Climate Change
Reducing Vulnerability through Global Cooperation

A. Climate Change, Environment and Development

Economic growth is essential to reducing poverty and to reaching societal goals such as the Millennium Development Goals. By 2050 global population is expected to have increased by 50%, mostly in developing countries. World income is likely to have increased from its current US$35 trillion to US$135 trillion and per capita incomes for a large proportion of the world's poor should reach levels where basic needs for food, clothing and shelter are readily met. Such growth will be dependent on our ability to minimize the impacts of economic development on the ecosystems services that underlie all of our livelihoods and our ability to minimize losses through natural hazards such as floods, storms and droughts. However, these rapidly changing social and economic circumstances will be played out against a background where the impacts of climate change become increasingly apparent. Uncertainty about future climate patterns will influence the decision making and planning processes.

Human-induced climate change is a global threat and is likely to adversely affect terrestrial and aquatic ecosystems and the biodiversity they contain and undermine long-term economic development prospects and in particular the ability of many poor people to escape poverty.

The Earth's climate is changing due to human activities and is projected to change even more in the coming decades. The Earth's climate has warmed, on average by about 0.6^{o}C, over the past 100 years in response to human activities, precipitation patterns have changed, sea levels have risen and most non-polar glaciers are retreating. The Earth's climate is projected to warm an additional 1.4 to 5.8^{o}C between 1990 and 2100 depending on development pathways and the effort taken to combat climate change (IPCC 2001). Changes in the mean climate will lead to changes in the frequency of events that are locally regarded as extreme; for example the number of heat-waves is projected to increase, while the number of damaging frost events is projected to decline. The incidence of floods is expected to increase due an increase in the frequency of heavy precipitation events and changes in such major meteorological phenomena as El Nino are likely to increase the frequency and severity of droughts and floods.

Many sectors in developing countries are already vulnerable to current climate variability and climate change is adding additional vulnerability. Loss of life and damage from extreme climate events is already a major barrier to development. Although it is difficult to separate the effects of climate change from other social and economic trends, it does appear that the impacts of weather related disasters – according to the Intergovernmental Panel on Climate Change (IPCC,2001) - are increasing two to three times more rapidly than impacts due to earthquakes Climate change will further reduce access to drinking water, negatively affect the health of poor people, and will pose a real threat to food security in many countries. The IPCC concluded that developing countries, and especially poor people within developing countries, are the most vulnerable to climate change and that more people will be adversely affected by climate change than will be benefited. The greater the rate and magnitude of change the more adverse the consequences. The major threats include:

- *Water*: Decreased water availability and water quality in many arid and semi-arid regions; and increased risk of floods[1]; and droughts in many other regions
- *Health*: Increased incidence of vector-borne (e.g., malaria and dengue) and water-borne (e.g., cholera) diseases, especially in the tropics and sub-tropics, as well as an increased incidence of deaths from extreme weather events, such as heat waves and floods;
- *Agriculture*: Decreased agricultural productivity for almost any warming in the tropics and sub-tropics, although an increase in productivity in temperate and high latitude regions at least for a warming of up to a few degrees C (about 2-3^{o}C);

[1] In some areas where the rate of glacial melting is increasing under climate change, there will be a temporary increase in river flow and the risk of major floods if glacial lakes collapse.

- *Biodiversity and Ecological Systems*: Many species that are already vulnerable are likely to become extinct, and some ecosystems, e.g., coral reefs, high mountain and high latitude ecosystems, and remnant native grasslands, are particularly vulnerable to climate change;
- *Human settlements*: Increased risk of displacement for millions of people in low lying coastal areas and Small Island States due to sea level rise and increased storm surges; and
- *National and regional conflict*: Increased risk of conflict in some regions because of food and water shortages, increased incidence of floods and droughts, sea level rise, depletion of natural resources and the increased incidence of disease.

B. The Intergovernmental Response

The UN Framework Convention on Climate Change (UNFCC) and the Kyoto Protocol were designed as the first steps in combating the adverse effects of climate change by halting and reversing the increasing rate of greenhouse gas emissions in industrialized countries. It sought to reduce emissions from industrialized countries to about 5% below 1990 levels by 2012. This is only a small step towards the long term goal of stabilizing the atmospheric concentrations of greenhouse gases, an objective that will ultimately require much larger emission reductions. The importance of the Kyoto Protocol lies in the recognition that there is a need for international cooperation to fight climate change through targets for emissions limitations for industrialized countries and cooperation with developing countries through the Clean development Mechanism, and the creation of an environment that favors innovation, adaptation to climate change and the development of clean technologies.

Now that the Kyoto Protocol will enter into force on February 16th 2005, the international community faces a number of important choices. These include, but are not limited to: (i) whether to negotiate a series of national targets for a second commitment period (2013-2017) or whether to focus directly on the core issue of setting and achieving the goal of limiting the long-term change in global mean surface temperature; (ii) how to fully engage the United States of America and other non-ratifying industrialized nations; (iii) how to engage the major emitters of greenhouse gases in developing countries, with an equitable allocation of emissions rights, i.e., countries such as China, India and Brazil; and (iv) how to adapt to climate change and which developing country expense are eligible for financial assistance.

If governments decide to negotiate a long-term target, then it should be based on the current understanding of the climate system, and the response of different ecological and socio-economic systems. The thresholds at which damage to ecosystems and critical socio-economic sectors in developing countries is no longer acceptable cannot be determined precisely, but the best guidance that can currently be given suggests a goal of limiting the increase in global mean surface temperature to 2°C above pre-industrial levels and limiting the rate of change to less than 0.2°C per decade[2]. This will require that the atmospheric concentration of carbon dioxide be limited to about 450 ppm (pre-industrial level was about 280 ppm, and the current level is about 375 ppm) and the emissions of other greenhouse gases stabilized or reduced. Stabilizing the atmospheric concentration of carbon dioxide at 450 ppm over the next 100 years will, according to the IPCC, have a negligible effect on the growth of global GDP[3] and would send a strong signal to the private sector that markets will exist for climate friendly technologies

Achieving such a goal should limit, or avoid, significant adverse changes to unique and threatened species and ecosystems, and socio-economic systems in developing countries and the probability of large-scale, high impact events, e.g., the collapse of the major ice sheets or a significant change in ocean circulation, should remain low. However, adverse effects of climate change on ecosystems are already apparent, and even the suggested maximum tolerable changes in global mean surface

[2] Refer to IPCC TAR and the similar conclusions by the EU and specialized NGOs

[3] Estimates of the costs of stabilization at 450 ppm ranges from about 0.02 - 0.1% per year, compared to annual average GDP growth rates of between 2-3% per year (IPCC 2001).

temperature will have, on average, adverse effects on food, water, human health and livelihoods, especially in developing countries. Adaptation assistance will be required for developing countries where adverse effects will be concentrated.

Adaptation activities will be most effective when integrated into broader national development strategies and where they may have economic and other environmental benefits. The most effective approach to improving the ability to anticipate and react to the adverse consequences of climate change is to reduce risk and minimize damage by integrating coping and adaptive actions as part of the broader developmental framework. However, the downside of an integrated approach is that it will be difficult to differentiate between the costs associated with managing current climate variability and the incremental costs associated with climate change. Therefore, a key issue for negotiators will be to clarify the eligibility of adaptative activities for funding through the financing mechanisms established under the Kyoto Protocol.

Setting a long-term stabilization target would provide a firm goal for current and future climate efforts; calibrate short-term measures and measure progress; encourage technological change; mobilize society to understand the adverse consequences of climate change and change their consumption patterns; and promote global participation. Such a long-term target would need to be reviewed from time to time in light of emerging new scientific understanding.

Achieving a long-term stabilization target will require the cooperation of all countries to follow low carbon pathways in their future economic development. Key issues will include setting intermediate targets and an equitable allocation of emissions rights that recognizes the principle of common but differentiated responsibilities that is embodied in the Convention (see next section). Stabilization will also have to be achieved against a background of current trends that point to a steady increase in global energy demand of 1.7% per year from 2000 to 2030 with 60% of that demand coming from developing countries where roughly 1 person in three still has no access to electricity. Over that same period roughly $6 trillion will be invested in energy technology. It is this investment that provides the opportunity to achieve greater carbon efficiency.

There is general agreement that society already possesses the fundamental scientific, technical and industrial know-how to start to address the energy-carbon problem for the next half century. A portfolio of technologies now exists in the energy supply, energy demand, waste management, agricultural and forestry sectors, that have already passed the laboratory bench and demonstration phases, and are in many cases now being implemented some-where in the world at full industrial scale, to meet the worlds energy needs over the next several decades years and places us on a trajectory that would limit the atmospheric concentration of carbon dioxide that avoids a doubling of the pre-industrial concentration. However, fundamental research is needed now to develop the revolutionary mitigation strategies for beyond the next several decades to remain on a trajectory that would eventually stabilize the atmospheric concentration of carbon dioxide at about 500 ppm. Consequently, we need to reduce the projected emissions of greenhouse gas emissions using a portfolio of energy production technologies including fuel switching (coal/oil to gas), increased power plant efficiency, carbon dioxide capture and storage pre- and post combustion, and increased use of renewable energy technologies (biomass, solar, wind, run-of-the river and large hydropower, geothermal, etc.), complemented by more efficient use of energy in the transportation, buildings and industry sectors and improved waste and land management. This must be complemented by increasing our public and private sector investments in energy-related technologies, e.g., the hydrogen economy, carbon capture, storage and nuclear fusion and fuel cell cars.

Policies and programs are needed to facilitate the widespread deployment of climate-friendly energy production and use technologies. These include: energy pricing strategies, carbon taxes, removing subsidies that increase GHG emissions, incorporating the costs of environmental damage into the price of fossils fuels, continued development of the emerging domestic and international carbon markets which will reduce the cost of compliance for industrialized countries and contribute to sustainable development in developing countries, voluntary programs, incentives for use of new technologies during market build-up, regulatory programs including energy-efficiency standards, education and training such

as product advisories and labels. These types of policies are needed to level the playing field for environmentally-friendly technologies to be fully deployed in both developed and developing countries.

C. Equitable Responsibilities

If the focus of negotiations is shifted from national emission allowances to a long-term greenhouse gas stabilization target, then the sum of the emissions from all countries, developed and developing, must be consistent with the agreed emissions pathway. A key issue that will have to be addressed with long-term targets is the equitable allocation of emissions rights. The principle of 'common but differentiated responsibilities' is well established in the UNFCCC. Hence, international debate will need to focus on how to achieve an equitable distribution of responsibilities over the coming decades. This includes the responsibilities for paying for the additional costs of low carbon development pathways and for adaptation to the climate change that we are already committed to through past actions.

In deciding what is equitable, a number of factors need to be considered: (i) responsibility – should those that caused the problem be responsible for mitigating the problem? (ii) entitlements – should all humans enjoy equal entitlements to a global public good? (iii) capacity – should those that have a greater capacity to act bear a greater burden? (iv) basic needs – should strong nations assist poor nations meet their basic needs? (v) comparability of effort – should the ease/difficulty of meeting a target be taken into account? and (vi) future generations – what is the responsibility of the current generation for future generations?

There are a series of allocation options, each with their own political difficulties, including: (i) in proportion to current emissions (otherwise known as "grandfathering") – unlikely to be acceptable to developing countries because of their low current per capita emissions, and in many cases low total emissions; (ii) in proportion to current GDP – again unlikely to be acceptable to developing countries given their current low GDPs; (iii) current per-capita emissions rights – unlikely to be acceptable to developed countries given their current high per capita emissions; (iv) transition from grandfathering to per capita emissions – numerous transition schemes have been proposed, e.g., contraction and conversion; (v) allocations taking into account historic emissions, e.g., the Brazilian Proposal; (vi) allocations taking into account basic needs; and (vii) allocations taking into account national circumstances, e.g., ability to pay. Deciding which allocation scheme, or combination of these options, is appropriate will have to result from negotiations involving all countries. It is important that developing countries have the resources and opportunity to play a full part in these negotiations.

Two approaches that are receiving significant attention are Contraction and Convergence and the "Brazilian" Proposal. Contraction and Convergence is a science-based global framework whereby total global emissions are reduced (i.e., contraction) to meet a specific agreed target, and the per capita emissions of industrialized and the developing countries converge over a suitably long time period, with the rate and magnitude of contraction and convergence being determined through the UNFCCC negotiating process. It applies principles of precaution and equity; principles identified as important in the UNFCCC but not defined. The proposal by Brazil, which is based on cumulative historical emissions and their impact on the increase in global mean surface temperature, aims at sharing equally the burden of mitigation among all countries, industrialized and developing.

Equity issues also extend to the costs of adaptation. Countries vary enormously in their exposure to potential damage from climate change and this exposure is usually unrelated to their contribution to the problem, by whatever means the contribution is measured. The most obvious example is that of low-lying, small island states whose physical existence is threatened by sea-level rise even though their contribution the greenhouse gas emissions has been negligible. It is generally agreed that wealthier nations have a responsibility to assist highly affected developing nations carry out adaptive measures.

There is an urgent need for a deeper debate about the meaning of "common but differentiated responsibilities". Developed countries have both the means and the responsibility, through past and current emissions, to bear a substantial portion of the costs of mitigating and adapting to climate change. Developing countries should facilitate low emission development pathways by adopting

policies and measures that are appropriate not only to current conditions - social, economic and climatic – but also to future conditions.

D. Building Global Multi-stakeholder Coalitions for a Climate Friendly Future

If we are to take action on climate change as an international issue, action is needed by a wide range of stake-holders. Addressing climate change will require governments, the private sector, bilateral and multilateral agencies, the Global Environment Facility (GEF operational priorities may need to be re-aligned given the emerging carbon market), non-governmental organizations and consumers to play a critical role in mitigating, and adapting to, climate change. Different actors have different roles along the research, development, demonstration and widespread deployment value chain and pipeline for environmentally-friendly technologies. Innovative partnerships will be particularly important in technology transfer and financing.

Wealthy countries should set the example and move towards climate friendly energy production and consumption patterns in order to reduce greenhouse gas emissions in conjunction with enhanced investments in energy R&D. Wealthy countries should also increase levels of assistance designed to assist developing countries to do the same, and facilitate the access to new technologies through appropriate technology transfer mechanisms. All countries should improve their policies governing the critical sectors of energy, transportation and water, including implementing appropriate pricing policies, which will help to more efficiently use their scarce natural resources. Beyond this, climate concerns need to be more fully integrated into national economic planning.

A critical condition for significant investment in climate-friendly technologies is the establishment by governments of an appropriate policy and regulatory framework, e.g., the elimination of perverse fossil fuel subsidies, the internalization of environmental externalities, and the provision of appropriate incentives for new technologies to overcome initial market barriers.

At the R&D and demonstration stages, there are roles for both governments and the private sector, recognizing that barriers to investment in R&D and demonstration include difficulty of capturing the economic benefits of the R&D and demonstration, long time horizons associated with capturing the benefits, high risks and high capital costs. At the stage of widespread deployment there are clear roles for the private sector and for Aid agencies, trade agencies, the Global Environment Facility and the multilateral development banks. At this stage the major barriers are high transaction costs, the prices for competing technologies rarely include externalities, and a lack of information. However, there is a critical stage in the pipeline, reducing the cost per unit (buy-down), which is normally an area of neglect by all actors, where the barriers include financing the incremental costs, cost uncertainty, and technological and other risks.

Mechanisms are needed to fill this gap in the innovation pipeline. One approach that has been used in industrialized countries where energy-sector restructuring has taken place, is to establish small guaranteed markets to assist in launching new climate-friendly technologies, where qualifying new technologies compete for shares of these markets. Competitions could be organized by guaranteeing markets sufficiently large that clean energy technologies manufacturers could expand production capacity to levels where the economies of scale can be realized, reducing unit costs by advancing along the learning curve. The incremental costs of these competitions in developing countries could be covered by bilateral donors, an international fund, or eligible for GEF funding.

Technology transfer results from actions taken by a wide range of actors, including project developers, owners, suppliers, buyers, recipients and users of technologies; financiers, and donors; governments, international institutions, civil society organizations. Developed and developing country governments need to provide an appropriate enabling environment to enhance technology transfer, by reducing risks, through sound economic policy and regulatory frameworks, transparency and political stability.

Regional and international financial institutions should play an enhanced role in financing and attracting private capital to climate-friendly technologies, e.g., renewable energy and energy efficiency technologies, in emerging markets.

The World Bank views climate change as a critical issue with intermediate and long-term environmental and development impacts and is ready to assist developing countries adapt to climate change and meet their energy needs while promoting low emission development pathways, through exploring technological and policy options and testing and demonstrating their feasibility, and through its lending, implementation of GEF projects and carbon financing. Thus the World Bank, working with our partners in government, civil society and the private sector, is committed to supporting developing countries by being actively engaged in the broad climate change agenda:

- In the area of adaptation to climate change, the Bank assists developing countries:
  - adapt to climate change by integrating issues of climate variability and change into national economic and sector planning; and
  - access the new funds that are being made available for adaptation through the Global Environment Facility and the Kyoto Protocol.
- In the area of mitigation, the World Bank is:
  - promoting energy sector reform (including good governance, energy pricing policies, elimination of fossil fuel and transportation subsidies, promoting the internalization of environmental externalities);
  - promoting energy efficiency standards;
  - providing financing, including grant resources from the GEF, and promoting mechanisms for market scale-up, for climate-friendly production and use technologies;
    - for last 10 years, World Bank Group has been among the largest investors in alternative energy in developing countries; it has invested more than $6 billion since 1990 in energy efficiency and renewable energy projects and programs in developing countries and mobilized more than an additional $10 billion for the same purposes from private and public sources and it has committed to increasing our lending for renewable energy technologies by 20 percent per year over the next five years; 14 percent of the current World Bank Group energy portfolio is in alternative energy compared to 4 percent in 1990;
  - providing carbon financing, which increases the internal rate of return for investments in these technologies;
    - the World Bank is working to ensure that poor countries have access to carbon financing, which is proving to be a powerful tool to improve the deployment of climate-friendly technologies; as of November 1st, 2004, the World Bank has a commitment of funds of $760 million from governments and the private sector. The funds include the Prototype Carbon Fund (PCF), which is a public-private partnership; the Community Development Carbon Fund, which extends carbon finance to smaller poorer countries; the BioCarbon Fund, which applies carbon finance to forestry and land use projects; and a series of country funds, e.g., the Netherlands and Italy, and
  - training and capacity building.

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