in developing countries. The UNFCCC estimated the additional investment needed for mitigation in developing countries in 2030 at \$176 billion.⁶⁰ About \$69 billion is for energy efficiency with a financially attractive payback that may require policy direction but likely would be funded mainly by private investors. About \$73 billion is for renewables, nuclear and CCS most of which reduces investments in conventional generation. The balance is for reduced deforestation and forest management and agriculture.

⁵⁹ UNFCCC, 2007, Figure VII-37, p. 158.

⁶¹ UNFCCC, 2007, Table IX-64, p. 175.

The CDM supports annual investments of roughly the same order of magnitude as the size of the market.⁶¹ If the post-2012 market is \$25 to \$100 billion as projected, the CDM and possible new mechanisms could support the investments needed for renewables and non-CO₂ emissions. At the upper end of the range, the CDM might also be able to support investment in CCS and reduced forest emissions.

Most proposals for expansion of the international carbon market for NAI Parties focus on the CDM, increasing the supply of credits from countries with no target or a non-binding target. The suggestions cover both expansion of the types of projects eligible under the CDM and possible new mechanisms. Suggestions for expansion of the project types:⁶²

- HFC-23 destruction projects at new HCFC-22 plants;
- CO₂ CCS;
- REDD;
- Sustainable development policies and measures (SD-PAMs);
- New nuclear generation stations;
- Sectoral CDM; and
- Policy CDM.

Other options for REDD, SD-PAMs and sectoral targets propose financial or other incentives, rather than tradable credits. The appropriate mechanism for an option depends on the marginal cost of its emission reductions and its scale relative to the size of the CDM. If the marginal cost of its emission reductions is higher than the market price of CERs the projects will not be economic and they will not be implemented even if they are eligible for the CDM. If the marginal cost of its emission reductions is low relative to the price of CERs and the potential scale is large, it could drive down the price of CERs and displace many other CDM project types. In both cases, financial or other incentives are better than including the option in the CDM.

Numerous new mechanisms, such as no lose targets, sectoral crediting and REDD targets, have been proposed. The mechanisms would differ from the CDM in terms of the process for approving the target and/or issuing the tradable credits, or they would create tradable credits that are not fully fungible with CERs. The operational details of most of these proposed mechanisms remain to be developed. If Parties agree to any of these mechanisms, there would be a need for modalities to define baseline emissions and verify the actual emissions to determine the credits earned.

Questions:

- What are the effects of adding new types of mitigation actions, such as CCS, to the CDM? How do those effects change if the cost per ton of CO₂ reduced is low (high) relative to the market price for CERs?
- What are the effects of adding new project types to the CDM?
- What are the effects of restricting the eligibility of particular host countries or project types?
- How would other crediting mechanisms differ from the CDM?
- What is the effect of a supplementarity requirement for developed countries?

4.2.3 The Adaptation Fund

A share of proceeds, currently 2% of the CERs issued for most projects, is the main source of revenue for the Adaptation Fund. Thus the revenue received by the Adaptation Fund depends mainly on the scale of the CDM. If the post-2012 market for CERs is \$25 to \$100 billion per year, the contribution to the Adaptation Fund would be \$0.5 to \$2 billion annually. This could be increased by increasing the share of proceeds from the current 2%. Further exemptions from the share of proceeds for groups of host countries of categories of

⁶¹ The UNFCCC (2007, p. 140) estimated the revenue to projects registered during 2006 at \$1 to \$1.5 billion and the total investment in those projects at \$7 billion, equivalent to 4.5 to 7 years of revenue. For projects that entered the pipeline during 2006 the corresponding figures are revenue of \$2 to \$2.5 billion and investment of \$26.4 billion or 10.5 to 13 years of revenue. Capoor and Ambrosi (2008, pp. 1 and 3) estimate the primary CER sales at \$7.43 billion and total investment in clean energy projects (not all projects) at \$33 billion, or about 4.5 years of revenue. These figures suggest that the investment is of the same order of magnitude as the sales revenue for the initial crediting period – 7 or 10 years. This means that if total emission reductions are stable, the investment in new projects is of the same magnitude as total sales.

⁶² Almost all of these proposals are being considered under various CMP agenda items or the Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol (AWG-KP). Additional material can be found in the UNFCCC documents for the agenda item or AWG-KP. Background on some of these proposals is also found in the paper: Climate Change Mitigation Negotiations with Emphasis on Developing Countries.

projects would reduce the revenue received by the Adaptation Fund. Proposals to extend the share of proceeds to other mechanisms are discussed below.

Questions:

- How does a change to the share of proceeds affect the Adaptation Fund?
- How does a change to the size of the CDM affect the Adaptation Fund?

4.3 Increased contributions by developed countries

Currently, financial assistance under the Convention relies on voluntary contributions by developed countries (Annex II Parties) to the Convention Funds or through bilateral or multilateral assistance.

4.3.1 New bilateral and multilateral funds

New bilateral and multilateral funds supported by voluntary contributions are being established to address climate change.

Cool Earth Initiative. As part of its Cool Earth Initiative, Japan announced the establishment of a five-year, \$10 billion fund to support efforts in developing countries to combat climate change. The fund will support climate change alleviation policies, adaptation policies for developing countries vulnerable to climate change and support for access to clean energy.

Questions:

- Which countries will be eligible? Will the support be in the form of grants or loans?

International Climate Protection Initiative.⁶³ Germany has decided to use some of the revenue raised from auctioning allowances for its domestic emissions trading scheme for national and international climate initiatives. The international component has a budget of €120 million in 2008 with a smaller allocation in subsequent years. Half of this amount will be used to fund sustainable

energy supply projects. The projects will include both investment and capacity building in emerging, developing and transition economies for improved energy efficiency, renewable energy and fluorocarbon reductions. The other €60 million will support climate change adaptation and measures to conserve climate-relevant biodiversity, mainly through bilateral projects.

Questions:

- Why will future allocations decline, when the share of allowances auctioned is rising?
- How much of the money will go to transition economies?
- Will the support be in the form of grants or loans?
- How is the level of support for a particular project determined?

Climate Investment Funds. The World Bank and regional development banks have established the Climate Investment Funds – the Clean Technology Fund (CTF) and the Strategic Climate Fund (SCF). The CTF is designed to promote scaled up demonstration, deployment and transfer of low-carbon technologies in power sector, transportation, and energy efficiency in buildings, industry and agriculture. The SCF will provide financing to pilot new development approaches or to scale-up activities aimed at a specific climate change challenge through targeted programs. The SCF will pilot national level actions for enhancing climate resilience in a few highly vulnerable countries. Other programs under consideration include: support for energy efficient and renewable energy technologies to increase access to “green” energy in low income countries; and investments to reduce emissions from deforestation and forest degradation through sustainable forest management. The funds have an initial target of \$5 billion. Each fund will be managed by a committee with equal representation from donor and recipient countries.

Questions:

- Which countries will be eligible? What types of projects will be funded?

⁶³ http://www.bmu.de/files/pdfs/allgemein/application/pdf/klimaschutzinitiative_flyer_en.pdf.

Global Climate Financing Mechanism. The European Commission and the World Bank are exploring the possibility of selling a bond and using the funds generated to finance initiatives aimed at helping the poorest developing countries deal with climate change. The concept is to raise money in the capital market to fund critical investments immediately and to repay the bonds from future ODA commitments, carbon linked revenue (such as auctioned allowances for national emissions trading schemes) or from another innovative sources. The GCFM would provide grants for adaptation actions, and possibly mitigation actions that contribute to domestic poverty reduction strategies, in LDCs and SIDS.

Questions:

- What types of adaptation projects will be funded? Who will determine which projects are funded? How will the funding level be determined? What types of mitigation projects will be funded?

4.3.2 Proposals funded by defined contributions from developed countries

Some recent proposals move from voluntary contributions to defined contributions.

Convention Adaptation Fund, Technology Fund and Insurance Mechanism.⁶⁴ The Alliance of Small Island States (AOSIS) has proposed the establishment of a new adaptation fund, a technology fund and an insurance mechanism. The funds would receive revenue from mandatory or assessed contributions from developed countries beyond traditional ODA and levies on carbon markets. Funds would be disbursed as grants rather than loans and Small Islands Developing States (SIDS) and LDCs should be given priority access to the Adaptation Fund. The Technology Fund would focus on accelerating development of renewable energy technologies. The Insurance Mechanism would create a pool of funds to help SIDS manage financial risk from extreme weather events.

Questions:

- What is the proposed formula for the assessed contributions? How would the proposal ensure that the funds are additional to ODA? How would priority for SIDS and LDCs be implemented?

Adaptation Fund and Multilateral Technology Acquisition Fund.⁶⁵ China has proposed that developed countries should contribute 0.5% of GDP for climate change, almost \$170 billion per year.⁶⁶ The funds could come from various sources, including auctioned allowances, in addition to government contributions. The money would go to enhance action on mitigation, adaptation and technology cooperation by establishing specialized funds such as a multilateral technology acquisition fund.

Questions:

- How would the money be divided between adaptation and technology acquisition? Would the technology fund focus on acquisition of proven technologies for mitigation or development and diffusion of new technologies?
- Is the 0.5% for climate change a mandatory or voluntary contribution? If a country's ODA is less than 1.2% of GDP how are the development and climate contributions determined?

Mechanism for Meeting Financial Commitments under the Convention. The G-77 and China have proposed the establishment of a new mechanism for meeting financial commitments under the Convention. The mechanism would be accountable to the COP, which would elect the members of its governing board. The main source of funds would be contributions by Annex II Parties "new and additional" to ODA and set at a level of 0.5% to 1% of their GNP. The mechanism would fund the agreed full incremental costs for the implementation of

mitigation, adaptation, technology deployment and diffusion, and other actions by developing countries.

Questions:

- What principles would be used to divide the money between mitigation, adaptation, technology deployment and diffusion, and other purposes?

Efficiency Penny.⁶⁷ A UN Foundation report on "Realizing the Potential of Energy Efficiency" proposes that G8 countries impose a small surcharge (e.g., 0.5 to 1%, 1 cent per dollar of sales, or 1 cent per unit of consumption) on end-use energy consumption (e.g., electricity, natural gas, and transportation fuels). The "efficiency penny" surcharge would raise about \$20 billion per year in G8 countries (\$8 billion from electricity, \$6 billion from natural gas, and \$6 billion from oil) without significantly affecting macroeconomic conditions. The revenue would be invested in energy efficiency measures with at least 25% of revenue going to energy efficiency policies, programs, and projects in developing and transition economies.

4.3.3 Proposals funded by contributions from developed and developing countries

In some proposals, both developed and developing countries contribute but developing countries are net recipients.

World Climate Change Fund.⁶⁸ Mexico has proposed the establishment of a World Climate Change Fund with revenue of at least \$10 billion per year. The fund would be open to all countries with annual contributions based on agreed criteria such as greenhouse gas emissions, population and GDP. All members could benefit from the fund, although it is expected that developed countries would be net contributors and developing countries would be net beneficiaries. The contributions would be divided among mitigation, adaptation and clean technology as agreed by the members.

Questions:

- Would participation by developed countries be mandatory; as net contributors they have no incentive to join? How will the governance regime ensure that members are able to agree a contribution scale and allocation of money among mitigation, adaptation and technology?
- Would funds be disbursed on a project basis or on a formula basis to member countries?

Multilateral Adaptation Fund.⁶⁹ Switzerland has proposed a global CO₂ levy of \$2/tCO₂. Every country, except those with per capita emissions less than 1.5tCO₂, would impose and collect the tax and forward a part of the revenue to the fund. The tax would generate an estimated \$48.5 billion. Low-, medium- and high-income countries would forward 15%, 35% and 60% respectively of the tax revenue collected. The remaining tax revenue (\$30.1 billion globally) would go into each country's National Climate Change Fund. The tax revenue forwarded to the Multilateral Adaptation Fund (\$18.4 billion) would be divided equally between a prevention pillar and an insurance pillar.

Questions:

- What measures would be supported by the prevention pillar and the insurance pillar? What countries would be eligible for financial support from the prevention pillar and insurance pillar?
- What conditions would be imposed on the National Climate Change Funds?

4.4 More stringent commitments by developed countries

As mentioned above, the scale of the CDM depends, in part, on the stringency of developed country commitments. Other proposals increase the stringency of developed country commitments to raise funds for adaptation, mitigation or technology cooperation.

⁶⁴ http://unfccc.int/files/meetings/ad_hoc_working_groups/lca/application/pdf/barbados_on_behalf_of_aosis.pdf

⁶⁵ http://unfccc.int/files/meetings/ad_hoc_working_groups/lca/application/pdf/china.pdf

⁶⁶ In 2006 ODA by OECD countries amounted to \$104 billion, which amounted to 0.31% of their GNI (about the same as GDP). This means that ODA would need to have been over \$130 billion higher to reach the 0.7% target. At 0.5% the climate change contribution would have been almost \$170 billion. This proposal would require OECD countries to almost quadruple their ODA, which seems very unlikely given the persistent failure to meet the 0.7% target.

⁶⁷ UN Foundation, 2007.

⁶⁸ http://unfccc.int/files/meetings/ad_hoc_working_groups/lca/application/pdf/mexico.pdf

⁶⁹ http://unfccc.int/files/meetings/ad_hoc_working_groups/lca/application/pdf/switzerland.pdf

4.4.1 Auction of Assigned Amount Units

Norway has proposed that a small percentage of the assigned amount units (AAUs)⁷⁰ of each country with an emissions reduction commitment be auctioned to raise revenue for adaptation.⁷¹ This proposal has the effect of making compliance with the national emissions reduction commitments more costly for developed countries. Their emission reduction commitments need to take the form of quantitative limits so that a share of the units can be auctioned.

A target reduction of 25 to 40% from 1990 emissions in 2020 has been suggested for developed countries. That would mean total allowable emissions (assigned amount) by these countries of 10 to 13 billion tons of CO₂-eq/yr. If 2% of that amount were auctioned with an average price of \$25 per tonne, the revenue would be \$5 to \$6.5 billion per year. As national commitments become more stringent the revenue generated falls unless the price rises and/or additional countries adopt commitments.

The Norwegian proposal differs from Germany's voluntary initiative described above. The Norwegian proposal is mandatory for all developed countries. The assigned amount units to be auctioned would not be issued to countries. They would be sold by a financial institution on behalf of the adaptation fund and the revenue would go directly to the fund. Germany is auctioning some of the allowances for its domestic emissions trading scheme. The revenue goes to the German government, which decides how it is to be used.

The European Commission has proposed a transition to auctioning all of the allowances in the EU ETS beginning in 2013 and proposes that member states should use 20% of the revenue for specified "green" purposes including international climate change action. This would be an extension of the German initiative to all European countries. If it were extended to all developed countries with domestic emissions trading schemes it could raise \$6 to \$10 billion per year.⁷²

To be fair extension of the EU proposal to all developed countries would require agreement on domestic emissions trading scheme design including coverage and share of allowances auctioned. Some developed countries, such as Russia and the Ukraine, may not implement a domestic emissions trading scheme, so they would not have any domestic allowances to auction. The share of national emissions covered by the domestic emissions trading scheme varies widely from less than 20% in some European countries to about 90% in New Zealand. The share of allowances auctioned also varies widely from zero in Canada to 100% in all EU schemes by 2020.

Questions:

- If developed countries know that a share of the assigned amount will be auctioned, will they not insist on less stringent commitments?

4.4.2 Nationally appropriate mitigation actions

The Republic of Korea has proposed that developing countries implement Nationally Appropriate Mitigation Actions (NAMA) with technology, financing and capacity-building support from developed countries.⁷³ The verified emission reductions achieved by NAMAs would earn credits that could be used by developed countries for compliance with their commitments. In effect, the NAMAs are a wholesale form of CDM and the rules, modalities and procedures could draw on those for the CDM. To create a demand for NAMA credits, developed countries would commit to more stringent targets. As with the CDM, a share of the proceeds from the sale of NAMA credits could be collected to fund adaptation. No estimate of the potential scale of NAMA reductions is available.

Questions:

- How would NAMAs differ from programmatic CDM? How would NAMAs differ from sectoral CDM? Would NAMA credits be CERs or different units?

⁷⁰ Parties with commitments under the Kyoto Protocol have accepted targets for limiting or reducing emissions. These targets are expressed as levels of allowed emissions, or "assigned amounts," over the 2008-2012 commitment period. The allowed emissions are divided into "assigned amount units" or AAUs equal to one metric tonne of CO₂ equivalent.

⁷¹ http://unfccc.int/files/meetings/ad_hoc_working_groups/lca/application/pdf/norway.pdf.

⁷² Assume that the national emissions commitments total 10 billion tonnes per year for developed countries. Assume that the commitments for countries with domestic emissions trading schemes range from 6 to all 10 billion tonnes. If the domestic emissions trading schemes cover about 40% of the total - 2.4 to 4.0 billion tonnes per year - and half of that amount - 1.2 to 2.0 billion tonnes - is auctioned at an average price of \$25 per tonne it would raise \$30 to \$50 billion and 20% of that would be \$6 to \$10 billion.

⁷³ http://unfccc.int/files/meetings/ad_hoc_working_groups/lca/text/plain/non-paper_from_korea.txt.

- Is implementation of NAMAs by developing countries voluntary? How will it be possible to ensure that developed country commitments are more stringent?

4.5 Other possible sources of funds

Several potential sources of funding that do not depend directly on developed country contributions have been suggested.

Extension of the 2% levy on CDM to other Market Mechanisms.⁷⁴ Some countries have proposed that the 2% share of proceeds collected from most CDM projects for the Adaptation Fund be applied to JI and IET. The UNFCCC estimated that applying a 2% levy to international transfers of units under JI and IET would generate \$10 to 50 million per year for 2008 – 2012.⁷⁵ This compares with its estimate of \$80 to 300 million per year for the levy on the CDM.

The UNFCCC does not provide an estimate for the post-2012 period because trading among countries with commitments will depend on the number of countries with commitments, the type(s) of commitments adopted, the relative stringency of the commitments, and the mitigation cost curves of those countries. The estimates for 2008-2012 are that extension of the levy would increase the revenue by 10 to 20%. The maximum contribution of the 2% levy on the CDM to the Adaptation Fund after 2012 is about \$2 billion per year. Based on the estimates for 2008-2012, extension of the levy to the other mechanisms would increase the post 2012 revenue by at most \$0.5 billion per year.

Another interpretation of the extension of the share of proceeds is to apply the 2% levy to all units issued to developed countries (AAUs and removal units (RMUs), which are units issued for removals by land use, land-use change and forestry (LULUCF) activities such as reforestation).⁷⁶ The quantity of AAUs issued is the country's

assigned amount. Basing the levy on the units issued raises a little more – the quantity of RMUs – revenue than the Norwegian proposal (Section 4.4.1); \$5 to \$6.5 billion per year. This is at least 10 times more than the revenue raised if the levy is applied only to units traded internationally. Thus, it is critically important to understand whether the share of proceeds applies to all units issued or only units traded internationally. Applying the share of proceeds to all units issued does not inhibit trading, but makes the commitment more stringent by the amount of the levy. Applying the share of proceeds to units traded internationally may inhibit international trade. But the levy would be collected primarily from units issued in countries with less stringent commitments; that is, those able to export units.

Questions:

- What are the options for applying the share of proceeds to JI and international emissions trading?

International Air Travel Adaptation Levy. Müller and Hepburn suggest that international air transport emissions be addressed through an international air travel adaptation levy (IATAL) or an emissions trading scheme with auction revenues hypothecated for adaptation (discussed below).⁷⁷ The IATAL is a charge based on the (per capita) flight emissions levied on the ticket price.

Müller and Hepburn suggest that the IATAL levy be set at an average of €5 (2005 \$6.5) per passenger per flight to generate €10 billion (2005 \$13 billion) annually⁷⁸. Air travel is projected to grow at over 4% per year for the next decade, so this mechanism is likely to generate increasing amounts of revenue over time. A levy on passenger tickets would not address the emissions associated with air freight.

Questions:

- How would the IATAL be implemented? How would the money be used? Who bears the cost of the levy?

⁷⁴ This is being considered by the CMP as part of the Article 9 review of the Kyoto Protocol.

⁷⁵ UNFCCC, 2007, Table IX-66, p. 186. All CDM units are transferred internationally. Application of the levy to the units (AAUs, RMUs and Emission Reduction Units (ERUs)) issued to each country has been proposed by Norway and is discussed below.

⁷⁶ ERUs are converted AAUs, so the share of proceeds would be applied only to AAUs and RMUs. ERUs would be exempt since the share of proceeds had already been collected for the AAUs that are converted to ERUs.

⁷⁷ Müller and Hepburn, 2006.

⁷⁸ This proposal is modeled on the 'international solidarity contribution' implemented by France in July 2006. It imposes a levy of €1 on all European economy class flights (€10 in business) and €4 on international economy flights (€40 in business), which is expected to generate revenue of €200 million per annum that will be devoted to fight pandemics, including access to anti-retroviral treatments for HIV/AIDS.

International Maritime Emission Reduction Scheme (IMERS). IMERS would implement a charge on the CO₂ emissions from international shipping based on fuel use.⁷⁹ Ship managers would report fuel use for voyages ended during the previous month. The fees would be collected from the fuel payers, typically charterers.⁸⁰ The fees would go to a fund established under the International Maritime Organization (IMO) and be used to:

- Fund maritime industry GHG improvements;
- Purchase CO₂ credits equal to the actual emissions in excess of an established emissions cap;
- Contribute to climate change adaptation in developing countries.

A fee of \$10 per tonne of CO₂ would raise about \$3 billion annually and raise shipping costs by about 3%. Assuming a market price of \$25 for CERs, about half of the revenue would go to adaptation.

Questions:

- Who would collect the revenue? How would the money be used? Who would bear the cost of the levy?

Auction of Allowances for International Aviation and Marine Emissions. Greenhouse gas emissions associated with international air and marine transport are rising rapidly and are currently not regulated. CO₂ emissions from fuel used for international air and marine transport could be regulated under a post-2012 climate regime in conjunction with the International Civil Aviation Organization and the International Maritime Organization.

An emissions trading scheme similar to IMERS could be established for international shipping. Rather than paying the fee of \$10/tCO₂, fuel payers would be responsible for remitting allowances for the CO₂ emissions from the fuel used. The ship managers and/or fuel suppliers would provide data on fuel use independently. The UNFCCC estimates that auctioning allowances equal to

the projected international marine emissions could generate revenue of \$12 billion in 2010, rising to \$13 billion in 2020.⁸¹

ICAO could implement an emissions trading scheme for international aviation. An emissions cap would be established for the sector. Airlines could use international aviation allowances or other Kyoto units, such as CERs, for compliance. Countries would agree to collect data on fuel sales by airline for international flights and to cooperate with compliance enforcement actions. Each airline would report its CO₂ emissions (based on its fuel use) and remit the necessary allowances and credits annually.⁸² The UNFCCC estimates that auctioning allowances equal to the projected international aviation emissions could generate revenue of \$10 billion in 2010, rising to \$15 billion in 2020.⁸³

Emissions trading schemes for international aviation and shipping could provide special treatment for countries that would be adversely affected, such as small island nations highly dependent on shipping and international tourism. That is very different from exclusion of all developing countries. Such an exclusion would benefit mainly a small number of relatively wealthy countries including Singapore, Dubai, Hong Kong, Malaysia and Thailand. Airlines and shipping companies would increase the prices of their services. The higher costs would be borne mainly by residents of developed countries. If the auction revenue were used for adaptation, developing countries would benefit most.

Questions:

- Is emissions trading technically feasible for international aviation and shipping? Who would bear the cost of the allowances purchased by the airlines/shipping companies?
- Who would benefit most for the use of the funds?

Funds to Invest Foreign Exchange Reserves.⁸⁴

Currently, most foreign exchange reserves are invested in

government, mainly American, treasury bills with low yield and significant exchange risk.⁸⁵ Countries could transfer a small part of their foreign exchange reserves into funds that would invest the money in energy efficiency, renewable energy and other mitigation measures. The investor(s) would establish the policies of the fund such as eligibility of investments and target return on investment. With an appropriate mix of investments it should be possible to maintain the value of the reserves contributed and earn a small return. A fund would provide some diversification in the foreign exchange reserve investments, but would be less liquid than treasury bills. Liquidity is important for foreign exchange reserves, so only a small part of the total, less than 5%, could prudently be contributed to such funds. Global foreign exchange reserves at the end of 2004 totaled \$3,941 billion. Contributing 5% of the reserves to funds would provide capital of \$197 billion.

Questions:

- What are the foreign exchange reserves of your country? How are they invested?
- What would be the advantages and disadvantages of investing a portion of them in a fund that provides low interest loans for energy efficiency and renewable energy?

Access to Renewables Programmes in Developed Countries.⁸⁶

A number of developed countries have programs to promote renewable energy, including feed-in tariffs, renewables obligations and targets with renewable energy certificates. One motivation for these programs is the environmental benefits of renewable energy. Reduction of greenhouse gas emissions is one such benefit.

Recognizing that the climate change mitigation benefits of greenhouse gas emission reductions do not depend on the location of the reductions, such programs could allow a share, say 5%, of the renewable energy supply to be met by sources in developing countries that meet the program requirements. Specifically verified deliveries of power by eligible renewable sources in developing countries would

receive certificates. Entities with compliance obligations under a renewables program could purchase certificates to a maximum of 5% of their compliance obligation. A 5% share of the renewable energy programs in developed countries in 2005 would have provided approximately \$500 million for renewable energy technologies in developing countries.

Questions:

- What types of renewable energy are produced in your country? What are their climate change benefits?

Tobin Tax.⁸⁷ James Tobin proposed a currency transaction tax as a way to enhance the efficacy of national macroeconomic policy and reduce short-term speculative currency flows. While the impact of such a tax on exchange rate volatility continues to be debated, there is a consensus that the tax rate should be 0.1% or lower to minimize the loss of liquidity. Although a currency transaction tax is widely accepted as being technically feasible, how it could best be implemented and enforced is still debated. But the biggest barrier is the global political consensus needed for universal adoption.

Nissanke (2003) assumes that the tax rate would need to be low for both political reasons (to achieve universal adoption) and technical reasons (to minimize market disruption and tax evasion). She estimates that a tax of 0.01% applied to wholesale transactions would generate revenue of 2003 \$15–20 billion.

Donated Special Drawing Rights.⁸⁸ In 2002, Soros and Stiglitz proposed that the International Monetary Fund (IMF) authorize a new form of special drawing rights (SDRs) to meet a share of the estimated cost of meeting the Millennium Development Goals (MDGs). SDRs are a form of intergovernmental currency issued by the IMF to provide supplemental liquidity for member countries. Under the proposal, the IMF would allocate new SDRs to all member countries and developed countries that do not need the additional liquidity would make their new SDRs available to approved international

⁷⁹ Stochniol, 2007.

⁸⁰ Separate emissions limits and fees could be established for different types of ships - container ships, bulk carriers, passenger ships. This would reduce the impact on developing countries since much of their ship traffic (food imports and exports) uses bulk carriers and they are growing more slowly than the total, so the fee for these ships would be lower than that for container ships.

⁸¹ The IMERS and UNFCCC estimates are not consistent. IMERS estimates revenue of about \$3 billion annually for a \$10/tCO₂ charge. The UNFCCC estimates revenue of about \$12 billion for an allowance price of \$23.60. At that price the IMERS estimate corresponds to revenue of about \$7.5 billion per year.

⁸² Other emissions at altitude also have an adverse climate impact, but it is not possible yet to monitor them accurately enough to include them in an emissions trading scheme.

⁸³ UNFCCC, 2007, Annex IV, Table 2, p. 204. These totals would be about 6% higher if a price of \$25 is used.

⁸⁴ UNFCCC, 2007, Annex IV.

⁸⁵ "Some analysts estimate that in local (appreciating) currency terms, the returns from these reserves are close to zero. Given the large reserves-to-GDP ratio of many Asian countries, the current investment strategies could be costing the countries between 1.5 and 2% of GDP each year." ADB, 2007.

⁸⁶ UNFCCC, 2007, Annex IV.

⁸⁷ UNFCCC, 2007, Annex IV.

⁸⁸ UNFCCC, 2007, Annex IV.

non-governmental organizations (NGOs) that would convert them to hard currencies and fund implementation of MDG projects.

A modification of the Soros and Stiglitz proposal could be envisaged to address climate mitigation and/or adaptation. It could be implemented in two stages. First, a special SDR issue of \$27 billion authorized by the IMF in 1997 would be released, of which approximately \$18 billion would be donated. The second stage would see annual issues of SDRs, of which some would be donated for climate mitigation and/or adaptation.

Questions:

- A Tobin Tax and donated Special Drawing Rights have been proposed to finance economic development and poverty alleviation. Are you aware of the reasons these proposals have not been implemented?

Debt-for-clean energy Swap.⁸⁹ Debt swap programs could become a new source of funding for clean energy (renewable energy and energy efficiency) projects. Under a debt swap program creditors negotiate an agreement whereby a portion of the debt owed to them is cancelled in exchange for a commitment by the debtor government to convert the cancelled amount into local currency for investment in clean energy projects.

Since the proceeds from debt swaps are in the local currency, they could be used to pay for imported products. Where other financing can be found to pay for imported clean energy technologies, the proceeds from debt-swap programs could be used to finance recurring local costs.

Questions:

- How much of the outstanding debt of your country is in default? In which countries are the creditors located? Has your country participated in any debt swaps?

4.6 Summary

Clearly, there are many possible options to enhance international investment and financial flows to developing countries. In choosing which of these possible options to adopt, countries may wish to consider:

- The amount of revenue likely to be generated relative to the overall need;
- Whether the option generates funds specifically for mitigation, adaptation or technology cooperation;
- Whether the funds are under the Convention;
- Whether the funds are based on a defined contribution; and
- Whether the funds pass through government budgets, since that could affect the amount contributed to international funds.

Table 6 lists the potential options discussed and provides the above information where it is available.

Questions:

- What is the best combination of options to provide the additional predictable financial and investment flows needed for mitigation, adaptation and technology cooperation on a sustained basis?

Table 6: Summary of the options to enhance international investment and financial flows to developing countries

OPTION	ESTIMATED ANNUAL REVENUE (BILLION \$)	SPECIFIC TO MITIGATION, ADAPTATION OR TECHNOLOGY	UNDER THE CONVENTION	DEFINED CONTRIBUTION	GO THROUGH GOVERNMENT BUDGET
Increasing the Scale of Existing Mechanisms					
The GEF Trust Fund	Currently \$0.25	N	Y	Y	Y
SCCF and LDCF	Currently \$0.10	A	Y	N	Y
The CDM and Other Possible Crediting Mechanisms	Currently \$25 to \$100	M	Y	N	N
The Adaptation Fund	\$0.50 to \$2	A	Y	N	N
New Bilateral and Multilateral Funds					
Cool Earth Initiative	\$2	N	N	N	Y
International Climate Protection Initiative	\$0.15	N	N	Y	Y
Clean Investment Fund	\$1 to \$2	N	N	N	Y
Global Climate Financing Mechanism	\$5 ^a	N	N	N	Y
Proposals Funded by defined Contributions from Developed Countries					
Convention Adaptation Fund, Technology Fund and Insurance Mechanism		N	Y	Y	Y
Adaptation Fund and Multilateral Technology Acquisition Fund	\$170	N	Y	Y	Y
Mechanism for Meeting Financial Commitments under the Convention	\$130 to \$260	N	Y	N	Y
Efficiency Penny	\$20	M	N	Y	Y
Proposals Funded by Contributions from Developed and Developing Countries					
World Climate Change Fund	\$10	N	Y	Y	Y
Multilateral Adaptation Fund	\$18	A	Y	Y	Y
More Stringent Commitments by Developed Countries					
Auction of Assigned Amount Units	\$5	A	Y	Y	N
Nationally Appropriate Mitigation Actions		M	Y	N	N
Other Sources of Funds					
Extension of the 2% levy on CDM to other Market Mechanisms	\$0.5 or \$5	N	Y	Y	N
International Air Travel Adaptation Levy	\$13	A	N	Y	N
International Maritime Emission Reduction Scheme	\$3	N	N	Y	N
Auction of Allowances for International Aviation and Marine Emissions	\$20 to \$40	N	N	N	N
Funds to Invest Foreign Exchange Reserves	Fund of up to \$200	M	N	N	N
Access to Renewables Programs in Developed Countries	\$0.5	M	N	N	N
Tobin Tax	\$15 to \$20	N	N	Y	N
Donated Special Drawing Rights	\$18	N	N	N	N
Debt-for-clean-energy Swap		M	N	N	Y

Note: A = Adaptation, M = Mitigation, N = No, and Y = Yes

a. The total payment to frontload €5 billion over the period of 2010 – 2014 would amount to €7.2 billion. Repayment would start in 2011 at €74 million, gradually rise to €380 million in 2015 and continue at that level until 2031.

⁸⁹ UNFCCC, 2007, Annex IV.

5. GOVERNANCE OF INTERNATIONAL INVESTMENT AND FINANCIAL FLOWS

At present the Convention funds are managed by the GEF with guidance from the Conference of the Parties. Operation of the GEF is directed by the GEF Council, which has different representation and rules of procedure than the COP. The Adaptation Fund has its own Board elected by, under the authority of and accountable to the CMP.

Many of the proposals to enhance the financial resources involve the creation of new funds for specific types of mitigation actions, adaptation needs, and technology development and transfer. Establishment of several new funds could create a need for an umbrella mechanism to coordinate the management of all funds under the Convention. Establishment of new bilateral and multilateral funds outside the Convention could lead to fragmentation and inefficient allocation of resources. Some of the proposals for enhanced funding allow voluntary participation and suggest that the fund be managed by the participants.

In short, a significant increase in the financial resources will raise issues relating to the governance of the funds.⁹⁰ **Governance issues apply both to the funds collected and to the manner in which those funds are disbursed. Governance issues include accountability to the COP, balanced representation of all Parties, transparency, and ease of access to the funding.**

Principles proposed for the collection and disbursement of financial resources under the Convention include equity, common but differentiated responsibility, the polluter-pays principle, adequacy, predictability, sustainability, new and additional funding, grant funding, simplified access and priority access for the most vulnerable countries. Agreeing upon and applying principles appropriate to each fund under the Convention will be a challenge.

Questions:

- What are the strengths of the current governance system for Convention funds? What are the weaknesses of the current governance system for Convention funds?
- What are the advantages/disadvantages of establishing new funds with relatively narrow purposes, such as a fund for REDD or a fund for renewable energy technologies?
- Would the creation of several new funds require the establishment of an umbrella mechanism to coordinate their management?
- How are governance issues best addressed?

⁹⁰ See the report on the workshop on investment and financial flows to address climate change, June 5, 2008. <http://unfccc.int/resource/docs/2008/awglca2/eng/crp03.pdf>.

6. EFFECTIVE DISBURSEMENT OF THE INTERNATIONAL FUNDS

Disbursement of substantially larger amounts for mitigation, adaptation and technology cooperation will raise important delivery issues, including:

- The share of the available funds to be allocated for mitigation, adaptation and technology cooperation;
- Whether the funds are distributed by country or project type;
- Whether funds are distributed for individual projects (like the GEF) or for “national programs”; and
- Whether, or under what conditions, funds can be provided through “direct access”.

How to allocate the available funds will be a major on-going challenge. Funds will need to be allocated among mitigation, adaptation and technology cooperation. The creation of separate funds with dedicated revenue sources may appear to address this issue. But the assignment of dedicated revenue sources is really an allocation of funds. And if one fund has a persistent surplus while another is continuously unable to fund proposed actions, the assignment of revenue sources will need to be reviewed.

The allocation of funds among mitigation, adaptation and technology cooperation is ultimately a political decision and will fall to the COP. However, an umbrella mechanism to coordinate the management of all funds under the Convention could provide advice to the COP.⁹¹

Within a given objective – mitigation, adaptation, technology cooperation – **funds will need to be allocated among different purposes.** Mitigation spending might need to be divided among CCS, REDD and several other types of mitigation actions. Adaptation spending might need to be divided among provision of health care, support for irrigation systems, coastal protection, reduction of the impacts of extreme weather events, etc. Technology funds may need to be split among cooperative research, demonstration projects, diffusion of available technologies, etc. Every allocation decision will implicitly involve a regional distribution of spending. The regional distribution of projects is a perennial issue for the CDM.

Every allocation decision will implicitly have a temporal dimension as well. Allocating funds for technology research means less money is available for diffusion of available technologies. Possible current mitigation efforts are sacrificed for, hopefully, larger future benefits. Funding

measures to reduce the impacts of extreme weather events should yield savings in the future, but it may reduce the money available to deal with immediate health care needs. These implicit choices cannot be avoided.

Fundamentally, the mitigation, adaptation and technology funds can be disbursed by country or by project type, or a combination of the two. To the extent that the funds are disbursed on the basis of the project type, the relevant Convention bodies must establish priorities and so implicitly or explicitly address regional and temporal equity. To the extent that the funds are disbursed by country, regional equity is explicitly addressed and project priorities and their temporal equity are delegated to the national government. Governments routinely face similar decisions. If the population disagreed with the decisions, it may lead to a change of government.

A country allocation may not be appropriate for mitigation and technology cooperation because those funding decisions have global consequences. A country allocation might be appropriate for adaptation since adaptation needs are local and an integral part of sustainable development. But it requires a basis for determining the country allocations that fairly reflects their needs.

The Bali Action Plan indicates that developing countries that are particularly vulnerable to the adverse effects of climate change, include the LDCs, SIDS and countries in Africa affected by drought, desertification and floods. More specific criteria are likely to be needed because some SIDS are quite rich and some relatively poor vulnerable countries would be excluded. The adverse reaction of many developing countries to the “pre-set criteria for country allocation” established through the resource allocation framework by the GEF attests to the difficulty of establishing such criteria.

Regardless of how funds are allocated, **disbursement could be on a project basis or a program basis.** A project approach enables each proposed project to be reviewed carefully, but it each project takes a long time to process and incurs high administrative costs. A program approach reduces the administrative costs, but may provide funding for some less cost-effective actions.

How available funds are delivered will need to change if the scale of funding increases significantly. At present,

⁹¹ See the report on the workshop on investment and financial flows to address climate change, June 5, 2008. <http://unfccc.int/resource/docs/2008/awglca2/eng/crp03.pdf>.

mitigation projects, whether through the CDM or Convention funds, are approved on a project-by-project basis. The process is costly and cumbersome, thus provoking calls for changes to administration of the CDM. Changes that would reduce the administrative burden for individual projects and changes, such as sectoral CDM, that would enable much larger reductions to be approved by a single decision.

Adaptation likewise is implemented on a project-by-project basis. The number of projects is still small because the funds are limited and few countries have established their adaptation needs and priorities. If funds are allocated to countries, approval could be based on proposed plans. If funds are disbursed for different purposes, suitable cost-sharing arrangements may be needed. The cost-sharing arrangements are likely to differ for coastal protection, health care, and other purposes. But predictable cost-sharing arrangements would enable national governments and international agencies to prepare and execute implementation plans.

The difficulty with the program approach is that the implementing agency or the national government must have some basis for establishing priorities for measures to be funded. Some countries have NAPAs, but they identify only “urgent” adaptation actions and do not address sectors/program needs. Some countries have Technology Needs Assessments, but they do not specify the specific actions or the scale of the actions needed by technology. In short, few if any countries currently have the information needed to support a program approach to mitigation, adaptation or technology cooperation internationally or on a country basis.

The issue of **direct access** is directly correlated to the issue of a project or programmatic approach as well as capacity for budgetary planning and for budget assistance. Under the GEF projects require an approved implementing agency; a country cannot access funds from the GEF directly. The Adaptation Fund allows developing countries to submit project proposals directly. Direct access to funds under the Convention is an important issue for developing countries.⁹²

Bangladesh is proposing establishment of a multi-donor climate fund to promote climate adaptation and mitiga-

tion in Bangladesh. The fund would pool contributions from various donors to support climate mitigation and adaptation activities in the country over a number of years. Priorities would be negotiated between Bangladesh and the fund’s contributors. The fund would promote robust fiduciary management, donor harmonization, lower transaction costs, efficiency and cost effectiveness.

Questions:

- How are mitigation and adaptation projects approved at the present time? Will this need to change if significantly more resources are available for those purposes? Why?
- What are the options for disbursing funds? Which option do you think is better for mitigation? For adaptation? For technology? Is one of these options better suited to your country’s capacity?

7. CONCLUSIONS

The Convention, the Kyoto Protocol and a post-2012 agreement foresee financial assistance from developed country Parties to developing country Parties. Developing country Parties will need financial assistance for mitigation, adaptation and technology cooperation. The exact amount of assistance needed for each of these purposes is not known, but it could amount to tens of billions of dollars per year.

The **CDM**, and possible new market mechanisms, could supply a substantial part of the funding needed for renewables and non-CO₂ emission reduction measures in developing countries under a post-2012 agreement. The ability of programmatic CDM to stimulate large energy efficiency projects remains to be determined. It may be better to provide direct financial support for measures whose marginal cost is substantially above or below the price of CERs and whose scale of the potential reductions is large, such as CCS and REDD emission reductions, to avoid disrupting the market.

Some **potential new sources** of funding are better suited to mitigation. These include access to renewables programs in developed countries, debt-for-clean-energy swaps, and funds to invest foreign exchange reserves (due to the need to earn a return on the funds).

Most of the contributions to the **GEF** Trust Fund for the climate change focal area have been allocated to long-term mitigation projects. Mitigation actions can more easily meet the GEF requirement of delivering global environmental benefits. The Resource Allocation Framework determines the funds available to each eligible country, but the funds allocated to a particular country may not be sufficient to support its commitments under the Convention.

Most of the funding for adaptation under the Convention consists of voluntary contributions to the LDCF and SCCF. The LDCF supports the immediate adaptation needs of the LDCs. The SCCF Program for Adaptation supports adaptation projects in all developing countries, including LDCs. The Adaptation Fund provides funding

for concrete adaptation projects and programs in developing country Parties to the Protocol. It is financed by a share of proceeds equal to 2% of CERs issued for CDM projects with exemptions for some project types.

The SCCF Program for Transfer of Technology is the only mechanism that supports technology cooperation.

The funds likely to be available through these mechanisms are likely to be far less than the needs, especially for adaptation and possibly for technology cooperation. Several options for increasing the financial support provided by developed countries have been proposed. Some continue to rely on voluntary contributions, while others propose defined contributions. Although, some of the proposals focus on mitigation, they could be used to raise finance adaptation and/or technology cooperation as well.

Potential sources of funding that do not depend on developed country contributions are also available. Some, such as the Tobin tax and donated SDRs were proposed for other purposes but have not been adopted, so the prospect of their being implemented to fund climate change appears slim. Extension of the CDM levy to the other mechanisms is feasible, but the amount of revenue raised depends on whether the levy is applied to the units issued or those traded internationally. Revenue can also be raised from international aviation and shipping, either through a tax or through regulation of their emissions.⁹³ Those options could generate funds on the scale likely to be needed.

Ensuring adequate, predictable and sustainable financial resources for mitigation, adaptation and technology cooperation will be an essential component of a post-2012 agreement. That is likely to require agreement on a mix of investment and financial flows including:

- *Increased funding for the financial mechanism of the Convention.* The fourth review of the financial mechanism will inform the fifth replenishment of the GEF. Those funds will be disbursed over four years beginning in 2011.

⁹² See, for example, the presentation by Philippines on behalf of the G&G and China available at: http://unfccc.int/files/meetings/ad_hoc_working_groups/lca/application/pdf/philippines.pdf.

⁹³ Emissions by international aviation and shipping (bunkers) are larger, and growing more rapidly, than those of most countries. Under the Convention Parties are responsible for the emissions that occur over their territory, hence international aviation and marine emissions are international emissions not developed or developing country emissions. All measures to raise revenue based on international aviation and marine emissions will collect most of the revenue from residents of industrialized countries. Almost all of the revenue raised will benefit residents of developing countries. The revenue flows are a better way to address the principle of common but differentiated responsibilities than efforts to apportion “responsibility” for international emissions. Some developing country economies may be adversely affected by measures to raise revenue based on international aviation and marine emissions. It should be possible to design the measures to reduce such adverse economic impacts, such as implementing the IMERS levy separately for different categories of vessels, or to accompany them with economic adjustment measures.

- *More stringent commitments by Annex I Parties to generate additional demand for credits from the CDM and possibly other mechanism.* Changes to the eligible project types and crediting mechanisms may be required to increase the supply of credits.
- *New sources of funds for mitigation, adaptation and technology co-operation.* Several options for new funds on the scale needed are available. They need to be assessed in terms of their political acceptability and their ability to provide predictable financial and investment flows on a sustained basis.

Raising substantial additional funds for mitigation, adaptation, and technology cooperation will give rise to important governance and delivery issues that will need to be addressed if the funds are to be used effectively.

BIBLIOGRAPHY

- ADB (Asian Development Bank), 2007. *Toward a New Asia Development Bank in a New Asia: Report of the Eminent Persons Group to The President of the Asian Development Bank*, Asian Development Bank, Manila.
- Adaptation Fund Board, 2008. *Report of the Second Meeting of the Adaptation Fund Board*, AFB/B.2/16. The Adaptation Fund, June 19, 2008. http://www.adaptation-fund.org/images/Report_of_the_Second_Meeting_of_the_Adaptation_Fund_Board_06.19.08.pdf. Access July 2008.
- Capoor, K. and P. Ambrosi, 2008. *State and Trends of the Carbon Market 2008*, World Bank, Washington, D.C., May. http://carbonfinance.org/docs/State_Trends_formatted_06_May_10_pm.pdf. Access July 2008.
- Fenhann, J., 2008. *The CDM Pipeline*, UNEP Risk Centre, April 1, 2008. <http://cdmpipeline.org/>. Access July 2008.
- GEF, 2004. *Programming to implement the guidance for the Special Climate Change Fund adopted by the Conference of the Parties to the United Nations Framework Convention on Climate Change at its Ninth Session*. GEF/C.24/12. http://thegef.org/Documents/Council_Documents/GEF_C24/C.24.12_Summary_FINAL.doc. Access July 2008.
- GEF, 2005a. *Overview of burden-sharing for GEF Replenishments*, GEF/R.4/14.
- GEF, 2005b. *Implementing the GEF Resource Allocation Framework*, GEF/C.27/5/Rev.1. http://thegef.org/Documents/Council_Documents/GEF_C27/C.27.5.Rev.1_Implementing_the_RAF.pdf. Access July 2008.
- GEF, 2008a. *Status Report on the Climate Change Funds as of March 4, 2008, (Report from the Trustee)*, GEF/LDCF.SCCF.4/Inf.2, March 20, 2008. http://www.thegef.org/uploadedFiles/Documents/LDCFSCCF_Council_Documents/LDCFSCCF4_April_2008/LDCF_SCCF.4.Inf.2%20Trustee%20Status%20Report%2003.21.08.pdf. Access July 2008.
- GEF, 2008b. *Progress Report on the Least Developed Countries Fund (LDCF) and the Special Climate Change Fund (SCCF)*, GEF/LDCF.SCCF.4/Inf.3, March 20, 2008. http://www.thegef.org/uploaded-Files/Documents/LDCFSCCF_Council_Documents/LDCFSCCF4_April_2008/LDCF_SCCF.4.Inf.3%20Progress%20Report%2003.21.08.pdf. Access July 2008.
- Müller, Benito and Cameron Hepburn, 2006. *IATAL — an outline proposal for an International Air Travel Adaptation Levy*, Oxford Institute for Energy Studies, EV 36, Oxford, UK, October 2006, www.OxfordClimatePolicy.org. Access July 2008.
- Nissanke, M., 2003. *“Revenue Potential of the Tobin Tax for Development Finance: A Critical Appraisal,”* School of Oriental and African Studies, University of London, London.
- Oxfam, 2007. *“Financing adaptation: why the UN’s Bali Climate Conference must mandate the search for new funds,”* Oxfam Briefing Notes, 4 December 2007. http://www.oxfam.org.uk/resources/policy/climate_change/downloads/bn_bali_adaptation.pdf. Access July 2008.
- Seres, S., 2007. *Analysis of Technology Transfer in CDM Projects*, UNFCCC Secretariat, Bonn. <http://cdm.unfccc.int/Reference/Reports/TReport/report1207.pdf>. Access July 2008.
- Soros, G. and J. Stiglitz, 2002. *Soros on Globalization, Appendix on special drawing rights proposal*. New York & London.
- UNDP, 2007. *Human Development Report 2007/2008: Fighting climate change. Human solidarity in a divided world*. UNDP, New York. <http://hdr.undp.org/en/reports/global/hdr2007-2008/>. Access July 2008.
- UNFCCC, 2007. *Investment and Financial Flows to Address Climate Change*, UNFCCC, Bonn.
- UN Foundation, 2007. *Realizing the Potential of Energy Efficiency*, UN Foundation, Washington, D.C. http://www.unfoundation.org/files/pdf/2007/Realizing_the_Potential_Energy_Efficiency_full.pdf. Access July 2008.
- World Bank, 2006. *Clean Energy and Development: Towards an Investment Framework*. DC2006-0002, World Bank, Washington, DC, USA.

ANNEXES

Annex 1: COP decisions

Annex 1.1 COP decisions related to financial mechanisms

ISSUE	DECISIONS	PROVISIONS
COP 13 (Bali, 2007)	Decision 6/CP.13	Fourth review of the financial mechanism
	Decision 7/CP.13	Additional guidance to the Global Environment Facility
COP 12 (Nairobi 2006)	Decision 1/CP.12	Further guidance to an entity entrusted with the operation of the financial mechanism of the Convention, for the operation of the Special Climate Change Fund
	Decision 2/CP.12	Review of the financial mechanism
	Decision 3/CP.12	Additional guidance to the Global Environment Facility
COP 11 (Montreal, 2005)	Decision 3/CP.11	Further guidance for the operation of the Least Developed Countries Fund
	Decision 5/CP.11	Additional guidance to an operating entity of the financial mechanism
COP 10 (Buenos Aires, 2004)	Decision 8/CP.10	Additional guidance to an operating entity of the financial mechanism
	Decision 9/CP.10	Assessment of funding to assist developing countries in fulfilling their commitments under the Convention
COP 9 (Milan, 2003)	Decision 4/CP.9	Additional guidance to an operating entity of the financial mechanism
	Decision 5/CP.9	Further guidance to an entity entrusted with the operation of the financial mechanism of the Convention, for the operation of the Special Climate Change Fund
	Decision 6/CP.9	Further guidance for the operation of the Least Developed Countries Fund
COP 8 (New Delhi, 2002)	Decision 5/CP.8	Review of the financial mechanism
	Decision 6/CP.8	Additional guidance to an operating entity of the financial mechanism
	Decision 7/CP.8	Initial guidance to an entity entrusted with the operation of the financial mechanism of the Convention, for the operation of the Special Climate Change Fund
	Decision 8/CP.8	Guidance to an entity entrusted with the operation of the financial mechanism of the Convention, for the operation of the Least Developed Countries Fund
COP 7 (Marrakech, 2001)	Decision 4/CP.7	Development and transfer of technologies (decisions 4/CP.4 and 9/CP.5)
	Decision 5/CP.7	Implementation of Article 4, paragraphs 8 and 9, of the Convention (decision 3/CP.3 and Article 2, paragraph 3, and Article 3, paragraph 14, of the Kyoto Protocol)
	Decision 6/CP.7	Additional guidance to an operating entity of the financial mechanism
	Decision 7/CP.7	Funding under the Convention
	Decision 10/CP.7	Funding under the Kyoto Protocol
	Decision 17/CP.7	Modalities and procedures for a clean development mechanism, as defined in Article 12 of the Kyoto Protocol paragraph 15 and paragraph 66 of the annex
	Decision 27/CP.7	Guidance to an entity entrusted with the operation of the financial mechanism of the Convention, for the operation of the least developed countries fund
Decision 28/CP.7	Guidelines for the preparation of national adaptation programs of action	
COP 5 (Bonn, 1999)	Decision 9/CP.5	Development and transfer of technologies: status of the consultative process
COP 4 (Buenos Aires, 1998)	Decision 2/CP.4	Additional guidance to the operating entity of the financial mechanism
	Decision 3/CP.4	Review of the financial mechanism
COP 3 (Kyoto, 1997)	Decision 11/CP.3	Review of the financial mechanism
	Decision 12/CP.3	Annex to the Memorandum of Understanding on the determination of funding necessary and available for the implementation of the Convention

ISSUE	DECISIONS	PROVISIONS
COP 2 (Geneva, 1996)	Decision 3/CP.2	Secretariat activities relating to technical and financial support to Parties
	Decision 11/CP.2	Guidance to the Global Environment Facility
	Decision 12/CP.2	Memorandum of Understanding between the Conference of the Parties and the Council of the Global Environment Facility
	Decision 13/CP.2	Memorandum of Understanding between the Conference of the Parties and the Council of the Global Environment Facility: annex on the determination of funding necessary and available for the implementation of the Convention
COP 1 (Berlin, 1995)	Decision 9/CP.1	Maintenance of the interim arrangements referred to in Article 21, paragraph 3, of the Convention
	Decision 10/CP.1	Arrangements between the Conference of the Parties and the operating entity or entities of the financial mechanism
	Decision 11/CP.1	Initial guidance on policies, program priorities and eligibility criteria to the operating entity or entities of the financial mechanism
	Decision 12/CP.1	Report of the Global Environment Facility to the Conference of the Parties on the development of an operational strategy and on initial activities in the field of climate change
	Decision 15/CP.1	Financial procedures
	Other Action Taken By The Conference Of The Parties (b)	Provision to developing country Parties of technical and financial support

Annex 1.2 COP and CMP decisions related to the Adaptation Fund

ISSUE	DECISIONS	PROVISIONS
CMP 3 (Bali 2007)	Decision 1/CMP.3	Advance version: Adaptation Fund
CMP 2 (Nairobi 2006)	Decision 5/CMP.2	Adaptation Fund
CMP 1 (Montreal 2005)	Decision 28/CMP.1	Initial guidance to an entity entrusted with the operation of the financial mechanism of the Convention, for the operation of the Adaptation Fund
	Decision 3/CMP.1	Modalities and procedures for a clean development mechanism, as defined in Article 12 of the Kyoto Protocol, paragraph 1
COP 7 (Marrakech, 2001)	Decision 17/CP.7	Modalities and procedures for a clean development mechanism, as defined in Article 12 of the Kyoto Protocol (see paragraphs 15 and 66 of the annex)
	Decision 10/CP.7	Funding under the Kyoto Protocol
	Decision 5/CP.7	Implementation of Article 4, paragraphs 8 and 9, of the Convention (decision 3/CP.3 and Article 2, paragraph 3, and Article 3, paragraph 14, of the Kyoto Protocol)

Annex 1.3 CMP decisions related to CDM

ISSUE	DECISIONS	PROVISIONS
CMP 3 (Bali 2007)	Decision 2/CMP.3	Further guidance relating to the clean development mechanism
	Decision 9/CMP.3	Implications of possible changes to the limit for small-scale afforestation and reforestation clean development mechanism project activities
CMP 2 (Nairobi 2006)	Decision 1/CMP.2	Further guidance relating to the clean development mechanism
CMP 1 (Montreal 2005)	Decision 2/CMP.1	Principles, nature and scope of the mechanisms pursuant to Articles 6, 12 and 17 of the Kyoto Protocol
	Decision 3/CMP.1	Modalities and procedures for a clean development mechanism, as defined in Article 12 of the Kyoto Protocol
	Decision 4/CMP.1	Guidance relating to the clean development mechanism
	Decision 5/CMP.1	Modalities and procedures for afforestation and reforestation project activities under the clean development mechanism in the first commitment period of the Kyoto Protocol
	Decision 6/CMP.1	Simplified modalities and procedures for small-scale afforestation and reforestation project activities under the clean development mechanism in the first commitment period of the Kyoto Protocol and measures to facilitate their implementation
	Decision 7/CMP.1	Further guidance relating to the clean development mechanism
	Decision 8/CMP.1	Implications of the establishment of new hydrochlorofluorocarbon-22 (HCFC-22) facilities seeking to obtain certified emission reductions for the destruction of hydrofluorocarbon-23 (HFC-23)

Annex 2. Glossary

TERM	DEFINITION
Adaptation	Adjustment in natural or human systems to a new or changing environment. Adaptation to climate change refers to adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation.
Asian Development Bank (ADB)	ADB is an international development finance institution whose mission is to help its developing member countries reduce poverty and improve the quality of life of their people. Headquartered in Manila, and established in 1966, ADB is owned and financed by its 67 members, of which 48 are from the region and 19 are from other parts of the globe. ADB's main partners are governments, the private sector, nongovernment organizations, development agencies, community-based organizations, and foundations.
Annex I Parties	Industrialized countries.
Annex II Parties	Industrialized countries that pay for costs in developing countries.
Alliance of Small Island States (AOSIS)	The AOSIS is a coalition of small island and low-lying coastal countries that share similar development challenges and concerns about the environment, especially their vulnerability to the adverse effects of global climate change. It functions primarily as an ad hoc lobby and negotiating voice for small island developing States (SIDS) within the United Nations system.
Bali Action Plan	The United Nations climate change conference in Bali culminated in the adoption of the Bali Road Map, which consists of a number of forward-looking decisions that represent the various tracks that are essential to reaching a secure climate future. The Bali Road Map includes the Bali Action Plan, which charts the course for a new negotiating process designed to tackle climate change, with the aim of completing this by 2009. It also includes the AWG-KP negotiations and their 2009 deadline, the launch of the Adaptation Fund, the scope and content of the Article 9 review of the Kyoto Protocol, as well as decisions on technology transfer and on reducing emissions from deforestation.
Capacity building	Increasing skilled personnel and technical and institutional abilities.
Capture and storage (CCS)	CO ₂ is already being captured in the oil and gas and chemical industries. Several plants capture CO ₂ from power station flue gases for use in the food industry. However, only a fraction of the CO ₂ in the flue gas stream is captured.
Clean Development Mechanism (CDM)	Defined in Article 12 of the Kyoto Protocol, the CDM is intended to meet two objectives: (1) to assist parties not included in Annex I in achieving sustainable development and in contributing to the ultimate objective of the convention; and (2) to assist parties included in Annex I in achieving compliance with their quantified emission limitation and reduction commitments. Certified Emission Reduction Units from CDM projects undertaken in NA1 countries that limit or reduce GHG emissions, when certified by operational entities designated by Conference of the Parties / Meeting of the Parties, can be accrued to the investor (government or industry) from parties in Annex B. A share of the proceeds from certified project activities is used to cover administrative expenses as well as to assist developing country parties that are particularly vulnerable to the adverse effects of climate change to meet the costs of adaptation.
Certified emission reductions (CERs)	A Kyoto Protocol unit equal to 1 metric tonne of CO ₂ -eq. CERs are issued for emission reductions from CDM project activities. Two special types of CERs called temporary certified emission reduction (tCERs) and long-term certified emission reductions (lCERs) are issued for emission removals from afforestation and reforestation CDM projects.
Climate	Climate in a narrow sense is usually defined as the 'average weather', or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years. These quantities are most often surface variables such as temperature, precipitation, and wind. Climate in a wider sense is the state, including a statistical description, of the climate system. The classical period of time is 30 years, as defined by the World Meteorological Organization (WMO).

TERM	DEFINITION
Climate Change	Climate change refers to a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land use. Note that UNFCCC, in its Article 1, defines "climate change" as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods". The UNFCCC thus makes a distinction between "climate change" attributable to human activities altering the atmospheric composition, and "climate variability" attributable to natural causes.
Conference of the Parties serving as the meeting of the Parties (CMP)	The Convention's supreme body is the COP, which serves as the meeting of the Parties to the Kyoto Protocol. The sessions of the COP and the CMP are held during the same period to reduce costs and improve coordination between the Convention and the Protocol.
Conference of the Parties (COP)	The supreme body of the Convention. It currently meets once a year to review the Convention's progress. The word "conference" is not used here in the sense of "meeting" but rather of "association," which explains the seemingly redundant expression "fourth session of the Conference of the Parties."
Deforestation	Conversion of forest to non-forest. For a discussion of the term forest and related terms such as afforestation, reforestation, and deforestation, see the Intergovernmental Panel on Climate Change (IPCC) Special Report on Land Use, Land-Use Change, and Forestry (IPCC, 2000).
Dynamic interactive vulnerability analysis (DIVA)	DIVA is a tool for integrated assessment of coastal zones. It is specifically designed to explore the vulnerability of coastal areas to sea level rise. It comprises a global database of natural system and socioeconomic factors, relevant scenarios, a set of impact-adaptation algorithms and a customized graphical-user interface. Factors that are considered include erosion, flooding salinization and wetland loss. DIVA is inspired by the paper-based Global Vulnerability Assessment, but it represents a fundamental improvement in terms of data, factors considered (which include adaptation) and use of PC technology.
Designated operational entity (DOE)	A Designated Operational Entity under the CDM is either a domestic legal entity or an international organization accredited and designated, on a provisional basis until confirmed by the CMP, by the Executive Board. It has two key functions: 1. It validates and subsequently requests registration of a proposed CDM project activity which will be considered valid after 8 weeks if no request for review was made. 2. It verifies emission reduction of a registered CDM project activity, certifies as appropriate and requests the Board to issue Certified Emission Reductions accordingly. The issuance will be considered final 15 days after the request is made unless a request of review is made.
Emission	In the climate change context, emissions refer to the release of greenhouse gases and/or their precursors and aerosols into the atmosphere over a specified area and period of time.
Energy efficiency	Ratio of energy output of a conversion process or of a system to its energy input.
Fossil fuels	Carbon-based fuels from fossil carbon deposits, including coal, oil, and natural gas.
Global Environment Facility (GEF)	Established in 1991, the GEF helps developing countries fund projects and programs that protect the global environment. GEF grants support projects related to biodiversity, climate change, international waters, land degradation, the ozone layer, and persistent organic pollutants. GEF is an independent financial organization that provides grants to developing countries for projects that benefit the global environment and promote sustainable livelihoods in local communities.
Greenhouse gas	A gas that absorbs radiation at specific wavelengths within the spectrum of radiation (infrared radiation) emitted by the Earth's surface and by clouds. The gas in turn emits infrared radiation from a level where the temperature is colder than the surface. The net effect is a local trapping of part of the absorbed energy and a tendency to warm the planetary surface. Water vapor (H ₂ O), carbon dioxide (CO ₂), nitrous oxide (N ₂ O), methane (CH ₄) and ozone (O ₃) are the primary greenhouse gases in the Earth's atmosphere.
Intergovernmental Panel on Climate Change (IPCC)	Established in 1988 by the World Meteorological Organization and the UN Environment Program, the IPCC surveys world-wide scientific and technical literature and publishes assessment reports that are widely recognized as the most credible existing sources of information on climate change. The IPCC also works on methodologies and responds to specific requests from the Convention's subsidiary bodies. The IPCC is independent of the Convention.
International Monetary Fund (IMF)	The IMF is an international organization of 185 member countries. It was established to promote international monetary cooperation, exchange stability, and orderly exchange arrangements; to foster economic growth and high levels of employment; and to provide temporary financial assistance to countries to help ease balance of payments adjustment.

TERM	DEFINITION
International Maritime Organization (IMO)	The Convention establishing the International Maritime Organization was adopted in Geneva in 1948 and IMO first met in 1959. IMO's main task has been to develop and maintain a comprehensive regulatory framework for shipping and its remit today includes safety, environmental concerns, legal matters, technical co-operation, maritime security and the efficiency of shipping.
International Emissions Trading (IET)	International Emissions Trading (Article 17 of the Kyoto Protocol) specifies that Annex I countries be allowed to trade assigned amount units (AAUs) with each other. Through emissions trading, an environmental (quantitative) target with a defined absolute upper load limit is to be achieved at minimum cost. Emitters will be assigned an emissions limit and receive permission to emit the specified emission quantity. The emitters receive certificates for the permitted amount of emissions. Emitters who want to emit amounts exceeding the assigned amount must obtain an additional certificate for each additional emissions unit. These can be purchased from other emitters who do not use up all the certificates assigned to them. Through the trading mechanism, a market price for the emissions certificates is established which reflects the costs of emission reduction. Each emitter can decide whether it is cheaper to reduce emissions through reduction measures or to purchase certificates for the generated emissions.
Investment	Investment from the perspective of the domestic economy is the purchase of capital equipment, e.g., machines and computers, and the construction of fixed capital, e.g., factories, roads, housing, that serve to raise the level of output in the future. From the perspective of an individual, investment is expenditure, usually on a financial asset, designed to increase the individual's future wealth.
Joint Implementation (JI)	Under Joint Implementation (Article 6 of the Kyoto Protocol) an Annex I country or an authorized institution or enterprise from an Annex I country A participates in an emission reducing project in another Annex I country B. Country A receives a certain amount of the resulting Emission Reduction Units (ERUs).
Least Developed Countries Fund (LDCF)	The LDCF was established to support a work program to assist Least Developed Country Parties (LDCs) carry out, inter alia, the preparation and implementation of NAPAs. The GEF, as the entity that operates the financial mechanism, has been entrusted to operate this fund.
Millennium Development Goals (MDGs)	The eight Millennium Development Goals – which range from halving extreme poverty to halting the spread of HIV/AIDS and providing universal primary education, all by the target date of 2015 – form a blueprint agreed to by all the world's countries and all the world's leading development institutions.
Mitigation	An anthropogenic intervention to reduce the sources or enhance the sinks of GHG.
National adaptation plans of action (NAPA)	Documents prepared by least developed countries identifying urgent and immediate needs for adapting to climate change. The NAPAs are then presented to the international donor community for support.
Non-governmental organizations (NGOs)	Organizations that are not part of a governmental structure. They include environmental groups, research institutions, business groups, and associations of urban and local governments. Many NGOs attend climate talks as observers. To be accredited to attend meetings under the Convention, NGOs must be non-profit.
Renewables, Renewable Energy	Energy sources that are, within a short time frame relative to the Earth's natural cycles, sustainable, and include non-carbon technologies such as solar energy, hydropower, wind, and biomass.
Research, development and demonstration (RD&D)	Scientific and/or technical research and development of new production processes or products, coupled with analysis and measures that provide information to potential users regarding the application of the new product or process; demonstration tests; and feasibility of applying these products processes via pilot plants and other pre-commercial applications.
Resource allocation framework (RAF)	In September 2005, the Global Environment Facility Council adopted the Resource Allocation Framework, a new system for allocating GEF resources to recipient countries to increase the impact of GEF funding on the global environment. The RAF allocates resources to countries based on each country's potential to generate global environmental benefits and its capacity, policies and practices to successfully implement GEF projects. As such, the RAF builds on GEF's existing country-driven approach and partnerships with Implementing and Executing Agencies, and provides countries with increased predictability in the allocation of GEF funds.
Sink	Any process, activity or mechanism that removes a greenhouse gas, an aerosol, or a precursor of a greenhouse gas or aerosol from the atmosphere.

TERM	DEFINITION
Special Climate Change Fund (SCCF)	The SCCF under the Convention was established in 2001 to finance projects relating to adaptation; technology transfer and capacity building; energy, transport, industry, agriculture, forestry and waste management; and economic diversification. This fund should complement other funding mechanisms for the implementation of the Convention. The GEF, as the entity that operates the financial mechanism, has been entrusted to operate this fund. The GEF Council approved a proposed program outlining plans to utilize SCCF resources in document GEF/C.24/12 "Programming to implement the guidance for the SCCF adopted by the COP to the UNFCCC at its ninth session".
Special drawing rights (SDRs)	The SDR is an international reserve asset, created by the IMF in 1969 to supplement the existing official reserves of member countries. SDRs are allocated to member countries in proportion to their IMF quotas. The SDR also serves as the unit of account of the IMF and some other international organizations. Its value is based on a basket of key international currencies.
Sustainable development	Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.
United Nations Framework Convention on Climate Change (the Convention) (UNFCCC)	The Convention was adopted on 9 May 1992, in New York, and signed at the 1992 Earth Summit in Rio de Janeiro by more than 150 countries and the European Community. Its ultimate objective is the 'stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system'. It contains commitments for all Parties. Under the Convention, Parties included in Annex I aim to return greenhouse gas emissions not controlled by the Montreal Protocol to 1990 levels by the year 2000. The Convention entered in force in March 1994.

MITIGATION TECHNOLOGY CHALLENGES: CONSIDERATIONS FOR NATIONAL POLICY MAKERS TO ADDRESS CLIMATE CHANGE

MARTINA CHIDIAC AND DENNIS TIRPAK

CONTENTS

Acronyms	213
Units and measurements	213
Foreword	214
1. Introduction	215
2. Mitigation options and costs	217
3. Trends in clean technology financing	221
4. Key technologies – consideration of issues relating to their development and deployment in developing countries	225
4.1 The research, development, demonstration, and deployment cycle	225
4.2 Deployment	227
4.3 Fossil fuel power generation	228
4.4 Biomass and bioenergy	230
4.5 Wind power	231
4.6 Buildings and appliances	233
4.7 Electricity transmission and distribution	234
4.8 Transport	235
5. Some issues relating to an international agreement	236
Bibliography	238
Annexes	239
Annex 1. Main mitigation technologies per economic sector	239
Annex 2. COP decisions related to technology transfer	242
Annex 3. Glossary	245

Acknowledgements

UNDP and the authors gratefully acknowledge the constructive suggestions made for this report by the UNFCCC secretariat and UNDP staff members, as well as Eric Martinot, Hernan Carlino, Erik Haites, Harald Winkler, Chad Carpenter, Naira Aslanyan and Susanne Olbrisch.

FOREWORD

The purpose of this paper is to review the role that existing technologies and those under development can play in meeting the climate change challenge. Additional purposes are to help the reader to consider which technologies could help meet the development needs of his/her country while limiting greenhouse gases (GHGs) and to identify specific suggestions under an international climate change agreement that could help introduce new technologies in developing countries.

The paper is an input to a series of workshops that UNDP will organize in developing countries with the aim of improving their capacity to respond to climate change. It borrows extensively from the International Energy Agency (IEA) report titled *Energy Technology Perspectives: 2008* and from a United Nations Environment Programme (UNEP) report titled *Global Trends in Sustainable Energy Investment 2008*. The paper summarizes the scope of the technology challenge needed to address climate change; the mitigation options and likely global costs; the trends in financing sustainable energy investments; and the status and issues relating to a selective set of technologies likely to be of particular interest to developing countries.¹ An extensive treatment of all technologies has not been possible, therefore the reader may wish to review the IEA *Energy Technology Perspectives 2008* report for a broader treatment of technologies. Questions are included at different parts of the document to help the reader reflect on the circumstances in his/her country. A final section provides insights about technology issues and options under consideration in the United Nations Framework Convention on Climate Change (UNFCCC) process to negotiate a new climate change agreement.

Climate change confronts us with a major technological challenge if we are to reduce GHG emissions to levels that will prevent dangerous anthropogenic interference with the climate system. The good news from the Intergovernmental Panel on Climate Change (IPCC) is that many mitigation scenarios for the medium term (i.e., until 2030) suggest there is considerable economic potential for reducing GHG emissions at costs ranging from negative to about \$100 per ton of carbon dioxide (CO₂). However, if we are to stabilize GHG emissions – for example, at

current levels by 2030 as a first step – additional mobilization of investment and finance (I&F) flows in the order of \$200 billion (mostly aimed at the energy supply and transportation sectors) would be needed. These additional I&F flows are large relative to the funds currently available, but low as compared to global Gross Domestic Product and investment. Recent evidence indicates that due to policies in some countries, investment in clean energy technologies is growing and that new financial products and markets are being developed worldwide.

There are many existing and emerging technologies, such as, advanced fossil fuel power generation, biomass and bioenergy, wind power, buildings and appliances, and electricity transmission and distribution technologies, that can help achieve a low carbon future and other environmental goals. Each of these is at a different stage of the research, development, demonstration and deployment (RDD&D) cycle, however they are not being developed and diffused at the rate required because of a number of technological, financial, commercial and regulatory barriers. Given the urgency of the climate change problem, policy makers in developing countries need to consider how they will contribute to reducing the rate of growth of GHG emissions in their countries, their unique circumstances and special technology needs, and how to encourage innovation and the diffusion of the technologies using both public and private finances. Policy makers also need to consider how the international community could help their countries through a “full package” approach, consisting of equipment, software, enhanced human capacities, regulatory and institutional support, and financial mechanisms designed for each element of the approach.

1. INTRODUCTION

The international debate on how to enhance and upscale the development and transfer of climate-friendly technology for mitigation and adaptation is gaining momentum in the framework of negotiations for a post-2012 climate agreement. This is reflected in the central role that issues relating to technology (notably to RDD&D as well as transfer) have had in past deliberations of the UNFCCC Long Term Dialogue and are having in current sessions of the Ad Hoc Working Group on Long-Term Cooperative Action (AWG-LCA). To a large extent, the relevance of these issues stems from the huge technology challenge posed by emissions stabilization at current levels, as well as from the fact that capacity building, technology transfer and finance are key to facilitate developing countries’ implementation of substantial action on mitigation and adaptation. (Information on the terminology used in this paper can be obtained from the glossary in Annex 3).

Climate change confronts us with a major technology challenge. For example, it is estimated that stabilizing CO₂ equivalent concentrations in the range of 535-590 ppm would lead to a temperature increase of approximately 2.8-3.2⁰ Celcius over pre-industrial levels. Achieving this level requires emissions to peak in the 2010-30 period (IPCC 2007a). Global CO₂ emissions (mainly from energy use) in 2050 would have to be in the range of -30 to +5% of 2000 levels. However, a temperature increase of 3⁰ Celcius would have significant global impacts according to the IPCC (IPCCb). Consequently, serious consideration is being given to limiting concentrations to approximately 450 ppm equivalent. This would imply the need to reduce global emissions between 50-85% by 2050. To achieve such a scenario, the world would have to undergo a significant transformation in its production and use of energy.

It is important to note that, for some technology-related issues, the ongoing international debate reflects a growing international consensus; others remain highly controversial. Reaching an international agreement on the concerted actions needed to upscale technology development and transfer and the means to deploy them widely will likely require further dialogue, as well as in-depth analysis of the circumstances of each country. (For an overview regarding Conference of the Parties (COP) decisions relevant to technology, please refer to Annex 2).

A growing consensus is being reached on a number of important issues:

- Several key technologies needed to achieve low-cost mitigation (in particular for developing countries and in the energy sector);
- The main (information and incentive) barriers that hinder the development and deployment of low-cost mitigation technologies in both industrialized and developing countries;
- The need to stimulate international technology cooperation in order to accelerate RDD&D and transfer of efficient climate-friendly technologies;
- The existence of a substantial financing gap that needs to be filled in order to reach the necessary upscaling of technology development and transfer. This calls for new and improved instruments to this aim.

However, there are important issues that remain controversial, for example:

- **How quickly we can change to a low carbon energy world.** This has serious implications for the urgency and scale of international technology cooperation, and concerns for example, whether we should focus on the dissemination of existing technologies or on research and development (R&D) for new technologies that are too costly at present.
- **The policy approach necessary to accelerate technology development and deployment.** Some analysts argue that climate policies alone (e.g., a price signal from carbon markets and project mechanisms such as Clean Development Mechanism (CDM) and Joint Implementation (JI)) provide enough incentives for technology development and diffusion, while others argue in favor of additional technology policy instruments (e.g., efficiency standards or goals, subsidies, and information diffusion instruments). However, in general, it is believed that a package of policies will be necessary to encourage innovation and large-scale mitigation efforts.
- **Investments for sustainable technologies.** Investments have increased in some countries, but as noted in UNFCCC 2007, there is a significant gap between current investments in developing countries and the level of funding that will be needed to reduce the rate of growth in GHG emissions. A significant shift in investments to sustainable technologies is needed, but how this can be achieved in an efficient way remains a subject of some analysis and political debate.
- **The role of intellectual property rights (IPRs) for**

¹ In the context of the current climate negotiations, there is substantial interest in developing adaptation technologies. The paper does not explore this topic because of the limited literature on the matter.

the development and deployment of climate-friendly technologies. Some developing countries argue that they increase the cost of access to technology and therefore act as a barrier to the adoption of climate friendly technologies and call for new, specific international mechanisms to purchase IPRs for key technologies and licencing policies. By contrast, most industrialized countries' representatives stress the need to grant IPRs and long lived patents to innovators in order to provide enough incentives for the development and commercialization of new technologies.

- **The form that international RDD&D co-operation should take.** There is some debate over this issue, notably, whether the object and financing for such cooperation should be decided in the framework of the UNFCCC or not.
- **The role and ultimate scope of carbon markets and the CDM for technology transfer.** Some suggest that CDM has hardly involved new technologies or North-South transfer of innovative solutions, while others note that many CDM projects have been initially developed solely by developing countries. Furthermore, most CDM projects have been implemented in a few fast-growing, middle-income developing countries (India, China and Brazil). By contrast, countries that could benefit the most from CDM related technology transfer and sustainable development effects – notably least developed countries (LDCs) – have hardly any participation in the CDM. While it is recognized that CDM has helped to mobilize investments in clean technology that in the mechanism's absence would not have been implemented (at least not to the same extent), the ability of CDM to fill the technology financing gap remains an open question.

2. MITIGATION OPTIONS AND COSTS

GHG emissions have been on a high growth path for the past few decades and will continue on that path unless climate change mitigation policies are considerably upgraded. Emissions have grown by 70% between 1970 and 2004, and in a business as usual scenario – i.e., if no further mitigation policies are implemented – an increase in a range of 25-90% (in absolute terms, 9.7-36.7 Gigatons CO₂ equivalent (GtCO₂-eq)) is projected for 2000-2030.

Most projected GHG emissions growth will continue to result from energy use and most additional emissions will originate in developing countries. More specifically, CO₂ emissions from energy use are expected to grow 40-110% over 2000-2030, with two-thirds of that increase coming from non-Annex I (NAI) countries. This reflects the importance of technological change in these countries for GHG emission stabilization.

It is necessary to substantially increase investment in clean energy technology development and deployment from current levels. In spite of climate policies, both government support and private expenditure on cleaner energy R&D are estimated to be low as compared to the levels achieved after the oil shocks of the 1970s and 1980s. Current government funding for energy R&D is estimated to be half of its 1980 level (in real terms).

It is also important to introduce regulatory and economic instruments that provide long-term incentives for technology development, demonstration, and deployment.² Policies introducing a carbon price, accompanied by measures to reduce barriers to technology adoption could substantially increase the incentives for (interest of) mitigation. For example, a carbon price of \$20 per ton of CO₂, accompanied by measures to overcome barriers to technology adoption, would make it worthwhile to reduce GHG emissions by 9-18 GtCO₂-eq per year (that is a 14-34% reduction as compared to a high growth business as usual scenario). If the carbon price reaches \$100 per ton of CO₂, mitigation would increase but not in the same proportion: it may reach 23-46% reduction in emissions relative to the same baseline scenario.

In general, it is believed that a mix of existing and new technologies and practices will be necessary to achieve the relevant mitigation levels predicted in the IPCC stabilization scenarios (see Annex 1 for more detailed information on available technologies and those under development in different sectors as well as for results on the relative importance of specific mitigation technologies). Even if the relative role of existing and new options remains controversial, a recent survey of mitigation measures for 2030 found that more than two-thirds of the measures with mitigation potential are available today (Vattenfall, 2008).

While there is considerable economic potential for reducing GHG emissions, the costs of different mitigation options (technologies) vary considerably. At one extreme, available mitigation options may imply net benefits of €150/ton CO₂. At the other end, they may entail costs approaching €80/ton CO₂ (see Figure 1). This means that emissions growth could be checked, but a careful cost assessment should be made in order to avoid high economic impacts (costs) of mitigation.

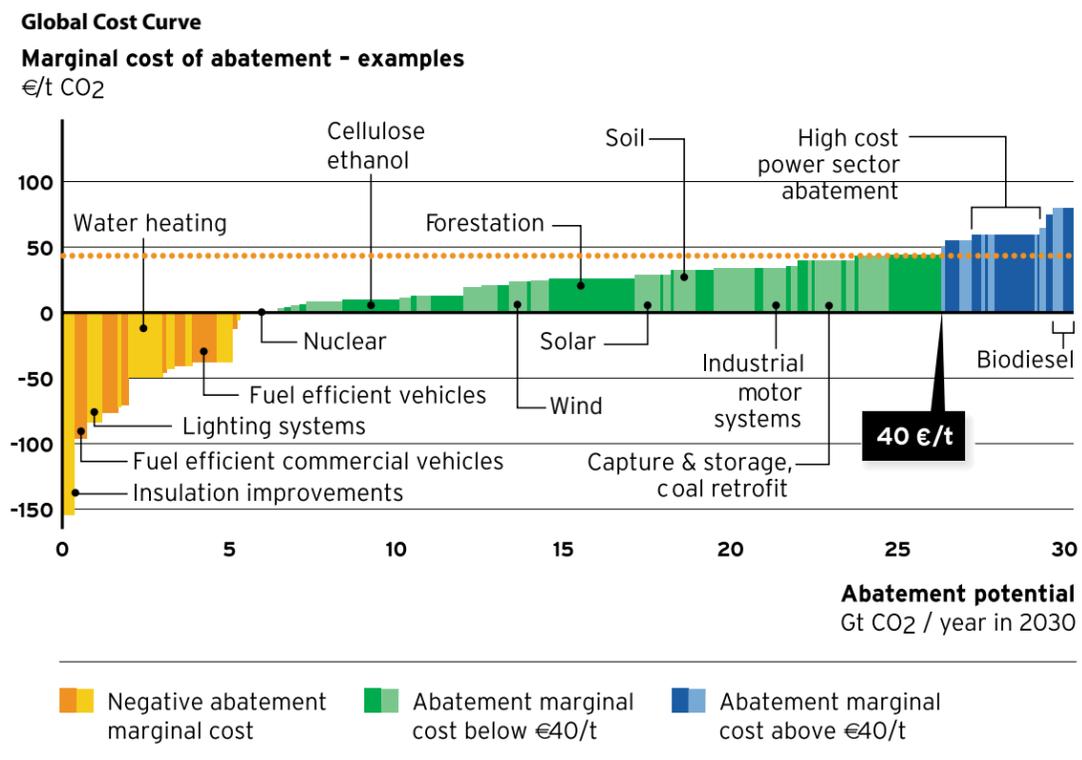
There is also a large potential for no-cost mitigation. Many mitigation opportunities, mostly related to improving energy efficiency in buildings, imply negative costs (i.e., net benefits) if implemented, but require specific action and policies to deal with implementation barriers (e.g., minimum regulatory requirements for insulation and equipment efficiency). According to IPCC Fourth Assessment Report (AR4), these no-cost measures add up to a mitigation potential of 6 GtCO₂-eq/yr. Similarly, Vattenfall's survey estimated that nearly one-quarter of the total mitigation potential identified for 2030 would entail net benefits (see Figure 1 for examples of no-cost technologies).

In general, energy efficiency measures play a key role for mitigation according to most studies. In particular, IEA and IPCC estimates put energy efficiency at the top of all mitigation options according to their large potential (see Annex 1). The Stern Review further stresses that energy efficiency provides the best option for the medium term (i.e., up to 2025) but for the longer term (up to 2050), renewable energy options show a larger potential.

² B.Metz et al 2007 (op.cit.), chapters 3 & 13.

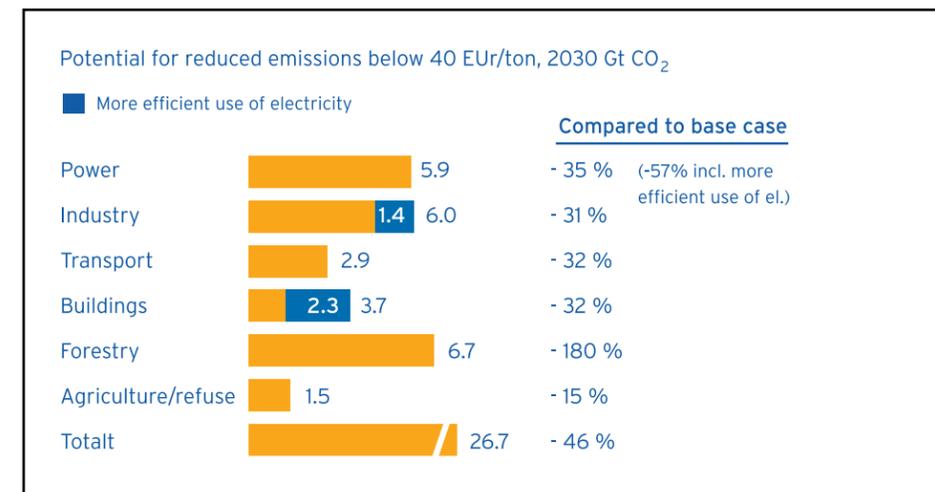
Likewise, Vattenfall (2008) shows that measures to improve the efficiency of electricity use in three sectors (power, industry, and buildings) result in the largest mitigation potential identified by 2030 (7.4 Gt CO₂, or 28% of total mitigation potential). At the sector level, avoided deforestation shows the highest potential (6.7 Gt or 25% of total mitigation potential) (see Figure 2).

Figure 1: Global mitigation cost curve



Source: Vattenfall (2008)

Figure 2: Potential emission reductions per sector, by 2030



Source: Vattenfall (2008)

As to the regional distribution of the world's aggregate mitigation potential, it is clear that some fast-growing developing countries already play an important role. When considering the mitigation potential at costs below €40/ton CO₂ (estimated at 26.7 GtCO₂), Vattenfall (2008) estimated that the US and Canada may contribute with 4.4 Gt (16.4%), China with 4.6 Gt (17.2%), European countries of OECD with 2.5 Gt (9.3%), Eastern Europe (including Russia) with 1.6 Gt (5.9%), other industrialized countries with a further 2.5 Gt (9.3%), and the rest of the world with 11.1Gt (41%).

More generally, the magnitude of necessary mitigation efforts and costs will depend on a number of features of future international climate agreements that should be carefully evaluated. More precisely, costs will be higher, the greater the ambitiousness of the stabilization goal, the lower the number of parties that will share the mitigation effort and the more limited the scope for flexibility (such as mitigation options allowed and flexibility mechanisms available, e.g., emissions trading).

For lower stabilization levels, the preferred technology options are low carbon energy sources (renewables, nuclear, etc.) and technologies that are not yet available at a commercial stage (such as carbon capture and storage (CCS)). If gases other than CO₂ and land use, land-use change and forestry (LULUCF) options are included, then greater flexibility for mitigation is achieved (and lower costs result).

Macroeconomic costs consistent with emissions stabilization between 445 and 710 ppm CO₂-eq are estimated as ranging from a 3% decrease in global GDP and a small increase compared with the business-as-usual scenario (IPCC, 2007a). However, regional costs may differ considerably from the global average. GDP loss may be substantially reduced if revenues from a tax or a permit auction is spent in low carbon technologies promotional programs or to reduce other distortionary taxes. Similarly, if induced technological change (i.e., accelerated innovation due to climate policies) is verified, then costs could be much lower than the previous estimate. Modelling studies consistent with stabilization at 550 ppm by 2100 indicate that equilibrium carbon prices would lie in a range of \$20-\$80 per ton of CO₂ by 2030 and \$30-\$155 per ton of CO₂ by 2050. If price incentives lead to technological change, then equilibrium carbon prices would be reduced to ranges of \$5-\$65 per ton of CO₂ by 2030 and \$15-\$130 per ton of CO₂ by 2050.

Irrespective of the precise costs involved, it is clear that one barrier to the implementation of cleaner technologies is the availability of finance to cover upfront costs. For example, renewable energy and energy efficiency solutions often face low operation costs (or even operation benefits, as reflected in a lower energy bill) but higher capital costs as compared to conventional energy or existing sources. In this regard, there is room for optimism, as shown by recent trends in clean energy (renew-

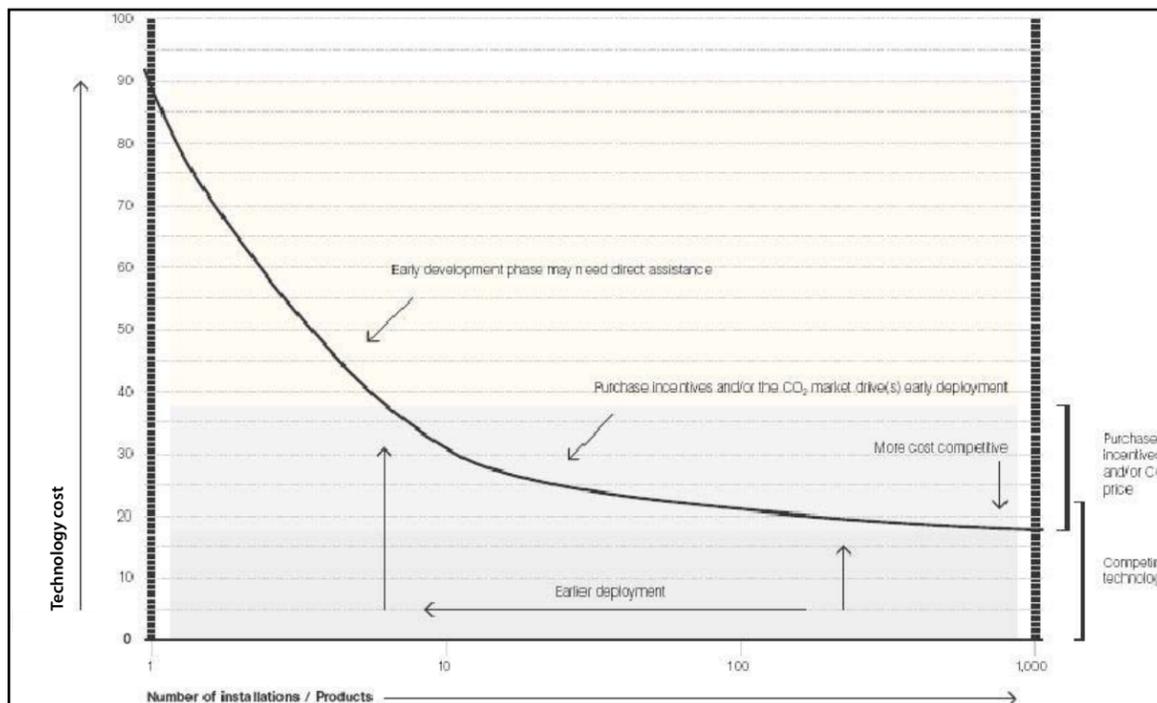
able energy and energy efficiency) financing (reviewed in the next section).

It is important to consider that technology finance and policy needs will vary at different stages of the technology development process (i.e., research, development, demonstration, commercial development, and deployment), as illustrated by *Figure 3* (WBCSD, 2007b and UNFCCC, 2007; chapter 9). For instance, in early stages of development, investment and financial flows are high, since technology has high costs as compared to competing technologies and substantial R&D efforts (investment) are necessary. However, private funding is in general unlikely to be available due to high perceived risks. At this stage, direct assistance (R&D subsidies) as well as public sector finance for demonstration may become crucial.

By contrast, when technologies reach the commercial stage, for early deployment to occur, purchase incentives and other policy driven signals (such as carbon markets) become highly relevant. At this stage, some forms of private sector finance may step in (e.g., venture capital).

For a wider deployment of available technologies, even if finance mechanisms may abound (e.g., bank project finance), purchase incentives should be reinforced to overcome adoption barriers whenever these technologies have higher cost than less climate friendly alternatives (e.g., with policy-driven carbon prices). As the adoption rate increases (*moving to the right of the horizontal axis in Figure 3*), technology costs will decrease, technologies will become common practice, and the barrier imposed by lack of access to finance will disappear. Before that happens, local funding sources may be scarce if these technologies are perceived to pose high technology or project specific risks (e.g., if they are new in a given national context). Policy and finance needs at the demonstration stage should not be underrated since many technologies with high R&D investments sometimes find it difficult to overcome barriers in this phase. As an example, it is important to consider that promising technologies, such as CCS and coal gasification, still need to successfully get through the demonstration stage.

Figure 3: Technology cost in relation to the number of installations/products



Source: UNFCCC (2007, chapter 9)

3. TRENDS IN CLEAN TECHNOLOGY FINANCING

It is increasingly recognized that the challenges to fill the finance gaps to upscale cleaner technology development and deployment are considerable but not insurmountable. First, because some investment and funding reallocation is desirable, e.g., in the energy sector, away from conventional carbon-intensive technologies to cleaner ones. Second, because the additional funding needs may easily become available. In order to stabilize GHG emissions at current levels by 2030, additional mobilization of I&F flows in the order of \$200 billion (mostly aimed at the energy supply and transportation sectors) would be needed (UNFCCC 2007). These additional flows will be large relative to the funds currently available, but low as compared to global GDP and investment. As a matter of fact, it will only represent 0.3-0.5% of global GDP and 1.1-1.7% of global investment in 2030. Furthermore, as shown below, funds and mechanisms available for finance clean energy technologies have grown considerably in recent years.

Current trends show that investment in clean energy technologies is growing fast and that new financial products and markets are being developed worldwide, (i.e., I&F mechanisms to this aim are broadening in scope and increasing in magnitude). Investment in sustainable energy³ has been estimated at \$148.4 billion in 2007 (growing 60% as compared to previous year) (UNEP/NEF 2008). Furthermore, current projections indicate that annual investment between now and 2030 will reach \$450 billion by 2012 and \$600 billion by 2020. Both traditional financing (financial system mechanisms for large scale projects, public subsidies) and new mechanisms (e.g., microfinance, public and private green funds, etc.) along with policies such as new regulations and guidelines are behind the observed growth in renewable energy generation capacities.

Total I&F in sustainable energy was mostly made up of asset finance (generation capacity projects) that reached \$84.5 billion in 2007. The rest was explained by public markets (\$23 billion), R&D funding (private and public) reaching \$17 billion, venture capital/private equity

(amounting to \$9.8 billion), and small scale projects that reached \$19 billion.

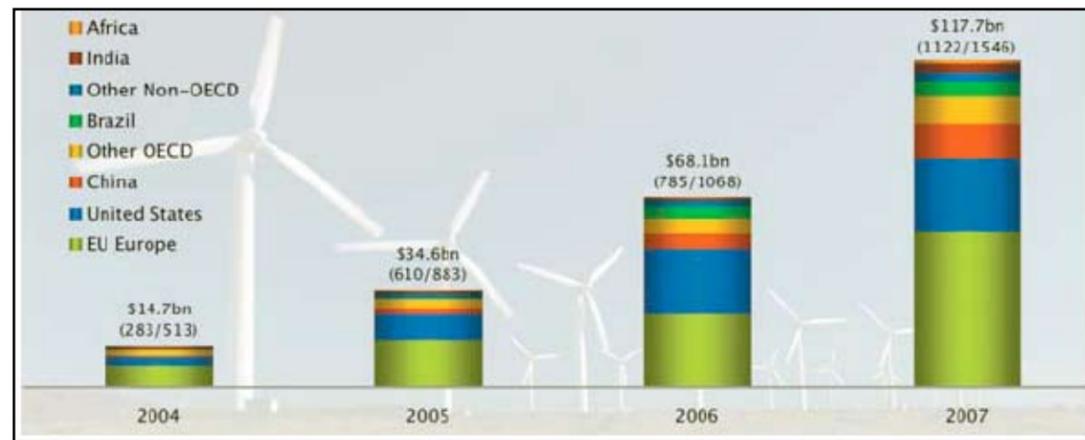
In order to guarantee that the necessary scale of (climate friendly) technological change is achieved, government budgets for R&D need to double and private incentives should be reinforced. Since the private sector is responsible for most climate-related I&F efforts (86%), private incentives for investment should be modified along with an upscale in public support for R&D in order to considerably upscale clean technologies development and deployment.

Investment in R&D and for new technologies to reach commercial stage is also growing, helped by funding from venture capital and private equity as well as public (stock and share) markets (UNEP/New Energy Finance (NEF), 2008). Furthermore, clean energy technology companies from developing countries (notably from India and China) have managed to raise funds from international capital markets via private equity (convertible bonds) and by raising venture capital and foreign direct investment.

As to regional distribution, the European Union (EU) is the world leader in sustainable energy investment (receiving \$55.8 billion), followed by the US (with \$26.5 billion). Developing countries currently receive roughly one quarter of global I&F related to climate change mitigation (UNFCCC, 2007) and sustainable energy investment (UNEP/NEF, 2008). However, developing countries should capture an increasing share of global investment to this aim, for various reasons. First, in these countries, mitigation investment is expected to be highly cost-efficient (due to the availability of low-cost mitigation options). It is estimated that developing countries will account for 46% of needed investment even if – by 2030 – they could produce 68% of global emissions reduction. Second, they will retain a growing share of energy-related investment and capacity. The question is whether developing countries will be able to finance the needed investment in order to cover their energy demands with clean energy sources.

³ This includes investment in renewable energy production, externally financed energy efficiency projects, R&D, and related equipment production capacity.

Figure 4: New investment in clean energy by region, 2007



Source: UNEP/NEF, 2008

As mentioned above, prospects are good since the availability of clean energy funding is rapidly growing and given that developing countries (at least the large, fast-growing ones such as China, India and Brazil) are gaining a higher share of clean energy-related I&F.

Current investment in sustainable energy is mainly aimed at new generation capacities (\$84.5 billion in 2007). In the high-growth context of renewable energy, developing countries managed to double their overall share of global sustainable energy investment, which reached 22% in 2007 (17% concentrated in three countries: China, India, and Brazil). This is mostly explained by the fact that China received \$10.8 billion of asset finance, Brazil accounted for \$6 billion and India for \$2.5 billion. Together, these three countries received 20% of global asset finance (aimed at energy generation or biofuel production projects). Since they are also becoming important players as renewable energy technology suppliers (in particular, Brazil for ethanol production, India for wind turbines, and China for solar panels), they are also capturing an increasing share of global public markets and private equity investment.

It is important to stress the contribution of new mechanisms to fund distributed generation capacities in developing countries (mostly home solar photovoltaics (PV), solar water heating and biomass cogeneration) that are being offered by microfinance (through specialty banks such as Grameen) and public programs receiving international finance from multilateral or bilateral development

banks (e.g., rural electrification devised at national level or renewable energy programs at municipality level). These technologies and programs help improve access of the poor and remote rural areas to (off-grid) energy services, most notably in countries (like China, Brazil, and India) where rapid growth is leading to increasing pressure to raise living standards and mounting energy demand. In some cases, host countries have also raised part of the necessary funding via carbon markets (in particular through the CDM). As discussed below, the CDM does not cover full costs. However, the funding raised through this channel may prove enough to overcome other investment (roll out) barriers. Even if the CDM does not cover full costs, the funding raised through this channel may prove enough to overcome other investment (roll out) barriers. In addition, many countries are expecting the CDM to further enlarge the funding opportunities available to these programs via new options for “programs of activities” and new sectors.

As to the technologies mostly favored by I&F trends, it is worth noting that, in recent years, the most favored technologies were wind energy, solar, and biofuels. The former accounted for \$50 billion investment, i.e., 43% of new investment, in 2007. Some 60% of new investment in wind capacity was installed in the US, Spain, and China. Together, wind, solar and biofuels explain 85% of total new capacity investment in 2007. For its part, venture capital and private equity were mostly directed at

solar technologies in 2007, with energy efficiency being the second most important technology receiving this type of funding, and biofuels ranking third. It is also worth noting that the only sector that nearly stagnated in 2007 was biofuels, to a large extent due to concerns related with food availability and high feedstock prices (that, for example, led to a freeze in the implementation of new biofuel minimum content policies in some countries, such as Mexico and China and slower growth in others, such as the US).

In spite of the good prospects, many challenges remain:

- First, it is worth noting that sustainable energy investment is still small in magnitude. It represents only 9% of global energy infrastructure investment and 1% of global fixed asset investment.
- Second, in spite of expanding policies to foster renewable energies, most energy policies still favor conventional (fossil fuel based) energy: the annual amount of global energy subsidies aimed at fossil fuels was \$180-\$200 billion, while subsidies directed at renewable energies totalled \$16 billion.
- Third, energy related R&D only received 4% of total government-funded R&D (UNEP/NEF, 2008). Similarly, it is worth noting that private and public funding for renewables R&D (amounting to \$16.9 billion in 2007 and involving a 30% growth in the past two years) has been growing, but at a much slower pace than venture capital directed at renewables (which grew 106% over the past two years).
- Fourth, with regard to the components of sustainable energy investment, a remaining challenge is to increase energy efficiency-related investment. Even if it is difficult to measure (since most investments in energy efficiency are self financed by companies and households), it is worth noting that (externally financed) energy efficiency investment only contributes to 3.7% of total investment in sustainable energy. This could be partly explained by the difficulties these type of projects face to reach traditional commercial funding (i.e., low scale, high transaction costs, difficult to specify, etc.). As a matter of fact, energy efficiency is financed via other channels (such as venture capital, private equity, and public markets). Externally funded

energy efficiency investment nearly doubled in Europe and the US suggesting that new mechanisms are becoming available. Further growth in energy efficiency funding depends on the enlargement and extension of newly designed programs that help bundle small energy efficiency projects (either at geographical level, e.g., municipalities, or sectoral level, e.g., appliance efficiency).

- Finally, many developing countries are not participating in the growth in financing for renewables and energy efficiency for various reasons, such as low investment levels in energy capacity, scarce CDM project development, and lack of specific policies to foster the application of clean energy sources. This may well be due to the lack of skills to promote such a public policy or due to other perceived priorities.

All the same, it is important to keep in mind that the renewables sector is playing an increasingly important role for energy provision and is set to become ever more relevant. Even if renewable sources (excluding large hydro) still only account for roughly 5% of global production and generation capacity, over the past two years they accounted for over 20% of new capacity and production.

Carbon markets (including the CDM and carbon funds) can play an important role for developing countries' uptake of renewable energy technologies.

However, it should be kept in mind that CDM projects do not fund full costs and are highly concentrated, both geographically and among project types. According to UNEP/Risoe figures,⁴ China and India concentrate more than two-thirds of credits (certified emission reductions (CERs)) expected by 2012, and four countries (China, India, Brazil, and Mexico) account for two-thirds of total CDM projects. China is the leader with 45% of CERs expected by 2012, India ranks second with 17%, Brazil follows with 10% and Mexico with 4% of total 2012 CERs. In terms of projects, India leads with 33% of projects, followed by China (17%), Brazil (13%), and Mexico (11%). This differing ranking has to do with the relative scale and global warming potential of different GHGs involved in projects of different countries. China, for example, generates a large share of its credits from

⁴ Taken from the CDM/JI pipeline as of April 2008. Available from www.cd4cdm.org.

HFC projects (large scale and with the highest global warming potential of all GHGs).

As to the importance of energy efficiency and renewable energy projects, they are quite salient in China, Brazil, and India. India is the leader in these types of projects, having developed 79 energy efficiency projects and 197 renewable energy projects (111 biomass, 49 wind, 36 hydro, and one solar). China has 115 renewable energy projects (56 wind energy, 51 hydro, and 8 biomass). For its part, Brazil has developed two energy efficiency projects and 64 renewable energy projects (37 biomass, 23 hydro and 4 wind), while Mexico has developed 37 renewable energy projects (5 wind, 3 hydro and 29 biogas).

It is estimated that the CDM will generate funding in the order of \$25 billion annually until 2012 (UNFCCC, 2007). Private and public carbon funds raised nearly \$13 billion by the end of 2007 (UNEP/NEF, 2008). Furthermore, even in the uncertain context we face before a post-2012 deal is reached, some large development banks and brokers are promoting (buying) post-2012 credits, thus giving continuity to carbon market transactions. However, most analysts believe the carbon market contribution should increase at least fourfold in order to reach the necessary scale of clean technology adoption in developing countries.

The recent developments reviewed above can be seen to bring new opportunities as well as new challenges for developing countries in order to upscale investment in clean energy technologies (and other mitigation options). Regarding the opportunities, it is increasingly important for these countries to identify them by assessing the different finance options available and their relative merits as well as their applicability to their national needs and circumstances.

There are considerable differences in technology needs and national capacities to identify and address them in different developing countries. While large, fast-growing countries seem to be profiting from current trends, smaller and lower income developing countries as well as LDCs are still to see the benefits of larger I&F markets for sustainable energy. As to the challenges, it is increasingly important that clean energy technologies and other mitigation options gain a more important role in long-term planning priorities and public/private investment strategies. International organizations and donors should help by providing technical assistance and capacity building to enlarge the ability at the local level to deal with

these challenges in smaller developing countries, especially in LDCs, and to find the adequate mix of finance options to implement the right technology solutions for their energy needs.

Questions:

- Does your country provide grants or other financing to support for research, development, or deployment of technologies?
- How is the construction of energy or other infrastructure projects financed in your country: development assistance, government or private loans, equity markets, private capital, or other financial instruments?
- Are there venture capital funds operating in your country or have venture capital funds provided financing to new companies in your country?
- What are the major obstacles to investments in your country, e.g., the creation of venture capital funds or new equity offerings in your country? What might the international community do to help improve the investment climate in your country?

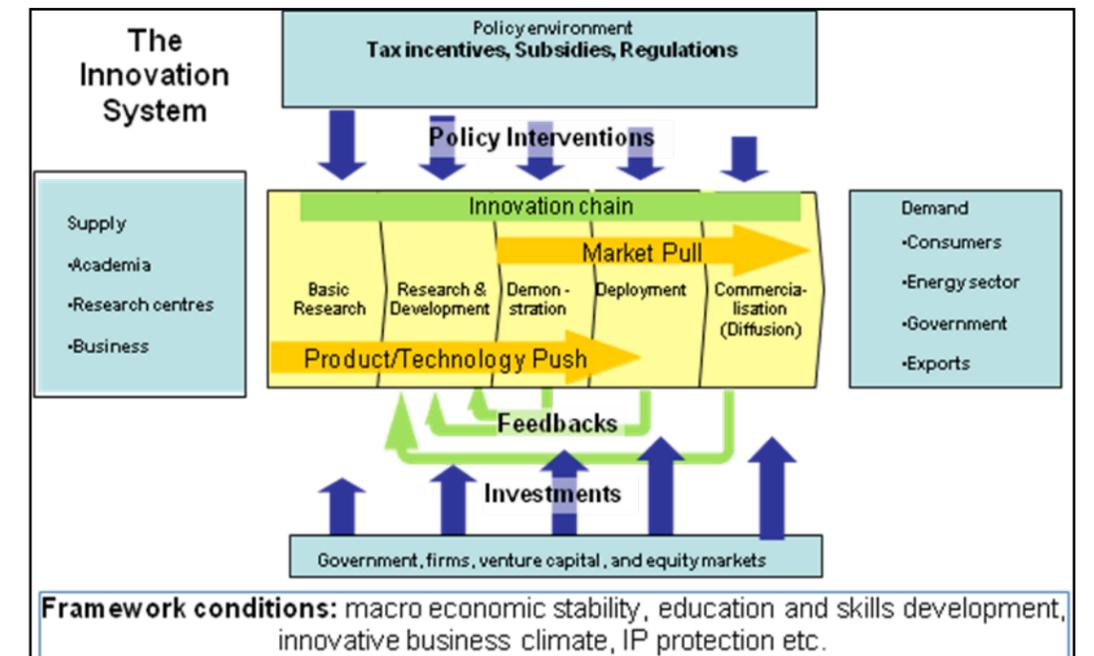
4. KEY TECHNOLOGIES – CONSIDERATION OF ISSUES RELATING TO THEIR DEVELOPMENT AND DEPLOYMENT IN DEVELOPING COUNTRIES

The International Energy Agency (IEA, 2008) lists over 300 new key energy technologies that may play a role in reaching a low carbon world, but it admits that even this list is not exhaustive. This section will focus on just a few technologies that may be of particular interest to developing countries, while recognizing that each country has unique circumstances and technology interests which may not coincide with those addressed in this section. We omit many that are either expensive (nuclear), not sufficiently mature (ocean energy) or diverse (industrial processes), but first a word about the research, development, and demonstration, and deployment cycle (RDD&D). This section does not focus on national policies to promote RD&D or the deployment of technologies, as this subject is treated in another paper in this series, *National policies and their linkages to negotiations over a future international climate change agreement* by Dennis Tirpak.

4.1 The research, development, and demonstration, and deployment cycle

The generally recognized phases of the innovation and deployment cycle for new technologies, while often depicted as a linear process, is in reality quite complex, with many feedback loops between the market and technology users and the R&D community (see Figure 5). In 2007, nearly \$17 billion was spent on R&D on clean energy and energy efficiency, with the corporate sector, which generally supports more applied research, accounting for \$9.8 billion and governments, which usually support more basic research, accounting for about \$7.1 billion. Europe and the Middle East saw the most corporate R&D activity, followed by the Americas and Asia. Patterns of government spending are the reverse, with Asian governments (notably Japan, China, and India) investing heavily in R&D.

Figure 5: The research, development, demonstration, deployment, and commercialization cycle



Source: IEA 2008

There are numerous mechanisms for collaborating and sharing technology R&D information, although some corporate R&D is proprietary (see Box 1).⁵ The IEA's implementing agreements are the largest of these with the participation of more than 60 non-IEA member countries.⁶ The aim is to share best practice, build capacity, and facilitate technology transfer.

However, there are limits to these efforts – i.e., not all developing countries can participate, some agreements are more active than others as progress is driven by the resources countries are willing to put into a particular agreement, and the participation of companies may be limited. Moreover, some efforts may not address topics of a high priority to developing countries and they cannot hope to capture the customer feedback loops noted above.

Given the large number of technologies and participants in the RD&D cycle, the international community, particularly the UNFCCC process, faces significant challenges if it wishes to accelerate R&D and the transfer of information among countries. If such improvements are to be made, they will have to be based on the experience of countries and their corporations. That being a goal, some key questions for the reader are:

Questions:

- Does your country provide any support for RD&D? Which R&D areas are of special interest to your country?
- Are the topics covered by the existing international mechanisms relevant to your country? What is missing?
- Are the existing international cooperative mechanisms transparent and open to your country?
- Has your government ever sought to participate in such a mechanism? If so, what was the result?
- What specifically is needed to enhance the participation of developing countries? Are there high priority R&D topics, of special interest to your country, that should be included in a future international agreement and perhaps subjected to oversight by the Convention process?

Box 1. Examples of coordinated international R&D and technology promotion activities

- **International Partnership for a Hydrogen Economy:** Announced in April 2003, the partnership consists of 15 countries and the EU, working together to advance the global transition to the hydrogen economy, with the goal of making fuel cell vehicles commercially available by 2020. The Partnership will work to advance the RD&D of hydrogen and fuel cell technologies and to develop common codes and standards for hydrogen use. See: www.iphe.net.
- **Carbon Sequestration Leadership Forum (CSLF):** This international partnership was initiated in 2003 and has the aim of advancing technologies for pollution-free and GHG-free coal-fired power plants that can also produce hydrogen for transportation and electricity generation. See: www.cslforum.org.
- **Generation IV International Forum:** This is a multilateral partnership fostering international cooperation in R&D for the next generation of safer, more affordable, and more proliferation-resistant nuclear energy systems. This new generation of nuclear power plants could produce electricity and hydrogen with substantially less waste and without emitting any air pollutants or GHG emissions. See: <http://nuclear.energy.gov/genIV/neGenIV1.html>.
- **Renewable Energy and Energy Efficiency Partnership:** Formed at the World Summit on Sustainable Development in Johannesburg, South Africa, in August 2002, the partnership seeks to accelerate and expand the global market for renewable energy and energy-efficiency technologies. See: <http://www.reeep.org>.
- **International Energy Agency Implementing Agreements:** A collaborative effort to share the development of, and information on, more than 40 key energy technologies among participating countries. See: <http://www.iea.org/textbase/techno/index.asp>.
- **Asia-Pacific Partnership on Clean Development and Climate:** Inaugurated in January 2006, the aim of this partnership between Australia, China, India, Japan, Republic of Korea, and the US is to focus on technology development related to climate change, energy security and air pollution. Eight public/private task forces are to consider (1) fossil energy, (2) renewable energy and distributed generation, (3) power generation and transmission, (4) steel, (5) aluminium, (6) cement, (7) coal mining, and (8) buildings and appliances. See: <http://www.asiapacificpartnership.org>.

⁵ Gupta, S., D. A. Tirpak, N. Burger, J. Gupta, N. Höhne, A. I. Boncheva, G. M. Kanoan, C. Kolstad, J. A. Kruger, A. Michaelowa, S. Murase, J. Pershing, T. Saijo, A. Sari, 2007: Policies, Instruments and Co-operative Arrangements. In *Climate change 2007: Mitigation. Contribution of Working Group III to the AR4 of the IPCC*, B. Metz, O. R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds), Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

⁶ For a list of existing IEA Implementing Agreements see <http://www.iea.org/Textbase/techno/index.asp>.

4.2 Deployment

The deployment stage of the technology cycle is one during which the technology has been demonstrated to be successful, but is not yet economically competitive except in niche markets. It may possibly need government support to overcome cost and non-cost barriers. Such support may range from providing financial incentives to introducing or reforming regulations to overcome barriers. Moving a technology forward at this stage often requires technical and economic feasibility studies, environmental assessments, preliminary approvals by local and national

governments, technology assessments, and other analyses. The prospect that a given technology will be produced and sold on the market may stimulate private industry to undertake applied research and improvements in the manufacturing process. Subsequent market feedback may suggest further avenues for improving technology and influence the ultimate adoption rate. This process, often called the learning rate, varies by technology and country. To date, none of the efforts adequately engages the private sector, which has the potential to bring far greater resources to bear on the challenges, combined with different and complementary skills.

Table 1: Types of interventions required to address specific local barriers to technology innovation and diffusion

ACTIVITY	GAP/NEED ADDRESSED	BENEFITS
Applied research and development Grant funding, open and/or directed at prioritized technologies	Inadequate support for relevant applied research for technologies where private funding is minimal due to classic innovation barriers	New ideas from local scientific knowledge base applied and developed to point of potential commercial relevance
Technology accelerators Designing and funding projects to evaluate technology performance, e.g., field trials	Uncertainty and skepticism about in-situ costs and performance, and lack of end user awareness	Reduction in technology risks and/or costs by independent collection and dissemination of performance data and lessons learnt
Business incubator services Strategic and business development advice to start-ups	Lack of seed funding and business skills within research / technology start-ups – the 'cultural gap' between research and private sectors	Investment and partnering opportunities created by building a robust business case, strengthening management capacity and engaging the market
Enterprise creation Creation of new low carbon businesses by bringing together key skills and resources	Market structures, inertia and lack of carbon value impede development of low carbon start-ups or new corporate products and services	Creation of new high growth businesses to both meet and stimulate market demand Development of local commercial and technical capabilities
Early stage funding for low carbon ventures Co-investments, loans, or risk guarantees to help viable businesses attract private sector funding	Lack of financing (typically first or second round) for early stage, low carbon businesses due to classic innovation barriers combined with perceived low carbon market/policy risks	Enhanced access to capital for emerging businesses that demonstrate commercial potential Increased private sector investment in the sector through demonstrating potential investor returns
Deployment of existing energy efficiency technologies Advice and resources (e.g., interest-free loans) to support organizations to reduce emissions	Lack of awareness, information and market structures limit uptake of cost-competitive energy efficiency or low carbon technologies	Improved use of energy resources through enabling organizations to implement energy efficient measures and save costs Catalyzing of further investment from organizations receiving support
Skills/capacity building Designing and running training programs	Lack of capacity to install, maintain, finance and further develop emerging low carbon technologies	Growth in business capacity and employee capabilities to enable more rapid uptake of existing and new low carbon technologies
National policy and market insights Analysis and recommendations to inform national policy and businesses	Lack of independent, objective analysis that can draw directly on practical experience to inform the local government and the market	Enhancing the policy and market landscape to support the development of the low carbon economy

Source: *Low Carbon Technology Innovation and Diffusion Centres, The Carbon Trust, www.carbontrust.co.uk*

The main barriers to technology deployment include: information (persuasive information about a new product), financing (to reduce the costs relative to other technologies and absolute costs), capacity to introduce or use technology, transaction costs, excessive or inadequate regulations, including investment policies, and uncompetitive markets. Efforts to overcome these barriers need to be tailored to individual technologies through the unique initiatives of the country wishing to deploy a technology and by the country providing the technology.⁷

However, developing countries, even after taking steps to address national barriers, often encounter obstacles to the deployment of technologies. One of the elements that make technology deployment more difficult in developing countries is the relation between the new technology and the countries' resource endowment and scale. In most cases, technologies reflect the original combination of resources (particularly capital, labor, technological capabilities, and, also scale of production) in a given country, which may not fit well with the particular technology that is to be deployed (see Table 1). The challenge facing the international community and national governments is to determine how these barriers can be overcome.

Questions:

- Given the respective roles of industry and governments, should the international community enhance the RD&D learning cycle? If so, how?
- Which barriers in your country are amenable to an international effort to reduce them?
- What mechanisms would be the most appropriate means of addressing each barrier to each technology in your country?
- Could a new international mechanism be a means to help your country overcome barriers? If so, what might its role be?

4.3 Fossil Fuel Power Generation

Overall, 40% of the world's electricity production comes from coal, 20% from natural gas, and the remainder mainly from nuclear and hydro. This percentage varies by

⁷ See the case studies in the paper by Tirpak titled, *National Policies and Their Linkages to Negotiations over a Future International Climate Change Agreement*, that is part of this series.

Table 2: Performance summary for different fossil-fuel-fired plants

PLANT TYPE		PULVERIZED COAL COMBUSTION (PCC)	PCC	PCC	PCC	NATURAL GAS FIRED COMBINED CYCLE (NGCC)	INTEGRATED GASIFICATION COMBINED CYCLE (IGCC)
Fuel		Hard coal	Hard coal	Hard coal	Hard coal	Natural gas	Hard coal
Steam cycle		Sub critical	Typical super-critical	Ultra-super-critical (best available)	Ultra-super-critical (AD700)	Triple pressure reheat	Triple pressure reheat
Steam conditions		180 bar 540 °C 540 °C	250 bar 560 °C 560 °C	300 bar 600 °C 620 °C	350 bar 700 °C 700 °C	124 bar 566 °C 566 °C	124 bar 563 °C 563 °C
Gross output	MW	500	500	500	500	500	500
Auxiliary power	MW	42	42	44	43	11	67
Net output	MW	458	458	456	457	489	433
Gross efficiency	%	43.9	45.9	47.6	49.9	59.3	50.9
Net efficiency	%	40.2	42.0	43.4	45.6	58.1	44.1
CO ₂ emitted	t/h	381	364	352	335	170	321
Specific CO ₂ emitted	t/MWh net	0.83	0.80	0.77	0.73	0.35	0.74

Note: MW = Megawatt, t/h = tons per hour
Source: IEA 2008

There are, of course, other emerging technologies that have the potential to make important contributions to the production of electricity in the future such as fuel cells. While several thousand systems are produced each year, more R&D is needed before these systems are ready for wide deployment.

CCS – a set of systems to capture CO₂ from large stationary sources – is also extremely relevant to the fossil fuel power sector. While used in the oil and gas industry to enhance oil recovery, the challenge is to demonstrate the feasibility to deploy this add-on technology at a reasonable economic cost. Several pre- and post-combustion processes are being considered to capture CO₂ and, subsequently, transport and inject it into deep geological formations. The most cost-effective capturing technologies are likely to add \$25-\$50 per ton of CO₂ avoided and result in a loss of generated electricity. Transportation costs may add an additional \$10-\$15 per ton of CO₂. Future cost projections depend on which technologies are used, how they are applied, how fast costs fall as the result of RD&D, market uptake, and fuel costs. On a smaller scale, there are a number of efforts underway to demonstrate other technologies for capturing CO₂ such as the use of

algae. Such technologies are unlikely to play a significant role in the power sector, but could find niche markets at other industrial facilities. They may also prove to be more adaptable to the needs of developing countries.

A number of initiatives relating to CCS have been announced by Algeria, Australia, Canada, EU, Norway, and the US, and interest has been expressed by China and South Africa. However, a number of legal, regulatory, environmental, financial, and technical barriers need to be overcome before large-scale deployment of CCS is made possible. The CSLF noted in Box 1, with the participation of 21 countries and the EU Commission, is the largest forum for international coordination of CCS activities. The CSLF aims to make these technologies broadly available and to address the wider barriers to deploying the technology.

Questions:

- What mixture of coal, oil, gas, hydro, nuclear, and other sources are used to produce electricity in your country? What is the average age and efficiency of these facilities?
- What plans do your utilities have for increasing

electricity in your country? What would be necessary to retrofit or replace the coal and gas fired power plants? What international assistance (technical, legal/regulatory, or financial) is needed by your country?

- Is your country interested in participating in an R&D consortium that addresses fossil-fuel power generation technologies?
- Can you envision a time in the next 10-15 years when your country would be interested in implementing a CCS project? Is your country interested in participating in cooperative R&D efforts such as the CSFL to stay abreast of developments in this field?

4.4 Biomass and Bioenergy

Biomass – i.e., organic material grown and collected for energy use – is a source of renewable fuel that can be converted to provide heat, electricity, and transport fuels. Total biomass consumption is estimated to be around 10% of global primary energy consumption, with approximately two-thirds consumed in developing countries as traditional fuels for cooking and heating. Some countries, such as Nepal, are dependent on traditional biomass to meet 90% of their total energy demand. With more people living in urban areas and because of the greater uptake of efficient stoves, such as small scale biogas converters and biomass-based liquid fuels such as ethanol gels, the overall efficiency of small scale biomass is expected to improve in the coming decades.

At a larger scale, biomass is consumed to provide heat and power and transport fuels. The scope for biomass to make a large contribution to global energy demand is dependent on its sustainable production, improved efficiencies in the supply chain, and new thermo-chemical and bio-chemical conversion processes.

Biomass can be used in a number of ways:

- Biomass can be co-fired with coal in traditional coal-fired boilers to produce electricity thereby making a contribution to CO₂ emission reductions. Co-firing has been successfully demonstrated in more than 150 installations worldwide. For regions with access to both coal and biomass, this may be an attractive option as it lowers investment costs for new boilers, enables higher efficiencies than in a dedicated biomass facility, reduces the risk of biomass supplies, and requires smaller storage areas.
- Biomass can also be gasified at high temperatures

using restricted oxygen to produce methane and other synthetic gases. The gas can be used in engines, gas turbines, and co-firing boilers. Small scale gasified solid biomass demonstration plants are widespread, but investment and operating costs still have to be reduced to gain a large market share.

- Biomass can also be used in CHP plants to produce both heat and electricity. While it is normally more costly to build a CHP plants than to have separate power and heating plants, such plants are cheaper to operate as less fuel is required and the lifetime of such facilities is longer.
- Biomass can also be converted to produce ethanol and biodiesel fuel. The use of sugar cane and grains has received a significant boost in the past few years as a number of developed countries have set targets for the use of ethanol and biodiesel as substitutes/supplements for/to conventional gasoline. However, there are many hurdles to be overcome and it remains unclear what contribution liquid biofuels will make to the global energy picture. Considerable research is underway to reduce the costs of biofuels using second generation technology that will use a wider variety of cellulosic materials and may some day be of importance to developing countries. Success in the development of second generation biofuel technologies will depend on many factors including: the level of public and private financial support, policies that encourage their production and use, demonstration and pre-commercial testing, better understanding of the potential resources, and analyses of the social, environmental, and other costs.

Table 3: Typical plant size, efficiency and capital cost for a range of bioenergy conversion plant technologies

CONVERSION TYPE	TYPICAL CAPACITY	NET EFFICIENCY	INVESTMENT COSTS
Anaerobic digestion	< 10 MW _e	10-15% electrical 60-70% heat	
Landfill gas	<200 kW _e to 2 MW _e	10-15% electrical	
Combustion for heat	5-50 kW _{th} residential 1-5 MW _{th} industrial	10-20% open fires 40-50% stoves 70-90% furnaces	EUR~100/kW _{th} stoves EUR 300-800/kW _{th} furnaces
Combustion for power	10-100 MW _e	20-40%	EUR 1 600-2 500/kW _e
Combustion for CHP	0.1-1 MW _e 1-50 MW _e	60-90% overall 80-100% overall	EUR 2 700-3 500/kW _e EUR 2 500-3 000/kW _e
Co-firing with coal	5-100 MW _e existing >100 MW _e new plant	30-40%	EUR 100-1 000/kW _e + power station costs
Gasification for heat	50-500 kW _{th}	80-90%	EUR 700-800/kW _{th}
BIGCC for power	5-10 MW _e demos 30-200 MW _e future	40-50% plus	EUR 3 500-5 000/kW _e EUR 1 000-2 000/kW _e future
Gasification for CHP using gas engines	0.1-1 MW _e	60-80% overall	EUR 1 000-3 000/kW _e
Pyrolysis for bio-oil	10 t/hr demo 100 t/hr future	60-70% ~ 85% with char	EUR 700/kW _{th} for 10 MW _{th} near commercial

Source: Based on IEA Bioenergy, 2007

Table 3 provides information on plant size, efficiency, and investment costs of different bioenergy conversion technologies. There are different outlooks for biofuels concerning future land availability, the rate of improvement in crop yields, environmental requirements, and estimates of available crop and forest residues. Compared to coal and gas, biomass is also more difficult to store, handle, and combust efficiently. Production costs vary with the size of the area to be harvested, types of crop and soils, nearness to roads, and storage requirements. Large scale plants can achieve economies of scale, but this can be offset by transportation costs needed to ensure the required volumes of material. In some countries, non-food types of crops (grasses) are being cultivated and harvested to provide an energy source. A large commercial processing plant of 400K t/yr would require a grass feedstock to be bought in from a radius of 100km to ensure 24-hour operation, seven days a week. There is however no reason why big biomass plants could not develop appropriate supply chains. Around 400 Gigawatt (GW) of modern biomass heat-production equipment, consuming 300 Megatons per year (Mt/yr) of biomass, is in operation worldwide.

Questions:

- Are commercial biomass facilities operating in your country? If so, what do they produce and on what scale?
- Has your country done an assessment of the potential for biomass to fill part of its energy demand? What type of biomass facilities would be of greatest interest to your country given its capacity and technological capabilities?
- What type of barriers currently exists to expanding the use of biomass? What form of international assistance would be needed to expand the use of biomass in your country? Would your country be interested in joining an international biomass R&D consortium?

4.5 Wind Power

Wind power has grown rapidly since the 90s. Global installed capacity reached 94GW in 2007, with more than 40 countries having wind farms. In 2007, global capacity increased by 40% or nearly 20 GW, with China, Spain, and the US the leading the way. A total of \$39 billion went into building new wind farms while \$11.3 billion

was raised in public markets.⁸ Some of the biggest manufactures are located in India and China. Much of this momentum, particularly in the US, was provided by “renewable performance standards”, i.e., state requirements for utilities to purchase a minimum amount of renewable energy.⁹

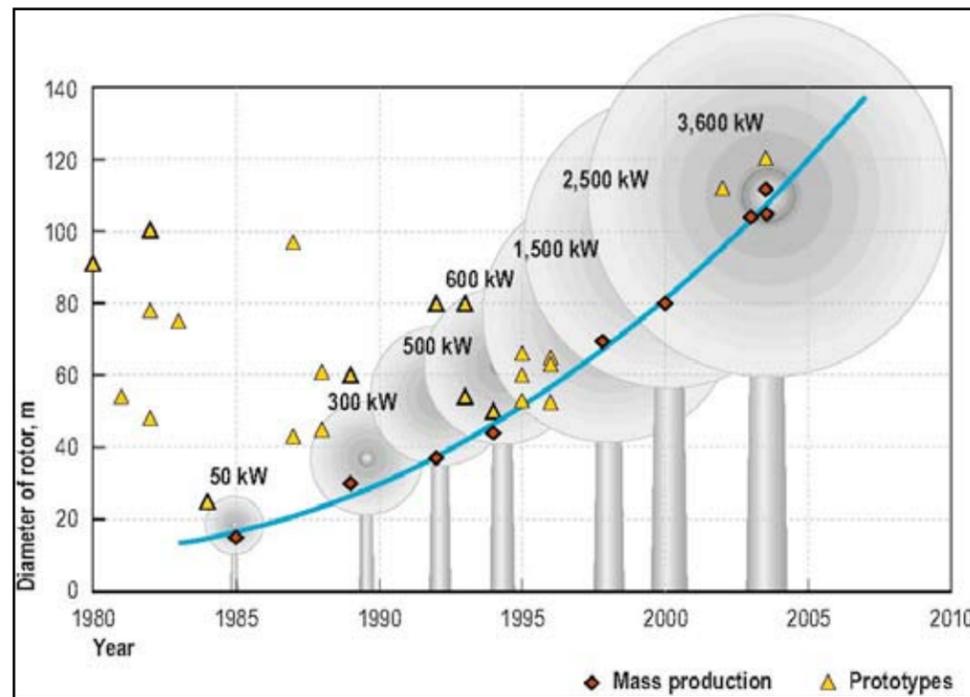
The outlook is for continued double digit growth. Costs have decreased by a factor of four since the 1980s as a result of scaling up of turbine sizes, increased manufacturing capacity, and other technological advances. Wind turbines need no fuel, incur almost no CO₂ emissions, and can be installed relatively quickly. However, turbine prices have risen since 2005 as a result of commodity prices.

Power from wind turbines is mainly a function of the wind regime at the site, turbine height and turbine efficiency. Turbines have nearly doubled in size every five

years, although this growth is not expected to continue. The largest wind turbines today are 5-6 MW units with a rotator diameter of up to 126 meters. In a search for good sites, many countries are now looking for offshore locations which can produce up to 50% more power than land-based sites. However, offshore wind farms face several challenges, particularly harsh conditions, competition with other marine users, environmental impacts, grid connections and higher costs driven by the need for secure foundations (see Figure 6).

The cost of electricity produced at sites with low average wind speeds ranges from \$0.089 to 13.5/kWh to \$0.065 to 9.4/kWh at high wind sites. The costs are expected to continuously drop to \$0.05-6/kWh over the next five to seven years. The investment cost structure for onshore wind farms is shown in Table 4.

Figure 6: Development of wind turbine size, 1980-2005



Source: German Wind Energy Institute (DEWI), 2006 in IEA 2008¹⁰

⁸ This total was buoyed by an IPO of Ibernova for \$7.2 billion which accounted for 60% of the total raised on the public market.

⁹ See the case studies on experience with wind in India, Senegal and Argentina in the paper by Tirpak titled, *National Policies and Their Linkages to Negotiations over a Future International Climate Change Agreement* that is part of this series.

¹⁰ DEWI, Deutsches Windenergie-Institut GmbH (2006), DEWI website: www.dewi.de.

Table 4: Cost structure for a typical medium-size onshore wind installation

	SHARE OF TOTAL COST %	TYPICAL SHARE OF OTHER COSTS %
Turbine (ex works)	74-82	-
Foundation	1-6	20-25
Electric installation	1-9	10-15
Grid connection	2-9	35-45
Consultancy	1-3	5-10
Land	1-3	5-10
Financial costs	1-5	5-10
Road construction	1-5	5-10

Source: IEA 2008

There are a large number of R&D initiatives that are aiming to improve wind power technologies. Examples include efforts to:

- Increase the size of turbines to 8-10MW and make them lighter, more reliable and fatigue resistant;
- Reduce or eliminate the need for gear boxes;
- Develop smart rotors;
- Improve grid interconnections and operating control systems;
- Continue cost reductions; and
- Minimize environmental impacts.

Questions:

- Does your country currently have a wind farm? If so, what has been the experience?
- Has your country conducted a survey of the wind potential and feasibility studies of potential wind farms? What are the main obstacles to the introduction of wind power and how could the international community help to overcome those problems?
- Suppose the international community offered to subsidize the capital costs associated with the installation of a wind farm in your country by up to 10%. Would this be sufficient to spur the introduction of wind power?

4.6 Buildings and Appliances

Residential, commercial, and public buildings encompass a wide array of technologies in the building envelope,

including: insulation, space heating and cooling systems, water heating systems, lighting, appliances, and consumer products. Unlike consumer products, buildings can last for decades, even centuries. Buildings are, however, often refurbished – heating and cooling systems are often changed after 15-20 years, while household appliances are often changed over 5-15 year time periods. Choosing the best available technology at the time of renovation therefore is important to long-term energy demand.

The IPCC (2007) has noted that there is, and will be, considerable opportunities to reduce emissions from the building sector at relatively low costs using existing technologies. Many of these technologies are economical based on life-cycle costs, but non-economic barriers slow their penetration in many countries. However, in many developing countries there is a boom in urban construction and, as incomes rise, a corresponding demand for energy-consuming appliances.

There are many examples of energy-saving measures. Well-designed, passive solar homes can minimize or eliminate the need for air conditioning. Evaporative coolers work well in hot, dry climates and cost about half as much to install as central air conditioners. The thermal performance of windows has improved greatly through use of multiple glazing layers, low-emissivity coatings and low conductivity frames. Solar thermal hot water systems, such as those used in China, can reduce the demand for energy in many countries at very reasonable costs. It has also been estimated that technical potential exists for a 30-60% improvement in the energy efficiency of appliances.

Table 5: Country average variations in direct use in power plants and transmission and distribution losses as a percentage of gross electricity production, 2005

COUNTRY	DIRECT USE IN PLANT (%)	TRANSMISSION & DISTRIBUTION LOSSES (%)	PUMPED STORAGE (%)	TOTAL (%)
India	6.9	25.0	0.0	31.9
Mexico	5.0	16.2	0.0	21.1
Brazil	3.4	16.6	0.0	20.0
Russia	6.9	11.8	-0.6	18.1
China	8.0	6.7	0.0	14.7
EU-27	5.3	6.7	0.4	12.5
US	4.8	6.2	0.2	11.2
Canada	3.2	7.3	0.0	10.5
Japan	3.7	4.6	0.3	8.7
World	5.3	8.8	0.2	14.3

Note: Transmission & distribution losses include commercial and technical losses. Commercial losses refer to un-metered use.
Source: IEA 2008

Countries have typically relied on appliance standards, labeling programs, and building codes to curtail the growth in the demand for electricity in the building and appliance sector. These efforts have had mixed results, particularly in countries that are rapidly developing and have poor enforcement capabilities. That said, the building and appliance sector represents a special challenge – one that is less dependent on the availability of technologies than on the introduction of well-designed and implemented government policies.

Questions:

- Are there technologies that your country has not had access to in the building and appliance sector?
- What obstacles has your country encountered in stimulating the introduction of new technologies?
- Do you view the deployment of technologies in this sector as largely a domestic matter or can the international community help in some way? If so how?

4.7 Electricity Transmission and Distribution

Much of the electricity that is produced is never used. Transmission and distribution losses account to 8.8% of the electricity produced worldwide. The losses are significantly higher in developing countries (5-25%), in part caused by illegal connections (see Table 5).

Most grid managers aim to transport electricity over the shortest possible distance. In many large countries the grid consists of a series of grids, often with different characteristics so that it may not be possible to optimize the demand for electricity in one part of the country with supply from another part. To cope with variable demand, utilities in developed countries typically use gas turbine peaking power plants which have lower capital cost to provide a flexible supply. However, developing countries often have short falls in electricity production that are met simply by curtailing electricity to different regions at certain times of the day. In some countries, such as India, a significant portion of the population does not have any access to electricity; therefore expanding the grid is a high priority. Additional losses, up to 3%, can be incurred in systems due to the need to transform the power to lower voltages.

Investment costs for transmission and distribution systems are of the same magnitude as production plant investments. Transmission and distribution costs for low-voltage users can account for 5-10% of the delivered electricity price. In most countries, these costs are averaged among all customers to the benefit of those in remote areas.

There are several technological options available or under development to improve efficiencies of the grid:

- Utilities can increase the use of high voltage lines. Losses in high-voltage, AC lines amount to 15% per

- 1,000km at 380kV and 8% per 1,000km at 750kV.
- It has become possible to transmit DC power at higher voltages and over longer distances with low transmission losses – typically 3% per 1,000km. Such systems require less land, are easier to control and can now be easily integrated with AC grids.
- New transformers are available that, if used to replace those that are 30 years' old, could reduce transformer losses by 90%.
- Storage options are also expanding beyond the traditional use of hydro-pump-storage systems. Research is underway to improve the use of super capacitors, batteries, and underground compressed air energy storage systems.

Questions:

- Assuming that there is a need to expand the availability of electricity for the poor and the reliability of electricity supplies for industry in your country, what barriers relating to transmission and distribution need to be overcome to meet these needs?
- How could the international community help to overcome these barriers? What would be the best means for the utility operators in your country to gain information, know-how and technology needed to improve their transmission and distribution systems?

4.8 Transport

Transport accounts for nearly half of the oil used worldwide and nearly 25% of energy-related CO₂ emissions. Since 1990, transport emissions of CO₂ worldwide have increased by 36%. According to IEA 2008, energy use for transport is likely to increase by more than 50% by 2030, with a significant part of this growth occurring in developing countries. The fastest growth is likely to come from air travel, road freight, and light duty vehicles. Two main factors influence the growth in emissions: the volume of travel and the changes in efficiency of the mode of travel, which have only partially offset the growth of the former in recent years.

Improving the fuel economy of light-duty vehicles is one of the most important and cost effective measures to save energy. With strong policies, available technologies have the potential to reduce the energy use per kilometer of new vehicles by up to 30% over the next 15 years. There are numerous options to improve efficiencies and reducing

emissions such as: increasing the use of biofuels particularly from sugar cane; improvements in drive trains, aerodynamics, tires and auxiliary equipment; hybridization; and light weight materials. Other technologies such as fuel cells and on-board storage of electricity (batteries and ultra-capacitors, H₂ storage) are not yet mature and may take some time before they are ready for widespread deployment.

In addition, modal shifts can have a large impact on energy use, but the dynamics of city growth are complex and what works in one city may not work in others. However, several elements appear to be important: strong urban planning, investments in public transport and non-motorized infrastructure, and policies to discourage car use (e.g., congestion charges and road pricing).

Given the nature of this paper, we cannot hope to cover all the emerging technologies or the modes of transport (truck, marine and air) in depth. However, this is a critical sector for most developing countries that are rapidly expanding transportation and facing congestion problems. We add a few questions below for consideration by the reader with the hope that they provoke more thorough and thought-provoking consideration.

Questions:

- Does your country have a record keeping system for data on motorized vehicles?
- Does your country have a transportation plan and does it encourage cities to develop integrated urban/transport development plans? Are there efficiency standards or other policy measures in place that promote the use of efficient vehicles?
- If your country has used subsidies to offset the price of gasoline, has your country adjusted these subsidies in light of the recent price of gasoline?
- How can the international community help to encourage a more efficient transport system in your country?

5. SOME ISSUES RELATING TO AN INTERNATIONAL AGREEMENT

The previous sections have provided insights into the RDD&D cycle, including the roles of industry and government, the trends in financing sustainable technologies, including some financial mechanisms, and the status of a few key technologies. In the political forum of the UNFCCC, Parties are currently struggling to find means to enhance innovation and expand the deployment, transfer to and commercialization of new technologies, particularly in developing countries. Various proposals have been put forth by Parties in submissions for the second session of the AWG-LCA and at workshops of the Expert Group on Technology Transfer (EGTT) in 2008. Examples of these proposals are listed in *Box 2*, however the list is by no means exhaustive.

The reader may wish to consider these proposals in the light of the current experience of his/her country in developing and deploying technology. Without going into the merits of each proposal, it may be useful to consider criteria that might guide the consideration of the list in *Box 2* and/or any additional ideas. However, keep in mind that it is generally recognized that a “full package” approach, i.e., not only equipment, but also software, human capacities, financial resources and assistance in developing an appropriate regulatory and institutional framework, is often needed. Such an approach would also have to address different technological stages: retrofitting existing equipment; wider deployment of existing climate friendly technologies and the development, and demonstration of new technologies. Each of these stages have unique barriers that may require a different financial solutions. Finally, the international community will need to determine how to monitor, report, and verify any agreement to enhance RDD&D of technology. A comprehensive discussion of options under consideration is beyond the scope of this paper, but the reader may wish to review FCCC/SBSTA/2008/INF.2 for additional information.¹¹

Following the framework of the RDD&D cycle (rather than the structure in *Box 2*), the following questions relating to evaluation criteria are posed for consideration:

A. Expanding technology research, development, and demonstration and promoting innovation

- Will the proposal encourage or discourage institutions from undertaking R&D?
- Are the technologies to be investigated of importance to your country?
- Is the proposal applicable to all technologies or just a few?
- What would be required of your government if it wished to avail itself of the new proposal?
- How might your government or industry benefit from the proposal?
- Can and, if so, how should the proposal be financed, evaluated and implemented?
- Would the “proposal” help the industry in your country?

B. Deploying, Commercialising, and Transferring Technology

- Is the problem to be addressed a real problem in your country?
- Does the problem warrant an international mechanism (and its associated bureaucracy) or would it be more appropriately addressed on a case by case basis?
- Can the “proposal” be implemented to the benefit of all or only a few countries?
- Will the “proposal” inhibit or encourage the participation of industries in the developed and developing country?
- Will the “proposal” result in additional investments for technology and capacity building in your country?
- Can the “proposal” be evaluated?

C. Financing Technology

- Does the financial “proposal” address a significant need and what are the chances of success if it is implemented?
- Are the financial needs of each part of the RDD&D cycle addressed by the proposal and is the proposed solution appropriate for each part of the cycle?
- Does the financial “proposal” address each element of the “full package approach” and is the proposed solution appropriate for each element?
- Can the financial proposal be evaluated and monitored?

Box 2. Proposals from Parties to the UNFCCC

i) Institutional arrangements for a new enhanced mechanism for RDD&D and transfer of technologies in a future international agreement:

The creation of a new body is proposed with mandate to adopt initiatives for enhanced action on, e.g.:

- Compulsory licensing;
- Patent purchase;
- Financing within UNFCCC framework for technology transfer;
- Incentive provisions for technology transfer;
- Funding for technology cooperation activities;
- Further identification of national and regional technology needs;
- Development of indicators, monitoring, verification and reporting of technology transfer activities and their impacts.

ii) New policy initiatives (co-ordinated at international level):

- Specific technology or sector-based approaches. In this regard, it is necessary to identify parties with an interest in particular technologies or sector initiatives for technology cooperation (RDD&D) or relating to project based mechanisms;
- Technology and efficiency standards;
- Identification of breakthrough technologies to be focused by multilateral technology cooperation;
- Creation of excellence centers to promote technology development and deployment, disseminate information, and participate in international technology cooperation;
- Information diffusion mechanisms (national and international).

iii) New financial mechanisms:

- Multilateral Fund (public funding) aiming at the purchase of licenses to support diffusion of existing technologies, provide financial incentives for technology transfer, support technology cooperation and promote capacity building activities;
- Venture capital initiative (private funding).

¹¹ FCCC/SBSTA/2008/INF.2 - Proposed terms of reference for a reporting on performance indicators and for a report on future financing options for enhancing technology transfer (SBSTA: Subsidiary Body for Scientific and Technological Advice).

BIBLIOGRAPHY

Climate Change 2007. Impacts, Adaptation and Vulnerability Contribution of Working Group II to the AR4 of the IPCC [M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, N.Y., USA.

Climate Change 2007. Mitigation. Contribution of Working Group III to the Fourth Assessment Report (AR4) of the IPCC [B. Metz, O. R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

DEWI, Deutsches Windenergie-Institut GmbH 2006. DEWI website: www.dewi.de. Access August 2008.

Gupta, S., D. A. Tirpak, N. Burger, J. Gupta, N. Höhne, A. I. Boncheva, G. M. Kanoan, C. Kolstad, J. A. Kruger, A. Michaelowa, S. Murase, J. Pershing, T. Saijo, A. Sari, 2007. Policies, Instruments and Co-operative Arrangements. In Climate change 2007: Mitigation. Contribution of Working Group III to the AR4 of the IPCC [B. Metz, O. R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

IEA 2007. Potential Contribution of Bioenergy to the Worlds Future Energy Demand, OECD/IEA Bioenergy, Paris. Available from: <http://www.ieabioenergy.com>.

IEA (List of Implementing Agreements): <http://www.iea.org/Textbase/techno/index.asp>. Access August 2008.

IPCC 2007a: Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report (AR4) of the IPCC [B. Metz, O. R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

IPCC 2007b: Climate Change 2007 – Impacts, Adaptation and Vulnerability Contribution of Working Group II to the AR4 of the IPCC [M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, N.Y., USA.

Stern N. (editor) (2006): The Stern Review Report: The Economics of Climate Change, London, HM Treasury. Available from http://www.hm-treasury.gov.uk/independent_reviews/stern_review_econom-ics_climate_change/sternreview_index.cfm. Also available from Cambridge University Press.

Tirpak, D. in collaboration with Sujata Gupta, Daniel Perczyk, and Massamba Thioue 2008. National policies and their linkages to negotiations over a future international climate change agreement, UNDP, 2008.

UNEP/NEF 2008. Global Trends in Sustainable Energy Investment 2008, UNEP SEFI, New Energy Finance. Available from <http://sefi.unep.org/english/globaltrends.html>. Access August 2008.

UNFCCC 2007. Investment and Financial Flows to Address Climate Change, Published by UNFCCC, Bonn. Available from www.unfccc.int.

Vattenfall 2008. “The Climate Threat. Can Humanity Rise to the Greatest Challenge of Our Times?”. Available from www.vattenfall.com. Access August 2008.

World Business Council for Sustainable Development 2007. Investing in a Low-Carbon Energy Future in the Developing World, WBCSD. Available from www.wbcsd.org.

ANNEXES

Annex 1. Main mitigation technologies per economic sector

As shown below, available studies point at a number of sectors (power, buildings, and industry) and related technologies (energy efficiency, CCS, and renewables) as the main contributors to GHG mitigation in the medium and long term.

SECTOR	EXISTING TECHNOLOGIES	NEW TECHNOLOGIES (AVAILABLE BY 2030)
Power (energy supply)	Improved supply and distribution efficiency Fuel switching (coal to gas) Nuclear power Renewable heat and power CHP CCS (early applications)	CCS for gas, biomass and coal fired electricity generation Advanced nuclear power Advanced renewables (tidal, concentrating solar, etc.)
Transport	Fuel efficient vehicles Hybrid vehicles Biofuels Modal shifts from road transport to rail Land use and transport planning	Second generation biofuels Advanced electric and hybrid vehicles
Buildings	Efficient lighting Efficient appliances/heating/cooling Improved cook stoves and insulation Passive and active solar design	Integrated design including technologies such as intelligent meters Solar PV integrated in buildings
Industry	Efficient end use electrical equipment Heat and power recovery Material recycling Control of non CO ₂ emissions Process-specific technologies	Advanced energy efficiency CCS for cement, ammonia and iron Inert electrodes for aluminium production
Forestry	Afforestation – reforestation Forest management Reduced deforestation Harvested wood product management Use of forestry products for bioenergy	Tree species improvement to increase biomass and carbon sequestration Improved remote sensing technologies for analysis of sequestration potential and mapping land use change
Waste management	Landfill methane recovery; waste incineration with energy recovery; composting of organic waste; controlled waste water treatment; recycling and waste minimization	Biocovers and biofilters to optimize methane oxidation
Agriculture	Improved crop and grazing land management to increase soil carbon storage; restoration of cultivated peat soils and degraded lands; improved rice cultivation techniques and manure management to reduce CH ₄ emissions; improved nitrogen fertilizer application techniques to reduce N ₂ O emissions; dedicated energy crops to replace fossil fuel use; energy efficiency	Improvements of crop yields

Source: Summarized from IPCC (2007a), chapter 13

Figure a: Stern Review estimates of mitigation potential for different technologies

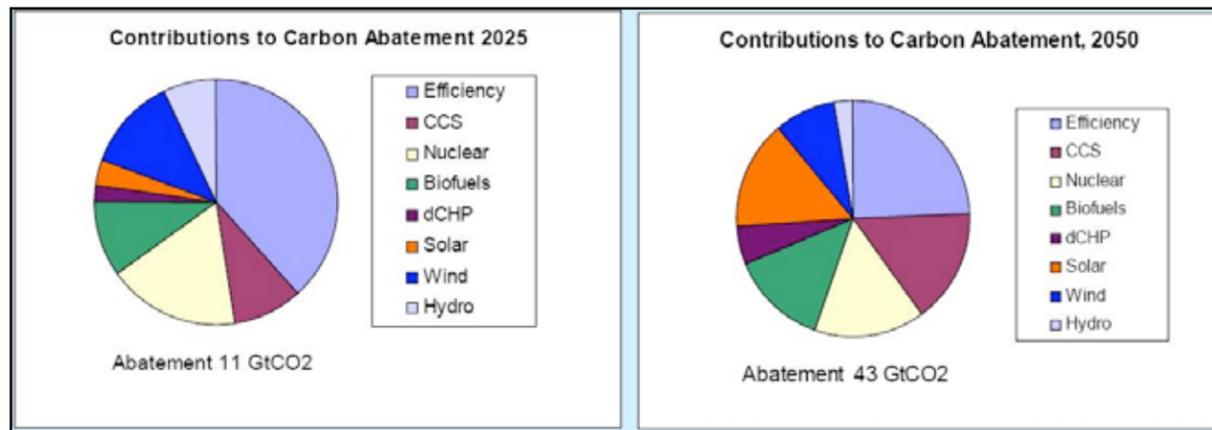
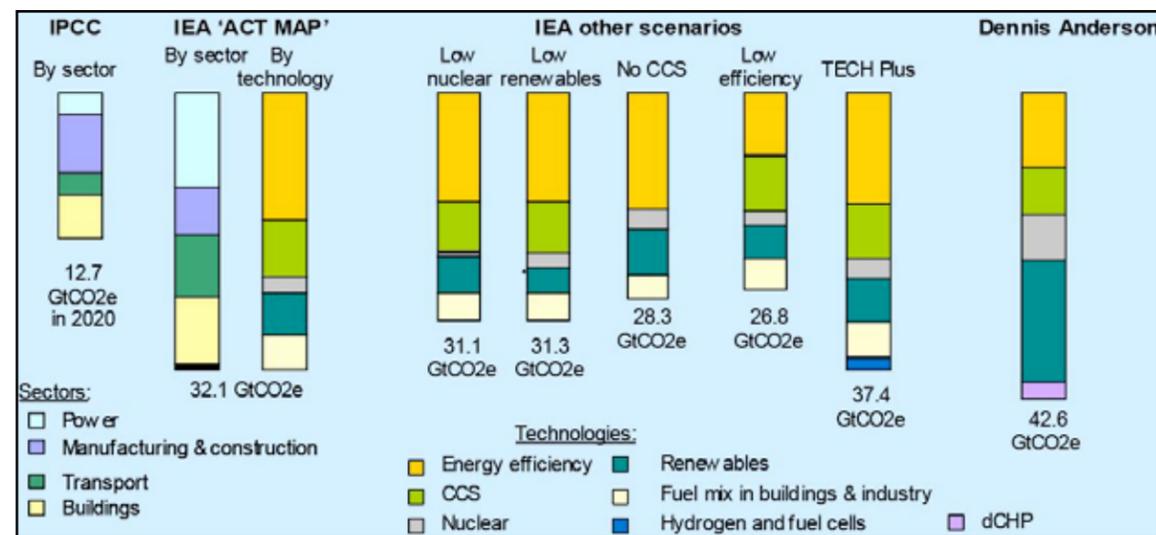


Figure b: Stern Review (Dennis Anderson) mitigation estimates vis-a-vis IEA and IPCC: sources of fossil fuel related emission savings in 2050



Source of figures a and b: Stern Review¹², chapter 9

The bars in *Figure b* show the composition of emissions reductions achieved in different models. The IPCC work relates to emissions savings in 2020, while the others relate to emissions savings in 2050. Separately, the IPCC have also estimated plausible emissions savings from non-energy sectors.

The IPCC reviewed studies on the extent to which emissions could be cut in the power, manufacturing and construction, transport, and buildings sectors. They find that for a cost of less than \$25/tCO₂-eq, emissions could be cut by 10.8-14.7 GtCO₂-eq in 2020. The savings presented in *Figure b* are around the mid-point of this range.

The IEA Energy Technology Perspectives report sets out a range of scenarios for reducing energy-related CO₂ emissions by 2050, based on a marginal abatement cost of \$25/tCO₂ in 2050 and investment in R&D of new technologies. The 'ACT MAP' scenario is the central scenario; the others make different assumptions on, for instance, the success of CCS technology and the ability to improve energy efficiency. Total emission savings range from 27 to 37 GtCO₂/yr. In all scenarios, the IEA finds that the CO₂ intensity of power generation is half current levels by 2050. However there is much less progress in the transport sector in all scenarios apart from TECH PLUS, because further abatement from transport is too expensive. To achieve further emission cuts beyond 2050, transport would have to be decarbonised.

¹² N.Stern (editor) (2006): The Stern Review Report: The Economics of Climate Change, London, HM Treasury.

Annex 2. COP decisions related to technology transfer

ISSUE	DECISIONS	PROVISIONS
COP 13 (Bali, 2007)	Decision 1/CP.13	Bali Action Plan
	Decision 2/CP.13	Reducing emissions from deforestation in developing countries: approaches to stimulate action
	Decision 3/CP.13	Development and transfer of technologies under the Subsidiary Body for Scientific and Technological Advice
	Decision 4/CP.13	Development and transfer of technologies under the Subsidiary Body for Implementation
	Decision 6/CP.13	Fourth review of the financial mechanism
	Decision 9/CP.13	Amended New Delhi work program on Article 6 of the Convention
	Decision 13/CP.13	Program budget for the biennium 2008–2009
	COP 12 (Nairobi 2006)	Decision 3/CP.12
Decision 4/CP.12		Capacity-building under the Convention
Decision 5/CP.12		Development and transfer of technologies
COP 11 (Montreal, 2005)	Decision 1/CP.11	Dialogue on long-term cooperative action to address climate change by enhancing implementation of the Convention
	Decision 2/CP.11	Five-year program of work of the Subsidiary Body for Scientific and Technological Advice on impacts, vulnerability and adaptation to climate change
	Decision 5/CP.11	Additional guidance to an operating entity of the financial mechanism
	Decision 6/CP.11	Development and transfer of technologies
	Decision 12/CP.11	Program budget for the biennium 2006–2007
COP 10 (Buenos Aires, 2004)	Decision 1/CP.10	Buenos Aires program of work on adaptation and response measures
	Decision 6/CP.10	Development and transfer of technologies
	Decision 12/CP.10	Guidance relating to the CDM
	Draft decision -/CMP.1	Simplified modalities and procedures for small-scale afforestation and reforestation project activities under the CDM in the first commitment period of the Kyoto Protocol and measures to facilitate their implementation
COP 9 (Milan, 2003)	Decision 3/CP.9	Report of the Global Environment Facility to the Conference of the Parties
	Decision 4/CP.9	Additional guidance to an operating entity of the financial mechanism
	Decision 5/CP.9	Further guidance to an entity entrusted with the operation of the financial mechanism of the Convention, for the operation of the Special Climate Change Fund
	Decision 16/CP.9	Program budget for the biennium 2004–2005
	Decision 19/CP.9	Modalities and procedures for afforestation and reforestation project activities under the CDM in the first commitment period of the Kyoto Protocol

ISSUE	DECISIONS	PROVISIONS
COP 8 (New Delhi, 2002)	Decision 1/CP.8	Delhi Ministerial Declaration on Climate Change and Sustainable Development
	Decision 3/CP.8	Consultative Group of Experts on National Communications from Parties not included in Annex I to the Convention
	Decision 6/CP.8	Additional guidance to an operating entity of the financial mechanism
	Decision 7/CP.8	Initial guidance to an entity entrusted with the operation of the financial mechanism of the Convention, for the operation of the Special Climate Change Fund
	Decision 10/CP.8	Development and transfer of technologies
	Decision 11/CP.8	New Delhi work program on Article 6 of the Convention
	Decision 12/CP.8	Relationship between efforts to protect the stratospheric ozone layer and efforts to safeguard the global climate system: issues relating to hydrofluorocarbons and perfluorocarbons
	Decision 13/CP.8	Cooperation with other conventions
COP 7 (Marrakech, 2001)	Decision 2/CP.7	Capacity building in developing countries (non-Annex I Parties)
	Decision 3/CP.7	Capacity building in countries with economies in transition
	Decision 4/CP.7	Development and transfer of technologies (Decisions 4/CP.4 and 9/CP.5)
	Decision 5/CP.7	Implementation of Article 4, paragraphs 8 and 9, of the Convention (Decision 3/CP.3 and Article 2, paragraph 3, and Article 3, paragraph 14, of the Kyoto Protocol)
	Draft Decision -/CMP.1	Matters relating to Article 3, paragraph 14, of the Kyoto Protocol
COP 6 (The Hague, 2000)	Decision 14/CP.7	Impact of single projects on emissions in the commitment period
	Decision 1/CP.6	Implementation of the Buenos Aires Plan of Action
COP 5 (Bonn, 1999)	Decision 9/CP.5	Development and transfer of technologies: status of the consultative process
	Decision 10/CP.5	Capacity-building in developing countries (non-Annex I Parties)
	Decision 12/CP.5	Implementation of Article 4, paragraphs 8 and 9, of the Convention and matters relating to Article 3, paragraph 14, of the Kyoto Protocol
	Decision 17/CP.5	Relationship between efforts to protect the stratospheric ozone layer and efforts to safeguard the global climate system
COP 4 (Buenos Aires, 1998)	Decision 1/CP.4	The Buenos Aires Plan of Action
	Decision 2/CP.4	Additional guidance to the operating entity of the financial mechanism
	Decision 3/CP.4	Review of the financial mechanism
	Decision 4/CP.4	Development and transfer of technologies
	Decision 5/CP.4	Implementation of Article 4.8 and 4.9 of the Convention (decision 3/CP.3 and Articles 2.3 and 3.14 of the Kyoto Protocol)
	Decision 11/CP.4	National communications from Parties included in Annex I to the Convention
	Decision 13/CP.4	Relationship between efforts to protect the stratospheric ozone layer and efforts to safeguard the global climate system: issues related to hydrofluorocarbons and perfluorocarbons
	Decision 3/CP.3	Implementation of Article 4, paragraphs 8 and 9, of the Convention
COP 3 (Kyoto, 1997)	Decision 9/CP.3	Development and transfer of technologies
	Decision 13/CP.3	Division of labor between the Subsidiary Body for Implementation and the Subsidiary Body for Scientific and Technological Advice
	Decision 15/CP.3	Program budget for the biennium 1998–1999
	Kyoto Protocol to the UNFCCC	Articles 2, 3, 10, 11

ISSUE	DECISIONS	PROVISIONS
COP 2 (Geneva, 1996)	Decision 7/CP.2	Development and transfer of technologies
	Decision 9/CP.2	Communications from Parties included in Annex I to the Convention: guidelines, schedule and process for consideration
	Decision 10/CP.2	Communications from Parties not included in Annex I to the Convention: guidelines, facilitation and process for consideration
	Decision 12/CP.2	Memorandum of Understanding between the Conference of the Parties and the Council of the Global Environment Facility
	Resolution 1/CP.2	Expression of gratitude to the Government of Switzerland
	Other action taken by the conference of the parties	The Geneva Ministerial Declaration
COP 1 (Berlin, 1995)	Decision 1/CP.1	The Berlin Mandate: Review of the adequacy of Article 4, paragraph 2 (a) and (b), of the Convention, including proposals related to a protocol and decisions on follow-up
	Decision 2/CP.1	Review of first communications from the Parties included in Annex I to the Convention
	Decision 6/CP.1	The subsidiary bodies established by the Convention
	Decision 11/CP.1	Initial guidance on policies, program priorities and eligibility criteria to the operating entity or entities of the financial mechanism
	Decision 13/CP.1	Transfer of technology

Annex 3. Glossary

TERM	DEFINITION
Adaptation	Adjustment in natural or human systems to a new or changing environment. Adaptation to climate change refers to adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation.
Ad Hoc Working Group on Long-term Cooperative Action under the Convention (AWG-LCA)	At its thirteenth session, the COP, by its decision 1/CP.13, launched a comprehensive process to enable the full, effective and sustained implementation of the Convention through long-term cooperative action, now, up to and beyond 2012, in order to reach an agreed outcome and adopt a decision at its fifteenth session. It decided that the process shall be conducted under a subsidiary body under the Convention, the AWG-LCA, that shall complete its work in 2009 and present the outcome of its work to the COP for adoption at its fifteenth session.
Afforestation	Is the direct human-induced conversion of land that has not been forested for a period of at least 50 years to forested land through planting, seeding and/or the human-induced promotion of natural seed sources.
Baseline	The baseline (or reference) is any datum against which change is measured. It might be a "current baseline," in which case it represents observable, present-day conditions. It might also be a "future baseline," which is a projected future set of conditions excluding the driving factor of interest. Alternative interpretations of the reference conditions can give rise to multiple baselines.
Biomass fuels or biofuels	A fuel produced from dry organic matter or combustible oils produced by plants. These fuels are considered renewable as long as the vegetation producing them is maintained or replanted, such as firewood, alcohol fermented from sugar, and combustible oils extracted from soy beans. Their use in place of fossil fuels cuts GHG emissions because the plants that are the fuel sources capture carbon dioxide from the atmosphere.
Capacity building	Increasing skilled personnel and technical and institutional abilities.
Carbon Capture and Storage (CCS)	CO ₂ is already being captured in the oil and gas and chemical industries. Several plants capture CO ₂ from power station flue gases for use in the food industry. However, only a fraction of the CO ₂ in the flue gas stream is captured.
Certified Emission Reductions (CERs)	A Kyoto Protocol unit equal to 1 metric tonne of CO ₂ equivalent. CERs are issued for emission reductions from CDM project activities. Two special CERs – temporary certified emission reduction (tCERs) and long-term certified emission reductions (lCERs) – are issued for emission removals from afforestation and reforestation CDM projects.
Clean Development Mechanism (CDM)	Defined in Article 12 of the Kyoto Protocol, the CDM is intended to meet two objectives: (1) to assist parties not included in Annex I in achieving sustainable development and in contributing to the ultimate objective of the convention; and (2) to assist parties included in Annex I in achieving compliance with their quantified emission limitation and reduction commitments. Certified Emission Reduction Units from CDM projects undertaken in non-Annex I countries that limit or reduce GHG emissions, when certified by operational entities designated by Conference of the Parties/ Meeting of the Parties, can be accrued to the investor (government or industry) from parties in Annex B. A share of the proceeds from certified project activities is used to cover administrative expenses as well as to assist developing country parties that are particularly vulnerable to the adverse effects of climate change to meet the costs of adaptation.
Climate	Climate in a narrow sense is usually defined as the 'average weather', or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years. These quantities are most often surface variables such as temperature, precipitation, and wind. Climate in a wider sense is the state, including a statistical description, of the climate system. The classic period of time is 30 years, as defined by the World Meteorological Organization (WMO).

TERM	DEFINITION
Climate change	Climate change refers to a change in the state of the climate that can be identified (e.g., using statistical tests) by changes in the mean and/ or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land use. Note that UNFCCC, in its Article 1, defines "climate change" as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods". The UNFCCC thus makes a distinction between "climate change" attributable to human activities altering the atmospheric composition, and "climate variability" attributable to natural causes.
Combined Heat and Power (CHP)	CHP is the simultaneous generation of usable heat and power (usually electricity) in a single process. Through the use of an absorption cooling cycle, trigeneration or CHP schemes can also be developed. CHP is a highly efficient way to use both fossil and renewable fuels and can therefore make a significant contribution to sustainable energy goals, bringing environmental, economic, social and energy security benefits.
Deforestation	Conversion of forest to non-forest. For a discussion of the term forest and related terms such as afforestation, reforestation, and deforestation, see the <i>IPCC Special Report on Land Use, Land-Use Change, and Forestry</i> (IPCC, 2000).
Emissions	In the climate change context, emissions refer to the release of GHGs and/or their precursors and aerosols into the atmosphere over a specified area and period of time.
Energy efficiency	Ratio of energy output of a conversion process or of a system to its energy input.
Finance	The science that describes the management of money, banking, credit, investments, and assets.
Fossil fuels	Carbon-based fuels from fossil carbon deposits, including coal, oil, and natural gas.
Integrated gasification combined cycle (IGCC)	IGCC is a process in which a low-value fuel such as coal, petroleum coke, or municipal waste is converted to low heating value, high-hydrogen gas in a process called gasification. The gas is then used as the primary fuel for a gas turbine. IGCC can also be viewed as the two-stage combustion of an opportunity feedstock. First, the feedstock is partially combusted in a reactor or gasifier. Then the combustion is completed in the gas turbine.
Intellectual property rights (IPRs)	IPRs, very broadly, are rights granted to creators and owners of works that are the result of human intellectual creativity. These works can be in the industrial, scientific, literary or artistic domains. They can be in the form of an invention, a manuscript, a suite of software, or a business name, as examples. In general, the objective of intellectual property law is to grant the creator of a work certain controls over the exploitation of that work, as the unfettered ability of others to copy the work or invention may deprive the creator of reward and incentive. For some IPRs, the grant of protection is also in return for the creator making the work accessible to the general public. Intellectual property law maintains a balance by (in most cases) granting the rights for a limited time. Some rights require registration, for example, patent right, whilst other rights accrue automatically upon the work's creation as in copyright.
International Energy Agency (IEA)	Paris-based energy forum established in 1974. It is linked with the Organisation for Economic Cooperation and Development to enable member countries to take joint measures to meet oil supply emergencies, to share energy information, to coordinate their energy policies, and to cooperate in the development of rational energy programs.
Intergovernmental Panel on Climate Change (IPCC)	Established in 1988 by the World Meteorological Organization and UNEP, the IPCC surveys world-wide scientific and technical literature and publishes assessment reports that are widely recognized as the most credible existing sources of information on climate change. The IPCC also works on methodologies and responds to specific requests from the Convention's subsidiary bodies. The IPCC is independent of the Convention.
Investment	Investment from the perspective of the domestic economy is the purchase of capital equipment, e.g., machines and computers, and the construction of fixed capital, e.g., factories, roads, housing, that serve to raise the level of output in the future. From the perspective of an individual, investment is expenditure, usually on a financial asset, designed to increase the individual's future wealth.
IPCC Fourth Assessment Report (AR4)	The main activity of the IPCC is to provide in regular intervals Assessment Reports of the state of knowledge on climate change. The latest one is "Climate Change 2007"; the Fourth IPCC Assessment Report.
IPCC Working Group III (WGIII)	Assesses options for mitigating climate change through limiting or preventing GHG emissions and enhancing activities that remove them from the atmosphere.
Mitigation	An anthropogenic intervention to reduce the sources or enhance the sinks of GHGs.

TERM	DEFINITION
Natural gas fired combined cycle (NGCC)	NGCC is an advanced power generation technology, which allows improving the fuel efficiency of natural gas. Most new gas power plants in North America and Europe are of this type. A gas turbine generator generates electricity and the waste heat is used to make steam to generate additional electricity via a steam turbine.
New Energy Finance (NEF)	New Energy Finance is a provider of information and research to investors in renewable energy, low-carbon technology and the carbon markets, operating across all sectors of renewable energy and low-carbon technology, including, wind, solar, biofuels, biomass, and energy efficiency, as well as the carbon markets.
Photovoltaics (PV)	This is the direct conversion of solar radiation – sunlight – into electricity by the interaction of light with the electrons in a semi-conductor device or cell.
Pulverized coal combustion (PCC)	Combustion and conversion systems can generally be categorized into either of the following two categories: 1) current commercial technologies or 2) emerging technologies. The CCBs currently produced and used primarily result from current commercial technologies, and of these, the most common are pulverized coal combustion, cyclone firing, and stoker firing.
Reforestation	The direct human-induced conversion of non-forested land to forested land through planting, seeding and/or the human-induced promotion of natural seed sources, on land that was forested but that has been converted to non-forest land (UNFCCC).
Renewables, Renewable Energy	Energy sources that are, within a short time frame relative to the Earth's natural cycles, sustainable, and include non-carbon technologies such as solar energy, hydropower, and wind, as well as carbon-neutral technologies such as biomass.
Research, development and demonstration (RD&D)	Scientific and/or technical R&D of new production processes or products, coupled with analysis and measures that provide information to potential users regarding the application of the new product or process; demonstration tests; and feasibility of applying these products processes via pilot plants and other pre-commercial applications.
Scenario	A plausible and often simplified description of how the future may develop, based on a coherent and internally consistent set of assumptions about driving forces and key relationships. Scenarios may be derived from projections, but are often based on additional information from other sources, sometimes combined with a narrative storyline.
Sector	A part or division, as of the economy (e.g., the manufacturing sector, the services sector) or the environment (e.g., water resources, forestry).
Special Report on Emission Scenarios (of the IPCC) (SRES)	The storylines and associated population, GDP and emissions scenarios associated with the SRES (Nakićenović et al., 2000), and the resulting climate change and sea-level rise scenarios. Four families of socio-economic scenario (A1, A2, B1 and B2) represent different world futures in two distinct dimensions: a focus on economic versus environmental concerns, and global versus regional development patterns.
SRES A1	The A1 storyline and scenario family describes a future world of very rapid economic growth, global population that peaks in mid-century and declines thereafter, and the rapid introduction of new and more efficient technologies. Major underlying themes are convergence among regions, capacity building and increased cultural and social interactions, with a substantial reduction in regional differences in per capita income.
SRES A2	The A2 storyline and scenario family describes a very heterogeneous world. The underlying theme is self-reliance and preservation of local identities. Fertility patterns across regions converge very slowly, which results in continuously increasing population. Economic development is primarily regionally oriented and per capita economic growth and technological change more fragmented and slower than other storylines.
SRES B1	The B1 storyline and scenario family describes a convergent world with the same global population, that peaks in mid-century and declines thereafter, as in the A1 storyline, but with rapid change in economic structures toward a service and information economy, with reductions in material intensity and the introduction of clean and resource-efficient technologies. The emphasis is on global solutions to economic, social and environmental sustainability, including improved equity, but without additional climate initiatives.
SRES B2	The B2 storyline and scenario family describes a world in which the emphasis is on local solutions to economic, social and environmental sustainability. It is a world with continuously increasing global population, at a rate lower than A2, intermediate levels of economic development, and less rapid and more diverse technological change than in the B1 and A1 storylines. While the scenario is also oriented towards environmental protection and social equity, it focuses on local and regional levels.

TERM	DEFINITION
Sustainable development	Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.
Technology Transfer	Transmission of know-how, equipment and products to governments, organizations or other stakeholders. Usually also implies adaptation for use in a specific cultural, social, economic and environmental context.
United Nations Framework Convention on Climate Change (the Convention) (UNFCCC)	The Convention was adopted on 9 May 1992, in New York, and signed at the 1992 Earth Summit in Rio de Janeiro by more than 150 countries and the European Community. Its ultimate objective is the 'stabilization of GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system'. It contains commitments for all Parties. Under the Convention, Parties included in Annex I aim to return GHG not controlled by the Montreal Protocol to 1990 levels by the year 2000. The Convention entered in force in March 1994.
World Business Council for Sustainable Development (WBCSD)	The World Business Council for Sustainable Development (WBCSD) is a CEO-led, global association of some 200 companies dealing exclusively with business and sustainable development.

KEY ISSUES ON LAND USE, LAND USE CHANGE AND FORESTRY (LULUCF) WITH AN EMPHASIS ON DEVELOPING COUNTRY PERSPECTIVES

CARMENZA ROBLEDO AND JÜRGEN BLASER

INTERCOOPERATION, BERN, SWITZERLAND

CONTENTS

Acronyms	253
Units and Measures	254
1. Introduction	255
2. LULUCF activities under the Convention and its Kyoto Protocol	256
2.1 Milestones in the process	256
2.1.1 Initial discussions	256
2.1.2 Adoption of the Kyoto Protocol (1997)	256
2.1.3 Conference of the Parties (COP) 7 (2001)	257
2.2 LULUCF activities in Annex I Parties	258
2.2.1 Accounting rules	258
2.2.2 Reporting requirements	259
2.3 LULUCF activities in non-Annex I Parties	260
2.4 Lessons learned from LULUCF negotiations	262
3. Technical and methodological issues and requirements for future LULUCF options	263
3.1 Carbon pools	263
3.2 Baseline or reference scenario	264
3.3 Leakage	265
3.4 Permanence	266
3.5 Additionality	267
3.6 Environmental and socioeconomic impacts of mitigation activities	267
3.7 Monitoring and reporting	267
4. Mitigation options in forestry with a focus on developing countries	269
4.1 Reducing emissions from deforestation and forest degradation	271
4.2 Forest management	275
4.3 Forest restoration	276
4.4 Afforestation and Reforestation	277
4.5 Substitution and the use of forest biofuel	278
5. Overview of existing policy options	280
5.1 Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol (AWG-KP)	280
5.2 Ad Hoc Working Group on Long-term Cooperative Action under the Convention (AWG-LCA)	280
5.3 Ongoing discussion in the SBSTA with regard to REDD	281
5.4 Policy Instruments and Approaches	282
5.5 Financing Options	283
6. Conclusion	286
Bibliography	288
Further reading	288
References	288

Acknowledgements

UNDP and the authors gratefully acknowledge the constructive suggestions made for this report by the UNFCCC secretariat and UNDP staff members, as well as Maria Gutierrez, Hernan Carlino, Jayant Sathaye, Chad Carpenter, Susanne Olbrisch and Naira Aslanyan.

Annexes	292
Annex 1. Key definitions in LULUCF	292
Annex 2. Definitions of deforestation and forest degradation	293
Annex 3. Input from the IPCC on LULUCF matters	295
Annex 4. Decision pathway for A/R CDM and REDD	296
Annex 5. From LULUCF to Agriculture, Forestry and Other Land Use (AFOLU)	297
Annex 6. Glossary	298
Tables	
Table 1: A comparison regarding LULUCF emissions and removals	258
Table 2: Mitigation options in forestry	269
Table 3: Estimates of carbon loss from forests attributed to deforestation	272
Table 4: Deforestation and forest degradation (DD) according to direct drivers in the 90s	273
Table 5: Estimated extent of degraded forest landscapes by category in Tropical Asia, Tropical America and Tropical Africa (million ha) in year 2000*	276
Table 6: Issues under current discussion	281
Table 7: Main positive and negative aspects of different policy instruments	282
Table 8: Some proposals for funding mechanisms on REDD	284
Figures	
Figure 1: Carbon pools in forests	263
Figure 2: Illustrative overview of mitigation options in forest management	271
Boxes	
Box 1: Key definitions of the UNFCCC relevant to LULUCF	257
Box 2: Handling of forests in an Annex I Party: Switzerland	260

Acronyms

AFOLU	Agriculture, Forestry and Other Land Use		
Annex I	Annex to the Convention listing industrialized and transitional countries	DD	Secretariat supports the work of the CPE. Deforestation and forest degradation
Annex II	Annex to the UNFCCC, listing mostly OECD countries, with additional commitments to assist developing countries with funding and technology transfer	ENCOFOR	Environment and Community-based Framework for Designing Afforestation, Reforestation and Revegetation Projects in the CDM
AR4	IPCC Fourth Assessment Report	EU ETS	European Union Emission Trading System
A/R	Afforestation and reforestation	FAO	Food and Agriculture Organization
ARWG	Afforestation/Reforestation Working Group	FCPF	Forest Carbon Partnership Facility
ARD	Afforestation, reforestation, deforestation (as a requirement for Annex I countries in the KP)	GEF	Global Environment Facility
AWG-KP	Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol	GFP	Global Forest Partnership
AWG-LCA	Ad Hoc Working Group on Long-term Cooperative Action under the Convention	GHG	Greenhouse gas
BAP	Bali Action Plan	GPG	Good Practice Guidance
CDM	Clean Development Mechanism	Ha	Hectare
CDM A/R	Afforestation and Reforestation project activities under the CDM	HFC	Hydrofluorocarbons
CER	Certified emission reductions	HWP	Harvested wood products
tCER	temporary CER	IFRT	International Forest Retention Fund
ICER	long-term CER	IPCC	Intergovernmental Panel on Climate Change
CFRT	Community Forest Retention Trust Account	ITTA	International Tropical Timber Agreement
CH ₄	Methane	ITTO	International Tropical Timber Organization
CO ₂	Carbon dioxide	Jl	Joint Implementation
COP	Conference of the Parties	KP	Kyoto Protocol
CMP	Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol (also known as COP/MOP)	LCA	Life Cycle Analysis
CPF	Collaborative Partnership on Forests; The 14 members of the CPF are the Center for International Forestry Research (CIFOR), UN Food and Agriculture Organization (FAO), International Tropical Timber Organization (ITTO), International Union of Forestry Research Organizations (IUFRO), CBD Secretariat, Secretariat of the Global Environment Facility (GEF), UNCCD Secretariat, UNFCCC Secretariat, United Nations Development Programme (UNDP), United Nations Environment Programme (UNEP), World Agroforestry Centre (ICRAF), World Bank, and World Conservation Union (IUCN). The UNFF	LULUCF	Land Use, Land Use Change and Forestry
		MRV	Measureable, reportable and verifiable
		N ₂ O	Nitrous Oxide
		NAI	Non-Annex I Parties (see above), mostly developing countries
		NFP	National Forest Program
		NLBI	Non-legally binding instruments
		NTEP	Non-timber forest products
		ODA	Official Development Assistance
		OECD	Organization for Economic Co-operation and Development
		PES	Payment for Environmental Services
		PFC	Perfluorocarbons
		REDD	Reducing Emissions from Deforestation and Forest Degradation
		SBSTA	Subsidiary Body for Scientific and Technological Advice
		SFM	Sustainable Forest Management
		TARAM	Tool for Afforestation and Reforestation Approved Methodologies
		UNDP	United Nations Development Programme
		UNEP	United National Environment Programme
		UNFCCC	United Nations Framework Convention on Climate Change

UNFF	UN Forum on Forests
WG I	Working Group I (of the IPCC, see above), assesses the literature on the physical science basis of climate change
WG II	Working Group II (of the IPCC, see above), assesses the literature on the impacts, vulnerability and adaptation to climate change
WG III	Working Group III (of the IPCC, see above), assesses the literature on the mitigation of climate change, i.e. reducing GHG emissions
WMO	World Meteorological Organization

Units and Measures

GtC	Gigatons of carbon
GtCO ₂	Gigatons of carbon dioxide: 1 billion tons CO ₂
MtCO ₂	Megatons of carbon dioxide: 1 million tons CO ₂
tC	tons of carbon
tCO ₂	tons of CO ₂

1. INTRODUCTION

Climate change is widely recognized as one of the most critical challenges the world has ever faced. The Intergovernmental Panel on Climate Change (IPCC) confirmed in its Fourth Assessment Report that there was “new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities” (IPCC, 2007). The IPCC also concluded the world faces an average temperature rise of around 3°C this century if greenhouse gas (GHG) emissions continue to rise at their current pace and are allowed to double from their pre-industrial level. The resulting impacts, even at the lower end of the range given by IPCC, are likely to be severe.

The land use sector, including forestry and agriculture, is an important source of anthropogenic GHG emissions. Land use change, mainly deforestation, contributed to about 20% of the GHG emissions from anthropogenic sources between 1989 and 1998 (IPCC, 2000 and 2007c). When adding all emissions from the land use, land-use change and forestry (LULUCF¹) sector the share is over 30%. In addition, the land use sector has great potential in mitigating climate change.

The role of LULUCF activities in the mitigation of climate change has long been recognized. The United Nations Framework Convention on Climate Change (UNFCCC) recognizes its importance in achieving the goal of stabilizing concentrations of greenhouse gas in the atmosphere and includes commitments relating to the sector. In addition, several articles of the Kyoto Protocol make provisions for the inclusion of land use, land-use change and forestry activities by Parties as part of their implementation efforts and contribute to the mitigation of climate change.

LULUCF will therefore play a key role in any post-2012 international climate change regime emerging from the current negotiating processes under the United Nations. The United Nations Climate Change Conference in December 2007 culminated in the adoption of the Bali Road Map, which consists of a number of forward-looking decisions that represent the various tracks that are essential to reaching a secure climate future. The Bali Road Map includes the Bali Action Plan (BAP),

which charts the course for a new negotiating process under the UNFCCC, with the aim of completing this by 2009. It also includes the current negotiations under the Kyoto Protocol, and their 2009 deadline, which focus on further emission reduction commitments for industrialized countries.

This paper introduces the key issues and challenges arising from the discussions on LULUCF under the UNFCCC and its Kyoto Protocol. It provides:

- An overview of LULUCF activities, including challenges in the past and present negotiations;
- A review of data and information on the key mitigation options in the LULUCF sector, with particular reference to forestry;
- A summary of the main LULUCF issues currently under negotiation.

LULUCF activities cut across a number of economic and development sectors. They are therefore not only important from a climate change perspective, but also in light of wider development policies, including food security, energy generation and wood production.

¹ In this document, the term LULUCF is used, as all decisions of the UNFCCC are based on this term. The 2006 IPCC Guidelines for National Greenhouse Gas Inventories propose a new term, AFOLU (Agriculture, Forestry and Other Land Use). AFOLU has essentially the same meaning as LULUCF in the IPCC Good Practice Guidelines of 2000 but integrating agriculture and LULUCF sectors (see annex 5, “From LULUCF to AFOLU”).

2. LULUCF ACTIVITIES UNDER THE CONVENTION AND THE KYOTO PROTOCOL

LULUCF activities are critical for achieving the overall objective of the UNFCCC to avoid “dangerous interference” with the global climate system. As reflected in the provisions of UNFCCC, this will require the application of policies that “cover all relevant sources, sinks and reservoirs of greenhouse gases” (UNFCCC 1992, Article 3.3). The Convention addresses five sectors considered as sources of anthropogenic emissions: industrial processes, energy, agriculture, waste and LULUCF.

The commitments by Parties to mitigate climate change are defined in Article 4. These commitments take into account Parties’ common but differentiated responsibilities and their specific national and regional development priorities, objectives and circumstances. Article 4 also refers to commitments relating to the LULUCF sector, such as to “develop, periodically update, publish and make available” national inventories of anthropogenic emissions by sources and removals by sinks of all GHGs (paragraph 1(a)). Also included are commitments to promote sustainable management, and promote and cooperate in the conservation and enhancement of sinks and reservoirs of all GHGs, including biomass, forests and oceans as well as other terrestrial, coastal and marine ecosystems (paragraph 1(d)).

2.1 Milestones in the process

2.1.1 Initial discussions

Under the Convention, much of the initial discussion relating to LULUCF focused on GHG inventories. The main issues of concern were how to compile activity data (a particular difficulty for poorer countries with problems in accessing satellite imageries, inventories or historic data) and how, based on this information, to accurately estimate emissions and removals by sinks. During the negotiations that led to the Kyoto Protocol in 1997, many countries highlighted the importance of including sinks and emissions from LULUCF in the Protocol’s commitments, subject to concerns about definitions, timing and scope. However, questions regarding LULUCF were considered too complex and a lack of scientific evidence increased the difficulties during the negotiations.

2.1.2 Adoption of the Kyoto Protocol (1997)

Under the Kyoto Protocol, Annex I Parties² agreed to quantified emission limitation and reduction objectives (QELROs) and LULUCF activities are eligible for achieving these objectives. Annex I Parties therefore must report and quantify emissions and removals by sinks in the LULUCF sector as part of their potential achievement of their targets. Possible LULUCF activities are included in two paragraphs of Article 3 of the Kyoto Protocol, with different methodological and reporting treatments:

- **Article 3.3** refers to afforestation, reforestation and deforestation, and these are mandatory for all Annex I Parties.
- **Article 3.4** refers to additional voluntary activities related to changes in GHG emissions by sources and removals by sinks in the agricultural soils and land-use change and forestry. By the end of 2006, Parties with commitments under the Protocol would have to decide which activities of Article 3.4 they would account towards their mitigation commitments.

These provisions added a number of new questions and issues for discussions, since Parties had to consider in more detail what activities qualified for reporting and as measures to achieve targets and under which reporting requirements. As a consequence, the UNFCCC Subsidiary Body for Scientific and Technical Advice (SBSTA), at its eighth session in 1998, requested the IPCC to prepare a report examining the scientific and technical implications of carbon sequestration related to LULUCF.

This IPCC Special Report on LULUCF, published in 2000, examines how carbon flows between the atmosphere and the five different “pools” (above-ground biomass, below-ground biomass, litter, dead wood and soil organic carbon) and how carbon stocks change over time (see IPCC 2000). Although the IPCC Special Report clarifies many issues, uncertainties regarding the real mitigation potential and limitations of activities under Article 3.4 were still significant.

2.1.3 Conference of the Parties (COP) 7 (2001)

The Marrakesh Accords, which were adopted at COP 7, provided the “rule book” for the Kyoto Protocol. The Marrakesh Accords provide a forest definition with range thresholds (see Box 1). Each Party is asked to define the national thresholds to be used during the first commitment period (2008-2012). This decision, to be made internally by each party, has a great impact on the mitigation potential of each country. While there may be different forest ecosystems within a country, the definition for the Kyoto Protocol has to be a single one for the entire country.

As an example, let us think about a country with two main ecosystems: savannas and humid forest with a certain level of tree cover degradation that initiated before 1990. The definition of the forest thresholds (forest cover, tree height and minimum area) will make more or less land eligible for future A/R CDM project activities. This and other similar requirements agreed in the Marrakesh Accords represented over the years a challenge for decision makers in all Parties.

The Marrakesh Accords also limit eligible LULUCF activities in the clean development mechanism (CDM) to afforestation and reforestation (A/R). The CDM, one of three flexible mechanisms under the Kyoto Protocol, allows emission-reduction (or emission removal) projects in developing countries to earn certified emission reduction (CER) credits. These CERs can be traded and sold, and used by industrialized countries to meet a part of their emission reduction targets under the Kyoto Protocol. As the CDM was a new market mechanism, the limit on LULUCF activities was subject to much debate among Parties.³

Under the Marrakesh Accords, the total number of credits that an Annex I Party may claim from A/R⁴ project activities under the CDM was limited to 1% of the Party’s total emissions in 1990 multiplied by five.⁵ These agreements apply to the first commitment period of the Protocol (2008-2012).

A proposal on “Reducing emissions from deforestation in developing countries and approaches to stimulate action” (REDD) was first considered by the COP in 2005. Since early 2006, discussions under the

Box 1: Key definitions of the UNFCCC relevant to LULUCF

Forest is a minimum area of land of 0.05-1.0 hectares with tree crown cover (or equivalent stocking level) of more than 10-30 % with trees with the potential to reach a minimum height of 2-5 meters at maturity in situ. A forest may consist either of closed forest formations where trees of various storeys and undergrowth cover a high proportion of the ground or open forest. Young natural stands and all plantations which have yet to reach a crown density of 10-30 % or tree height of 2-5 meters are included under forest, as are areas normally forming part of the forest area which are temporarily unstocked as a result of human intervention such as harvesting or natural causes but which are expected to revert to forest;

Afforestation is the direct human-induced conversion of land that has not been forested for a period of at least 50 years to forested land through planting, seeding and/or the human-induced promotion of natural seed sources;

Reforestation is the direct human-induced conversion of non-forested land to forested land through planting, seeding and/or the human-induced promotion of natural seed sources, on land that was forested but that has been converted to non-forested land. For the first commitment period, reforestation activities will be limited to reforestation occurring on those lands that did not contain forest on 31 December 1989.

Source: FCCC/CP/2001/13

² The distinction between Annex I Parties (i.e., developed countries) and non-Annex I Parties (i.e., developing countries) corresponds to the Convention. Under the Kyoto Protocol, countries with quantified emission limitation or reduction commitments (38 developed countries and countries with economies in transition) appear in Annex B. Over the years the terms have been used interchangeably. In this document, when referring to countries included in Annex B of the Kyoto Protocol, the term Annex I Parties is used. Non-Annex I Parties (NAI) have no quantified emission limitation or reduction commitments under the Protocol and are not included in Annex B.

³ Other important requirements of importance for NAI are the need of creating a Designated National Authority, and the request for defining how to deal with proving sustainable development in/for the CDM.

⁴ Afforestation and reforestation refer to the enhancement of sinks through the planting of trees on non-forest land and are eligible activities in the CDM (A/R CDM). A/R CDM is ruled, with respect to eligibility, modalities and procedures, by a number of decisions as outlined in annex 5, “Decisional pathway for A/R CDM and REDD”.

⁵ Even though a cap for A/R CDM project activities has been introduced, to date only a few projects have been submitted and the cap of 1% will most probably not be reached until the end of the first commitment period.

Table 1: A comparison regarding LULUCF emissions and removals

Country	Year	Gross emissions*	LUCF emissions	LUCF removals	Net emissions
A	1990	100	25	50	75
	2010	95	25	25	95
B	1990	100	0	25	75
	2010	120	0	25	95

* Gross emissions are from sources not including the LUCF sector
Source: Ward, 2004

UNFCCC process have focused on: the identification of drivers for deforestation; scientific, technical and methodological issues relating to estimating and monitoring emissions from deforestation; and costs and technical barriers for the implementation of activities to reduce deforestation. Parties have also been considering a range of policy approaches and positive incentives and deliberated the advantages and disadvantages of various financing options.

At COP 13, the Bali Action Plan was adopted, which states that: “Policy approaches and positive incentives on issues relating to reducing emissions from deforestation and forest degradation in developing countries; and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries”. Also at COP 13, another major decision to stimulate action was adopted, which provides a mandate for several elements and actions, including further strengthening ongoing efforts and support for capacity-building, technical assistance and transfer of technology. In 2008, a program of work is being undertaken on methodological issues, such finding ways to measure forest degradation.

2.2 LULUCF activities in Annex I Parties

Annex I Parties have to fulfil a number of requirements, the most important of which relates to accounting rules and reporting. Under the Kyoto Protocol, Annex I countries are required to identify lands that are afforested, reforested and deforested (ARD) over the period of 1990-2005 and to account separately for net emissions

and removals from each of these land areas during the commitment period.

2.2.1 Accounting rules

The adoption of clear definitions and criteria at the national level is essential to the correct accounting and monitoring of LULUCF activities, since different rules apply to different activities. The emissions and removals from LULUCF activities are accounted according to two main rules:

- **Gross-net accounting** only considers carbon stock changes resulting from the difference between emissions and removals in the commitment period and does not draw comparison with the base year.
- **Net-net accounting** compares emissions and removals connected to a certain activity during the commitment period with emissions and removals during the base year. A credit is created when a net carbon sink can be measured comparing the two different periods.

The examples in Table 1 show how, for country A, a reduction in removals from LUCF⁶ sector due to a change in age class of the growing forest for example can mean a huge increase in net emissions even though gross emissions decreased (Ward, 2004). Furthermore, any agreement on which an accountability approach is to be used when reporting mitigation activities in forestry can have an impact on the forest management decisions.⁷

During the Kyoto Protocol’s first commitment period (2008-2012), afforestation, reforestation, deforestation

and forest management must follow gross-net accounting, while net-net accounting rules must be applied to revegetation, cropland management and grazing land management.

The gross-net accounting was applied to forest management for the first commitment period because net-net accounting was seen as disadvantageous for countries where the carbon sinks were projected to decline over time because of saturation. At the same time, a credit cap was established for forest management to avoid the production of credits generated by indirect and natural effects as well as changes in human management prior to 1990 that could be generated in applying gross-net accounting.

At the COP 6 (part II) in 2001, a cap for forestry activities equal to 15% of projected removals, or 3% of base year emissions, was established. Natural and indirect effects are not taken into account for Article 3.3 activities but deforestation must be accounted at the national level as an adverse activity to afforestation and reforestation.

2.2.2 Reporting requirements

Another important requirement for Annex I Parties is reporting. According to Article 4.1 of the UNFCCC, Annex I Parties must submit to the UNFCCC annual inventories of national GHG emissions and removals that are subject to an annual review. The inventories must be reported under standardized formats and must cover emissions and removals from six sectors, including the LULUCF sector.

For LULUCF, the UNFCCC reporting is based on the methodologies presented in the IPCC Guidelines and the 2003 IPCC Good Practice Guidance for LULUCF.⁸ The LULUCF data are presented in the six identified land-use categories (i.e., forest management, grassland management, etc.). For every land-use category, carbon stock changes must be reported. Additional data are required for the Kyoto Protocol reporting that are supplementary to the information reported under the Convention. This additional data and requirements have been agreed during the negotiations under the Kyoto Protocol. In principle the supplementary requirements and methodologies for

measuring, estimating and reporting of activities under Article 3.3 and 3.4 are also described in the Good Practice Guidance for LULUCF.

By the end of 2006, Parties had to provide additional information on the definition of forest that they would adopt at the national level – the so-called minimum dimensional threshold values. They had also to list the Article 3.4 activities that they would elect to report on, information on national monitoring system associated with the elected activities, and information on how definitions are to be applied to national circumstances listing criteria to identify areas qualifying for an activity or the other.

During the Kyoto Protocol’s first commitment period, supplementary spatial information on units of land subjected to Article 3.3 and 3.4 activities is to be reported, as well as information on methods and approaches to estimate emissions and removals. Parties must also provide information that demonstrates that Article 3.3 and 3.4 activities are human-induced and have taken place since 1990.

The estimates for GHG emissions and removals for Article 3.3 and 3.4 shall be clearly distinguished from anthropogenic emissions from the energy sector, industrial processes, agriculture, waste and solvent and other product using compiling specific tables for reporting. Absence of overlaps between Article 3.3 and 3.4 activities must be demonstrated and uncertainty of emissions and removals estimates must be documented (IPCC 2003).

Options for using the above mentioned activities for mitigating climate change in a post-2012 regime are discussed in chapter 5 of this document.

⁶ The term LUCF refers only to land use changes. LULUCF also includes emissions and sinks from land uses that remain the same.

⁷ The issue of how to account for changes in carbon stocks over time is currently one of the many relevant aspects on how to deal with emission reductions from deforestation and forest degradation in a post-2012 mitigation regime (see chapters 3 and 5).

⁸ On the basis of the experience using the 1996 IPCC Guidelines for reporting and following a request of the SBSTA, the IPCC prepared the Good Practice Guidance for LULUCF, approved in 2003. The Good Practice Guidance for LULUCF were meant to provide clear methodological guidance for a better selection of methods, to facilitate identification of more significant GHG emission sources, to provide methods for consistent time series that allow quality improvement and control over time, and to facilitate the review process. These materials can be downloaded in various languages from <http://www.ipcc.ch/ipccreports/methodology-reports.htm>.

Box 2: Handling of forests in an Annex I Party: Switzerland

Switzerland informed the UNFCCC Secretariat in November 2006 that it would count forest management as a carbon sink according to Article 3.4 of the Kyoto Protocol. Switzerland has a cap of 1.83 million t carbon dioxide (CO₂) per year to account for forest management. This corresponds to 40% of the total commitment of Switzerland as an Annex I Party. In spite of this potential, there are accounting difficulties: (i) the transaction costs for assessment, monitoring and reporting are high and only acceptable for large forest owners which are in Switzerland in the minority; (ii) the risk of windfalls and thus of creation of a source of GHG-emissions is high due to weather hazards, particularly considering the longer term accounting beyond 2012; (iii) to reduce that risk there is a need of silvicultural interventions that eventually reduces the sink capacity of forests; and (iv) adaptation measures may be eventually needed to regenerate forests and might also reduce the sink capacity.

Switzerland's forests sequestered in average 2.7 million t of CO₂ per year between 1990 and 1999 because of low harvest of wood. Since then, there has been considerable increase of wood harvesting because of increased demand for timber and wood energy, but also due to increased frequency and intensity of storms that lead to increased windfall and insect calamities. It is not clear yet what the sequestration potential of Swiss forests will be in between 2008-2012.

The mitigation of Swiss forests is highest when (i) the standing volume (carbon reservoir) is maintained or increasing; (ii) the yearly increment in wood (carbon sequestration) is fully used; (iii) harvested wood is used with long-term effects (housing, furniture, etc); and (iv) at the end of the production cycle the wood is used as energy source.

With respect to forests in the post-2012 negotiations, it is essential for Switzerland that the assessment methods for forest management be simplified and that the missing link between carbon sink and carbon substitution be considered, e.g. through accounting for harvested wood products (HWP) that could help encourage silvicultural measures without losing the value of the forest carbon sink.

2.3 LULUCF activities in non-Annex I Parties

According to Article 4 of the Convention, both Annex I and non-Annex I Parties have to report their LULUCF emissions as part of their national communications. Information is to be provided using common report formats and in accordance with guidance given by the IPCC.

Providing LULUCF information in the national communications is not an easy task for many non-Annex I Parties. The lack of consistent information is a major concern. Other concerns relate to: a) the fact that the flexibility provided by the IPCC guidance allows Parties to use different methods and tiers which lead to different results; b) Parties do not always provide equivalent information due to the different methods used; c) the information provided and the methods used are not always transparent (this is especially relevant when recalculating inventories over time); and d) given that reporting is obligatory on three GHGs only (CO₂, methane (CH₄) and nitrous oxide (N₂O), information on the three other relevant GHG emissions, (hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and SF₆) is insufficient.

With regard to the mitigation strategy, the CDM is the only flexible mechanism that allows non-Annex I Parties to assist⁹ Annex I Parties in their efforts to achieve their GHG emission reduction targets under the Kyoto Protocol. LULUCF activities included in the CDM are afforestation and reforestation (A/R CDM) as defined in Box 1. While CDM procedures for the other five sectors were already agreed upon between before 2003, rules and procedures that govern A/R CDM for the first commitment period were only finally decided in 2004 (see list of relevant decisions in Annex 4). Hence, it is only since the year 2005 that forest sector stakeholders in non-Annex I Parties can undertake A/R CDM projects according to defined rules. This partly explains the "delay" that LULUCF projects have compared with projects in the other sector eligible in CDM.

The most important elements of the rules and procedures in A/R CDM regulate:

- **The market size for A/R projects**, which is limited during the first commitment period (2008-2012) to 1% of the emissions of each Annex I country in 1990, multiplied by five;¹⁰
- **Eligible activities in the LULUCF sector for CDM**

until 2012, which are restricted to afforestation and reforestation. Activities in bioenergy are also eligible until 2012 as far as these are undertaken using an approved methodology and considering all other clarifications made by the Executive Board of the CDM with this regard. Forest management and reduced emissions from deforestation are not eligible forestry activities under the CDM;

- **Agreement on the modalities and procedures for CDM projects** in forestry and the process for proposing and getting approved corresponding methodologies;
- **Definition of small-scale projects** and their first simplified methodology; and
- **Baseline and monitoring methodologies for the CDM**, which are to be presented by project developers and approved by the Executive Board of the CDM.

Considering the limited experience in A/R CDM compared with CDM projects of other sectors, it is too early to make an accurate evaluation of the impacts of the A/R CDM on poverty alleviation or in terms of net contribution of A/R CDM within the global mitigation portfolio.¹¹ Even if the carbon market is active, its real development starts only in 2008 with the beginning of the first commitment period. Still, some early observations¹² are worth mentioning.

A/R CDM is a well regulated system that creates additional costs compared with traditionally designed forest plantations; e.g., to assess the carbon potential, new and often complex methodologies need to be developed in the design stage of the project, and the project cycle needs to include many actors and steps that are not yet well known locally. A/R CDM projects require, at least at the beginning, a high level of knowledge of the internationally agreed modalities, procedures and methodologies.

Since such knowledge is presently barely available in many developing countries, there is often a need to engage international expertise, which further increases the project

preparation costs. The major part of these costs has to be paid before CDM payments are received. Because of the mentioned circumstances many developing countries have yet not been in a position to use the A/R CDM, even if they consider it as an attractive option.¹³

A/R CDM has stimulated new interest for planting trees, especially in seriously degraded areas. This can be indeed a new opportunity for the forest sector, as it can open the possibility to promote long-term activities such as restoration of forestland or tree plantations. Nonetheless, the forest sector in many countries is reacting very slowly to the opportunities provided by the CDM, and often A/R CDM activities are proposed without consideration of existing forest strategies. A/R CDM, especially of the small-scale variety, offers a possibility to poor people to get involved, particularly through the promotion of community forestry, which could have an important developmental impact in rural areas. However, for the time being, small-scale A/R projects have proven being largely out of reach for local communities, given the complexity in the design of the project, the legal requirements in respect to property rights on land, carbon pools and carbon credits and the transaction costs involved in project preparation. Thus, currently, almost all existing A/R CDM projects have targeted either publicly-owned reforestation areas or plantations promoted on privately owned land.

The fact that CERs coming from A/R CDM projects are excluded of the EU Emissions Trade Scheme (EU ETS) also implies a considerable constraint in market opportunities for mitigation activities from the forestry sector in developing countries.

In conclusion, mitigation activities in the forestry sector under the CDM have been limited to date. Opportunities to increase activities include simplifying procedures, developing certainty over future commitments, reducing transaction costs, and building confidence and capacity among potential buyers, investors and project participants (Robledo et al. 2008).

⁹ The term "assist" the Annex I Parties is the exact wording in Article 12 of the Kyoto Protocol.

¹⁰ "For the first commitment period, the total additions to a Party's assigned amount resulting from eligible LULUCF project activities under Article 12 shall not exceed 1% of base year emissions of that Party, times five" (FCCC/CP/2001/13, Decision 11/CP.7).

¹¹ The reason for this is mainly the lack of overall agreement by Parties on how to deal with LULUCF than delay in implementation.

¹² These observations are based on the authors' experience with the A/R CDM in Latin America, Asia and Africa.

¹³ Some bi- and multilateral development agencies have reacted to this fact and are funding capacity building for the preparation of A/R CDM projects, mainly through workshops, tools development and model project development.

2.4 Lessons learned from LULUCF negotiations

Negotiating LULUCF in the framework of the UNFCCC and its Kyoto Protocol has demonstrated to be very difficult for both Annex I and non-Annex I Parties. While in previous years there was still considerable scientific uncertainty on the potential of LULUCF activities in mitigating climate change, substantial progress has been made in recent years by the IPCC, including the publication of the IPCC Good Practice Guidance (GPG) in 2003 and the IPCC 2006 Guidelines. Additional to the work of the IPCC, a number of tools and instruments to design an A/R CDM project activity are available, also in developing countries (e.g., ENCOFOR toolbox or TARAM for A/R CDM¹⁴). Nevertheless, there remain some important issues that maintain uncertainty about the potential of the A/R CDM. These are related to:

- Technical issues relevant only to forestry activities (carbon accounting, leakage, treatment of environmental and socio-economic impacts etc. See next section for more information);
- Lack of accurate information in many developing countries;
- Link to other critical development issues given wider environmental and social impacts;
- General sense of low governance in the forest sector, especially in developing countries;
- Some Parties argue that LULUCF mitigation options could be used to delay emission reductions in the energy and transportation sectors. This has had a negative influence on how LULUCF activities have been considered in the climate change negotiations over time.

Based on the first experiences with LULUCF, stakeholders directly involved in the implementation of LULUCF activities from Annex I and non-Annex I Parties expressed a desire for simpler or more cost-effective ways to support the overall objective of the Convention through forestry activities. Some Annex I Parties want more flexibility to achieve their targets, while some developing countries

would prefer larger markets for CDM or other credits. For non-Annex I Parties, the issue is about creating appropriate incentives. Negotiations on a post-2012 agreement provide an opportunity to reassess procedures, to extend the list of eligible LULUCF activities, and possibly to simplify the manner in which LULUCF activities are included in the future climate change regime.

The fact that the contribution of LULUCF to Annex I Parties' reduction commitments was agreed after the establishment of Kyoto targets constituted a major difficulty for using the whole potential of LULUCF as a means for mitigating climate change. That happened mainly because LULUCF was seen during the previous negotiations as a way to offset emissions, i.e., to avoid changing energy and consumption paths of the major emitters. **A post 2012 mitigation regime will likely need to include a wider set of eligible activities in non-Annex I countries including agriculture, forestry, and other land uses.**

Chapter 5 explains the current negotiations and how LULUCF is included in the ongoing processes.

Questions:

- How is LULUCF considered in the national communication and/or GHG inventory in your country?
- Has your country participated in the LULUCF negotiations? If yes, how is the process in your country to define positions and negotiation strategies regarding LULUCF in the UNFCCC?
- How was the participation of the forest sector representatives of your country in the UNFCCC negotiations?
- Which are the lessons learned by your country during these negotiations?
- What incentives would be needed for promoting action on LULUCF in your country?
- According to the questions before, do you consider LULUCF as a key sector for your country in future negotiations? If yes, please discuss the kind of support your country will require to be well prepared for the negotiation process.

3. TECHNICAL AND METHODOLOGICAL ISSUES AND REQUIREMENTS FOR FUTURE LULUCF OPTIONS

As mentioned in sections 2.3 and 2.4, there are a number of technical and methodological issues that have evolved with the negotiations. Technical and methodological issues and requirements for carbon accounting have been developed to accurately quantify the mitigation potential of a particular LULUCF activity. Technical and methodological issues relate mainly to how to define a baseline or a reference scenario, how to treat leakage, permanence and additionality, and how to monitor and report emission reductions or carbon sinks (see the glossary for definitions in Annex 2). These technical and methodological issues might need – in general terms – to be reassessed and complemented according to the LULUCF activities that become an eligible in a post-2012 agreement. In particular, there is the possibility that reducing emissions from deforestation and forest degradation (REDD) and/or forest restoration become eligible.

3.1 Carbon pools

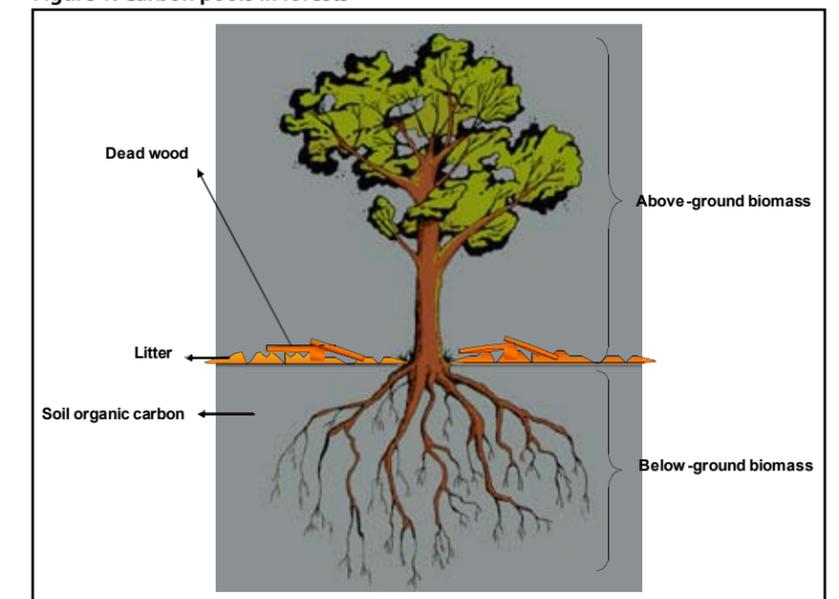
Carbon in forestry mitigation activities can be found and measured in five so called “pools” or “reservoirs.”

These are:

- Below-ground biomass;
- Above-ground biomass ;
- Litter;
- Dead wood;
- Soil organic carbon (see Figure 1).

Ideally, one should collect data of changes in carbon stocks in all five pools, but doing so in an accurate and cost effective manner remains a major challenge. In order to facilitate the calculation of such changes, models and algorithms have been developed, especially for the two first pools. However, basis information on carbon stocks and stock change in each pool remains scarce and/or inaccurate, particularly in developing countries. Hence, Parties to the Kyoto Protocol have agreed that afforestation and reforestation project activities under the CDM (CDM A/R) participants may choose not to account for one or more carbon pools, as long as the excluded pool is not a net GHG emitter (Decision 19/CP.9, later adopted by the Parties to the Kyoto Protocol as Decision 5/CMP.1).

Figure 1: Carbon pools in forests



Source: Robledo et al, 2008

¹⁴ ENCOFOR (Environment and Community-based Framework for Designing Afforestation, Reforestation and Revegetation Projects in the CDM) tools can be downloaded from http://www.joanneum.at/encofor/tools/tool_demonstration/Tools.htm. The TARAM tool (Tool for Afforestation and Reforestation Approved Methodologies) can be downloaded from <http://carbonfinance.org/Router.cfm?Page=BioCF&FID=9708&ItemID=9708&ft=DocLib&CatalogID=40526>.

3.2 Baseline or reference scenario

The baseline concept was defined for those project activities to be included in two of the Kyoto Protocol's cooperative mechanisms: Joint Implementation (Article 6) and the CDM (Article 12).¹⁵

A baseline scenario is a term defined for the CDM. It relates to the sum of the changes in carbon stocks in the carbon pools within a given area that would have occurred in the absence of a LULUCF project activity.

For the A/R CDM, three approaches were agreed for estimating the baseline¹⁶:

- (a) Existing or historical, as applicable, changes in carbon stocks in the carbon pools within the project boundary;
- (b) Changes in carbon stocks in the carbon pools within the project boundary from a land use that represents an economically attractive course of action, taking into account barriers to investment;
- (c) Changes in carbon stocks in the pools within the project boundary from the most likely land use at the time the project starts.

By August 2008, over 90% of the approved A/R CDM methodologies have chosen the approach (a) "historical".

According to the current modalities and procedures for the CDM forestry projects have to define a baseline for eligible activities within the project boundary (local level). The only exception is the "programmatic CDM" that was agreed at COP 11 in 2005. Some countries are currently working an A/R Programmatic CDM (e.g., Pakistan), but there is scarce experience on the opportunities and limitations of this approach. A shift to regional baselines implies a major change in these modalities and procedures for the A/R CDM and will need to be agreed by the Parties to the Kyoto Protocol.

[Discussions regarding baseline in a post 2012 regime \(particularly REDD\):](#)

Baselines are an essential part of any arrangement aiming at REDD as they provide the necessary refer-

ence against which performance can be assessed. For estimating the baseline in REDD activities, two issues should be considered when analysing: scale and time scenario.

- **With regard to the scale of the baseline/reference scenario, there are three levels to consider: local, regional or national.** Local and regional baselines are linked to project activities, while national baselines are based on the possibility to use mainly national policies to reduce GHG emissions. However, it is possible to foresee a combination between these approaches where national baselines could be used as a reference for emission reductions in project activities at the local level. Regardless of whether a baseline is developed at national or project level, it will be important that the methods used are consistent across countries and rather conservative in their assumptions and outcomes, given the broad uncertainties that prevail in its assessment.
- **With regard to the time period, there are two approaches:** to consider only past trends or to consider past and future trends. The first approach is more favorable for countries with high rates of deforestation in the past, as these countries would have the greatest potential for claiming emission reductions in the future (e.g., in the Congo Basin in Africa). The second approach would be more favorable for countries that had a low rate of deforestation in the past but are threatened by a high future deforestation rate.

Another ongoing discussion refers to the appropriateness of baselines at the project level for REDD. Some authors argue that a regional baseline could contribute to increased transparency and accuracy in the estimations as well as to reducing transaction costs (Sathaye and Andrasko, 2007). Most of the current analysis on regional baselines refers to avoiding deforestation activities; there is virtually no experience available for reducing forest degradation, respectively forest restoration activities.

Within the ongoing discussion on REDD, two terms appear without specific definition: baseline and reference scenario. The term baseline has not been

defined in this context. Negotiations are now mainly based on the experience made through the CDM. Similarly, the term "reference scenario" has not yet been defined; neither in the Convention nor in the Kyoto Protocol. It seems that the reference scenario focuses on past (historical) data and extrapolates it into the future, similar to one of the three approaches defined for the CDM (approach 22a: Existing actual or historical emissions as applicable, in Decision 5/CMP.1).

Another important question on the baseline/reference scenario relates to approaches for estimating GHG emissions. As observed in Table 1, the difference between gross and net emissions can be significant. A decision on net or gross emissions needs to consider the wide range of implications of both calculation options. The implications linked to these two different options are currently not clear in the negotiations and should be considered carefully in future sessions before any decision is made.

It is important to recall that all emission reductions and sinks need to be monitored over time. The monitoring reports are those that provide the definitive information on the changes in carbon stocks. Hence the baseline is only an indicative of the emission reductions or removals that are expected from a mitigation activity.

Questions:

- How is the data availability in your country? Is there data on deforestation and forest degradation rates over time? Is there data on land cover by 1999, 2000 and current data.
- With regard to the time period considered when defining the baseline/reference scenario, what approach would be more accurate for your country (only past trends, or past and future)?
- Which would be the best option for your country: Baseline per projects, baseline at the level of a region (e.g., an eco-region) or national baseline. Would it be the same answer for each mitigation option (i.e., reforestation, afforestation, REDD, forest restoration, etc)?

3.3 Leakage

In the A/R CDM, leakage has been defined as the increase in GHG emissions by sources that occurs outside the boundary of a given area (in A/R CDM in the project area) which is measurable and attributable to the particular activities envisaged (Decision 5/CMP.1).

A/R CDM methodologies need to include procedures for addressing and, if needed, for estimating leakage in the baseline and for measuring leakages in the monitoring. Considering that defining the system boundaries for estimating something "outside the boundary of the project" is extremely difficult, A/R CDM approved methodologies have dealt with leakages by identifying the potential displacement of people or products due to the proposed project activity. Based on such analysis the methodologies propose a leakage management area where the potential displacement of people or activities is addressed.¹⁷ Specific tools for estimating leakage according to this approach have been developed by the Afforestation/Reforestation Working Group of the CDM Executive Board (ARWG).

In the discussion on REDD, some are referring to "displacement of emissions" when referring to leakages. As displacement of emissions has not been defined yet in any of the existing decisions, there is a lack of clarity about the differences between "displacement of emissions" and "leakages".

The main discussion on leakage revolves around differences on how to deal with it, depending on whether the national and/or the sub-national approach is to be used. In general terms, the discussion on leakage tends to accept that if an accurate national baseline/reference scenario and monitoring system can be set at the national level, risks of unaccounted leakage would disappear. This affirmation is based on the idea that if any displacement of activities or communities due to a REDD activity takes place, national inventories will reflect it. Therefore emissions resulting from displacement will need to be considered in the calculation of the net emission amount for the sector in a country.

¹⁵ Baseline under Joint Implementation and the CDM: Baseline is the scenario that reasonably represents the anthropogenic emissions by sources or anthropogenic removals by sinks of greenhouse gases that would occur in the absence of the proposed project. (Decisions 16/CP.7 and 17/CP.7).

¹⁶ See Decision 5/CMP.1 Article 22.

¹⁷ For A/R CDM approved methodologies see http://cdm.unfccc.int/methodologies/ARmethodologies/approved_ar.html

Those supporting a sub-national approach (including the possibility for project activities at the local level) argue that good experience has been gained through the treatment of leakage in the A/R CDM, which could be used as a basis for addressing potential leakage in a REDD project.

As for common points for A/R CDM and REDD, one key aspect in the discussion on leakage is how to define what “outside the boundary” means. Is it meant to consider any displacement of GHG emissions within the region, the country or also at the international level?

There is some literature analysing potential international leakage in the forest sector. According to some authors, the international wood trade/wood exploitation can be heavily affected by activities aimed to mitigating climate change (Sathaye and Andrasco, 2007a). This concern has increased after 2005 when the discussion on REDD started, as for some the risk for international leakages due to REDD activities can be so high that emissions reduced in a country could be replaced by emissions in another one.

International leakage has not been considered for any other sector under mitigation yet, even though international leakage in sectors such as energy or transportation could be even higher than in the forestry sector. There are different reasons for it, but perhaps one of the most important is that quantifying and moreover monitoring international leakage would have strong technical and legal implications, e.g., on international liabilities, and therefore it is very difficult to implement.

Questions:

- Which are the major risks of leakages in your country?
- Do you think that these risks can be reduced/addressed at the local level or is it necessary to define procedures and methodologies at the national level?
- What will be the position of your country if international leakages in forestry are to be negotiated in the future? Do you think that international leakage in other sectors should then also be addressed?

3.4 Permanence

The issue of permanence is related to the possibility that carbon in reservoirs can be emitted at any time, making emission reductions non-permanent. Permanence relates to the period of time that carbon remains in the biosphere. Due to different risks, including fires and pests, carbon can be released into the atmosphere, thereby reducing the climate change mitigation effect of a project. The IPCC has clarified that a short-term reduction in emissions has a positive short-term impact in mitigating climate change. However, it is important to promote a permanent effect on the atmosphere. Concerns on permanence are only related to non-Annex I Parties without commitments, because countries with commitments need to regularly report their progress considering all emissions from the LULUCF sector. If a given forest is degraded or a fire occurs, these emissions will be automatically included in the national inventories.

Proposals for dealing with non-permanence in the LULUCF in the future include (a) using temporary credits;¹⁸ (b) banking credits and debits from one commitment period to the next; (c) reducing future financial incentives to take into account emissions from deforestation above the agreed level; and (d) by mandatory setting aside of a share of the emission reductions. Furthermore, some Parties consider sustainable forest management as a means to promote the permanence of emission reductions.

The treatment of permanence is especially relevant if Parties agree on a market mechanism for REDD. In the case of A/R CDM, the question of permanence added to the transaction costs; the experience has also shown that temporary credits are cheaper than permanent credits. Thus, in REDD, the possibility of implementing permanence issues will depend on whether the approach is fund or market based.

Questions:

- Which proposal for dealing with permanence is the most convenient according to the circumstances in your country?

3.5 Additionality

Additionality¹⁹ is the result of the GHG emissions reduced by the project (project scenario) minus those emissions that would occur in the absence of the project (baseline), minus the leakage caused by the project. It is a term used within the CDM and therefore applies only to project activities undertaken in NAI. Currently, additionality is estimated and monitored using the approved A/R CDM methodologies.

As the current negotiations on REDD are under the Convention and financing solutions for REDD activities is still under discussion, the question as to whether activities in REDD have to be additional or not is open. The same occurs with other mitigation options that are not yet included in the A/R CDM such as forest restoration.

Questions:

- Under which circumstances should LULUCF be additional (e.g., only for projects, or for national activities too)?
- How does national legislation and enforcement affect the additionality of LULUCF activities in your country (e.g., if there is a forest conservation law)?
- In your country, which other forestry projects can affect the additionality of LULUCF activities (e.g., Forest Law Enforcement and Governance - FLEG)?
- What about programs in other sectors (e.g., infrastructure projects affecting natural forests)?

3.6 Environmental and socioeconomic impacts of mitigation activities

Until now, environmental and socio-economic impacts have been considered only in the A/R CDM. According to Decision 5/CMP.1, project proponents should ensure that there is no potentially significant negative socio-economic or environmental impact from the A/R CDM project activity. If such a potential impact is identified, project proponents must define how to reduce the impact. Further, these potential negative impacts will be then included in the monitoring. The “potential negative

impact” is defined by the host country where the A/R CDM project activity takes place.

Positive socio-economic and environmental impacts (or co-benefits) are not considered in the modalities and procedures and therefore there is no need to report on them.

In Annex I countries, socio-economic or environmental impacts regarding LULUCF activities or activities in other sectors are not ruled under the Kyoto Protocol. Furthermore, CDM projects outside A/R CDM do not need to take into account social impacts. **This means, e.g., that many potential negative impacts of biofuel project activities on social systems are simply not considered, addressed or monitored. This is an issue of concern, especially when discussing the potential of biofuels for substitution (see chapter 4 for biofuels as a mitigation option).**

Questions:

- How are “potential negative impacts” currently defined in your country?
- Do you see a need for identifying and monitoring co-benefits?
- Do you think that socio-economic and/or environmental impacts and benefits are to be considered for other LULUCF activities besides A/R CDM?

3.7 Monitoring and reporting

Maintenance of the reservoirs (pools) needs to be regularly monitored, and under the CDM also verified. These data have to be consistently reported so that a clear quantification of the global emission reductions can be calculated. To do so, reliable methods are needed to accurately assess emission reductions over time. While such methods exist, they tend to be very expensive. The experience in the ongoing A/R CDM shows that monitoring costs can be very high (in some cases 25% of the total project cost). Similar indications have been done by Annex I countries on their costs for monitoring and reporting. **Monitoring and reporting requirements need to be agreed in such a way that accurate quantification of the**

¹⁸ Temporary CERs expire at the end of the commitment period subsequent to the commitment period for which they were issued; long-term CERs are valid until the end of the project's crediting period up to maximum of 60 years.

¹⁹ The definition of additionality, as in Decision 17/CP.7, para. 43: A CDM project activity is additional if anthropogenic emissions of greenhouse gases by sources are reduced below those that would have occurred in the absence of the registered CDM project activity.

emission reduction over time is possible, while at the same time making technologies and capacity building available for developing countries.

Questions:

- Which forestry activities are already being monitored in your country (for the UNFCCC, UN Forum on Forests (UNFF), Food and Agriculture Organization (FAO) or others)?
- Are there some synergies that could reduce monitoring costs in the A/R CDM?
- How could monitoring and reporting requirements be simplified?

4. MITIGATION OPTIONS IN FORESTRY WITH A FOCUS ON DEVELOPING COUNTRIES

In order to understand the entire potential of LULUCF in climate change mitigation, this chapter summarizes the different options in a systematic way. They all are open to consideration in a post-2012 climate change regime. In its Fourth Assessment Report, the IPCC concluded that forest-related mitigation activities can considerably reduce emissions from sources and increase CO₂ removals by sinks at a low cost, and can be designed to create synergies with adaptation and sustainable development. Forest mitigation options have to be considered as an immediate option to be applied over the next 20 to 30 years. The longer-term mitigation potential of such options remains, however, unclear. Global change will impact carbon mitigation in the forest sector, but the magnitude and direction of this impact cannot be predicted with confidence over longer period. Global change may affect tree growth and decomposition rates, the area, type, and intensity of natural disturbances, land-use patterns, and other ecological processes.

Forestry can make a very significant contribution to a low-cost global mitigation portfolio that provides synergies with adaptation and sustainable development. However, this opportunity is not being taken fully into consideration in the current institutional context and has resulted in only a small portion of this potential being realized at present (mainly through the A/R CDM).

Forestry mitigation options include reducing emissions from deforestation and forest degradation, enhancing carbon sinks through enhancing the sequestration rate in existing and new forests, providing wood fuels as a substitute for fossil fuels, and providing wood products for more energy-intensive materials. Properly designed and implemented, forestry mitigation options can have substantial co-benefits in terms of employment and income generation opportunities, biodiversity and watershed conservation, provision of timber and fiber, as well as aesthetic, cultural and recreational services. Table 2 presents a simple classification of the mitigation options in forestry.²⁰ For each option, the corresponding forest management approach is specified. The combined effects of reduced deforestation and degradation, afforestation, forest management, agro-forestry and bio-energy have the potential to increase from the present to 2030 and beyond. Thus, they all are important when discussing the implementation of the BAP.

The carbon mitigation potential from reducing deforestation, promoting forest management, afforestation, and agro-forestry differ greatly by activity, regions, system boundaries and the time horizon over which the options are compared (IPCC 2007c IPCC Fourth Assessment Report (AR4), WG III).

Table 2: Mitigation options in forestry

Mitigation options (general)	Mitigation options in the UNFCCC or its Kyoto Protocol (KP) (LULUCF)	Forest Management Options
Reduction of GHG emissions	Reducing emissions from deforestation and forest degradation (REDD)	Sustainable management of (natural) forests Committing forests for REDD
Carbon sequestration	Afforestation Reforestation	Plantation, forestry, agroforestry, agro-sylvo-pastoral systems In forested areas: enrichment, planting, guided natural regeneration
	Enhancement of sinks through forest restoration (not yet clearly defined)	
Carbon substitution	Substitution through harvested wood products: using forest products for electricity and fuel	Forest Biofuel plantations, sustainable use of wood production

²⁰ It is understood that these mitigation options consider all five carbon pools, including organic soil carbon.

Realization of the mitigation potential requires institutional capacity, investment capital, research and development, and knowledge transfer, as well as appropriate policies and incentives and international cooperation.²¹ **Under the mitigation options of reducing emissions and increasing carbon sequestration, there are four forest management options²² to be considered, including:**

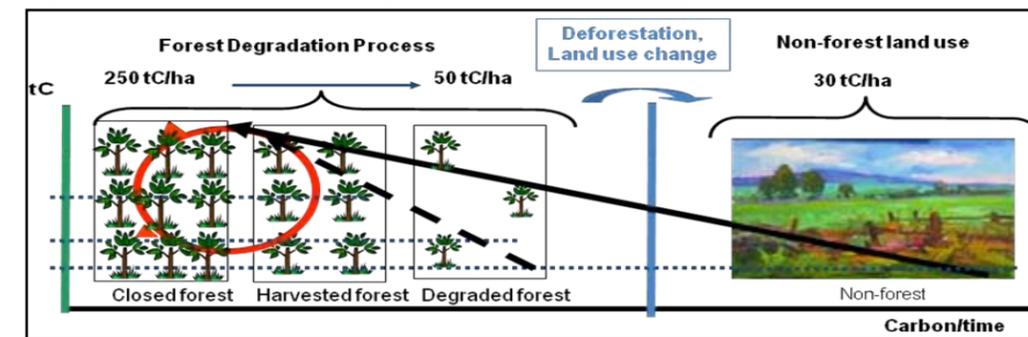
- Reducing emissions from deforestation and forest degradation (REDD);
- Forest management (sustainable use of existing forests);
- Forest restoration (restoring degraded forest areas to a sustainably used forest);
- Afforestation and reforestation²³ (restoring lost carbon stocks to a sustainably used forest).

Figure 2 illustrates the link between different forest management options. Note that the forest degradation process is defined as the loss of existing carbon stocks through unsustainable use of forest resources. Degraded forests are still considered as forest area and not submitted to any land use change. Nevertheless, most of the existing carbon stock is lost within forested areas through overharvesting of timber, fuelwood and other forest products. Reversing forest degradation through enhancement of sinks is here defined as forest restoration.

The assessment of the potential of any of these forest mitigation options should include the overall policy framework of the sector. Especially important is the analysis of the impact of mitigation options on the availability and quality of forest goods and services and the overall development goals of a given country. International processes and agreements such as the non-legally binding instrument (NLBI) on all types of forest of the UNFF elaborated in 2007 or the 2006 International Tropical Timber Agreement (ITTA) can have potentially a profound impact on the future use of forests resources. Global and regional cooperation programs such as those from the

Collaborative Partnership on Forests (CPF), the Forest Law and Enforcement & Governance (FLEG), the Global Forest Partnership (GFP), both initiatives of the World Bank and more tailor-made approaches towards REDD, such as the Forest Carbon Partnership Facility (FCPF) of the World Bank or the UN-REDD Initiative of FAO, UNDP and UNEP will certainly shape the future LULUCF agenda beyond 2012. Equally important are national legislation and programs resulting from the National Forest Program (NFP) Approaches that define goals and strategies for managing forests at a national and/or sub-national level over decades to come.

Figure 2: Illustrative overview of mitigation options in forest management



	Sustainable management of forests (for conservation, timber or multi-use): Keeping a relatively high carbon stock over a specific period of time; this principle is applied for example in a production forest that is managed according to sustained yield criteria. A medium carbon stock is maintained over a rotation period, e.g. 30 years.
	Restoring degraded forests (for regaining the entire range of goods and services): Most of the carbon emissions from forestry happen through forest degradation processes. Restoring lost carbon pools based on close-to-nature silviculture and bringing them back into a sustained yield managed forests or in conservation forests is a major option to enhance GHG sinks.
	Afforestation and reforestation (from non-forests to forests): Planting new forests on non-forest land and bringing them back into a full carbon stocked forest (e.g. through A/R CDM). Forests are artificially created and can include dense plantations of exotic trees or agroforestry systems.

Source: Authors' compilation

Questions:

- Does your country participate in other international processes that make decisions on future use of the forest resources? Which ones?
- How is the forest policy framework in your country?
- At which level are decisions made regarding use and management of forest resources in your country?
- Which forest management option would be the most promising forest mitigation option in your country?

4.1 Reducing emissions from deforestation and forest degradation

In the short term, the carbon mitigation benefits of reducing deforestation can be greater than the benefits of afforestation. That is because deforestation is the single most important source, with a net loss of forest area of 7.3 million ha/yr between 2000 and 2005. Deforestation, as

defined in the framework of the UNFCCC, is the direct human-induced conversion of forested land to non-forested land. There is yet no agreed definition on forest degradation in the UNFCCC. Of several variations of definitions proposed by the IPCC, the most recent is a direct human-induced long-term loss (persisting for X years or more) of at least Y% of forest carbon stocks (and forest values) since time T and not qualifying as deforestation or an elected activity under Article 3.4 of the Kyoto Protocol.²⁴

Deforestation (including land-use change) and forest degradation are the main emission sources in many developing countries (Stern, 2007). Latest figures released by the IPCC in 2007 indicate that land use change contributed to more than 20% of global carbon dioxide emissions, of which tropical deforestation very likely makes the largest part. Estimates on their share of the total global anthropogenic emissions differ according

²¹ Many efforts are now underway to provide technology and knowledge transfer. One of the most comprehensive approaches by mid-2008 is the development of the READINESS Plan of the Forest Carbon Partnership Facility of the World Bank (FCPF). More than 20 countries are preparing such plans with considerable financial support of the international community through the FCFP.

²² Other important elements in the overall context of mitigation options in forests are: How to treat reduced impact logging? How to treat "pioneer agroforestry"? How to treat synergies between REDD and adaptation? How to treat the substitution potential of wood products?

²³ In the newest reports of the IPCC and the Secretariat, "agroforestry" has been included in the agricultural sector. Nevertheless, it needs to be clarified that many A/R CDM projects that count under afforestation/reforestation are promoting agroforestry systems.

²⁴ See also Annex 1 on key definitions in LULUCF

to the source and the type of activity included (Schlamadinger et al., 2007). Deforestation causes significant GHG emissions – an estimated 7.6 billion tones of CO₂ per year in 2000, about 15 to 20% of all GHG emissions (Baumert et al., 2005). Houghton (2005a) estimates that forest conversion, forest degradation and shifting cultivation altogether were responsible for carbon emissions equivalent to 15-35% of fossil fuel emissions in the 1990s. While these figures have a large degree of uncertainty, they stress the relevance of including efforts to combat deforestation in climate negotiations.

In some circumstances, deforestation and degradation can be delayed or reduced through the complete protection of forests (Soares-Filho et al., 2006), through sustainable forest management practices, or by providing economic returns from non-timber forest products and forest uses not involving tree removal. Protecting forests from all harvests typically results in maintained or increased forest carbon stocks, but also reduces the wood and land supply to meet other societal needs. Reducing deforestation and degradation is the forest mitigation option with the largest and most immediate carbon stock impact in the short term per hectare and year globally. The mitigation costs of reduced deforestation depend on the causes of deforestation (commercial agriculture, subsistence farming, wood extraction), the associated returns from the non-forest land use, the returns from potential alternative forest uses, and on any compensation paid to the individual or institutional landowner.

Table 3: Estimates of carbon loss from forests attributed to deforestation

(from different authors; carbon loss to the atmosphere in Gigatons of carbon per year (GtC/yr) / Gigatons of carbon dioxide per year (GtCO₂/yr))

Region	Fearnside (2000) 1981-1990	Malhi and Grace (2000) 1980-1995	Houghton (2003) 1990s	DeFries et al. (2002) 1990s	Achard et al. (2004) 1990s
America	0.94 (3.45)	0.94 (3.45)	0.75 (2.75)	0.43 (1.58)	0.44 (1.61)
Africa	0.42 (1.54)	0.36 (1.32)	0.35 (1.28)	0.12 (0.44)	0.16 (0.59)
Asia	0.66 (2.42)	1.08 (3.96)	1.09 (4.00)	0.35 (1.28)	0.39 (1.43)
Total	2 (7.33)	2.4 (8.8)	2.2 (8.06)	0.91 (3.33)	0.99 (3.63)

Source: Adapted from UNFCCC, 2007b

According to the FAO, the rate of deforestation during the 1990s was 12.9 million hectares yearly, corresponding to emissions of 5.8 Gigatons of CO₂ (GtCO₂)/yr (FAO, 2006 and IPCC, 2007c). Nearly all deforestation is occurring in developing countries situated in the tropical and subtropical climatic belt. Figures about forest degradation are inevitably not as detailed. The International Tropical Timber Organization (ITTO) (2002) estimates the extent of degraded forest in the tropics to be about 850 million ha, corresponding to 40% of the entire forested area in the tropics. For defining the mitigation potential of REDD until 2030 (UNFCCC 2007a), only the deforestation figure as advanced by FAO has been considered. The regions with the highest emissions from deforestation and forest degradation are situated in the humid and semi-humid tropics, in particular in Africa, Asia and Latin America. In temperate areas and boreal climatic zones forest areas are stable or increasing.

Table 3 summarizes existing data on carbon loss from deforestation. It gives a good characterization of the range of carbon emissions that result from using different assessment approaches. This is precisely the type of data that leaves many negotiators and also scientists wondering about the feasibility of implementing REDD at a national scale when the data are so scattered and weak. However, techniques are rapidly improving, for example, through considerable efforts of technology transfer programs such as the World Bank's FCPF, UN-REDD and the work in improving remote sensing forest monitoring promoted inter alia by various members of the Collaborative Partnership on Forests.

As stated earlier, drivers for deforestation and forest degradation differ greatly by activities, regions, system boundaries and the time horizons. A report prepared for the UNFCCC Secretariat (Blaser & Robledo, 2007) quantified the mitigation potential of REDD based on the analysis of the opportunity costs of different use alternatives. This analysis considered a simplified approach to characterize the following direct drivers of deforestation and forest degradation (see Table 4):

- Commercial agriculture (national and international markets);
 - o Commercial crops;
 - o Cattle ranching (large scale);
- Subsistence farming;
 - o Small scale agriculture/shifting cultivation/slash and burn agriculture;
 - o Fuelwood and non-timber forest products (NTFP) gathering for local use, mostly family-based;
- Wood extraction;
 - o Commercial timber (legal and illegal) for national and international markets;
 - o Traded fuelwood (commercial at sub-national and national level).

Table 4: Deforestation and forest degradation according to direct drivers in the 90s

Main direct drivers	Deforestation & degradation (% of total)	Area of deforestation & degradation (million ha-1)
1. Commercial agriculture		
1.1 Commercial crops	20	2.6
1.2 Cattle ranching (large scale)	12	1.6
2. Subsistence farming		
2.1 Small scale agriculture/shifting cultivation	42	5.5
2.2 Fuel-wood and NTFP gathering	6	0.75
3. Wood extraction		
3.1 Commercial timber (legal and illegal)	14	1.8
3.2 Fuel-wood/charcoal (traded)	5	0.7
Total	100	12.9

Source: Based on UNFCCC 2007 and 2007a; and Blaser and Robledo 2007
Database used: FAO-FRA 2000 and 2005

Calculating the cost of implementing REDD is extremely difficult and explains the wide variations in estimates. When using the opportunity cost of direct drivers as a basis for the calculation, and if emissions from deforestation and forest degradation are to be reduced to zero by 2030, a minimum investment of \$12.2 billion²⁵ per year would be necessary to compensate the opportunity costs of deforestation and forest degradation (UNFCCC 2007a). According to this calculation, an average price of \$2.80/tCO₂ will cover the opportunity cost of deforestation and forest degradation of 8.5 million of hectares yearly. This would represent an emission reduction of -GtC 3.76 tCO₂/year (65% of the emissions). For this scenario, the price of \$2.80/tCO₂ will also improve livelihood conditions in many regions, as this price is higher than the opportunity cost of the poverty-driven deforestation and forest degradation. Such an improvement would depend on various factors, especially on the administration and transaction costs of REDD activities and the specific conditions of each region (socio-economic, institutional, access to infrastructure, etc.) (UNFCCC 2007a).

When the highest marginal cost to completely stop deforestation – the “choke price” – is applied to the projected deforestation to estimate the cost of reduced deforestation prices vary between \$11 to \$77 per tCO₂ (excluding transaction costs) (Sathaye et al. 2007). Applying those prices (to the projected emissions due to the loss of primary forest in each region) yields a cost of \$25 to 185 billion per year to stop deforestation (UNFCCC 2007a and Trines 2007).

Effective implementation of REDD faces a number of methodological problems. The key ones – as summarized from the analysis in chapter 3 – are the following:

- **“Leakage” or “Displacement”.** This is the possibility that carbon emissions avoided in one location will simply relocate to another location (an issue for any carbon emission mitigation approach). The avoidance of displacement is a justification for adopting a national framework for REDD implementation rather than, or in addition to, a project-based approach,

because calculation of carbon credits on a national level would take account of domestic leakage.

- **Permanence.** Because of the possibility that forests might be destroyed through fire or other natural calamities, or through increased pressures on forest land, there is no guarantee of a permanent carbon reservoir and CO₂ sequestration, leading to debate over whether REDD carbon credits should be temporary or permanent. However, as Watson, Noble et al. 2000, section 2.3.6.2, show, even a one-time reduction in deforestation rates will have a permanent effect on atmospheric carbon levels, unless the baseline deforestation rate is exceeded.
- **Establishment of baseline/reference scenarios.** This issue refers not only to the methodological issues of measuring baseline or reference scenarios, but also their appropriate definition, as the establishment of generous baseline levels would benefit both suppliers and buyers of subsequent carbon credits. Also, countries that have historically chosen to address deforestation rates should not be penalised for this form of “early action”.
- **The relative role of market-based and non-market financial mechanisms.** While market-based approaches will most probably play a major role in REDD, many developing countries face significant needs to build necessary capacity for which market-based funding is hardly at disposal. A system to ensure equitable sharing of benefits accrued from sale of credits derived from REDD needs to be established. There are also political issues related to the idea that the carbon market could constrain national sovereignty in determining land use and forest management policies.

The relative advantages of national or project-based REDD frameworks, or a hybrid of the two, needs to be assessed in order to develop an effective and comprehensive implementation system. Similarly, the role of temporary and permanent credits needs to be resolved, as do the methodological issues related to the establishment of baseline or reference scenarios.

Questions:

- How do you assess the emission reduction potential of REDD in your country?
- What are the capacity needs in your country for the development of a national and a project-based approach to REDD?
- What institutions could be used or need to be developed in order to ensure equitable sharing of benefits derived from carbon credits earned through REDD?
- What is the baseline/reference scenario, and how would you assess it in your context: net or gross emissions?
- Discuss and evaluate: national baseline scenario, sub-national and project baseline scenario. What are the opportunities and risks?
- Have there been any early actions in your country to address REDD?

4.2 Forest management²⁶

Forest management, as defined by the UNFCCC, is a system of practices for the stewardship and use of forest land aimed at fulfilling relevant ecological (including biological diversity), economic and social functions of the forest in a sustainable manner.

Forest management activities include silvicultural interventions that promote a greater proportion of the desired species, tree population and size structure, which in terms of timber means promoting the maximum volume of usable growing stock and, therefore, of carbon which may not be released to the atmosphere. They also include harvesting systems that maintain partial forest cover, minimize losses of dead organic matter or soil carbon by reducing soil erosion, and avoid slash and burning and other high-emission activities. Replanting or natural regeneration promotion after harvest or natural disturbances accelerates tree growth and reduces carbon losses. Economic considerations are typically the main constraint, because retaining additional carbon on site delays revenues from harvest (IPCC 2007c). The use of

fertilizers or drainage of forest soil (especially in peat lands) can have a negative effect on the overall carbon balance and should, therefore, be minimized. Moderate drainage, however, can lead to increased peat carbon accumulation (Minkinen et al., 2002). Landscape-level carbon stock changes are the sum of stand-level changes in the different pools, and the impacts of forest management on carbon stocks ultimately needs to be evaluated at a landscape level. Increasing harvest rotation lengths can increase some carbon pools (e.g., tree boles) while decreasing others (e.g., harvested wood products) (Kurz et al. 1998).

The basic assumption is that the production forest area in 2030 will be the same as today. The basis for the cost estimates for this to be achieved is the ITTO Expert panel report on estimating the costs to achieve the ITTO Objective on Sustainable Forest Management (SFM).²⁷ This report was produced in 1995, based on an analysis using Criteria and Indicators for SFM. The ITTO report estimated the costs of SFM for all tropical production forests in ITTO member countries (about 350 million ha.) at \$6.25 billion. Considering present values (2007) and applying a 5% devaluation factor, this would correspond to about \$12 per ha by the year 2030.

For non-Annex I tropical and subtropical countries, the cost estimate for achieving sustainable forest management would therefore be around \$7.3 billion. For non-Annex I countries with temperate and boreal forests that have potential to increase carbon stocks through forest management, the amount of \$20 per ha-1 (as indicated by Whiteman, 2006), an additional \$1 billion can be estimated as cost of forest management for these countries.

In the long term, a sustainable forest management strategy aimed at maintaining or increasing forest carbon stocks while producing an annual sustained yield of timber, fibre or energy from the forest will generate a meaningful sustained mitigation benefit. Most mitigation activities require up-front investment with benefits and co-benefits typically accruing for many years to decades.

²⁵ \$1 Billion = \$1000 Million

²⁶ This subsection is based on the report prepared by Blaser and Robledo for the UNFCCC Secretariat, which was used as input for the “Background paper on analysis of existing and planned investment and financial flows relevant to the development of effective and appropriate international response to climate change” (UNFCCC, 2007a).

²⁷ See ITTO at: <http://www.itto.or.jp>

Questions:

- How do you assess the mitigation potential of forest management in your country?
- What is more convenient for your country: a national or a project based approach?
- What is the baseline/reference scenario, and how would you assess it in your context: net or gross emissions?
- Are there ongoing or planned programs on (sustainable) forest management in your country?

4.3 Forest restoration

Forest restoration is a combination of planting trees and human-induced natural regeneration within a degraded forest area that has lost most of its carbon stock.²⁸ Forest restoration thus is a strategy applied in degraded forest areas. Forest restoration aims to enhance and accelerate natural processes of forest regeneration (including carbon stocks) in order to regain the desired species composition and growing capacity of the forest ecosystem. In terms of mitigating climate change, forest restoration becomes complementary to reducing emissions from reducing forest degradation. One could try to reduce as far as possible emissions from degradation. In those areas where such a strategy is not completely successful, and where degradation has already taken place, one would need to restore the forest. Under current conditions there is a huge area of degraded forest that could be restored while improving overall livelihood conditions (including biodiversity, long-term income and health).

Table 5: Estimated extent of degraded forest landscapes by category in Tropical Asia, Tropical America and Tropical Africa (million ha) in year 2000*

	Asia (17 countries)	America (23 countries)	Africa (37 countries)	Total
Degraded primary and secondary forest	145	180	175	500
Degraded forest land	125	155	70	350
Total	270	335	245	850

Source: Blaser and Robledo, 2007, based on Blaser and Sabogal (2002): ITTO Guidelines for Forest Restoration and Secondary Forest Management.

*Authors' estimates. Based on FAO (1982, 1990, 1995, 2001); Sips (1997); Wadsworth (1997); WRI-World Bank (2000). In tropical America, about 38 million ha are classified as secondary forests. For the other regions it is not possible to distinguish between degraded primary forests and secondary forests.

²⁸ In the context of forest management, forest degradation is the reduction of the capacity of a forest to produce goods and services. 'Capacity' includes the maintenance of ecosystem structure, functions and carbon stocks (ITTO, 2002a).

The potential of forest restoration can be summarized as follows:

- Forest restoration is an issue in all non-Annex I countries where REDD is considered;
- The forest restoration potential is estimated to cover about 850 million ha;
- Considering an average carbon stock of 30 tC/ha in living carbon pools (above and below ground biomass) in degraded forests, this amounts to 25 GtC for the pantropical area;
- Fully stocked, these 850 million ha would amount to 57 GtC;
- Hence the maximum carbon stock restoration potential through restoration of degraded forest would amount to 32 GtC.

Taking a price of \$12 per ton of carbon, as paid today by some of the CDM A/R projects, there would be an additional potential cost of about \$38 billion that has not been included in the A/R CDM for the first commitment period. Still, this activity can be considered for a post-2012 forest mitigation regime.

Questions:

- How do you assess the sequestration potential of forest restoration in your country?
- What is more convenient for your country: a national or a project based approach?
- What is the baseline/reference scenario, and how would you assess it in your context: net or gross emissions?
- Are there ongoing or planned programs on forest restoration in your country?

4.4 Afforestation and reforestation

Afforestation, as defined in classical forestry science, is planting trees on non-forested land (afforestation) or on forested land without trees in 1990 (reforestation).²⁹ As noted above, under the UNFCCC, these two terms have a particular definition and have been used as such for A/R CDM. Both terms, in the LULUCF context, refer to

planting trees on land that is defined as non-forests.

In general terms, afforestation and reforestation initiatives have been driven mainly by the private sector for undertakings such as commercial plantation forestry, or by governments, particularly for soil and watershed protection. The drivers that influence afforestation and reforestation vary according to region and often even within a country.

A particular form of A/R CDM is the use of agroforestry. Agroforestry refers to the planting of trees among or around crops or on pasture land as a means of preserving or enhancing the productivity of the land. In many parts of the world, smallholder agroforestry systems are tree- and species-rich systems producing non-wood and wood products for both home use and market sale. These systems can sequester large amounts of carbon that are retained in the biosphere over time. While the individual systems may be of limited size, on a per area basis smallholder systems accumulate significant amounts of carbon, equal or beyond the amount of carbon stored in degraded forests. Their ability to simultaneously address smallholders' livelihood needs and store large amounts of carbon makes smallholder agroforestry systems viable project types under A/R CDM, with its dual objective of emission reductions and sustainable development. Simplified smallholder A/R CDM projects based on agroforestry concepts still needs to be refined, in particular with respect to the bundling of approaches and to the acceptance of a carbon accounting approach at landscape level.

Sathaye et al. (2006) projected the potential land area planted and the removals by sinks (including planting forests and agroforestry systems) benefits across a number of scenarios relative to 2100 and compared them to a reference scenario. For 2050 the range of land area planted is between 52 and 192 million ha whereas the carbon benefits range from 18 to 94 million t of CO₂. According to the same authors, the forest establishment costs range from \$654 per ha to \$1580 per ha (ORNL 1995). Using this range, the initial investment required for mitigation equivalent to 18–94 million t CO₂ through afforestation/reforestation on 52–192 million hectares of

²⁹ The European Environmental Agency recently defined forest plantations as forest stands established by planting or/and seeding in the process of afforestation or reforestation. They are either: a) of introduced species (all planted stands), or b) intensively managed stands of indigenous species which meet all the following criteria: one or two species at plantation, even age class and regular spacing. It excludes stands which are established as plantations but which have been without intense management for a significant period of time; these should be considered semi-natural.

land would be \$34–303 billion. The IPCC WG III AR4 estimate of the mitigation potential of afforestation by 2030, i.e., 1,618 to 4,045 Mt CO₂/year, is substantially lower than the estimate of Sathaye et al. (2006). Using a similar ratio between carbon sequestered and hectares planted, the WG III AR4 estimates would require 4.6–8.2 million ha. At establishment cost of \$654–1580 per ha that would be \$3–12.9 billion or \$0.1–0.5 billion per year over 25 years.

Questions:

- How do you assess the sequestration potential of afforestation and reforestation activities in your country?
- What is more convenient for your country: a national or a project based approach?
- What is the baseline/reference scenario, and how would you assess it in your context: net or gross emissions?
- In your country, do there exist tree planting programs and what are their purposes?
- Which would you see as promising LULUCF activities for a post-2012 climate regime?

4.5 Substitution and the use of forest biofuel³⁰

Mitigation options in the forestry sector include extending carbon retention in harvested wood products, product substitution and producing biomass for bio-energy. This carbon is removed from the atmosphere and is available to meet society's needs for timber, fibre, and energy. Biomass from forestry can contribute 12–74 EJ/yr to energy consumption, with a mitigation potential roughly equal to 0.4–4.4 GtCO₂/yr depending on the assumption of whether biomass replaces coal or gas in power plants (IPCC 2007 AR4, WG III).

Forest biofuel refers either to energy carriers derived from processed or unprocessed plants biomass, such as the plantation of *Jatropha* and other forest trees and shrubs or to so-called second generation biofuels - that is deriving biofuels from cellulosic material, in particular from wood.

Bioethanol and biodiesel are the most common forms of biofuels. For the forestry sector, wood substitution, ethanol from wood (second generation biofuels) and biodiesel from vegetable oils from trees and bushes (e.g., palm oil or *Jatropha*-oil) are the most important options.

Recently, the commercial use of biomass for bioenergy has received a boost from high oil prices and the policies that governments have initiated to promote renewable energy sources. Over the past few years, the areas under biofuel plantations have increased dramatically around the world, particularly of soybeans and oil palm. This latter produces more oil per hectare than any other oilseed, and can be blended directly with petroleum-based diesel, producing a cleaner fuel. Malaysia and Indonesia account for 85% of the palm oil produced worldwide (Carrere 2006).

Rising demand for intensively produced biofuel outside forests, such as palm oil, will decimate biodiversity unless producers and politicians can work together to preserve as much remaining natural forest as possible. Even if recognising that tree crops have a considerable mitigation potential, some aspects need to be taken into account when assessing the overall benefits for sustainable development:

a) Potential impacts on deforestation

Because palm oil plantations are often established after natural forests have been logged and then burned to clear the land for planting, the increasing area under plantations of oil palm may seriously threaten the remaining tropical forests in some developing countries. Furthermore, large parts of palm oil producing countries in South East Asia consist of peatlands, initially covered by rainforests. Rainforest peatlands are rapidly being destroyed through deforestation and drainage for plantations (mainly oil palm and pulp wood).

In other regions (e.g., Latin America), forests are being cleared to extend the area under soybean cultivation. While the market for soybeans has been traditionally for food and animal fodder, there is an increasing interest in using this crop to produce bio-diesel.

b) Potential impacts on food security

There are considerable concerns on the impacts of biofuel production on food prices and hence global food security. This concern is based on the fact that producing crops for biofuels increases competition on available land and food production. Since available land is a limited good, the market price and changes in demand of a given forest product has a great impact on decisions regarding which crop should be produced and/or brought to which market (Peskett et al., 2007).

If, for example, demand for *Jatropha* seeds increases due to a boom in the biodiesel market, *Jatropha* plantations, which are normally done on "waste land" will become competitive for agricultural land (Von Braun and Pachauri, 2006). The impact on the global food market has already been felt during the first semester of 2008. Further stress to the food market will increase social discomfort and augment social disparity worldwide.

c) Integrated environmental impacts of biofuels

Besides the GHG balance, other environmental impacts need to be carefully understood when discussing the possibility of using biofuel. Impacts on soil degradation, resource depletion, biodiversity loss, ecotoxicity, air pollution and water contamination have been included in a research study using the Life Cycle Analysis framework (LCA) by Zah et al. (2007). According to this report, to date almost all biofuels are beyond the environmental benchmark for fossil fuels. If the environmental integrity of the Convention is to be maintained, a better understanding of the real potential impacts of biofuels needs to be ensured before promoting large biofuel programs for mitigation.

Questions:

- Do you have information regarding the potential for biofuel crops in your country?
- Is there any program supporting biofuel production in your country?
- Is the promotion of forest biofuels a priority in your country?
- Are you aware of the environmental and/or social impacts due to forestry biofuel production in your country?

³⁰ Biofuels are considered normally under the energy sector. This short section intends to present the issue as it is relevant for policy makers in the forest sector. It is not a comprehensive presentation nor an analysis on the potentials for and difficulties in using biofuels as a means for mitigating climate change.

5. OVERVIEW OF EXISTING POLICY OPTIONS

Currently there are three major negotiation processes under the UNFCCC: the Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol (AWG-KP), the Ad Hoc Working Group on Long-term Cooperative Action under the Convention (AWG-LCA) and the ongoing discussions under SBSTA. At COP 15 in 2009, these discussions should converge on a consistent agreement for a post-2012 mitigation regime.

This section will first present the way LULUCF issues are considered in these ongoing negotiation processes. After that, some more detailed analysis of the policy options on REDD, as well as other mitigation options in forestry, will be presented.

5.1 Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol (AWG-KP)³¹

Article 3.9 of the Kyoto Protocol establishes the need to consider future commitments for Annex I Parties at least seven years before the end of the first commitment period. The AWG-KP was created for pursuing this aim. Results should be ready for adoption by the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol (CMP) at the earliest possible time to ensure that there is no gap between the first and second commitment period of the Kyoto Protocol.

Under this negotiating process, there is a specific agenda item on LULUCF, where all activities included in Article 3 of the Protocol are under discussion. The following are under consideration:

- Activity-based approach based on Article 3.3 and 3.4 of the Kyoto Protocol;
- Land-based approach based on reporting under the Convention;
- Harvested wood products (HWP).

Besides, potential new activities such as wetland management, restoration and degradation and forest

degradation are included in the discussions. Key elements in the discussion include the possibility or need for using discounting factors limiting the magnitude of LULUCF for Annex I Parties' compliance and many legal aspects. Conclusions and decisions of this process are bound to have impacts on monitoring and reporting requirements for LULUCF in Annex I Parties.

5.2 Ad Hoc Working Group on Long-term Cooperative Action under the Convention (AWG-LCA)³²

The AWG-LCA was created to conduct the comprehensive process to enable the full, effective and sustained implementation of the Convention through long-term cooperative action, now, up to and beyond 2012, as agreed in the BAP, Decision 1/CP.13). Regarding forests, the BAP includes in paragraph 1(b)(iii):

Policy approaches and positive incentives on issues relating to reducing emissions from deforestation and forest degradation in developing countries; and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries;

In the majority of the submissions for the first meeting of the AWG-LCA, LULUCF is mentioned as an important option for mitigating climate change.³³ The major issues for discussion are:

- Which activities to include. In the submissions, the following activities were mentioned when discussing mitigation options in developing countries: REDD, forest conservation, sustainable forest management and enhancements of sinks. Some Parties also mentioned afforestation and reforestation as well as forest management;
- Consequences on reporting measurable and verifiable emission reductions and enhancements in stocks;
- Need for consistency with the ongoing work under the AWG-KP.

5.3 Ongoing discussion in the SBSTA with regard to REDD

In accordance with Decision 2/CP.13, the SBSTA started a program of work on methodological issues related to a range of policy approaches and positive incentives for REDD. Parties have been asked to provide their views on outstanding methodological issues, including: assessments of changes in forest cover and associated carbon stocks and GHG emissions; incremental changes due to sustainable

forest management; demonstration of reductions in emissions from forest degradation; implications of national and sub-national approaches, including displacement of emissions; options for assessing the effectiveness of actions. There is a clear link between this process and the work of the AWG-LCA. It is, therefore, of key importance that policy makers keep consistency in their positions when participating in these two processes. Submissions made by Parties point to priorities for discussion (see Table 6).

Table 6: Issues under current discussion

The issues	The discussion
Activities to be considered	Some parties would like to concentrate on deforestation and forest degradation as they consider that other potential activities bring many uncertainties to the discussion. Others also want to consider conservation, sustainable forest management and/or enhancements of sinks.
Definitions	The definition of forest has a great impact on REDD as well as on the potential for all other mitigation options in forestry. It is imperative to clarify which definition should be used. Some Parties highlight the need of having a definition that addresses different national circumstances and different ecosystems types within a country. The definition of other terms such as degradation, sustainable forest management and conservation also needs to be clarified in the context of mitigating climate change.
National and sub-national approaches	Some Parties favor national approaches, while other Parties highlight the need to include also sub-national approaches with a certain level of flexibility. Issues for argumentation are treatment of emissions displacement, monitoring requirements, accuracy and treatment of uncertainties.
Reference scenario or baseline	The reference scenario seems to be linked to historical data while the baseline seems to include also future trends. For those countries with a high deforestation rate in the past, the reference scenario appears to be a more adequate option while for those countries with potential increments in deforestation rates in the future the possibility to build up a baseline considering these future trends looks more adequate.
Measurable, Reportable and Verifiable (MRV) requirements	This issue is discussed under the monitoring requirements. The discussion in the submissions is how far satellite imagery is enough (in terms of adequacy of the technology and installed capacities in developing countries) and/or how other monitoring tools and existing information can be used (e.g. inventories, ground check, etc).
Funding mechanism	This concerns the possibility of having a market mechanism or of creating a fund for REDD compensation. In both cases, it is assumed that some kind of payment needs to be considered as a key incentive for REDD (see Table 8 for a detailed information on the mechanisms that have been discussed).
Effectiveness of support given by Annex I countries	In the submissions, Parties refer to the need to have clarity about the criteria for support, the amount of resources invested and a way for assessing its effectiveness.

³¹ Bear in mind that only Parties that have already ratified the Kyoto Protocol participate in this negotiation; that is the Parties acting as the meeting of the Parties (CMP) of the Kyoto Protocol.

³² All parties in the Convention participate in this negotiation (this process distinguishes between developed and developing countries).

³³ These documents can be downloaded under <http://unfccc.int/documentation/documents/items/3595.php#beg>.

5.4 Policy Instruments and Approaches

In the discussion on policy instruments and approaches, two elements need to be differentiated: the kind of policy instruments that can be used for tackling emissions of GHG from deforestation and forest degradation; and the level on which this instrument is to be applied – local, regional or national (see Tirpak et al. 2008). What kind of instrument can be used for accommodating forestry mitigation options, including REDD, in a post-2012 regime? Within the UNFCCC and according to the ongoing processes explained before, we can identify three options that have different advantages and disadvantages (see Table 7):

- **The CDM:** Currently, only afforestation and reforestation are eligible LULUCF activities under the CDM. In a post-2012 regime, the mechanism could have other eligible activities from the forest sector. Given that the CDM is a project-based mechanism, the level of action will be mainly local. A national approach would be used in the case of developing a sectoral CDM in forestry. Funding would depend on the market for emission reductions, since the CDM is a market mechanism. The major issue under this scenario is the appropriateness of the modalities and

procedures for the A/R CDM as stated in Decision 5/CMP.1.

- **A new cooperative mechanism within the KP:** This alternative foresees the introduction of a new mechanism under the Kyoto Protocol.³⁴ In this case, Parties would have more flexibility to agree on specific definitions for forestry activities, since specific definitions can only be set for this new mechanism. Additionally, Parties will be free to decide at which level each mitigation option should be addressed. Further, agreement on modalities and procedures would depend on the architecture of the mechanism. However, only Parties that have ratified the Kyoto Protocol would be eligible for participating in such a mechanism.
- **A new protocol:** This case provides the greatest number of possibilities for setting commitments (voluntary or not), definition of activities, mechanisms, modalities and procedures. Besides, all Parties to the Convention could participate in a new protocol. However, many issues would then need to be negotiated. A potential new protocol should be seen within a wider perspective and taking into account all potential mitigation sectors.

Table 7: Main positive and negative aspects of different policy instruments

Options	Advantages	Disadvantages
An eligible activity under the CDM	<ul style="list-style-type: none"> • Proven ability of the CDM to provide incentives for action • Institutional framework already in place 	<ul style="list-style-type: none"> • A political agreement is not likely • Technical hurdles • Limited to project-based action • Uncertainties related to the international price for carbon as a major driver for action.
A new mechanism under the Kyoto Protocol	<ul style="list-style-type: none"> • Ability of the GHG market to provide incentives for action • Flexibility within Kyoto Protocol limits 	<ul style="list-style-type: none"> • Controversy could lead to less flexibility in the design • Technical hurdles as for the CDM
A second protocol	<ul style="list-style-type: none"> • Flexible to accommodate realities beyond climate change (i.e. biodiversity) 	<ul style="list-style-type: none"> • No institutional framework exists • No clarity about modalities and procedures • Many issues to be negotiated before action can take place

Source: Forner, Blaser, Jotzi and Robledo (2006), modified.

³⁴ There are three flexible mechanisms defined by the Kyoto Protocol. Article 6 defines Joint Implementation; Article 12 defines the Clean Development Mechanism; and Article 17 defines International Emissions Trading. For more information see: <http://unfccc.int/resource/docs/convkp/kpeng.pdf>.

Regarding positive incentives, the following options have been considered in the submissions: direct regulation (e.g., national policies), taxes and subsidies, transfer payments and permit trading. While taxes and subsidies are defined at the national level, regulation for transfer payments and permit trading can also be agreed at the international level. There is some literature analysing the pros and cons of each of these incentives (e.g., Kaimowitz and Angelsen 1998, von Amsber 1998, Lele et al. 2000, Espach 2006, Forner et al., 2006). One common conclusion is that a given incentive is not better or worse per se, but its success depends on the overall institutional framework as well as on the possibilities to enforce the institutional agreements at various levels and to monitor results.

Questions:

- Which policy instruments have been used in your country in the forest sector? Is there any evaluation/assessment available for these policies?
- Which incentive mechanisms have been used in your country in the forestry sector? Is there any evaluation/assessment available of these instruments?

5.5 Financing Options

There is general agreement that any mechanism for promoting mitigation options in the forest sector in developing countries should include the provision of new and additional financial resources. However, there are different positions on where these resources should come from and which kind of mechanism should be agreed. Many submissions include proposals on financing mechanisms for REDD (see Table 8). How far these proposals could include other forestry options has not yet been discussed. The following are the key issues and points considered during the discussions REDD:

- Possible sources of funding include: official development assistance (ODA), establishment of funds, multilateral sources, public-private partnerships, payment for environmental services (PES) and market mechanisms;
- Non-market financial resources are acceptable for the majority of the Parties, but funding will generally be limited. Market-based approaches facilitate private sector participation and are more likely to be long-term and sustainable;

- Consideration of approaches to reward actions on REDD needs to be broad and include several alternatives;
- There is a need for additional and innovative financial mechanisms, as well as for reinforcing existing support;
- Up-front financing is needed for institutional and technical capacity building, technology transfer and pilot activities;
- Implementation of actions on the ground requires long-term, sustainable funding;
- It is important that rewards or/and compensation reach “actors” on the ground;
- Governance of the forest resources will play a major role in all forest mitigation options;
- Funding should be provided for demonstrable emission reductions from reduced deforestation;
- There is the concern that market based approaches could devalue the price of existing carbon credits (under the believe of some that forest based carbon could flood the market);
- A new supply of credits must be met by new demand created by deeper reduction commitments by Annex I Parties;
- Any funding mechanism should ensure permanence of emission reductions and/or enhancement of sinks.

Questions:

- Which are the advantages and challenges of market mechanisms for your country? Which are the advantages and disadvantages of funds? Which financing option seems to be more appropriate?
- Do you have upfront financing mechanisms for forestry activities in place in your country?
- Which other kind of taxes and subsidies are used in the forestry sector in your country?

Table 8: Some proposals for funding mechanisms on REDD

Types of mechanism	Characteristics
REDD Mechanism	<ul style="list-style-type: none"> Accounts for gross carbon emission reductions and non-CO₂ emission reductions only in existing forest areas on a national basis. Market Mechanism (higher accuracy and value) and/or non-market incentives (lower accuracy and value). Voluntary policy approaches. Gross reductions of GHG emissions against a reference scenario (defined as a function of the emissions rate and a development adjustment factor) for a reference period. Nationally-based. However, it could be implemented synergistically with the project-based A/R CDM.
REDD Stabilization Fund	<p>Accounts for carbon emissions and removals and non-CO₂ emissions in countries participating in the REDD Mechanism that seek to maintain and stabilize existing forest areas on a national basis. It is meant to be especially useful for countries with low deforestation and forest degradation rates and for the maintenance of forests.</p> <p>New and additional funding as:</p> <ul style="list-style-type: none"> A levy on Emission Reduction Units (similar to that imposed on the CERs generated under the CDM). A tax on carbon intensive commodities and services. New and additional ODA.
REDD Enabling Fund	<p>A special purpose group of funds designed to prepare and support developing countries that seek to participate in the mechanisms above, including through piloting activities. It is meant to create capacities in some developing countries so that they can participate in a REDD system.</p> <ul style="list-style-type: none"> Means: new and additional financial resources Three voluntary tracks: REDD non-market (or fund-based) mechanisms; REDD market-based mechanisms; and REDD stabilization instrument REDD is considered solely under the Convention. Therefore, no mechanism aimed at fulfilling commitments by Annex I countries. Related to "avoided deforestation" or "conservation." Based on voluntary reductions by developing countries. Seeks positive incentives for the net reduction of emissions from deforestation in developing countries. Incentives should encompass the provision of new and additional financial resources, technology transfer, capacity building and enhancement of endogenous capacities. Financial incentives to be provided by Annex I countries voluntarily engaged. Means: new and existing national public policies and measures. Only ex-post results can be considered. Reductions are to be calculated based on a comparison between the rate of emissions from deforestation for a certain past period with the reference emissions rate. Countries can create a credit or a debit. Credits will be converted to financial incentives coming from developed country partners according to their obligations under the UNFCCC. Developing countries will then be either: ready for a prompt start; or require capacity building. Scheme based on country's individual definitions for deforestation.
Credit for early action	Early action on REDD to be also eligible for crediting.
Avoided Deforestation Carbon Fund (ADCF) <i>Note: Many similarities with the REDD Stabilization Fund</i>	<ul style="list-style-type: none"> Aimed at providing resources for the implementation of specific activities that: a) reduce emissions from deforestation; and/or b) maintain low rates of deforestation. This fund could be financed through: <ul style="list-style-type: none"> Voluntary contributions. An X% levy of Emission Reduction Units or Assigned Amounts Units (similar to the CERs). A tax on carbon intensive commodities and services in Annex I countries. Fund replenishment instruments based on the "polluter pays" principle.
Enabling Fund	<ul style="list-style-type: none"> Aimed at supporting capacity building and piloting activities. Sources of replenishment should be identified and additional ODA required

Types of mechanism	Characteristics
Market-based mechanism	<ul style="list-style-type: none"> Including the CDM and other market mechanisms and coupled with an appropriate demand (e.g. by increasing reduction commitments of Annex I countries).
Preparatory scheme for a post-2012-regime	<ul style="list-style-type: none"> Assessment of national implementation of policies to combat deforestation. Activities to improve monitoring and reporting capacity required for REDD. Process to define baselines or reference scenarios including the anticipation of future trends. Positive incentives including: <ul style="list-style-type: none"> Voluntary funding. Similar as during the phase on Activities Implemented Jointly. Other sources of funding and support.
Financial mechanism for Compensated Conservation	<ul style="list-style-type: none"> Aimed at compensating countries for maintaining and increasing forests as carbon pools as a result of effective conservation measures and increasing/improving forest cover backed by verifiable monitoring systems. <ul style="list-style-type: none"> Additionality: Proposal of Compensated Conservation intended to be outside the Kyoto Protocol's CDM, so no need to prove additionality . Baseline: Increment/decrease to be evaluated as a gain or a loss against a predetermined base year/cut off year (for example 1990). There is a need for supporting NAI in fulfilling technical and methodological requirements for monitoring and reporting. Verification: through independent inspections. Proposes a new financial mechanism linked to verifiable carbon increments through ODA and Global Environment Facility (GEF) funds, or the Climate Change Adaptation Fund be enhanced and made available for such incentives. Capacity building would be canalized through the UNFCCC. Fiscal incentives to flow against one single National Project. Recipient country to decide distribution of incentives amongst participating communities, including investment in further conservation activities in forests or other wooded lands.
Forest Retention Incentive Scheme <i>Note: Established under the UNFCCC and would relate to REDD</i>	<p>Community Forest Retention Trust Accounts</p> <ul style="list-style-type: none"> Communities that wish to set aside forest areas or manage them on a sustainable basis would seek funding to establish a Community Forest Retention Trust Account (CFRT Account). Sources of funding for the CFRT Account could include: <ul style="list-style-type: none"> The Special Climate Change Fund. Bilateral ODA. Corporate sponsorship. NGO contributions. Government contributions (including through debt-for-nature swaps and similar measures). <p>Forest Retention Certificates</p> <p>Once the CFRT Account is established communities could apply for Forest Retention Certificates. These Certificates would be based on an estimate of the amount of GHG emissions reduced by the project in a period of time. This estimate would be based on current emission trends compared with potential actions to reduce these emission trends.</p> <p>International Forest Retention Fund</p> <p>Funding for the redemption of these Certificates would come from an International Forest Retention Fund (IFRT) established under the UNFCCC; redemption of the Certificates would be granted ex-post. Communities could deposit these redeemed Certificates into their CFRT Account or use the money as the community sees fit. Procedures for assessment and auditing would be kept as simple as possible to minimize transaction costs. The Certificates could only be redeemed by the IFRT. They cannot be sold, transferred or traded.</p>

Source: Submissions by Parties

6. CONCLUSIONS

LULUCF is a complex but highly important issue that will play a vital role of LULUCF in any post 2012 mitigation regime. The current system of including LULUCF activities as climate change mitigation option under the UNFCCC and Kyoto Protocol is not perfect. It is the result of complex negotiations that initially focused on sectors other than LULUCF. Today, with a far better understanding of the problems associated with the accounting, compliance procedures and implementation, it is possible to improve the existing framework under a post-2012 climate agreement.

A range of issues and proposals has been outlined in this paper and non-Annex I Parties will need to carefully consider the implications of integrating the various mitigation options in the LULUCF sector. Some key points may warrant further reflection in preparing positions in respect to LULUCF:

- **While the land use sector, including forestry, is an important source of anthropogenic GHG emissions, it also has great potential for mitigating climate change.** LULUCF activities, including REDD, forest restoration and forest management, can contribute to mitigate climate change through both GHG emission reductions and removals by sinks. Only the LULUCF sector offers these two possibilities for mitigation of climate change—all other sectors can only contribute through emission reductions.
- **Many LULUCF activities have the potential of being an appropriate and cost-effective adaptation measure, reducing overall vulnerability of social systems and ecosystems to climate change.** Forestry, in particular, has an important role to play. Managing in a sustainable manner the 30% of the global land area that is under forest cover will not only contribute to the mitigation of climate change and contribute as an effective adaptation measure, but has many other collateral environmental and socio-economic benefits. This integrative view clarifies why it is so important to consider forestry options and the whole LULUCF sector for mitigation in a consistent way and as part of a wider development concept (see also Blair, T. and the Climate Group, 2008). In this respect, two additional observations are key:
 - **LULUCF mitigation options have to be designed as complementary approaches to mitigation options taken in other sectors.**

They should also not perpetuate emission patterns that are not sustainable;

- **LULUCF mitigation options need to be based on accurate, while practical, accountability methods.** Currently, more integrative schemes are being introduced in the UNFCCC negotiation that are aimed at facilitating a path for a better integration of LULUCF in the post 2012 mitigation regime (The Terrestrial Carbon Group, 2008).
- **A post 2012 mitigation regime should include the LULUCF sector in a way that the maximum mitigation potential can be used.** This implies the need to agree on general decisions and detailed modalities and procedures that allow undertaking a maximum of activities in all countries while ensuring the environmental integrity of the Convention.
- **All Parties should strive to fully understand the potential role of, and multiple constraints in, LULUCF, and in the forest sector in particular.** This will help ensure that decisions at the international level can be applied at the local level at an affordable cost.
- **The UNFCCC, its Kyoto Protocol and any kind of agreement for a post-2012 regime will have an impact on governing land-use and forests in all parts of the world, particularly in developing countries.** An important consideration for policy makers is the need for effective governance in the forest sector in order to achieve a meaningful role for the sector in mitigating climate change.
- **With increased attention to forests mitigation options, particularly through the ongoing discussion on REDD, it is expected that the countries who clarify forest and carbon tenure aspects and effectively address illegality in forestry and land-use practices are more likely to immediately benefit from future forest mitigation incentives.** Climate change-relevant investment in the forest sector is a long-term undertaking. This requires security with respect to land-use and long-term commitment by involved parties.
- **Parties negotiating under the UNFCCC may need to clarify their own mitigation potential in LULUCF activities, including all possible LULUCF options.** This, coupled with a clear understanding of the potential and weakness of the forest and land-use sector at national and sub-national levels, would build

the basis for their participation in the negotiations.

- **Parties may also need to coordinate their national sectoral policies when defining how to use LULUCF activities as a mitigation option.** LULUCF can have many implications on specific land use planning (e.g., whether forests are available for sustainable forest management; or whether available land is to be used for biofuels or food crops production). A country's priorities should be reflected in sectoral and cross-sectoral policies that allow an appropriate implementation of LULUCF activities.

BIBLIOGRAPHY

Further reading

The report of the *Breaking the Climate Deadlock* initiative was launched in Chiba, Japan, on 20 March 2008 in the framework of the preparation of the G-8 meeting of July 2008. The report aims to build decisive political support among the key players – US, EU, China, India, Japan, and Russia – for a framework international agreement on climate change and the strategies for its subsequent implementation that will result in GHG emissions reductions consistent with those advocated by the scientific consensus. Attached to the report are a number of expert briefing papers, the most relevant for LULUCF are one on ‘Sustainable Biofuels’ by Richard Heap, Royal Society and the one on *Reducing Emissions from Deforestation and Degradation in non-Annex I countries* by Romain Pirard, IDDRI. The main report can be downloaded as pdf document in English, Japanese and Chinese under www.theclimategroup.org/index.php/special_projects/breaking_the_climate_deadlock/.

The Stern report provides valuable background information on the effect of climate change on the world economy. It focuses on three policy elements including carbon pricing, technology policy and energy efficiency and sets a framework for the inclusion of forestry as an effective economic mitigation option. *Stern, N. 2006. Stern review on the economics of climate change. UK Government Economic Service. London, www.sternreview.org.uk.*

In order to get an inside of the particular perspective of a broader group of civil society stakeholders on the issues relating to forests and carbon, the following document is very useful: Griffiths, T.O., 2007: *Seeing ‘RED - Avoided Deforestation and the rights of Indigenous Peoples and local communities*. Forest Peoples Program. www.fern.org/media/documents/document_4074_4075.pdf.

Most of the references presented in the section below provide valuable information on the various issues presented in this report.

References

- Aukland, L., P. Moura-Costa, S. Bass, S. Huq, N. Landell-Mills, R. Tipper and R. Carr, 2002. *Colocando los cimientos para el MDL. Preparando al sector uso de la tierra. Una guía rápida a los MDL. IIED, London.*
- Blair, T. and the Climate Group, 2008. *Breaking the Climate Deadlock A Global Deal for Our Low-Carbon Future*. Report submitted to the G8 Hokkaido

- Toyako Summit June 2008.
- Baumert et al., 2005. *Navigating the Numbers. Greenhouse Gas Data and International Climate*. World Resources Institute, Washington DC.
- Blaser, J. and C. Robledo, 2007. *Initial Analysis on the Mitigation Potential in the Forestry Sector*. Report prepared for the Secretariat of the UNFCCC. August 2007. http://unfccc.int/files/cooperation_and_support/financial_mechanism/application/pdf/blaser.pdf.
- Carrere, R., 2006 (Coord). *Oil palm from cosmetics to Biodiesel Colonization lives on. World Rain Forest movement*. ISBN: 9974 - 7969 - 7 - 0.
- FAO 2006. *Global Forest Resource Assessment 2005. Progress toward sustainable forest management*. FAO Forestry Paper 147. FAO, Rome.
- Forner, C., J. Blaser, F. Jotzo, C. Robledo. 2006. Keeping the forest for the climate's sake: avoiding deforestation in developing countries under the UNFCCC. *Climate Policy* 6, 2006.
- Houghton, R. A., K. T. Lawrence, J. L. Hackler, S. Brown, 2001. The spatial distribution of forest biomass in the Brazilian Amazon: a comparison of estimates. *Global Change Biology* 7(7): 731–746. doi:10.1046/j.1365-2486.2001.00426.x.
- Houghton, R.A., 2005. *Above ground Forest Biomass and the Global Carbon Balance*. *Global Change Biology* 11 (6), 945–958 doi:10.1111/j.1365-2486.2005.00955.x.
- Houghton, R.A., 2005a. *Tropical deforestation as a source of GHG emissions*. In: Moutinho, P., Schwartzman, S. (Eds.), *Tropical Deforestation and Climate Change*. Amazon Institute for Environmental Research and Environmental Defense, Belém, Brazil, pp. 13–22.
- IPCC, 2007a. *Climate Change, 2007: The Physical Science Basis: Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Summary for Policymakers.
- IPCC, 2007b. *Climate Change, 2007: Climate Change Impacts, Adaptation and Vulnerability: Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Summary for Policymakers.
- IPCC, 2007c. *Climate Change, 2007: Mitigation Options: Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Chapter 9 – Forestry. Final draft.

- IPCC, 2003, Edited by Jim Penman, Michael Gytarsky, Taka Hiraiishi, Thelma Krug, Dina Kruger, Riitta Pipatti, Leandro Buendia, Kyoko Miwa, Todd Ngara, Kiyoto Tanabe and Fabian Wagner. *Good Practice Guidance for Land-Use, Land-Use Change and Forestry*.
- IPCC, 2001. *Third Assessment Report of the Intergovernmental Panel on Climate Change* [Houghton, J.T., Y. Ding, D.J. Griggs, M. Nougues, P.J. van der Linden, X. Dai, K. Maskell, and C.a. Johnson (eds)]. Cambridge University Press, Cambridge, United Kingdom and New York, USA.
- IPCC, 2000. *Land Use, Land-use Change and Forestry: Special Report to the IPCC*. Cambridge University Press. Cambridge, United Kingdom.
- ITTO, 2002. *ITTO Yokohama Action Plan 2002 – 2006*. Yokohama, Japan.
- ITTO, 2002a. *ITTO guidelines for the restoration, management and rehabilitation of degraded and secondary tropical forests*. Prepared by Juergen Blaser (Intercooperation) and Cesar Sabogal (CIFOR). ITTO Policy Development Series No. 13. Yokohama, Japan.
- Jung, M., 2003. *The role of forestry sinks in the CDM – Analysing the effects of policy decisions on the carbon market*. HWWA Discussion paper 241. Hamburgisches Welt-Wirtschafts-Archiv. Hamburg Institute of International Economics. Hamburg, Germany.
- Kauppi, P., R.J. Sedjo, M. Apps, C. Cerri, T. Fujimori, H. Janzen, O. Krankina, W. Makundi, G. Marland, O. Masera, G.J. Nabuurs, W. Razali, and N.H. Ravindranath, 2001. Technical and economic potential of options to enhance, maintain and manage biological carbon reservoirs and geo-engineering. In *Mitigation 2001. The IPCC Third Assessment Report, [Metz, B., et al., (eds.)]*, Cambridge, Cambridge University Press.
- Jinxun, L., Changhui, P., Apps, M., Danga, Q., Banfield, E. and Kurz, W. 1998. *Forest Ecology and Management*. Volume 169, Issues 1-2, 15 September 2002. Pp. 103-114.
- Minkinen K., R. Korhonen, I. Savolainen, J. Laine, 2002. *Carbon balance and radiative forcing of Finnish peatlands 1900-2100: The impact of forestry drainage*. *Global Change Biology* 8(8): 785–799. doi:10.1046/j.1365-2486.2002.00504.x.
- Madlener, R., C. Robledo, B. Muys, B. Héctor and J. Domac, 2003. *A sustainability framework for enhancing the long-term success of LULUCF projects? CEPE,*

- working paper 29*. ETH Zentrum, Zürich.
- Nabuurs, J., O. Masera (coordinating lead authors). 2007. Chapter 9, *Forestry. IPCC Fourth Assessment Report*. In IPCC, 2007: *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [B. Metz et al (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. <http://www.ipcc.ch/pdf/assessment-report/ar4/wg3/ar4-wg3-chapter9.pdf>.
- Niles J.O., S. Brown, J. Pretty, A. S. Ball et J. Fay, 2002. *Potential carbon mitigation and income in developing countries from changes in use and management of agricultural and forest lands*. Contribution to the Special Theme Issue ‘Carbon, biodiversity, conservation and income: an analysis of a free-market approach to land-use change and forestry in developing and developed countries’. The Royal Society, 10.1098/rsta.2002.1023.
- Peskett, L., Slater, R., Stevens, C & Dufey, A. (2007) *Biofuels, agriculture and poverty reduction*. ODI Report.
- Robledo, C., Blaser, J., Byrne, S., Schmidt, K. (2008). *Climate Change and Governance in the Forest Sector: An overview of the issues on forests and climate change with specific consideration of sector governance, tenure and access for local stakeholders*. Rights and Resources Initiative. In press.
- Robledo, C. and O. Masera, 2007. *Developments in UNFCCC/IPCC discussions regarding reducing emissions from forest degradation and deforestation and implications for tropical forests and tropical timber producers*. Presented at the XLII Session of the International Tropical Timber Council. Paper No. 9. Port Moresby, Papua New Guinea.
- Robledo, C., M. Kanninen, L., Pedroni, 2005. *Tropical forests and adaptation to climate change: in search of synergies*. CIFOR, Bogor, Indonesia. 186p. ISBN: 979-24-4604-4.
- Robledo, C. and C. Forner, 2005. *Adaptation of forest ecosystems and the forest sector to climate change*. Forest and Climate Change Working Paper 2. FAO. Rome.
- Robledo, C. and C. Forner, 2004. *Introducción a la adaptación de los ecosistemas forestales y del sector forestal*. Elaborado para la FAO, Borrador para comentarios.
- Robledo, C. and R. Tippmann, 2004. *Opportunities and*

- challenges for the timber industry to participate in CDM activities. Prepared for the FAO advisory committee on paper and wood products. (In print).
- Sathaye, J.A., W. Makundi, L. Dale, and P. Chan. (Accepted in print 2007)? *GHG Mitigation Potential, Costs and Benefits in Global Forests: A Dynamic Partial Equilibrium Approach*. Energy Journal, (forthcoming).
- Sathaye, J. and K. Andrasko, 2007. *Special issue on estimation of baselines and leakage in carbon mitigation forestry projects*. Mitigation and Adaptation Strategies for Global Change 12(6): 963-970.
- Sathaye, J. and K. Andrasko, 2007a. *Land use change and forestry climate project regional baselines: A review*. Mitigation and Adaptation Strategies for Global Change 12(6): 971-1000.
- Scherr, S., A. Khare and A. White, 2003. *Current status and future potential of markets for ecosystem services of tropical forest*. Report prepared for ITTO. Forest Trends, Washington.
- Schlamadinger, B. et al., 2007. *A synopsis of land-use, land use change and forestry (LULUCF) under the Kyoto Protocol and Marrakech Accords*. Environmental Science and Policy 10 (2007): 271-282.
- Shin, S., 2003. *Kyoto-Protocoll, Wettbewerb- und WTO - Handelssystem*. HWWA Discussion paper 215. Hamburgisches Welt-Wirtschafts-Archiv. Hamburg Institute of International Economics. Hamburg, Germany.
- Soares-Filho, B.S., D.C. Nepstad, L.M. Curran, G.C. Cerqueira, R.A. Garcia, C.A. Ramos, E. Voll, A. McDonald, P. Lefebvre and P. Schlesinger, 2006. *Modelling conservation in the Amazon basin*. Nature 440, 520-523.
- Terrestrial Carbon Group, 2008. *How to Include Terrestrial Carbon in Developing Nations in the Overall Climate Change Solution*. <http://www.terrestrialcarbon.org>, July 2008.
- Stern, N., 2007. *The Economics of Climate Change: The Stern Review*. Cambridge, UK: Cambridge University Press.
- Trines, E., N. Hohne, M. Jung, M. Skutsch, A. Petsonk, G. Silva-Chavez, P. Smith, G. Nabuurs Gert-Jan., P. Verweij, B. Schlamadinger, 2006. *Integrating agriculture, forestry and other land use in future climate regimes. Climate change. Scientific assessment and policy analysis*. Report 500102002.
- Trienes, 2007. *Investment flows and finance schemes in the forestry sector, with particular reference to developing countries' needs*. A report for the Secretariat of the UNFCCC.
- UNCTAD, 1994. *International Tropical Timber Agreement*.
- UNFCCC, 2007. *Report on the analysis of existing and potential investment and financial flows relevant to the development of an effective and appropriate international response to climate change. Dialogue on long-term cooperative action to address climate change by enhancing implementation of the Convention. Fourth Workshop. Vienna, August 2007*. Dialogue Paper 8.
- UNFCCC, 2007a. *Background paper on Analysis of existing and planned investment and financial flows relevant to the development of an effective and appropriate international response to climate change*.
- UNFCCC, 2006b. *Background paper for the workshop on reducing emissions from deforestation in developing countries. Working paper No.1 (a) (2006)*. http://unfccc.int/files/methods_and_science/lulucf/application/pdf/part_i_scientific_issues.pdf.
- UNFCCC 2006c. Report of the Subsidiary Body for Scientific and Technological Advice on its Twenty-Fifth Session, held at Nairobi from 6 to 14 November 2006. FCCC/SBSTA/2006/11 <http://unfccc.int/resource/docs/2006/sbsta/eng/11.pdf>.
- UNFCCC 2006d. Report of the Conference of the Parties serving as the Meeting of the Parties to the Kyoto Protocol on its first session, held at Montreal from 28 November to 10 December 2005. Addendum Part two? FCCC/KP/CMP/2005/8/Add.3. <http://unfccc.int/resource/docs/2005/cmp1/eng/08a03.pdf#page=3>.
- UNFCCC, 2005. *Report of the Conference of the Parties on its Tenth Session*, FCCC/CP/2004/10.
- UNFCCC, 2004. *Report of the Conference of the Parties on its Ninth Session*, FCCC/CP/2003/6.
- UNFCCC, 2003. *Estimation, reporting and accounting of harvested wood products*. FCCC/TP/2003/7.
- UNFCCC, 2002. *Report of the Conference of the Parties on its Eighth Session and Delhi Declaration*, FCCC/CP/2002.
- UNFCCC, 2001. *Marrakech Accords*, FCCC/CP/2001/13/.
- UNFCCC, 1992: United Nations Framework Convention on Climate Change.
- Ward, M. 2004. Where to with LULUCF? First, how did

- we get to here? <http://homepages.paradise.net.nz/murrayw3/documents/pdf/Where%20to%20with%20LULUCF.pdf>.
- Von Braun, J. & Pachauri, R.K. 2006. The promises and challenges of biofuels for the poor in developing countries. <http://www.ifpri.org/pubs/books/ar2005/ar05eab.pdf>.
- Watson, R., I. Noble, B. Bolin et al. (2000). *IPCC Special Report on Land Use, Land-Use Change and Forestry*. Cambridge, IPCC: 377.
- Winkler, H., 2008. Climate change mitigation negotiations, with an emphasis on options for developing countries. UNDP.
- Wright, E. and J. Erickson, 2003. *Incorporating catastrophes into integrated assessment: Science, impacts and adaptation*. Climate Change 57: 265 – 286. Kluwer Academic Publishers, Netherlands.
- Zah, R., R. Hischer, et al., 2007. *Ökobilanz von Energieprodukten: Ökologische Bewertung von Biotreibstoffen*. Bern, Bundesamt für Energie, Bundesamt für Umwelt, Bundesamt für Landwirtschaft: 206.

ANNEXES

Annex 1. Key definitions in LULUCF

The Kyoto Protocol establishes which LULUCF activities have to be accounted under Article 3.3, and those additional LULUCF activities that are accounted on a voluntary basis by a Party under Article 3.4. It also lists the fundamental requirements for those activities: they must be human-induced and they must have taken place after 31st December 1989. A clear definition of Article 3.3 and 3.4 activities was adopted at the seventh session of the Conference of the Parties in Marrakech. The adopted decisions, part of the so-called Marrakech Accords, also give a definition of 'forest'. (Decision 11/CP.7 in FCCC/CP/2001/13/add.1). According to Decision 11/CP.7

Forest is a minimum area of land of 0.05-1.0 hectares with tree crown cover (or equivalent stocking level) of more than 10-30% with trees with the potential to reach a minimum height of 2-5 meters at maturity in situ. A forest may consist either of closed forest formations where trees of various story and undergrowth cover a high proportion of the ground or open forest. Young natural stands and all plantations which have yet to reach a crown density of 10-30% or tree height of 2-5 meters are included under forest, as are areas normally forming part of the forest area which are temporarily unstocked as a result of human intervention such as harvesting or natural causes but which are expected to revert to forest.

Afforestation is the direct human-induced conversion of land that has not been forested for a period of at least 50 years to forested land through planting, seeding and/or the human-induced promotion of natural seed sources.

Reforestation is the direct human-induced conversion of non-forested land to forested land through planting, seeding and/or the human-induced promotion of natural seed sources, on land that was forested but that has been converted to non-forested land. For the first commitment period, reforestation activities will be limited to reforestation occurring on those lands that did not contain forest on 31 December 1989.

Deforestation is the direct human-induced conversion of forested land to nonforested land.

Revegetation is a direct human-induced activity to increase carbon stocks on sites through the establishment of vegetation that covers a minimum area of 0.05 hectares and does not meet the definitions of afforestation and reforestation contained here.

Forest management is a system of practices for steward-

ship and use of forest land aimed at fulfilling relevant ecological (including biological diversity), economic and social functions of the forest in a sustainable manner.

Cropland management is the system of practices on land on which agricultural crops are grown and on land that is set aside or temporarily not being used for crop production.

Grazing land management is the system of practices on land used for livestock production aimed at manipulating the amount and type of vegetation and livestock produced.

As stated in the Marrakech Accords, by the end of 2006 each Annex I Party with commitments under the Kyoto Protocol has to choose a national definition of forest and decide which of the additional activities will be elected at the national level. For elected activities a Party has to document how the definitions will be applied to national circumstances and to list the criteria that determine under which activity a land would be assigned in order to minimize or avoid overlapping of land categories.

The area qualifying for each activity may change on the basis of the elected forest definition. For instance, the election of the highest range values may reduce the area eligible for afforestation and reforestation. At the same time, the forest dimensional thresholds will identify the separation between revegetation and afforestation and reforestation in countries that will elect for revegetation. The establishment of a vegetation cover that does not meet the country's definition of forest may be reported under revegetation. Other criteria can influence the area qualifying for a specific activity. Very important here are the concept of *human-induced* and the *precedence conditions and/or hierarchy* among elected activities of Article 3.4.

Deforestation and forest degradation are terms with various definitions. The differences may be the result of the specific goals for which the definition was set (see Annex 2). However, within the framework of the UNFCCC, it is important to keep in mind that definitions should serve the final objective of the Convention, which is *the stabilization of greenhouse gas concentrations in the atmosphere at a level that prevents dangerous anthropogenic interference with the climate system*. Further, the Article 2 of the Convention adds that *such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development in a sustainable manner (Text of the UNFCCC)*.

Annex 2. Definitions of deforestation and forest degradation

Forest	
UNFCCC/KP	<p>Forests are defined in the Marrakech Accords as follows:</p> <p>Forest is a minimum area of land of 0.05-1.0ha with tree crown cover (or equivalent stocking level) of more than 10-30% with trees with the potential to reach a minimum height of 2-5 metres at maturity in situ. A forest may consist either of closed forest formations where trees of various storeys and undergrowth cover a high proportion of the ground or open forest. Young natural stands and all plantations which have yet to reach a crown density of 10-30% or tree height of 2-5 metres are included under forest, as are areas normally forming part of the forest area which are temporarily unstocked as a result of human intervention such as harvesting or natural causes but which are expected to revert to forest.</p> <p>Note: According to the modalities and procedures for afforestation and reforestation within the CDM, each non-Annex I country had to submit their definition on forest for the first commitment period within the ranges established in the Marrakech Accords (Decision 5/CMP.1).</p>
IPCC	<p>Forest land: This category includes all land with woody vegetation, consistent with thresholds used to define forest land in the national GHG inventory, sub-divided at the national level into managed and unmanaged, and also by ecosystem type as specified in the IPCC Guidelines (since forest management has a particular meaning under the Marrakech Accords, a subdivision of managed forests as described in Chapter 4 of the IPCC Good Practice Guidance for LULUCF may be required). The category also includes systems with vegetation that currently fall below, but are expected to exceed, the threshold of the forest land category.</p> <p>Further, in the Good Practice Guidelines for LULUCF the IPCC uses the definition of forest agreed as part of the Marrakech Accords.</p>
FAO (Forest Resources Assessment – FRA- 2005)	<p>Land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10% or trees able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use.</p> <p>Explanatory notes:</p> <ol style="list-style-type: none"> 1. Forest is determined both by the presence of trees and the absence of other predominant land uses. The trees should be able to reach a minimum height of 5 meters in situ. Areas under reforestation that have not yet reached but are expected to reach a canopy cover of 10% and a tree height of 5 meters are included, as are temporarily unstocked areas, resulting from human intervention or natural causes, which are expected to regenerate. 2. Includes areas with bamboo and palms provided that height and canopy cover criteria are met. 3. Includes forest roads, firebreaks and other small open areas, forest in national parks, nature reserves and other protected areas such as those of specific scientific, historical, cultural or spiritual interest. 4. Includes windbreaks, shelterbelts and corridors of trees with an area of more than 0.5 hectares and width of more than 20 meters. 5. Includes plantations primarily used for forestry or protection purposes, such as rubberwood plantations and cork oak stands. 6. Excludes tree stands in agricultural production systems, for example in fruit plantations and agroforestry systems. The term also excludes trees in urban parks and gardens.
ITTO	<p>ITTO defines various related terms:</p> <p>Permanent forest estate (PFE): Land, whether public or private, secured by law and kept under permanent forest cover. This includes land for the production of timber and other forest products, for the protection of soil and water, and for the conservation of biological diversity, as well as land intended to fulfil a combination of these functions.</p> <p>Planted forest: A forest stand that has been established by planting or seeding.</p> <p>Primary forest: Forest which has never been subject to human disturbance, or has been so little affected by hunting, gathering and tree cutting that its natural structure, functions and dynamics have not undergone any changes that exceed the elastic capacity of the ecosystem.</p> <p>Production PFE: That part of the PFE assigned to the production of timber and/or other extractive uses.</p> <p>Protected area: An area of land and/or sea especially dedicated to the protection and maintenance of biological diversity and of natural and associated cultural resources, and managed through legal or other effective means.</p> <p>Protection PFE: That part of the PFE in which the production of timber (or other extractive uses) is prohibited.</p>

Forest Degradation	
UNFCCC/KP	None available yet. <i>However, at the 28th session of SBSTA (June 2008), several parties made submissions with recommendations for consideration in the development of an appropriate definition. Most of these recommendations focused on use or adaptation of the IPCC definition.</i>
IPCC	a) A direct human-induced loss of forest values (particularly carbon). Likely to be characterized by a reduction of the tree crown cover. Routine management from which crown cover will recover within the normal cycle of forest management operation is not included. b) Changes within the forest that negatively affect the structure or function of the stand and site, and thereby lower the capacity to supply products and/or services. c) Direct human-induced activity that leads to a long-term reduction in forest carbon stocks.
FAO	FAO 2000: A reduction of the canopy cover or stocking within the forest through logging, fire, wind felling or other events, provided that the canopy cover stays above 10%. In a more general sense, forest degradation is a long-term reduction of the overall potential supply of benefits from the forest, which includes wood, biodiversity and any other product or service. FRA 2005: Changes within the forest, which negatively affect the structure or function of the stand or site, and thereby lower the capacity to supply products and/or services.
UNEP/CBD/SBSTTA 2001	A degraded forest is a secondary forest that has lost, through human activities, the structure, function, species composition of productivity normally associated with a natural forest type expected on that site.
ITTO	The reduction of the capacity of a forest to produce goods and services. 'Capacity' includes the maintenance of ecosystem structure and functions.
Deforestation	
UNFCCC/KP	Deforestation is the direct human-induced conversion of forested land to non-forested land.
IPCC	Deforestation is the direct human-induced conversion of forested land to non-forested land (considered in IPCC 2003 as in the Marrakech Accords for the Kyoto Protocol).
FAO (FRA 2005)	The conversion of forest to another land use or the long-term reduction of the tree canopy cover below the minimum 10 % threshold. Explanatory notes: 1. Deforestation implies the long-term or permanent loss of forest cover and implies transformation into another land use. Such a loss can only be caused and maintained by a continued human-induced or natural perturbation. 2. Deforestation includes areas of forest converted to agriculture, pasture, water reservoirs and urban areas. 3. The term specifically excludes areas where the trees have been removed as a result of harvesting or logging, and where the forest is expected to regenerate naturally or with the aid of silvicultural measures. Unless logging is followed by the clearing of the remaining logged-over forest for the introduction of alternative land uses, or the maintenance of the clearings through continued disturbance, forests commonly regenerate, although often to a different, secondary condition. In areas of shifting agriculture, forest, forest fallow and agricultural lands appear in a dynamic pattern where deforestation and the return of forest occur frequently in small patches. To simplify reporting of such areas, the net change over a larger area is typically used. 4. Deforestation also includes areas where, for example, the impact of disturbance, overutilization or changing environmental conditions affects the forest to an extent that it cannot sustain a tree cover above the 10 % threshold.

Sources: ITTO, 2005; IPCC, 2003; FAO, 2004; Decision 11/CP.7; FCCC/CP/2001/13/Add.1

Annex 3. Input from the IPCC on LULUCF matters

The main activity of the IPCC is to provide at regular intervals assessment reports of the state of knowledge on climate change. The latest assessment, the Fourth Assessment Report, was completed in 2007.

The IPCC produces also special reports, methodology reports, technical papers and supporting material, often in response to requests from the Conference of the Parties to the UNFCCC or from other environmental Conventions

Besides the information in the four assessment reports, the IPCC has produced other material that focuses on LULUCF matters:

- Special Report on Land Use, Land Use Change and Forestry (2000)
- Technical Paper on Climate Change and Biodiversity (2002)
- Methodology reports.
- Guidelines for National Greenhouse Gas Inventories (2006, 1996, 1994)
- Good Practice Guidance for Land Use, Land-Use Change and Forestry (2003)
- Definitions and Methodological Options to Inventory Emissions from Direct Human-Induced Degradation of Forests and Devegetation of other Vegetation Types (2003).

The IPCC Guidelines include generic methodologies applicable to multiple land-use categories, consistent representation of lands, as well as methodologies for the six land categories emissions from livestock, manure and soil management as well as emissions from lime and urea applications. Finally the guidelines also consider harvested wood products. With the last Guidelines (2006), the IPCC has made an effort in the following:

- Promoting integration between agriculture and land use, land use change and forestry;
- Using managed land as a proxy for identifying anthropogenic emissions by sources and removals by sinks;
- Consolidating previously optional categories, and ensuring consistency with the concept of managed land as a proxy for identifying anthropogenic emissions by sources and removals by sinks;
- Providing detailed guidance for inclusion of harvested wood products in GHG inventories using any of the

approaches that are currently under discussion within the UNFCCC process;

- Including methods to estimate CO₂ emissions due to land use change in wetlands.

Although the IPCC has produced very valuable material regarding LULUCF, the sector remains a complex item for any negotiation. What are then the difficulties in considering LULUCF when mitigating climate change? Even if there is a general agreement on the importance of the sector as "emitter" as well as a "sink" there are some open questions on the ability to devise practical means to include the accounting of sinks in an equitable manner that adequately maintains the environmental integrity of any agreement. Two particular issues are of concern given associated uncertainties: data and the potential non-permanence of removals by sinks.

The previous work from the IPCC is key in considering other issues related to the way emissions and sinks from LULUCF are understood and accounted for in the current arrangements and in future negotiation. The most important of these issues are:

- Should removals of CO₂ from the atmosphere be considered as credits against the debit from an emission?
- Which are the advantages and disadvantages of using a net-net or a gross-net approach and which are the implications of each approach for accounting any reduction commitment in the LULUCF sector?
- Is reducing emissions from LULUCF? as creditworthy as increasing removals?
- How should the emissions from land use (without any land use change) in a future agreement be considered?

Annex 4. Decision pathway for A/R CDM and REDD

The eligibility, modalities and procedures for forestry activities under the CDM are ruled by the following decisions:

“Marrakesh Accords”, COP 7, 2001 (FCCC/CP/2001/13)

- Decision 11/CP.7: “Land Use, Land-Use Change and Forestry”
- Decision 17/CP.7: “Modalities and procedures for a clean development mechanism as defined in Article 12 of the Kyoto Protocol”

COP 9, 2003 (FCCC/CP/2003/6)

- Decision 19/CP.9: “Modalities and procedures for afforestation and reforestation project activities under the clean development mechanism in the first commitment period of the Kyoto Protocol.”

COP 10, 2004 (FCCC/CP/2004/10)

- Decision 13/CP.10: “Incorporation of the modalities and procedures for afforestation and reforestation project activities under the clean development mechanism into the guidelines under Articles 7 and 8 of the Kyoto Protocol.”
- Decision 14/CP.10: “Simplified modalities and procedures for small-scale afforestation and reforestation project activities under the clean development mechanism in the first commitment period of the Kyoto Protocol and measures to facilitate their implementation.”
- Decision 15/CP.10: “Good practice guidance for land use, land-use change and forestry activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol.”

COP 11 and CMP 1, 2005 (FCCC/CP/2005/10)

Two of the decisions above, which were originally drafted by the COP, were adopted by the first CMP, which took place in Montreal, Canada, in December 2005 and re-numbered as follows:

- Decision 5/CMP.5: “Modalities and procedures for afforestation and reforestation project activities under the clean development mechanism in the first commitment period of the Kyoto Protocol.”
- Decision 6/CMP.1: “Simplified modalities and procedures for small-scale afforestation and reforestation

project activities under the clean development mechanism in the first commitment period of the Kyoto Protocol and measures to facilitate their implementation.”

COP 12 and CMP 2

- No major decision on REDD or A/R

COP 13 and CMP 3

- Decision 1/CP.13: “Bali Action Plan.”
- Decision 2/CP.13: “Reducing emissions from deforestation in developing countries: approaches to stimulate action.”
- Decision 1/CMP.3: “Adaptation Fund”
- Decision 9/CMP.3: “Implications of possible changes to the limit for small-scale afforestation and reforestation clean development mechanism project activities.”

Annex 5. From LULUCF to Agriculture, Forestry and Other Land Use (AFOLU)

History within the IPCC deliberations:

- Revised 1996 IPCC Guidelines approach – Land-Use Change and Forestry (LUCF)
 - Identifies major likely land use sources
- 2000 Good Practice Guidance and Uncertainty Management
 - Defines GPG and applies it to Agriculture
- Good Practice Guidance for Land Use, Land-Use Change and Forestry (GPG LULUCF)
 - Expanded Guidance covering all carbon pools
 - Guidance on the representing Land Areas
- 2006 IPCC Guidelines for National Greenhouse Gas Inventories
 - Now (AFOLU)
 - Essentially the same as to GPG LULUCF but integrating Agriculture and LULUCF sectors
 - Extended default values & some improved methods

Changes from LULUCF to AFOLU in a nutshell:

- **Basic methodological approach continued from 1996 IPCC Guidelines, GPG LULUCF to 2006 Guidelines AFOLU:**
 - Stock changes: accounting of emissions and removals
 1. Inputs (e.g., growth) - outputs (e.g., harvest, decay)
 2. Total stock at end minus total stock at beginning
- **GPG LULUCF & AFOLU consider all carbon pools**
 - Improved completeness implies both more accurate and reliable results and increased data needs
- **The AFOLU Guidance in the 2006 Guidelines maintains the basic structure, definitions and methods of the GPG LULUCF**
 - Improved guidance in some areas
 - More and improved default data
 - Integration of Agriculture reduces chance of double counting or omissions, some simplification of categories
 - Do not pre-empt accounting choices, all the

information needed is retained

- Mapping between the GPG LULUCF classification and the AFOLU classification is straightforward.
- Effort and data requirements much the same as for LULUCF

IPCC guidelines in all UN languages can be downloaded under <http://www.ipcc-nggip.iges.or.jp>

Annex 6. Glossary

This section presents the definitions regarding mitigation as given in UNFCCC decisions.

Actual net GHG removals by sinks is the sum of the verifiable changes in carbon stocks in the carbon pools within the project boundary, minus the increase in emissions of the GHGs measured in CO₂ equivalents by the sources that are increased as a result of the implementation of the afforestation or reforestation project activity, while avoiding double counting, within the project boundary, attributable to the afforestation or reforestation project activity under the CDM.

Afforestation is the direct human-induced conversion of land that has not been forested for a period of at least 50 years to forested land through planting, seeding and/or the human-induced promotion of natural seed sources.

Baseline net GHG removals by sinks is the sum of the changes in carbon stocks in the carbon pools within the project boundary that would have occurred in the absence of the afforestation or reforestation project activity under the CDM.

Carbon pools are those carbon pools referred to in the Annex to Decision 5/CMP.1 (Modalities and Procedures for A/R CDM) and are: above-ground biomass, below-ground biomass, litter, dead wood and soil organic carbon.

Cropland management is the system of practices on land on which agricultural crops are grown and land that is set aside or temporarily not used for crop production.

Deforestation is the direct human-induced conversion of forested land to non-forested land.

Forest is a minimum area of land of 0.05-1.0 hectares with tree crown cover (or equivalent stocking level) of more than 10-30% with trees with the potential to reach a minimum height of 2-5 metres at maturity in situ. A forest may consist either of closed forest formations where trees of various storeys and undergrowth cover a high proportion of the ground or open forest. Young natural stands and all plantations which have yet to reach a crown density of 10-30% or tree height of 2-5 metres are included under forest, as are areas normally forming part of the forest area which are temporarily unstocked as a result of human intervention such as harvesting or natural causes but which are expected to revert to forest.

Forest management is a system of practices for stewardship and use of forest land aimed at fulfilling relevant ecological (including biological diversity), economic and

social functions of the forest in a sustainable manner.

Grazing land management is the system of practices on land used for livestock production aimed at manipulating the amount and type of vegetation and livestock produced.

Leakage is the increase in GHG emissions by sources which occurs outside the boundary of an afforestation or reforestation project activity under the CDM which is measurable and attributable to the afforestation or reforestation project activity.

Long-term CER or "ICER" is a CER issued for an afforestation or reforestation project activity under the CDM which expires at the end of the crediting period of the afforestation or reforestation project activity under the CDM for which it was issued.

Net anthropogenic GHG removals by sinks is the actual net GHG removals by sinks minus the baseline net GHG removals by sinks minus leakage.

Project boundary geographically delineates the afforestation or reforestation CDM project activity under the control of the project participants. The project activity may contain more than one discrete area of land.

Reforestation is the direct human-induced conversion of non-forested land to forested land through planting, seeding and/or the human-induced promotion of natural seed sources, on land that was forested but that has been converted to non-forested land. For the first commitment period, reforestation activities will be limited to reforestation occurring on those lands that did not contain forest on 31 December 1989.

Revegetation is a direct human-induced activity to increase carbon stocks on sites through the establishment of vegetation that covers a minimum area of 0.05 ha and does not meet definitions of afforestation and reforestation.

Small-scale afforestation and reforestation project activities under the CDM are those that are expected to result in net anthropogenic GHG removals by sinks of less than 16 kilotonnes of CO₂ per year and are developed or implemented by low-income communities and individuals as determined by the host Party. If a small-scale afforestation or reforestation project activity under the CDM results in net anthropogenic GHG removals by sinks greater than 8 kilotonnes of CO₂ per year, the excess removals will not be eligible for the issuance of temporary CER (tCER) or ICERs.

Temporary CER or "tCER" is a CER issued for an afforestation or reforestation project activity under the CDM which expires at the end of the commitment period following the one during which it was issued.



For further information:

Veerle Vandeweerd
Director
UNDP Environment & Energy Group
304 East 45th Street
Room FF-982
New York, NY 10017
Email: veerle.vandeweerd@undp.org
Phone: +1 (212) 906 5020

© Copyright United Nations Development Programme, October 2008. All rights reserved.