LDC paper series

Mitigation - pledges, impacts and effects on LDCs

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Summary

This paper shows that ambitious global greenhouse gas mitigation action in a transparent and effective international climate regime is of great importance to LDCs. **Through such ambitious global mitigation, impacts and damage to LDCs can be limited, and financial and technological flows can be generated from developed to developing countries.**

Current greenhouse gas mitigation pledges are insufficient to bring emissions on a path that keeps global average temperature increase to below 2°C relative to preindustrial, let alone returning to below 1.5°C. Many scientific studies have confirmed this and **show technologically and economically feasible options to move from the currently pledged emission levels for 2020 to lower emission levels in line with 2 and 1.5°C** (Sections 2, 3 and 5).

Currently, **the policy framework surrounding the insufficient pledges is weak, or not yet established**. Uncertainty exists about (a) the legal nature of the future framework, (b) the accounting rules to be applied for measuring, reporting and verification (MRV) of mitigation action, or for carry-over of surplus emission allowances of Annex I to future commitment periods, and (c) the modalities and provisions for accounting for National Appropriate Mitigation Actions (NAMAs), also in relation to the Clean Development Mechanism (CDM). It is therefore **unclear how much mitigation action will be ultimately carried out and how developing countries will receive sufficient financial support for mitigation action** (Section 2).

Urgent and immediate action is required for developing countries. **Delaying mitigation action shifts the cost burden from developed countries to developing countries**. Instead of developed countries implementing relatively more costly measures in the near future, developing countries will face higher adaptation costs and residual damages (level of climate-change impacts beyond adaptation potential) in the medium and long term (Section 3).

The distribution of emission mitigation actions depends on considerations of equity. This can be elaborated in terms of distributing the costs of mitigation or adaptation, distributing future emission allowances, or rights, and ensuring institutional and procedural fairness. A definition of "fair emission reduction burdens" for both developed and developing countries cannot only be the result of an objective analytical exercise, but by necessity results from choices and principles accepted by stakeholders through a dialogue. **Based on the bulk of equity principles, LDCs would be subject to very small or no emission reduction obligations** (Section 4).

Until 2020, emission trajectories in line with long-term global goals of 2°C and 1.5 overlap. Available energy-economic literature shows that the costs of mitigation to follow such global emission trajectory for 2°C are low to moderate. For example, recent studies show that the estimated costs over the 21st century t**o stay below 2°C lead to a loss of global GDP by 2100 of 1.7% or less, compared to the baseline. This is equivalent to a delay of less than 2 years in achieving the level of GDP growth that would otherwise have occurred by the end of the century. Reaching emission levels that can be in line with 1.5°C, would be possible at a moderate carbon price of US$30 per tCO_2 mitigated** (Section 5).

Global mitigation of greenhouse gases matters to LDCs. First, **ambitious mitigation action will reduce the impacts related to climate change, which are expected to affect developing countries especially**, for example in the agricultural sector. Additionally, **ambitious mitigation action would reduce so-called residual damages** (damages to which nations cannot adapt, not even with unlimited adaptation money). Second, **ambitious global mitigation action will incite flows of both mitigation money and technology into the economies of LDCs** for implementing NAMAs, contributing to a sustainable development of their economies (Section 6).

1) Introduction

In its Fourth Assessment Report, the IPCC estimated that what is needed for global warming to not exceed 2°C above preindustrial levels was an emission reduction by developed countries to 25-40% below 1990 by 2020, and a substantial deviation from business as usual in parts of the developing world[1]. Related publications indicated that this deviation in 2020 would be a 15-30% reduction below business as usual. So far the mitigation targets that countries have proposed as part of the Cancun Agreements fall well short of such aggregate reductions consistent with reaching the 2°C goal. There is therefore, a significant gap between emissions expected from the pledges for 2020 and emission levels consistent with a 1.5°C and 2°C limit above pre-industrial levels. However, the most recent scientific literature shows that it is technically feasible to reduce to the emission levels in 2020 consistent with 1.5°C and 2°C, at a moderate cost.

This paper will firstly look at the current mitigation targets on the table from both developed and developing countries and make an assessment of what this adds up to in terms of a gap to meet the goal decided in Cancun. Secondly, the paper will look at the pledges and what this means for adaptation and mitigation costs and will look at what is a fair emission burden and how feasible it is for developed countries to meet the necessary mitigation targets. Finally, the paper will summarize the findings and highlight why mitigation can be an important issue for LDCs.

2) What is the current status of mitigation in the negotiations?

As part of the Cancun Agreements, the mitigation targets of all Annex I countries as well as the NAMAs from 48 developing countries were compiled by the UNFCCC in two information documents[2]. Out of the 48 countries that submitted NAMAs, twelve countries were LDCs[3]. The NAMAs that have been submitted from developing country Parties are diverse: the targets are defined in different ways and on different sectors. See the associated CDKN paper "How could LDCs benefit from NAMAs?" for more information.

Ambition of mitigation targets

Since Cancun there have been no new announcements that would increase the level of ambition and thereby help to close the "emission gap" between the reductions proposed and what is needed (see below). Many developed countries put forward conditions to enhance the level of ambition towards the high end of their proposals associated with the Copenhagen Accord. So far, these conditions have not been met and hence the implied overall reduction is low. Meanwhile, scientific assessments[4] show that even the high end of reductions would not be enough to set the world on a path towards reaching 1.5 and 2°C targets. Furthermore, the same scientific assessments show that the rules on emissions trading and LULUCF will impact the effective reductions resulting from the developed countries' pledges. This generally leads to less effective aggregate emissions reductions and thus higher emissions from developed countries.

The targets proposed by Annex I countries in aggregate add up to 13-18% below 1990[5]. Compared to the 25-40% range estimated by the IPCC to be required, this aggregate reduction is insufficient to achieve the 1.5 and 2°C climate goals mentioned in the Cancun Agreements. Moreover, after accounting for existing and proposed provisions for LULUCF credits, and including carry over and trading of surplus emission allowances (Assigned Amount Units – AAUs) from the first commitment period to the next, the reductions become much smaller, adding up to 1-7% below 1990[6].

The Annex-I reductions also fall far short of what a number of Parties have called for: at least 45% reduction below 1990 by Annex I Parties in aggregate by 2020, as part of a fair and necessary contribution to global efforts, for stabilisation of greenhouse gas concentrations at well below 350 ppmv of CO_2 equivalent and to hold global average surface temperature increases to well below a 1.5°C rise over pre-industrial levels over the long-term. Over 100 countries have called for a 1.5°C goal first proposed by the LDCs and AOSIS in 2008.

Policy surrounding mitigation targets

To date, the negotiations on mitigation have not addressed how these targets and actions will be inscribed into a legally binding agreement. The discussion on legally binding agreements (LBA) is fraught with difficulties including when a LBA will be agreed. Furthermore, the question remains how the actions that developing countries have pledged fit into a legally binding agreement.

Since Cancun, the negotiations on mitigation have largely focused on the issues of measuring, reporting and verification (MRV) and have not led countries to increase their level of ambition. In particular the negotiations have focused on the type of reporting and verification for both developed and developing countries. However, what has not been reached is agreement on the rules for what countries should and should not report and therefore what needs to be verified. What is essential in the MRV discussion are clear rules on what the common accounting system will be. This means for Annex I countries that the rules and guidelines for accounting LULUCF must be agreed, and that clear definitions and an understanding must be agree on what type of market mechanism will be decided. Finally, clear modalities and provisions for emission reductions which entail rules for banking or carry-over of surplus emissions into future commitment periods, how to define the units themselves (if they are not AAUs for example), the length of the commitment period and the base year for setting the target must be agreed to ensure comparability and consistency in the targets taken by countries.

For developing countries, the modalities and provisions of accounting towards their NAMAs are not yet clear. Will there be a market mechanism developed for NAMAs? What will the role of CDM continue to be? For example, the EU has recently introduced legislation for its emissions trading system, which prioritises the LDCs in the CDM. After 2012 CERs to be used within the EU- ETS will be limited to projects in Least Developed Countries and those that were registered before 2012. Therefore a number of rules and guidelines for developing country NAMAs will also need to be agreed to ensure that the MRV provisions adopted are rigorous that are non-intrusive, non-punitive and respectful of national sovereignty. Furthermore, there will need to be an agreement on the type of emission reduction target for developing countries as currently a number of different options have been proposed (i.e. reduction targets against per unit of GDP; reductions which deviate from business-as-usual scenarios; reductions below a base year either 1990 or 2009; and a number of countries did not pledge a reduction target)[7].

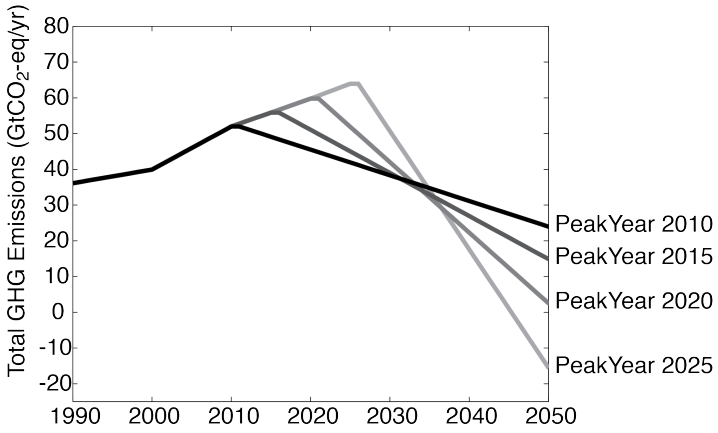
For both developed and developing countries, the MRV modalities and provisions will need to be based on clearly defined rules and guidelines on what and how to count their emission reductions. All of these rules and provisions for accounting have large impacts on the emission reduction level that will be achieved from these pledges and hence how the global goal will be met.

3) Current reduction targets: implications for adaptation/mitigation

Achieving the temperature targets of the Cancun Agreements, such as limiting warming to below 1.5 and 2°C above pre-industrial, requires global emissions to stay within a certain budget between now and 2050[8]. If emissions are relatively high in the first decades of this time period, this must be compensated by deeper reductions later on. Hence, by "overspending" the budget in the earlier years (until around 2020) both steeper emission reductions in later decades and a deeper absolute reduction level by 2050 is required (as illustrated in Figure 1). If reductions are delayed beyond 2020, the required emission reduction rates after the peak increase significantly and move beyond anything that can be regarded as feasible[9].

Based on more complex calculations that included energy-economic feasibility aspects, both the IPCC AR4 (2007) and UNEP Gap report (2010) concluded that global emissions need to peak before 2020. This was also confirmed with the 9 November 2011 release of the IEA World Energy Outlook 2011, which analysed the feasibility of a 450 scenario (roughly comparable to an even chance of warming below 2°C) that peaks global energy-related CO_2 emissions in 2017. Given the arguments above, a global emissions peaking year close to 2015 and no later than 2020 is advisable as a global goal.

Figure 1 If total global emissions peak later, reductions around 2050 need to be more ambitious if the cumulative emission budget between 2000 and 2050 is to remain the same. Emissions in this illustration follow SRES A1B baseline projections ('business-as-usual'; IPCC 2000) until the emission peak. The emission budget here corresponds to a total level of 2,000 $GtCO_2e$ between 2000 and 2050, leading to a roughly 50% chance of staying below 2°C for each of the emission pathways. The pathways are modelled as a linear trajectory for illustrative purposes. Other trajectories would produce the same overall conclusions. Source: Climate Analytics and PIK



In 2010, UNEP[10] led an international research effort to compile the results of many studies that estimated the global emission pathways over the 21st century that lead to global warming below 1.5 and 2°C above pre-industrial. The resulting UNEP Emission Gap Report[11] found that, until about 2030, global emission levels for a 2°C goal overlap with those for a 1.5°C goal (see Figure 2). The scenarios assessed by UNEP are all considered economically and technologically feasible[12]. Furthermore, the UNEP assessment considered almost exclusively pathways that assume an "economic optimal" (least expensive) path from today until the end of the century.

Some emission pathways may exist that peak at somewhat higher emissions in 2020 and still could lead to achieving the 2°C target. However, such higher 2020 emissions are associated with higher risks defined by (i) higher costs overall (e.g. over the period 2010-2050), (ii) higher post-2020 reduction rates, and (iii) higher dependence on technologies that are currently still under development, or on the drawing board. This results in much lower policy flexibility after 2020 (for example, higher investments of which the "return on investment" for the climate is subject to higher uncertainty) and therefore a higher risk of non-compliance.

According to the pathways evaluated in the UNEP Emission Gap[13] report, global emissions need to be at a level of 39-44 $GtCO_2e$/yr by 2020 for a likely chance to meet the 2°C goal, and

need to steeply decline afterwards. Instead, the most recent estimates of the effects of the current reduction targets[14] put global emissions on a pathway reaching 54 $GtCO_2e$ /yr in 2020. The latter estimates take into account the current provisions proposed by Annex-I Parties, such as LULUCF credits, which lead to higher effective emission allowances than suggested by the pledges themselves, as well as the effects of the full carryover, use and trading of surplus emission allowances from the first commitment period under the Kyoto Protocol to the next, which effectively eliminates the need for any "real" emission reductions by Annex I. The difference between the 54 $GtCO_2e$ /yr level and the 44 $GtCO_2e$ /yr upper UNEP level means a "gap" remains between where all country pledges together would bring us in 2020, and where we would need to be in 2020 to achieve the 1.5 and 2°C targets. With the most recent emission estimates for 2020, this gap is at least 10 $GtCO_2e$ /yr.

The UNEP Emission Gap report shows that this gap can be closed by a combination of actions: (1) agreeing on stringent accounting rules which address LULUCF crediting, surplus AAUs and market mechanisms, as well as (2) deeper reduction pledges for 2020.

At the end of 2010, UNEP outlined that the gap can be reduced from 9 down to 5 $GtCO_2e$ depending on the how the negotiations evolve. As mentioned above, based on the most recent estimates, the value most in line with the current status of the negotiations would be at the top or above this range, at about 10 $GtCO_2e$. The lower values of the UNEP range would be achieved by (a) agreeing and implementing more stringent rules and (b) parties deciding that they will implement their conditional emission reduction proposals. Stringent rules would close the gap by 1.1-2.4 $GtCO_2e$. If countries were to move from the unconditional pledge to the full implementation of the more ambitious, but currently still conditional, pledges, the gap could reduce by 1.6-2.9 $GtCO_2e$. Decisions on these matters and conditions are still part of the on-going negotiations. Strong decisions have to be taken to reduce the emissions gap towards a 1.5 or 2°C path from its current estimate of 10 $GtCO_2e$, and the overall ambition has to be raised beyond what is currently on the table. Finally, the UNEP report implicitly includes emission reductions from the international aviation and shipping sectors, about which no international agreement has been reached yet.

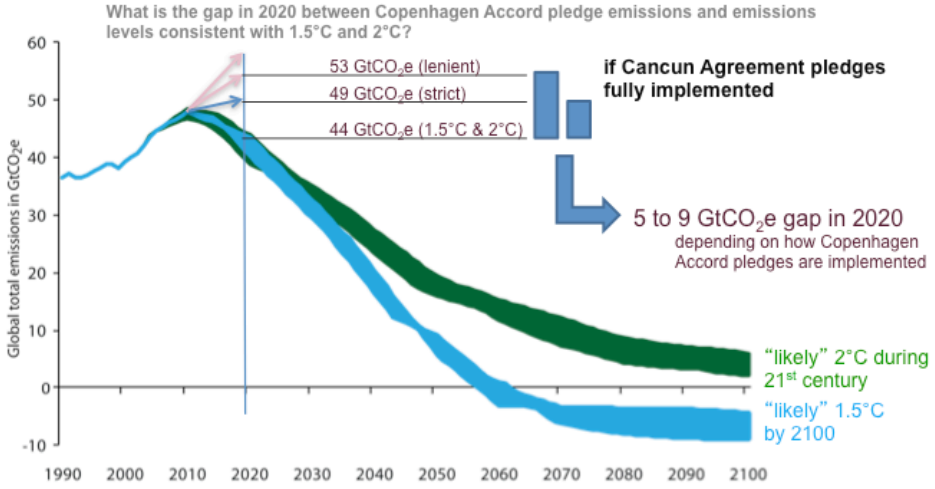


Figure 2 DRAFT FIGURE Global total emission pathways in the 21st century that lead to a likely (better than 66%) chance of staying below 1.5°C and 2°C. Indicative levels for 2020 for these pathways can be compared to the 2020 levels where current emission reduction pledges lead. Adapted from UNEP (2010).

Studies of the mitigation costs show that high levels of ambition are possible in the short term, and that higher short-term costs associated with higher ambition will result in lower long-term costs[15]. However, if there is a deliberate policy to delay action to minimise short-term mitigation costs, this has the potential to lock-in long-term fossil fuel emitting infrastructure and limit the rate at which emissions can decline in the future. The UNEP Emissions Gap report found that delayed action may have economic benefits in the short term, but also has risks associated with higher temperatures (for a temporary time period). The latter leads to higher mitigation costs over the long term and larger and prolonged damages from the impacts of climate change[16].

Importantly, delaying mitigation action shifts the cost burden from developed countries to developing countries, which have to face additional adaptation needs and higher levels of "residual damage", i.e. damage beyond adaptation potential, even with unlimited funding. Limiting warming to below 1.5°C give natural systems a better chance to survive and adapt, and would limit damage to LDCs ecosystems. Limiting warming in the longer term below this 1.5°C level, would bring greater certainty in avoiding the worst impacts of climate change. It will reduce, but not eliminate major risks and damages to LDCs, and will still require substantial support from the international community for adaptation. The accompanying paper "Science aspects of the Review of the 2°C target and aim for 1.5°C" provides an overview on the impacts and risks associated with 1.5°C and higher levels of warming.

4) What are fair emission reduction burdens for both developed and developing countries and how are LDCs affected?

The UNEP Emissions Gap report unambiguously shows that the mitigation effort to limit global temperature increase to below 1.5°C or 2°C relative to pre-industrial is substantial. No country alone can fix the problem. The question therefore arises how this global mitigation effort should be distributed among regions and countries.

Distributing emission efforts depends on considerations of equity, judgments of fairness, and transparency. The IPCC's Fourth Assessment Report (AR4)[17] indicates that equity can be elaborated in terms of distributing the costs of mitigation or adaptation, distributing future emission allowances or rights and ensuring institutional and procedural fairness. In general distributing the mitigation effort is achieved by allocating specific emission allowances to countries. Many distribution approaches for such emission allowances have been analysed in the scientific literature[18,19,20,21], each tackling the question from a different point of view.

A definition of "fair emission reduction burdens" for both developed and developing countries can therefore not just be the result of an objective analytical exercise, but must result from a dialogue between all stakeholders about which equity or fairness principles are shared by all. Below, we provide a very brief overview of different views and approaches of these principles without being exhaustive and without implying a value judgment on any of them. With the exception of the first, none of these approaches demand a significant contribution from LDCs to global emission reduction efforts. In fact, a cost-effective spread of the use of mitigation potential that includes potential in LDCs, combined with (financial) obligations by developed countries and no mitigation obligations by LDCs, implies a net financial flow from developed countries into LDCs for mitigation purposes. This will be quantified in section 6.

Contraction and Convergence

The contraction and convergence approach[22] allocates emissions to countries in a way such that (1) the global emissions are reduced following a specified global path in line with 1.5 or 2°C (contraction), and (2) the per capita emissions of each respective country converge. At the end of the contraction and convergence approach (i.e. 2050), all countries have the same per capita emissions.

South-North Dialogue Proposal

The "South-North Dialogue" proposal[23,24] differentiates the mitigation allowances for each country based on three criteria relating to responsibility, capability and mitigation potential. Every country is assigned to one of six groups, depending on their overall score on the three criteria. The countries are not assigned statically to one group, but can move dynamically to another group, if their criteria change significantly. Annex I excluding Annex II is the first group and Annex II countries form the second group. Newly industrialized countries (NICs), rapidly industrializing developing countries (RIDCs), the least developed countries (LDCs) and the "other" developing countries (ODCs) are the remaining four groups. Each group receives specific types of targets, ranging from: a reduction from a base year (e.g. Annex I), to a reduction below a baseline (e.g. NICs), to no target at all (LDCs).

Equal Cumulative per Capita Emissions

The equal cumulative per capita emissions proposal was first proposed by the Chinese delegation at COP14 in Poznan[25]. The proposal defines that over a given time period (for example 1990 until 2100), the sum of yearly emissions from countries divided by the sum of their respective populations over the same timeframe must be equal.

Greenhouse Development Rights

The Greenhouse Development Rights proposal[26] consists of an allocation regime in which the global mitigation effort is split up using a burden sharing key that is calculated from two indicators: a country's capacity and its responsibility. In calculating a country's capacity and responsibility, the relative wealth of every citizen in a country is taken into account. For example, a country's capacity depends on the share of a country's population that exceeds the so-called development threshold per capita of US$9000/year (PPP). Likewise, for the responsibility of a country, a distinction is made between "survival emissions" and "luxury emissions". Finally, a combination of both indicators defines which share of the mitigation burden is allocated to each respective country.

IPCC AR4 reduction numbers

One of the most well-known allocations of emission reduction burdens is the allocation as described in Box 13.7 of the Working Group III contribution to the IPCC's AR4. Based on multiple approaches to allocate emissions between regions (contraction and convergence, multistage, Triptych and intensity targets, among others), the AR4 indicates that for the scenarios of the 450 ppm-CO_2e category, the reduction in 2020 should be 25 to 40% below 1990 levels for Annex I. Under some allocation approaches, however, required reductions by Annex I would be higher. Linked to this assessment for Annex I, AR4 estimated a necessary a substantial deviation from the baseline in the non-Annex I regions Latin America, the Middle East, East Asia, and Centrally-planned Asia.

5) How feasible are warming targets and emission reduction targets?

To put the warming goals of the Cancun agreements into perspective, Figure 3 shows the effect of future emissions on the level of warming over the 21st century. "Geophysical inertia" denotes the minimum warming possible due to laws of physics: even in the fully hypothetical case that all global emissions were cut to zero in the year 2016 warming would not decline to much below 1°C above pre-industrial by 2100. Feasible energy-economic mitigation scenarios as included in the UNEP (2010) Gap Report discussed above allow warming to be held below 1.5°C and 2°C with high probability (blue and green lines in

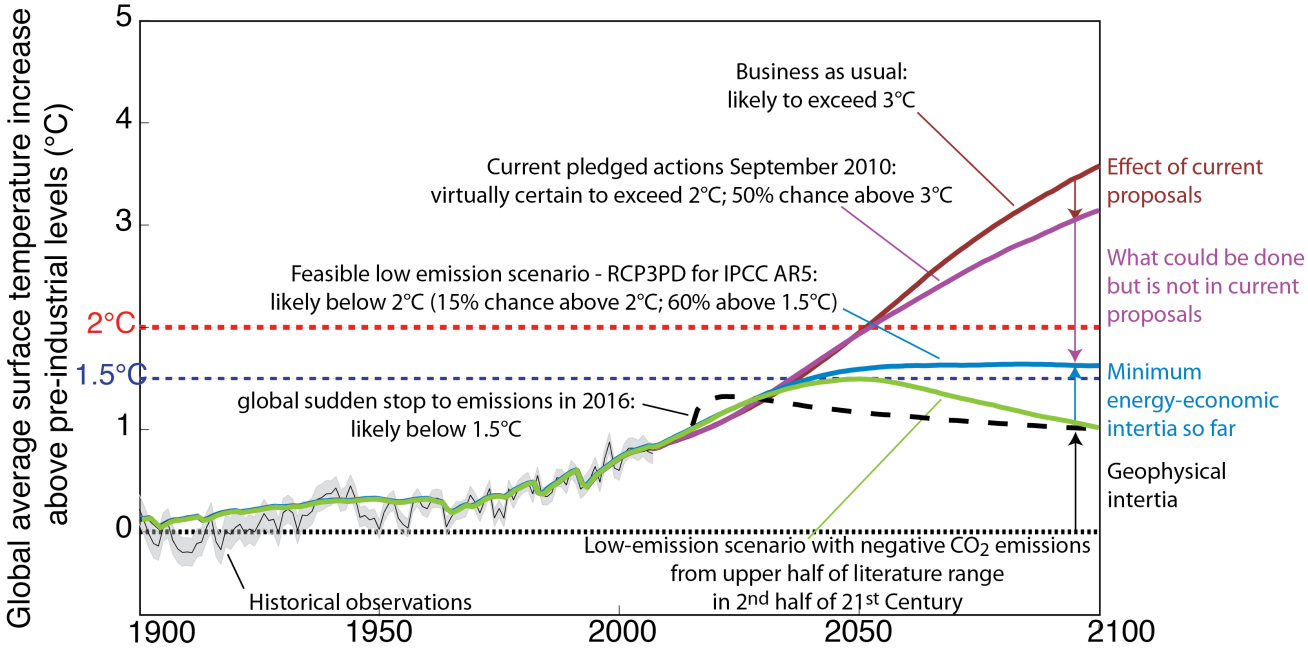


Figure 3), possibly after a temporary overshoot in the case of 1.5°C.

Figure 3 Global-mean warming trajectories resulting from various emission pathways to illustrate the levels of warming that are plausible in the 21st century. The dark-red pathway shows projected emissions under a "business-as-usual" estimate without climate policy beyond current policy. The black dashed pathway shows the evolution of global-mean temperature that would result if global emissions could be reduced immediately to zero after 2015, which illustrates the geophysical feasibility of a very low warming level, without any regard for technical, economical, political or social implications. The purple line shows the impact of currently proposed emission reductions by UNFCCC Parties and the blue line is an example of a relatively low emission scenario that has been developed for evaluation in the upcoming IPCC Fifth Assessment Report and is technically and economically feasible. This is not a minimum and therefore this does not imply that lower pathways are not feasible. Hence, the green line shows deeper late-century reductions, with negative CO_2 emissions technically possible through, for example, large-scale use of modern bio-energy combined with carbon capture and storage. Source: Climate Analytics.

Emission pathways that limit greenhouse gas concentrations and temperatures to relatively low levels appear to be technically and economically feasible, based upon the published scientific literature[27]. Reductions of 25-45% from 1990 levels for Annex I in aggregate lie within the range of reduction potential identified in the literature for Annex I as a whole. Energy-economic models, such as those use in IPCC AR4 estimate costs to lead to a 1.7% reduction of GDP or less by 2100, compared to the baseline[28]. A reduction of global GDP by 2100 of 1.7% is

comparable to a delay of less than 2 years in achieving the level of GDP growth that would otherwise have occurred.

The present proposals of the Annex I parties, which would reduce emissions by a total of 0 to 2 $GtCO_2$/yr by 2020 compared to business-as-usual (after accounting for LULUCF credits and full carryover of surplus allowances – see section 3), imply estimated carbon prices for domestic reduction options similar to or below those projected for the EU trading system in the period 2015 to 2020. There can be little question of the feasibility of these modest reductions being achieved.

For larger reductions, such as that required to limit Annex I group emissions to 45% below 1990 levels by 2020, up to about 10 $GtCO_2e$/yr reductions from business-as-usual projections for 2020 are required. With estimates of global low-cost reduction potentials of 9-17 $GtCO_2e$/yr at costs of order $30 per ton $GtCO_2e$, the overall costs would seem to be feasible[29].

6) Why does mitigation matter for LDCs?

Significant regional climate changes impacts in LDCs have been observed and published from only the 0.8°C temperature rise over the past one and a half century (see e.g. related paper "Science aspects of the 2°C and 1.5°C global goals in the Cancun Agreements"). Further impacts will be felt by increasing temperatures. Agriculture is undoubtedly the most important and climate sensitive sector in most African countries, as well as LDCs in Asia, the Caribbean and Pacific. Climate change is expected to jeopardize food supply, hence, exacerbate poverty and malnutrition. Malnutrition remains one of the largest health issues globally, and it has its largest number of cases in Africa. Rainfall changes and increased drying and droughts are more likely with higher temperatures. About 25% of Africa's population (about 200 million people) currently experiences severe water shortages. In 2050, a temperature increase of about 2°C, will put 350 to 600 million people at risk of increased water stress globally. A 2°C temperature increase means substantial losses predicted for some countries due to sea-level rise of up to 14% of GDP[30] and the costs of adaptation could amount to at least 5%-10%of GDP[31]. Coral reefs are also projected to stop growing due to ocean acidification once CO2 concentrations climb above ~450 ppm. Further aspects of the risks of un-mitigated warming levels for LDCs are addressed in the accompanying paper "Science aspects of the Review of the 2°C target and aim for 1.5°C".

Significant economic and technical potential for emission reductions in LDCs exists, but in almost all of the equity cases, reduction obligations for LDCs are zero, or at least smaller than for other countries, due to their low per capita emissions, for example. However, LDCs can receive a monetary benefit from financing of mitigation activities within LDCs (e.g. through CDM or even emissions trading in future). Therefore, it is in the interest of LDCs that a strong mitigation obligation is taken up by the major emitters. Obviously, at least as important is the reduction in climate impacts expected from successful strong mitigation efforts, leading to lower adaptation costs and residual damages (damages that need to be absorbed, because no adaptation is possible).

Figure 4 illustrates the fundamental shift in balance of costs and benefits, if a stronger long-term goal is assumed. Generally, in the equity principles assessed by the authors, mitigation funding flowing into the West-African, East-African and South-Asian regions leads to benefits (see blue bars), to different extent for different equity principles. In addition, for a more ambitious warming target adaptation costs and in particular residual damages will be reduced. Unfortunately, the authors of the study have not performed this analysis for a 1.5°C target.

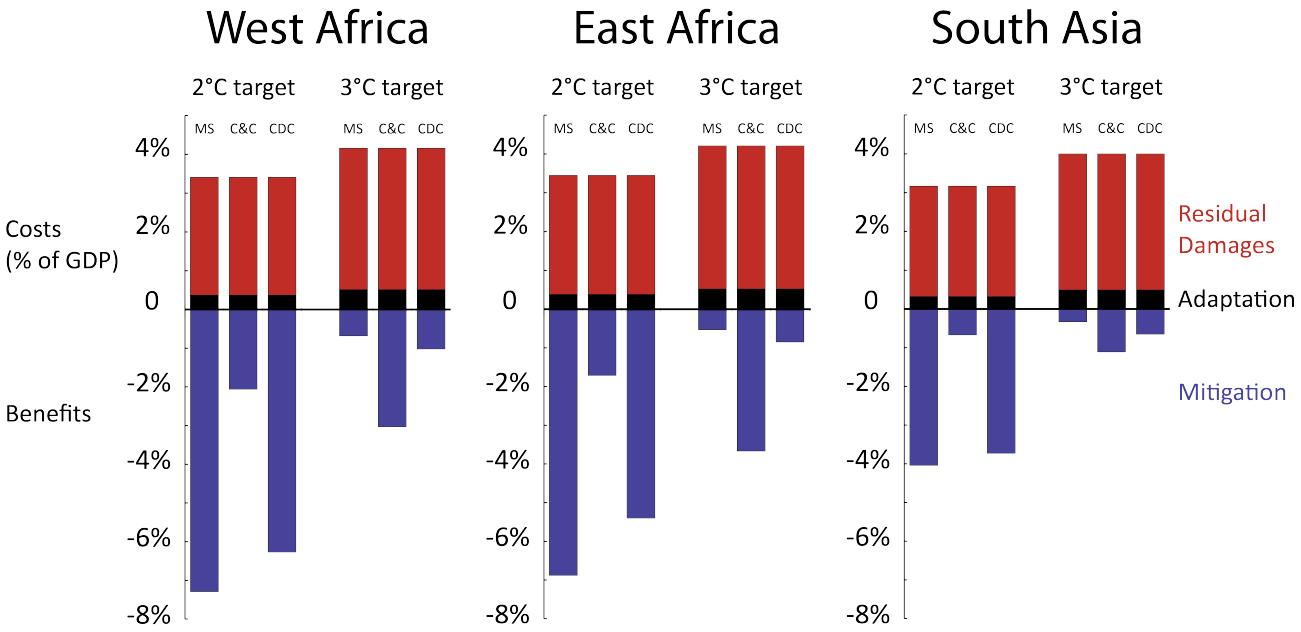


Figure 4 Illustration of the trade-offs for three regions between costs and benefits from mitigation, adaptation and residual damages associated with global mitigation efforts aimed at 2 and 3°C targets. The implications are different for different regimes that allocate the global emission burden to regions. For explanation of these regimes see Section 4, MS: Multi-Stage, C&C: Contraction & Convergence, CDC: Common but Differentiated Convergence. The costs are expressed in % of regional GDP discounted over 2005-2100. Source: PBL, Hof et al. (2010).

It would be beneficial to LDCs to position themselves to ensure the greatest benefits from mitigation, not only to avoid the impacts of climate change, but also to secure a sustainable development future within the emerging global low-carbon economy and its opportunities for development. To this end, developed countries should make a strong commitment to support all developing countries including the LDCs to acquire clean technologies and build capacity for its energy requirements, adaptation and sustainable development. This requires new, sustained and predictable financing in the order of at least USD100 billion per year by 2020 for both mitigation and adaptation. This may not be enough and what is needed is identification of scalable sources of long-term finance including finance to address loss and damages facing the LDCs and SIDS. A number of LDCs have already identified measures to reduce their emission reduction burden. It is essential that LDCs be given flexibility in MRV and access to funding to deliver on their NAMAs.

There is a close link between mitigation actions and the ability to generate funding to support adaptation and mitigation actions by developing countries. Climate policies can deliver environmental benefits but they can also generate financial revenues, especially when market mechanisms are used[32]. The main feature of market-based instruments is that they put a price on carbon emissions, which motivates emitters to internalize the social costs that result from their emissions. The carbon price is determined through the demand for emissions allowances and the total number available. Therefore, through ambitious mitigation targets embedded in a robust climate policy regime, governments can send a strong signal to polluters that emission

allowances will become scarce in the future. The strength and robustness of this scarcity signal – and hence the level of mitigation ambition – will determine the price for emissions allowances.

Putting a price on emissions can generate new and additional climate finance streams. The UN Secretary General's High Level Advisory Group on Climate Finance (AGF) Report provided an analysis of the revenue potential of these different sources[33]. Revenue estimates were provided through a range of funding sources that can be expected at different levels of carbon prices and hence at different levels of mitigation ambition. For some of the sources the lower estimate differed substantially from the higher estimate. For example potential revenues from auctioning of Assigned Allowance Units and auctioning of allowances in domestic trading schemes were estimated to be between USD 2 billion and USD 8 billion a year based on the lower mitigation pledges submitted to the UNFCCC in 2010. In a more ambitious scenario (assuming a 25% reduction across developed countries by 2020 below 1990 levels and the introduction of emission trading schemes in all developed countries) the AGF estimated revenues in the order of USD 14 billion to USD 70 billion annually[34].

The AGF analysis shows that the level of ambition has an impact on a number of potential promising sources to generate new and additional climate funding. Therefore, ambitious mitigation targets and a robust climate policy regime are in the interest of LDCs, as they have the potential to yield higher revenue streams for adaptation and mitigation.

7) Conclusions

An effective climate regime needs to have at its core ways to raise the level of ambition of climate mitigation so as to meet the global goal of staying well below 2°C above pre-industrial levels and making sure that the 1.5°C goal above pre-industrial levels is achievable. This paper has shown that what is needed is deeper emission reduction targets that are not diluted with additional credits or lenient rules, which is the case now for developed countries. Mitigation is as important an issue for LDCs as adaptation as any delay in mitigation action will not only be more costly but also have large impacts on LDCs and other vulnerable countries, which will increase the cost burden further. An important aspect in this is the fact that adaptation potential is physically limited and residual damage exists to which adaptation is not feasible. This effect is strongest for the most vulnerable countries and is indeed a key characteristic to define vulnerability. Furthermore there could be potential benefits for the sustainable development of many LDCs that want to undertake NAMAs to achieve low-carbon development. There are also direct benefits from mitigation for LDCs in an equity frameworks that allocates the global emission obligations to the regions that have the highest capacity to carry this burden, or have the highest responsibility to reduce emissions Moreover, ambitious mitigation targets and a robust climate policy regime are needed as they have the potential to yield higher revenue streams for adaptation and mitigation. Finally, this paper has demonstrated that it is feasible for Annex I to take deeper targets that fall in the low-cost range. What needs to be stimulated is the political will to increase this level of ambition.

[1] Latin America, Middle East, East Asia, and Centrally-planned Asia

[2] Compilation of economy-wide emission reduction targets to be implemented by Parties included in Annex I to the Convention, Revised note by the secretariat, 7 June 2011 http://unfccc.int/resource/docs/2011/sb/eng/inf01r01.pdf; and Compilation of information on nationally appropriate mitigation actions to be implemented by Parties not included in Annex I to the Convention, Note by the secretariat, 18 March 2011 http://unfccc.int/resource/docs/2011/awglca14/eng/inf01.pdf

[3] The LDCs who submitted NAMAs include: Afghanistan, Benin, Bhutan, Cambodia, Central African Republic, Chad, Ethiopia, Eritrea, Madagascar, Mauritania, Sierra Leone and Togo.

[4] UNEP (2010) "The Emissions Gap Report", Nairobi, pp 55; Rogelj, J., J. Nabel, et al. (2010). "Copenhagen Accord pledges are paltry." Nature 464(7292): 1126-1128.

[5] See UNFCCC (2011). Technical Paper FCCC/TP/2011/1: Quantified economy-wide emission reduction targets by developed country Parties to the Convention: assumptions, conditions and comparison of the level of emission reduction efforts. , United Nations Framework Convention on Climate Change: 40. Available from: http://unfccc.int/resource/docs/2011/tp/01.pdf

[6] See the online analysis of Climate Action Tracker: www.climateactiontracker.org

[7] China and India pledged reduction targets against per unit of GDP; twelve countries pledged reductions which deviate from business-as-usual scenarios; five countries pledged reductions below a base year either 1990 or 2009; twenty-nine countries pledged NAMAs without a reduction target by 2020.

[8] Meinshausen, M., N. Meinshausen, et al. (2009). "Greenhouse-gas emission targets for limiting global warming to 2°C." Nature 458(7242): 1158-1162.

[9] Den Elzen, M. and N. Höhne (2010). "Sharing the reduction effort to limit global warming to 2°C." Climate Policy 10: 247-260.

[10] United Nations Environment Programme

[11] UNEP (2010) "The Emissions Gap Report", Nairobi, pp 55

[12] For the assessment of emission pathways consistent with 2°C, only pathways which were considered technologically and economically feasible were included in the UNEP assessment. These pathways are generated by so-called integrated assessment models (IAMs). Such models model technological and economic constraints which are faced when changing from an energy system with high greenhouse gas emissions to an energy system with significant low emissions. These constraints are, for example, limitation to the speed with which new technologies can be scaled up. However, very little of such analysis with IAMs have been carried out that look specifically at the 1.5°C target. Therefore, the UNEP assessment published preliminary results for pathways in line with 1.5°C, based on an analysis of the characteristics of what pathways in line with 1.5°C would have to look like from a physical science perspective and taking into account possible emission reductions throughout the 21st century. Ongoing research in these areas will increasingly help clarify issues surrounding scenarios in line with these temperature levels.

[13] UNEP (2010) The Emissions Gap Report, Nairobi, pp 55.

[14] Rogelj, J., C. Chen, et al. (2010). Analysis of the Copenhagen Accord pledges and its global climatic impacts, a snapshot of dissonant ambitions. Environmental Research Letters 5(3): 034013.

[15] den Elzen, M., D. van Vuuren, et al. (2010). "Postponing emission reductions from 2020 to 2030 increases climate risks and long-term costs." Climatic Change 99(1): 313-320; Dellink, R., G. Briner and C. Clapp (2010), "Costs, Revenues, and Effectiveness of the Copenhagen Accord Emission Pledges for 2020", OECD Environment Working Papers, No. 22, OECD Publishing; IEA (2010). World Energy Outlook; Amann, M. et al (2009). GAINS: Potentials and costs for greenhouse gas mitigation in Annex I countries. IIASA; Krey, V. and K. Riahi (2009). "Implications of delayed participation and technology failure for the feasibility, costs, and likelihood of staying below temperature targets--Greenhouse gas mitigation scenarios for the 21st century." Energy Economics 31(Supplement 2): S94-S106; Project Catalyst (2009). PROJECT CATALYST BRIEF: Financing Needs; Stern, N. (2007). STERN REVIEW: The Economics of Climate Change. Chapter 10; IPCC (2007). AR4. Summary for policy makers.

[16] UNEP (2010) The Emissions Gap Report, Nairobi, pp 55.

[17] IPCC (2007). Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, UK and New York, USA, Cambridge University Press: 860.

[18] den Elzen, M. G. J. and P. Lucas (2003). FAIR 2.0 - A decision-support tool to assess the environmental and economic consequences of future climate regimes. Bilthoven, the Netherlands, National Institute for Public Health and Environment (RIVM): 93; Berk, M. M. and M. G. J. den Elzen (2001). "Options for differentiation of future commitments in climate policy: how to realise timely participation to meet stringent climate goals?" Climate Policy 1(4): 465-480; Baer, P., T. Athanasiou and S. Kartha (2007). The Right to Development in a Climate Constrained World: The Greenhouse Development Rights Framework, www.ecoequity.org/GDRs; and many more

[19] den Elzen, M.G.J., Höhne, N., (2008), Reductions of greenhouse gas emissions in Annex I and non-Annex I countries for meeting concentration stabilisation targets, Climatic Change 91(3–4), 249–274

[20] Gupta, S., D. A. Tirpak, et al. (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 and L. A. Meyer. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

[21] den Elzen, M.G.J., Höhne, N. (2010). Sharing the reduction effort to limit global warming to 2°C. Climate Policy 10 (3), 247–260.

[22] Meyer A (2000) Contraction & Convergence. The global solution to climate change. Green Books, Bristol, UK.

[23] Ott HE, Winkler H, Brouns B et al (2004) South–North dialogue on equity in the greenhouse. A proposal for an adequate and equitable global climate agreements. Eschborn, Gesellschaft für Technische Zusammenarbeit, www.erc.uct.ac.za/recentpub.htm or www.south-north-dialogue.net

[24] den Elzen, M. G. J., Höhne, N. et al. (2007). "Differentiation of countries' future commitments in a post-2012 climate regime – An assessment of the "South-North Dialogue" Proposal." Environmental Science & Policy 10: 185-203.

[25] UNFCCC, 2008. Report on the workshop on a shared vision for long-term cooperative action. Cop14. Poznan. URL: http://unfccc.int/resource/docs/2008/awglca4/eng/crp06.pdf

[26] Baer, P., T. Athanasiou and S. Kartha (2007). The Right to Development in a Climate Constrained World: The Greenhouse Development Rights Framework, www.ecoequity.org/GDRs

[27] e.g. Clarke, L., Edmonds, J., Krey, V., Richels, R., Rose, S. & Tavoni, M. (2009). International climate policy architectures: Overview of the

EMF 22 International Scenarios. Energy Economics, 31, S64-S81.

[28] Knopf, B., O. Edenhofer, H. et al (2008) Report on first assessment of low stabilisation scenarios, D-M2.6, PIK, Potsdam, Germany

[29] UNEP (2011) Bridging the Emissions Gap: A UNEP Synthesis Report, Report DEW/1470/NA, 56 pp.

[30] Van Drunen, M.A., Lasage, R. & Dorland, C. (eds.) Climate Change in Developing Countries: An Overview of Study Results from the Netherlands Climate Change Studies Assistance Programme (CABI Publishing Amsterdam, 2005).

[31] Niang-Diop, I. Impacts of climate change on the coastal zones of Africa (2005).

[32] OECD (2010) Cost and Effectiveness of the Copenhagen Pledges – Assessing global greenhouse gas emissions targets and actions for 2020]

[33] AGF (2010) Report of the Secretary-General's High-level Advisory Group on Climate Change Financing. UN.

[34] ibid