A Viable Global Framework for Preventing Dangerous Climate Change

CAN Discussion Paper

COP9, Milan, Italy

Includes CAN Position Paper on adequacy of commitments:
"Preventing Dangerous Climate Change"

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CLIMATE ACTION NETWORK
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Introduction and Overview

CAN believes that climate action must be driven by the aim of keeping global warming as far below 2ºC as possible[1] in order to prevent dangerous interference with the climate system. A viable international system for achieving this objective must reflect the moral responsibility of those who have benefited the most from the use of the global commons to reduce their emissions first and to compensate the victims of climate change. Below CAN outlines in this discussion paper what might become the main elements of a viable regime to prevent dangerous climate change. This regime must be built on core principles of equity and fairness and include an appropriate balance of rights and obligations.

In this paper it is argued that the climate regime needs three parallel, inter-linked tracks operating on the same or a very similar timetable: The Kyoto track, a Greening (decarbonisation) track and an Adaptation Track. The Kyoto track builds upon the UNFCCC and the Kyoto Protocol, with its system of legally binding absolute emission reductions and compliance regime. This track, with its legally binding tradable emission obligations provides the core of a system that will drive rapid technological development and diffusion, and provide the technological basis for win-win solutions to climate and sustainable development objectives. The 'Greening' (decarbonisation) track would drive the rapid introduction of clean technologies that can reduce emissions and meet sustainable development objectives in developing countries. The industrialized countries would provide resources and technology to drive much of this track. The Adaptation track provides the resources to the most vulnerable regions (small island states, least developed countries) to deal with unavoidable climate changes. Countries receiving support under the Adaptation track could also operate in the Greening (decarbonisation) track.

The level and the character of the mitigation actions within this framework would be determined by reference to agreed level of per capita emissions, ability or capacity to act (including measures such as per capita income) and historical responsibility. In this context industrialized countries have the obligation to act first to reduce their emissions in absolute terms. The emission reduction targets in the emission reduction stage of the Kyoto track would be set with a strong reference to the need for per capita emissions to converge over the course of the 21st century. Other fairness criteria such as historical

[1] CAN argues in the position paper on adequacy that a global temperature target is superior to a global concentration target.

responsibility would also play a role in setting the overall timing, level and character of the emission action required of different countries. A combination of factors such as per capita emissions, ability or capacity to act and historical responsibility could be used to determine when and how countries move from the 'Greening' or decarbonisation track to the Kyoto track.

Many of the proposals being put forward as an alternative to the Kyoto framework do not offer a viable route to the achievement of the global goal of rapid emission reductions. Most of the alternatives involving voluntary actions being promoted are essentially predicated on not doing anything that would substantively reduce emissions. The fact that the current US administration rejects the Kyoto Protocol does not mean that the regime of legally binding emission targets for industrialized countries has failed, cannot work in the future or is not an essential element of an international system to prevent dangerous climate change.

Countries would need to move forward and rapidly develop these parallel tracks as a matter of urgency. The Kyoto ratifying countries should move forward with their implementation and start developing plans for deeper reductions in the second commitment period and be ready to discuss this concretely in 2005 when progress on Kyoto is to be reviewed. The Greening (decarbonisation) track needs to be developed promptly and industrialized and developing countries should begin concrete discussion together on how to operationalize this so that it can contribute to the overall global goal. This work, and the development of a framework for deciding upon the level of action of each country, needs to be done on the same timetable as the work on the Kyoto track. For the second commitment period of the Kyoto Protocol it is clear that only a relatively small number of countries not in Annex B would need to join the binding emission obligations track. Accelerated work on the adaptation track should be initiated immediately in order to identify concretely the needs of countries and regions that will be adversely affected by the further unavoidable warming even under the 2ºC global temperature limit.

Basic Principles

The core principles that should form the basis for the allocation of actions to limit and reduce global emissions are those of equity, responsibility and ability or capacity to act.

- The equity principle requires, amongst other things, that all have equal access to the atmospheric commons. One of its implications is those that have already contributed to the climate change problem substantially need to create the space for others to emit more in the future. In addition the setting of the relative emission targets for countries should be designed to give increasing weight to the aim of per capita emissions convergence over the course of the 21st century. Intergenerational equity is also important and means that the present generation should not pass to future generations unfair burdens. Delaying action on climate change now would transfer large costs to future generations.
- The principle of historical responsibility is an important element in determining who should act and when.

- The ability to pay and the capacity to act are important principles in deciding who should act, when and in what way.

Further principles enunciated in the CAN position on adequacy of commitments, entitled "Preventing Dangerous Climate Change"[2] that need to be applied in designing and running the international regime for the prevention of dangerous climate change are:

- The precautionary principle, found, *inter alia*, in Article 3.3 of the UNFCCC.
- The general principle of international law that activities within the jurisdiction of one country must not lead to grave damage on another state's territory.
- The right to sustainable development, in particular equitable access to affordable energy services, livelihoods, food security, health, water and other basic human needs.
- The basic right to life and physical integrity, as they are embodied in a number of international treaties and the Universal Declaration of Human Rights.
- The obligations on Parties to treaties must be performed in good faith.

One of the central concerns in operationalizing these principles and in particular in setting the qualitative character and quantitative nature of what each country would do in relation to their emissions of greenhouse gases is that action in this area should not jeopardize sustainable development objectives. Actions in this area should be designed to ensure that sustainable development objectives are met, in particular the provision of energy services and the enhancement of health objectives. Another main issue is the relative balance between rights and obligations of countries and in this context there should be a strong weighting towards the rights of developing countries as expressed in the principles above and operationalized through the application of the equity, historical responsibility and capability principles. In operationalizing a global framework of action to prevent dangerous climate change the Rio principles should be recalled and applied, in particular in relation to the provision by developed countries of resources and funding for development.

A Framework for Action: Three Parallel Tracks for Climate Policy in the 21st century.

The framework for action proposed here for discussion involves three parallel tracks. Track 1 is the Kyoto track with legally binding emission reductions in successive commitment periods. This system provides the essential driving force for technological innovation and change leading to large emission reductions from the richer countries. Track 2 is a Greening (decarbonisation) track for the developing countries that are not currently taking on actions under the Kyoto Track. This track is also a critical part of the global climate protection system and aims in large part at rapidly introducing sustainable energy production and end-use technologies, systems and practices. This should result in Greening (decarbonisation) of energy services in developing countries whilst accelerating the achievement of sustainable development objectives. As countries develop they would need to move from Track 2 to Track 1 (see below). Track 3 is the adaptation track for the

[2] Attached to copies distributed at COP-9 and at http://www.climnet.org/pubs/CAN-adequacy30102002.pdf

most vulnerable regions and countries to deal with climate change that is deemed to be unavoidable.

Each of these tracks has quite different needs and instruments. Track 1 already has the Kyoto Protocol and all of its rules and architecture, including a compliance system. An appropriate architecture and instrument or instruments to drive Track 2 is yet to be developed and work needs to begin soon on this. Transitions from Track 2 to Track 1 must be triggered by rules that include both the relative level of developed country action as well as a measure of per capita emissions and per capita income in the developing countries. Track 3 is beginning to develop as a consequence of decisions taken in Marrakech in relation to, *inter alia*, the Special Climate Change Fund (SCCF), the Adaptation Fund and the Least Developed Country (LDC) fund. The elaboration of this is a high priority. Countries requiring assistance under Track 3 would also be eligible for involvement Track 2 and, in appropriate circumstances, Track 1.

Kyoto Track

Track 1 is the Kyoto Protocol track with its legally binding, tradable emission limitation and reduction obligations. In addition to the present Annex B countries other countries will need to join this track in the second commitment period and beyond as their economic and development situation allows according to agreed criteria. The determination of which additional countries should join the legally binding obligation structures of the Kyoto Protocol would have to be based on criteria that involved a combination of factors involving relative per capita emissions, per capita income, and historical responsibility. For the second commitment period this would most likely involve a relatively small number of developing countries that are at the upper end of the income range for this group. Important elements of the Kyoto architecture include the successive, legally binding commitment periods of 5 years and the fact that the emission obligations are not an unlimited right to emit. In accordance with the principle of historical responsibility and the equity principle, Annex I (industrialized) countries must take the lead in substantially reducing emissions (see below) before asking developing countries to take on reduction commitments. Voluntary action or even binding sectoral intensity targets as have been proposed by some are not an adequate replacement for legally binding emission limitation and reduction obligations.

Greening (Decarbonisation) Track: Energy for Sustainable Development

Track 2 is a Greening (decarbonisation) track for the majority of countries whose level of economic development does not require their involvement in the Kyoto track. Track 2 should be designed to enable developing countries to follow a low carbon path to development. Actions and policies in this track should rapidly accelerate the introduction of new, sustainable technologies, many of which would already have been introduced, tested and commercialised in the Track 1 countries as a consequence of their emission reduction programmes. The agreed level of action and the effect on emissions could be driven by a number of factors. The availability of resources and technology from the industrialized countries is critical as is also the capacity and ability of the developing countries to act. There is a necessary linkage between the level of emission reduction undertaken by Kyoto track countries and the level of action to be undertaken by countries

on the Greening (decarbonisation) track to reduce the growth in their emissions. Countries operating under this track would need to ensure that they are adopting no regrets measures as a matter or priority. Where technical or other assistance is required to do so, this needs to be made available from the industrialized countries. The provision of resources and technology by the industrialized countries to activities in developing countries under this track would need, in addition to the factors mentioned above, to be modulated by the relative capacity of individual countries.

All large emitters (absolute emissions) would need to be involved in the Greening (decarbonisation) track. The least developed countries, where their emissions remain below an agreed level, would not need to be involved. There would however be significant incentives from a sustainable development perspective for LDCs to be involved, should they wish.

Various ideas have been proposed that could be used to guide the level and character of actions in the Greening (decarbonisation) track. These include the concept of SD PAMs (Sustainable development policies and measures), sectoral carbon intensity targets and the Triptych approach. The latter is a concept that is specifically designed to take into account national circumstances in setting goals for policy action: three sectors are distinguished – domestic, energy intensive, internationally exposed industry and the power sector (see den Elzen (2003)). Each of these approaches has useful elements and should be further explored for their application to Greening (decarbonisation) policies under Track 2.

Adaptation Track

Track 3 is an adaptation track designed to meet the needs of key vulnerable regions (including Least Developed Countries, Small Island Developing States) to assist with anticipating and through adaptation measures limiting the unavoidable effects of climate changes up to an agreed level of global mean warming. Those that bear the main responsibility for these climate changes, the industrialized countries, would be required to fund these measures. A certain level of climate change is now unavoidable virtually irrespective of policy action and this should form the benchmark for the analysis and costing of adaptation measures for the most vulnerable regions[3]. Adaptation measures will not in all cases be sufficient to limit damages to acceptable levels from the unavoidable climate change and sea level rise that would result even if global temperatures are kept below a 2ºC increase limit. Compensation for these damages would need to be included in Track 3. Existing elements of the UNFCCC/Kyoto Protocol system that would form part of a coherent Track 3 are the Adaptation Fund, the Special Climate Change Fund and the LDC fund.

Countries requiring assistance under the Adaptation track would also be eligible and able to operate under Track 2 or even Track 1, depending on their relative circumstances.

[3] The level of unavoidable warming can be calculated in different ways and with different assumptions leading to quire different results, however it would seem that a further warming of at least 0.5ºC above the present cannot be avoided under virtually any scenario.

Equity and fairness

Equity and fairness must be central elements of any viable framework for international action. The framework outlined here is one that reflects this priority, however it is recognized that there is often no single answer to the question of what is an equitable and fair system. It is clear though that several factors need to be taken into account in designing and operationalizing an international climate protection regime that can meet these objectives. No single measure, not even relative per capita emissions, can provide the sole basis for this, although any equitable and fair system needs to give prominent weight to this factor.

Fair Rules for Deciding the Level of Action

The scheme outlined above essentially involves three mitigation stages through which countries would move over time and which are important in operationalizing the principles of equity, responsibility and capacity described at the beginning of this paper. In the first stage, which is embodied in Track 2, the Greening (decarbonisation) track, all developing countries with the exception of the LDCs are involved. In the second stage countries move from Track 2 to Track 1 and begin to stabilize their emissions. In other words in this state countries move from a situation where their emissions are growing to one where emissions stabilize. This would entail a binding obligation to stabilize emissions for an agreed period of time prior to beginning the reduction phase and countries in this stage would fall fully under all of the provisions of the Kyoto Protocol and its procedures and rules. Where appropriate, countries could also enter this stage with a binding limit to the growth of their emissions. The third stage, also part of Track1, is the main reduction stage, into which all Annex B countries should be moved by the second commitment period.

Countries would have to move from stage 1 to stage 2 according to criteria involving a combination of relative per capita emissions (equity), and ability/capacity to act (one factor of this is per capita income) and responsibility. The level at which emissions would be stabilized under in stage 2 could be essentially determined as the level of emissions at which the country meets the agreed criteria for the transition from stage 1 to stage 2. Some flexibility, but not much, could be permitted in setting the initial stabilization level taking into account domestic circumstances. Movement from stage 2 to stage 3 would occur automatically after a period of 5 or ten years.

Emission Reduction Targets

Emission reduction targets would be set in the emission reduction stage of Track 1, the Kyoto track, with reference to the need for per capita emissions to converge over the course of the 21st century. In this context the level of reductions for each country under stage 3 would need to be driven quite strongly by relative per capita emissions with reference also to other fairness criteria such as historical responsibility. Further analytical work is needed to fully explore the implications of combining historical responsibility with per capita emissions convergence. Flexibility may also be needed in the application of a relative per capita allocation system to take account also of specific domestic circumstances.

Emission reduction targets would be set iteratively every five years. The current Annex B countries would need to achieve emission reductions in the range of 60-80% by the 2050s [4], with continuing declines thereafter in order to provide space for developing country emissions, while keeping global temperatures below 2ºC. Global emissions would need to peak by the 2020s at the latest,[5] with substantial global reductions by the 2050s[6]. Within this overall picture some developing countries would continue to increase their emissions for sometime after the 2020s before beginning the stabilization stage.

For environmental effectiveness, emission reduction targets must be comprehensive and include all of the Kyoto sources and gases as well the emissions from international aviation and marine bunker fuels, which are currently not included in the Kyoto system.

Systems that would not work or that are not practicable

A number of systems that would in effect replace the Kyoto system have been proposed and most of these either would not work or could not be implemented effectively. Most would not work because they would allow emissions to increase even if fully implemented, which is unacceptable given the need for overall emission reductions in order to limit global warming to below 2ºC. Other proposal, whilst meeting some of the equity and fairness principles outlined at the beginning of this discussion paper are not practicable or not sufficiently flexible to accommodate the full range of issues in reaching agreement on a global framework.

[4] With respect to the limiting of the global temperature increase below 2ºC and taking into account a range of 'reference' or business as usual scenarios for developing countries as well as a range, but not the full range, of scientific assumptions. If the climate sensitivity were in the upper end of the IPCC range of 1.5º-4.5ºC for a doubling of CO_2 then larger reductions would be needed by mid-century.

[5] If global emissions peaked later than this it would imply very large rates of emission reduction and for higher climate sensitivity values may render the achievement of a below 2ºC warming limit unachievable.

[6] An average of seven contemporary climate models, with standard representation of carbon cycle feedbacks, indicates that a global reduction of 20-30% relative to 1990 of all greenhouse gases by the 2050s would be needed.

Systems that would not work

The Bush policy in the USA of a non-binding relative intensity target is clearly not going to reduce emissions and in fact allows emissions to increase very substantially. This is clearly unacceptable. In this context CAN notes that the serious action proposals within the USA are all based on a cap and trade system. It is clear that when the United States Government decides to treat climate change as a serious issue requiring serious emission reductions it will in all likelihood seek to use a system involving legally binding tradable commitments. As the US demonstrated during the Kyoto negotiations this system will drive technology development and commercialisation. Far from being a 'straitjacket', as claimed by the present Administration, such a system is most likely to provide the foundation for the technological innovation required to achieve very deep emission reductions in the coming decades.

Many of the proposals being put forward in the context of discussions about future action, such as the Orchestra of Treaties, technology partnerships or voluntary actions do not offer a viable route to the achievement of the global goal of rapid emission reductions. Other proposal based on relative intensity targets present other problems and for a number of reasons appear not to be a viable basis for the replacement of legally binding absolute emission limits under the Kyoto track. The fact that the current US administration rejects the Kyoto Protocol does not mean that the regime of legally binding emission targets for industrialized countries has failed, cannot work in the future or is not an essential element of an international system to prevent dangerous climate change. Many alternatives involving voluntary actions being promoted are essentially premised on not doing anything that would substantively reduce emissions.

Systems that are not practicable

In a qualitatively different category, the Contraction and Convergence system could in principle achieve the environmental targets and is based on an equity principle, as expressed in its per capita convergence rules. This system however has a number of drawbacks and weaknesses that mean that it is not judged to be a viable basis for a negotiable and practicable regime. In terms of the equity issue, whilst CAN favours the strong use of a relative per capita convergence rule in allocating emissions in the reduction phase of the climate regime, applying this from the beginning presents major problems. In relation to equity and fairness many feel that additional criterion are needed beyond the per capita metric, including some measure of historical responsibility for climate changes, some measure of ability to pay as well as a reflection of different national circumstances. Whilst C&C may appear to provide greater certainty in relation to the achievement of an environmental target, this would not work in practice if there were major emitters who did not join it. Under the pure C&C system there is no fix for this issue. A variety of other factors also need to be taken into account and it is felt that the framework outlined above has the flexibility necessary for a workable international system that can meet the tests of equity and fairness (for further information the reader is referred to multi criteria analyses of different systems, including the Contraction and

Convergence system and an approach analogous to the framework outlined here, the multi-stage approach such as that of den Elzen *et al.* (2003)[7]).

Proposals such as the Per Capita Plus system have been outlined at least at the broad conceptual level that would significantly modify the C&C system and have the potential to fit within the framework outlined here. Such a system would be weighted heavily towards a per capita allocation principle but recognising additional factors such as historical responsibility, ability to pay, different national circumstances and also the need to establish a system that is negotiable and that would be acceptable to all key countries.

Conclusion

In this discussion paper the Climate Action Network has outlined what it thinks could form a viable global framework of action for preventing dangerous climate change. This paper is designed to prompt wider debate both within the climate policy world and beyond. CAN looks forward to receiving feedback and reactions, positive or negative to these ideas.

References

den Elzen, M. G. J. (2003). "Exploring Climate Regimes for Differentiation of Future Commitments to Stabilise Greenhouse Gas Concentrations." Integrated Assessment **2003**(In the press).

den Elzen, M. G. J., M. M. Berk, P. Lucas, B. Eickhout, and D. P. van Vuuren (2003). Exploring climate regimes for differentiation of commitments to achieve the EU climate target. Bilthoven, The Netherlands, RIVM: 136.

[7] See, for example, Tables 10-1 and 10-2 on pages 95 and 97 respectively of this report. The multi-criteria analyses include criteria relevant to environmental, political, economic, technical and institutional and regime effectiveness. The political criteria include issues such as the comprehensiveness of equity criteria, acceptability to key countries and negotiating flexibility. The economic criteria include factors such as accounting for differences between countries and avoidance of disproportionate burdens. Regime criteria include the effects on the stability of the international climate protection system.

CLIMATE ACTION NETWORK
"Preventing dangerous climate change"

Position Paper on the Adequacy of Commitments
Released at COP-8, New Delhi, India

Summary

Climate Action Network calls on Parties to set limits to climate change as a matter of urgency

The Climate Action Network is concerned that Parties are losing sight of their ultimate obligation under the Climate Convention to prevent dangerous climate change. Parties should, as a matter of urgency, begin discussing the limits to climate change that would prevent dangerous changes from occurring.

Preventing dangerous climate change is an equity issue

Averting dangerous climate change is an equity issue. The IPCC Third Assessment Report has established that developing countries are most at risk of climate change and they will suffer damages at even quite low levels of warming. These damages rise rapidly with temperature. The human activities leading to dangerous climate changes are caused largely by the consumption levels, patterns, and associated production, of the wealthy industrialized countries, but their impacts will, and are, falling disproportionately upon the poor. As a consequence setting strong climate targets is an equity issue, both within the current generation, and in relation to those to come.

Some are already experiencing dangerous changes

Some communities, notably on some small island developing states and in the high Arctic, are clearly already suffering human induced climate impacts today. Drought in Southern Africa and India, recent unusual floods China, Vietnam and other parts of Asia and central Europe have been associated by scientists with projected human induced climate changes and clearly portend much worse to come.

Developing countries will suffer the most from already committed warming

Due to historical and current greenhouse gas emissions, and the fact that emissions cannot be reduced to zero overnight, we know we are already committed to future warming and sea level rise. This unavoidable commitment will cause increased risk of disease, hunger, water shortage and coastal flooding for somewhere between tens of millions and some billions of people depending on the impact area and the rate and extent of the warming. Major adaptation efforts will be required to minimize the adverse health, food security, water supply, storm and sea level rise consequences of these impacts.

Climate change should be kept below a peak of 2°C warming and then reduced as rapidly as possible.

The Climate Action Network believes that the global mean warming needs to be limited to a peak increase of below 2°C (above pre-industrial times) and that the warming should be reduced as fast as possible from this peak.

Peaking at less than 2°C will not prevent major damages, but we are already committed to a warming of over 1°C

Temperatures approaching 1-2°C entail significant damages, however, even if the atmospheric concentrations of greenhouse gases were held at present day levels, a warming of 1°C or above may not be avoidable. This committed warming is likely to cause irreversible damage to some unique ecosystems and the extinction of endemic species contained in them. Significant damages to agricultural production in some developing country regions, growing water shortages and increasing exposure to health risks will also occur. This is not 'acceptable' under any definition of the word.

Sea level rise will be difficult to stop; only rapid reductions in temperature have a chance.

Providing the temperature drops as quickly as possible (after peaking at below 2°C) there is the possibility that sea level rise over the next several centuries can be limited to half a metre and perhaps even arrested, but this cannot be guaranteed. There remains however the possibility that even these warming goals could trigger the collapse of the West Antarctic Ice Sheet with a resulting sea level rise of several metres over a number of centuries. There appears to be substantial likelihood that the even a warming of 1°C could lead to the decay or loss of significant ice mass from the Greenland Ice sheet in coming centuries, causing significant sea level rise.

Doubling CO_2 targets or 450 ppmv CO_2 stabilization targets will lead to dangerous climate change.

Long term climate targets such as doubling of CO_2 concentration (above pre-industrial levels) would result in temperature increases, when other gases are taken into account, significantly higher than 3°C. The new IPCC "low" concentration scenario results in a CO_2 concentration of 450 ppmv CO_2 and a total greenhouse gas concentration equivalent to approximately double pre-industrial CO_2 levels. This would produce a long-term temperature rise of 2.5°C for the IPCC best estimate of climate sensitivity and higher if the climate sensitivity is higher. If the scientific assessments of the impacts of climate change are correct, such increases would impact severely upon the vast majority of the earth's population. The resulting sea level rise over a few centuries could eliminate whole island countries in the Pacific, Indian Ocean and elsewhere, overwhelm Bangladesh and cause untold damage and suffering to regions with low lying coastal populations in the coming centuries. This would be totally irreversible on any meaningful timescale. Targets such as these are often cited in the economic literature, without formal justification, as "safe". It is clear that they are not.

Option of avoiding 2°C increase will disappear within the next decade or so unless urgent action is taken

It is clear from the IPCC Third Assessment Report that unless urgent action is taken to reduce emissions rapidly, beyond those reductions agreed in the Kyoto Protocol for its first commitment period, the option of limiting the temperature increase below 2°C will disappear from the policy map within the next two decades.

Global emissions need to peak within next 20 years

The inertia of the climate system means that keeping the global mean temperature increase below 2°C will require rapid global emission reductions, with emissions peaking within the next 20 years and declining quickly thereafter.

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Introduction

The primary and ongoing legal obligation on **all** countries belonging to the Climate Convention is to prevent dangerous climate change. The Climate Action Network supports this objective. This position paper outlines the position that CAN has reached on this issue after substantive deliberations based upon the IPCC Third Assessment Report and other inputs and considerations.

CAN believes that governments should move as a matter of urgency to consider and decide upon the limits to climate change that, if met, would enable fulfilment of Article 2 of the United Nations Framework Convention on Climate Change (UNFCCC) which states:

> *"The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. 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 to proceed in a sustainable manner."*

In undertaking this work CAN believes that important principles embodied in the UNFCCC, other treaties and generally in international law need to be fully accounted for and in particular would like to remind governments that:

- The precautionary principle must be applied so that scientific uncertainties do not stand in the way of decisions that protect the climate system and prevent dangerous climatic changes. This is expressed, *inter alia*, in Article 3.3 of the UNFCCC.
- The general principle of international law must be observed that activities within the jurisdiction of one country must not lead to grave damage on another state's territory.
- The right to sustainable development in particular access to affordable energy services, livelihoods, food security, health, water and other basic human needs.
- The basic right to life and physical integrity, as they are embodied in a number of international treaties and the Universal Declaration of Human Rights, demand the immediate implementation of mitigating climate change.
- The obligations on Parties to treaties must be performed in good faith.

This paper describes the impacts that can be associated with different levels of global mean warming, discusses considerations on setting climate targets that might prevent dangerous climate change, thereby operationalizing Article 2, climate targets and ceilings, and concludes by pointing out what the CAN climate targets and ceilings mean for emissions.

What are the impacts associated with climate change?

Setting long-term climate targets involves decisions as to whether or not the impacts projected at different levels of temperature change can be considered dangerous.

The IPCC Third Assessment Report (TAR) provides a very substantial amount of information on the impacts that can be expected from different levels of warming in the future. Below some of the key findings of the IPCC TAR are outlined with identified impacts associated with four ranges of temperature $< 1^{o}C$, $1\text{-}2^{o}C$, $2\text{-}3^{o}C$ and $3\text{-}4^{o}C$ or above. It will be seen that even small degrees of warming are very likely to result in substantial damages. It will also become clear that warming above $1\text{-}2^{o}C$ results in rapidly escalating damages whose magnitude and extent is qualitatively different from lower temperatures. Unfortunately it will also be clear that warming below $2^{o}C$, within the band of already committed warming, entails substantial damages to some developing countries and unique natural systems.

Firstly though it is important to recall the IPCC's finding that the climate changes that have occurred this century are already affecting human communities and ecosystems. The IPCC projects that much larger changes over the coming decades will occur unless decisive GHG emissions mitigation action is taken. Amongst the key findings in this context from the TAR are:

- There is new and stronger evidence that most of the observed warming over the last 50 years is attributable to human activities.
- The 20th century trends of increasing temperature, sea-level rise, and increased precipitation will very likely continue and intensify in the 21st century.
- The globally averaged surface temperature is projected to increase by 1.4 to 5.8°C over the period 1990 to 2100 and temperature will continue to rise in the following centuries.
- Global mean sea level is projected to rise by 0.09 to 0.88 metres between 1990 and 2100 and this rise will continue substantially unabated for many centuries, long after atmospheric greenhouse gas concentrations are stabilized.
- There is likely to be an increase in extreme weather events such as heat waves, droughts and in other places increased precipitation leading to floods, and higher minimum temperatures and fewer cold days.
- Glaciers and ice caps are projected to continue their widespread retreat during the 21st century, with tropical and subtropical glaciers retreating the most and in some case disappearing

Impacts at different levels of warming

Less than 1°C warming

- Developing countries
  - Net negative market sector impacts in developing countries and net market sector gains in developed countries. Applying more weight to impacts on poor countries indicates negative aggregate impacts globally.
  - Livelihoods of the most vulnerable populations adversely affected.
- Water
  - Shrinking ice and snow cover disrupts hydroelectric capacity and systems dependent on spring thaw timing.
- Ecosystems
  - Changes in growing seasons, shifts in population ranges, and premature reproduction in plants, insects, and birds threaten the integrity of complex systems dependent on timing of seed dispersal, pollination, availability of food, etc.
  - Extinction of some critically endangered and endangered species. Species immediately threatened by rising sea levels and shrinking ranges include the Bengal tiger (Ganges delta), the mountain gorilla (Central Africa), the spectacled bear (Andes mountains), resplendent Quetzal (Central America).

1-2°C global mean warming

- Developing Countries
  - Many developing countries will suffer from net market losses in important sectors.
  - Globally some regions may have net market benefits and others principally developing countries have net market losses.
  - Majority of people adversely affected by climate change and livelihoods of the most vulnerable populations dependent on natural ecosystems increasingly adversely affected.
- Food security
  - There is the likelihood of significant damages to crop production in tropical and subtropical countries sufficient, among other things to reverse agricultural self-sufficiency progress in many developing nations.

Heat waves will damage crops (rice unable to form grains, fruit unable to set) and livestock will suffer from heat stress (reductions of milk production and conception difficulties in dairy cows).

- Water shortage
  - Decreased water supply and quality will occur in regions already suffering from water scarcity and drought such as the Mediterranean, southern Africa, and arid parts of central and south Asia affecting half a billion people.
- Floods
  - More flood damage will result from intense storms, especially in areas affected by deforestation, wildfires, insect infestations, and ecosystem degradation.
- Extreme events

Increasing frequency and intensity of extreme weather events will result in increased insurance costs and decreased insurance availability (coastal areas, floodplains).

- Health effects
  - Direct - Increased heat related deaths and illness, affecting particularly the elderly, sick, and those without access to air conditioning;
  - Indirect - more illness and death resulting from increased frequency and intensity of extreme weather events.

- Increased risks to human life, risk of infectious disease epidemics, and many other health risks where floods, droughts or storms increase in frequency and/or intensity.

- Ecosystems
  - Wildfires and insect infestations will disrupt relationships in complex ecosystems already undergoing stress from direct effects of heat. Increased disturbances of ecosystems by fire and insect pests.
  - **Coral bleaching** events will increase in frequency and duration, leading to destruction of brain corals and loss of related reef ecosystems.
  - Loss of up to 10% of coastal wetlands globally from sea level rise will eliminate habitat of major migratory bird populations.
  - 30-40% of nature reserves adversely affected
- Ice Sheets and Sea Level Rise
  - Meltdown of the Greenland ice sheet is likely with global mean warming above 1-3°C, and would lead to several meters sea level rise over several centuries with disastrous consequences for millions.

2-3°C global mean warming:

- Developing Countries
  - Most regions (developed and developing countries) will suffer net market losses in important sectors that will affect global economic aggregates e.g. net global economic losses are likely.
- Food security
  - 50-120 million more people at risk of hunger, and food prices will increase throughout the global economy.
  - Crop yields will drop in regions affected by more drought conditions and there is likely to be a general decrease in cereal crop yields extending beyond the tropics to mid-latitude and temperate regions.
- Water shortage
  - More than 3 billion more people at risk of water shortage.
- Floods
  - 100 million more people at risk of coastal flooding
- Extreme events
  - Floods, droughts and other extreme event would further increase
- Health effects
  - It is likely that 300 million people would be at greater risk of malaria and much increased exposure to dengue fever.
- Ecosystems
  - Losses of unique ecosystems and their endemic species (e.g. Cape region of south Africa and some cloud forests)
  - Substantial damage to coral reefs, reduced species biodiversity and fish yields from reefs.
  - Significant damage or disruption to arctic ecosystems, boreal forests, mountain ecosystems.
- Ice Sheets and Sea Level Rise
  - Rapid decay of the Greenland ice sheet for appears likely in this temperature range leading to 1-2 metres sea level rise by 2500 and 2.3-3.5 metres over the next thousand years depending on the extent of the heating.
  - The model range for sea level rise induced by thermal expansion is 0.44-1.96 metres by 2500 and for greater than 1000 years 0.53m-1.96m (for doubling of CO_2).
  - Increasing risk of instability or decay of the West Antarctic Ice Sheet

3-4°C global mean warming:

The IPCC was unable to assess impacts in details for temperatures much in excess of the 2-3°C warming range due to lack of literature however the following general conclusions can be made:

- Developing Countries
  - Economic damages rise more quickly
- Food security
  - Food security situation worsens
- Water shortage
  - Water shortages worsen
- Floods and Extreme events
  - More floods and other extreme events
- Health effects
  - Adverse health effects worsen
- Ecosystems
  - Elimination of tropical glaciers and significant reduction in ice cap and temperate glacier volume will alter hydrology and dependent ecosystems.
  - Coral death from sea temperature increases lasting for 6 months or more will eliminate whole reef ecosystems.
  - Other ecosystems under threat include atolls, mangroves, boreal and tropical forests, alpine meadows, prairie wetlands, and remnant native grasslands.
- Ice Sheets and Sea Level Rise
  - The decay of the Greenland ice sheets appears to be virtually certain at this level of warming.

Abrupt and irreversible changes

The impacts cited above do not in general assess the prospects of abrupt and irreversible changes in the climate system. One such potential change is the shutdown of the North Atlantic thermohaline circulation system which could occur, at thresholds that are uncertain, well within the range of temperatures projected over the next century and beyond. Such a shutdown is likely to have global implications with precipitation declines in the northern hemisphere and particularly large and rapid changes in South America and Africa, according to one model assessment.

Considerations on setting climate targets that might prevent dangerous climate change

As outlined above the IPCC in its Third Assessment Report has identified a range of impacts corresponding to different levels of global mean temperature increase however a decision as to what is dangerous is clearly a political issue and one driven by values.

The impacts outlined above for different ranges of temperature increase in global mean surface temperature show clearly that virtually any level of warming will result in adverse effects on developing countries and ecosystems. However it is clear that even if the atmospheric concentrations of CO_2 and other greenhouse gases were held at present day levels a warming of 1-1.5°C above pre-industrial levels is most likely not avoidable. This committed warming seems likely to cause negative market impacts for developing countries as well as yield reductions in highly vulnerable agricultural regions. Irreversible damage to some unique ecosystems and the extinction of many of the species contained in them also

seems likely. Sea level rise commitment also appears significant. These and other factors mean that there will have to be substantial focus on adaptation in the most vulnerable regions.

Most of the impact analyses have focussed on the 21st century and not considered the inertia in the climate system which would continue to warm and result in rising sea levels for centuries after stabilization of atmospheric concentrations of CO_2 and other greenhouse gases. The shorter-term impacts identified for the 21st century at and above 2°C warming already appear very severe with the scale of impacts rising in most cases very quickly beyond this level. For developing countries, and particularly for the poorest, a 2°C warming is associated with very large impacts, which are only likely to worsen with time. These could undermine, if not reverse in some cases, progress towards sustainable development.

It seems doubtful that coral reefs, some Arctic and other sensitive ecosystems, would survive an extended period of global mean warming above 2°C, with large damages already expected at or below this temperature range. Such damages would adversely affect the livelihood and well being of the human populations dependent upon them.

The future of the Greenland and West Antarctic Ice sheets, both of which contain ice sufficient to raise sea level by around 6 metres, is also under doubt for long-term global mean temperature increase beyond 1°C. There appears to be a very high probability that a 1-3°C warming could initiate the decay of the Greenland ice sheet if sustained for a significant period of time. For the West Antarctic Ice sheet there appears to be a significant risk that continued warming of the oceans around the ice sheet could trigger an unstable collapse leading to sea level rise of several metres over a number of centuries.

Arresting sea level rise due to thermal expansion is deeply problematic irrespective of the ice sheet response. The IPCC has found that the sea level rise would continue to rise for a very long time years after the 21st century stabilization of CO_2 at double pre-industrial levels. After 500 years the rise is estimated to be in the range of 0.5-2 metres, some 4-9 times **greater** than at the time of stabilization itself. And this likely to be only half of the eventual increase in sea level over a thousand years or more.

One of the consequences of human induced climate change is sea level rise, whose consequences are long lasting and essentially irreversible and which, unless urgent action is taken, could result in substantial or complete loss of territory of some countries, particularly small island states. More broadly it is becoming increasingly clear that human induced climate change caused substantially by one set of countries could cause significant harm to the health and welfare of people from a much larger poorer group of countries.

As a consequence of these and other considerations the conclusion reached by CAN is that the global mean temperature will need to be brought down as rapidly as possible from any peak reached in the coming century. The factors leading to CAN concluding that global mean warming will need to be reduced as fast as possible after peaking include:

- Need to absolutely minimize and if possible limit long term sea level rise to permit the continued survival of a number of countries and coastal ecosystems.

- Minimize damage to many natural ecosystems by limiting the period of peak warming and to avoid and/or limit the potential for large-scale positive feedbacks from the carbon cycle.
- Limit the risk of major and irreversible ice sheet decay or even collapse which could lead to many metres of sea level rise in future centuries.
- Minimize damages to health, agriculture and water supply.
- Avoiding potentially irreversible non-linear climate impacts requires that atmospheric greenhouse gases return as close as possible to pre-industrial levels in the next few centuries.

Limiting the rate of change is also important, in order to allow natural ecosystems to "adapt" - if they can adapt at all. We need to keep the rate of temperature change at no more than about 0.1°C/decade as much as possible, realising that we have already broken that barrier and will almost inevitably move well out of that range in the coming decades, with the corollary that the long term rate of change should approach zero and (hopefully) move into the negative range late this century or early next, until the anthropogenic influence on global temperatures is reduced below the level of natural variability.

Operationalizing Article 2

CAN believes that global mean temperature is the most appropriate surrogate for impacts of all kinds in operationalizing Article 2. It is recognizing that this has limitations but policy needs to have a relatively simple measure to guide action and there is no other readily obvious measure that can be used in setting global targets. Where there is uncertainty in converting local and regional estimates of damages to the global mean level the precautionary principle should be applied. Once a global mean surface temperature limit this needs to be converted into greenhouse gas emissions over timeframes ranging from five year commitment periods to centuries. It seems clear, given the complexities of the climate system and the remaining uncertainties in climate science, particularly in the area of climate sensitivity, that setting a specific long-term GHG concentration target to correspond to such limits is not feasible and may not be wise.

The scale and magnitude of the impacts and risks identified above raise a further key issue in relation to the operationalizing of Article 2 of the UNFCCC. Many have assumed that prevention of dangerous climate change would be associated with the stabilization of greenhouse gas concentrations at above current levels and sometime in the coming century or century and a half. As described in the preceding section the Climate Action Network has reached the conclusion that the global mean warming will need to be reduced over time from whatever peak is reached. This means that a stable atmospheric concentration of CO_2 and other greenhouse gases may not be approached for several centuries.

Climate targets and ceilings

Taking account of the issues and factors mentioned above the Climate Action Network believes that:

- The global mean temperature increase should be kept below 2°C above pre-industrial levels with the temperature being reduced as rapidly as possible after the time of peaking.

- The rate of warming should be brought below a ceiling of 0.1°C temperature change per decade as soon as possible in order to allow ecosystems to adapt.

Limiting the global mean increase of temperature to below 2°C is unlikely to be "safe" in the sense that risk of large damages or of rapid irreversible changes are completely avoided. The best that can be said is that the lower the peak temperature, the lower is the risk. Nevertheless peaking the warming at below 2°C and reducing as fast possible thereafter will reduce the probability of large scale dangerous changes for most regions and hopefully limit the damage to natural and human ecosystems.

What do these targets and ceilings mean for emissions and concentration

The consequence of these targets for the peak concentration of CO_2 in the coming century cannot be determined with precision as it would depend on reductions taken for other gases, on the climate sensitivity and other factors. Nevertheless a plausible range of parameters indicates that CO_2 concentration would have to peak no higher than 450 ppmv and probably somewhat lower[8]. As a consequence of the need to reduce the warming, arrest the thermal sea level rise and minimize the risk of ice sheet decay or collapse cited above, the CO_2 concentration would then have to be reduced.

In practical terms emissions corresponding to progress towards meeting the temperature targets will need to be calculated at each time step (e.g. five year commitment period) taking into account the temperature change and sea level rise targets, scientific uncertainty in relation to the climate sensitivity, carbon cycle and other system components, and the potential for extreme outcomes, abrupt change and surprises. Article 3.3 of the Climate Convention requires the application of the precautionary principle in this context to ensure that emission reductions in each period are consistent with the achievement of the climate targets and ceilings. It is beyond the scope of this paper to describe the range of emissions that would correspond at each five-year period, however some important conclusions can be reached as to the overall shape of the global emission reductions needed.

The slow rate of uptake of CO_2 by the ocean means that global CO_2 emissions to the atmosphere will need begin to drop quite rapidly well before the peak concentration is reached, and will need to be close to zero by 2100. Absolute reductions of about 80% by Annex 1 countries by mid-century relative to 1990 are needed, followed by further reductions towards zero by 2100. Per capita emissions in Annex I countries have to fall quickly as a consequence. Rapid decoupling of economic growth and emissions in developing countries will also need to start soon to ensure that global emissions of CO_2 reach close to zero by the end of the century. In achieving full account must be taken of the rights of people to sustainable development and in particular the provision of affordable energy services.

[8] Other non-CO_2 greenhouse gases would add approximately 100 ppmv CO_2 equivalent to give an effective CO2 concentration of around 550 ppmv CO_2 equivalent. The equilibrium warming that would result from this is in the range of 1.5-4.5°C for the IPCC estimate of the range of climate sensitivity to a doubling of CO_2 or 2.5°C for the IPCC's best estimate. With a transient peak in greenhouse gas concentrations the equilibrium would of course not be reached, however a sizeable fraction of it would and for mid range climate sensitivities would almost certainly approach and could exceed 2°C.