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Who picks up the remainder? Mitigation in developed and developing countries

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A fair, effective, flexible and inclusive climate regime beyond 2012 will need several political balances. Mitigation and funding will be at the heart of the agreement. The IPCC's Fourth Assessment Report indicates that absolute reductions will be needed in Annex I (AI) countries and substantial deviation from baseline in some non-Annex I (NAI) regions by 2020. Although the latter was not explicitly quantified by the IPCC, the EU subsequently proposed a range for developing countries. Sharing the burden for mitigation is essentially zero-sum: if one does less, the other has to do more. We critically examine the implicit assumption that NAI countries would pick up the remainder of the required global effort minus the AI contribution. We suggest that greater levels of ambition can be achieved by turning the formula around politically, starting from the achievable 'deviation below baseline' given NAI's national programmes and appropriate international support. AI countries may have to exceed the IPCC ranges or pay for the remainder. For notional levels of NAI mitigation action, Annex I has to reduce by between –52% and –69% below 1990 by 2020, only dropping to a domestic –35% with commitments to offset payments through the carbon market. Given the large mitigation gap, a political agreement on the question of 'who pays' is fundamental. The carbon market will provide some investment, but it mainly serves to reduce costs, particularly in developed countries, rather than adding to the overall effort. Market-linked levies and Annex I public funding will therefore be crucial to bridge the gap.

Keywords: climate finance; climate negotiations; Copenhagen; developed countries; developing countries; mitigation; post-2012

Un régime climatique pour la période s'ouvrant après 2012, qui soit équitable, efficace, flexible et inclusif, dépendra de plusieurs équilibres politiques. La mitigation et le financement seront deux thèmes centraux de l'accord. Le quatrième Rapport d'évaluation du GIEC indique que d'ici 2020 des réductions absolues seront requises dans les pays de l'Annexe 1 (AI) ainsi qu'une déviation importante par rapport aux émissions de référence de certaines régions non inscrites à l'Annexe 1 (NAI). Bien que celle-ci n'ait pas été explicitement quantifiée par le GIEC, l'UE a par la suite proposé une fourchette pour les pays en développement. Le partage du fardeau pour la mitigation est essentiellement à somme nulle : si l'une des parties en fait moins, l'autre aura plus à faire. Nous examinons de manière critique l'hypothèse implicite que les NAI assumeront le reste de l'effort planétaire mise à part la contribution de l'AI. Nous suggérons qu'une ligne plus ambitieuse peut être obtenue en retournant la formule politiquement, à commencer par la « déviation au-dessous du niveau de référence », réalisable à partir des programmes nationaux des NAI et d'un soutien international approprié. Les pays de l'AI dépasseront peut-être les valeurs du GIEC ou auront à payer pour la différence. En fonction de niveaux conceptuels d'actions de mitigation des NAI, l'Annexe 1 aura à réaliser des réductions de l'ordre de –52% à –69% au-dessous de 1990 d'ici 2020, tombant à –35% de réductions intérieures, sous réserve d'objectifs de paiements compensatoires sur le marché du carbone. Etant donné le large écart relatif à la mitigation, un accord politique sur la question de « qui paie ? » est fondamental. Le marché du carbone apportera des capitaux, mais sa fonction principale est de réduire les coûts, en particulier pour les pays développés, plutôt que d'alourdir l'effort global. La relève d'impôts à l'échelle du marché et un financement public de l'Annexe 1 seront de ce fait essentiels pour combler cet écart.

Mots clés: Copenhague; finance pour le climat; mitigation; négociations sur le climat; pays en développement; post-2012

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1. Political context: from Bali to Copenhagen

While the Bali Action Plan (UNFCCC, 2007a) has four equally important building blocks, much of the negotiating outcome in Copenhagen will depend on mitigation. Three essential parts of the mitigation puzzle are captured in paragraphs 1b(i) and 1b(ii) of the Action Plan – mitigation commitments by developed countries, mitigation actions by developing countries, and support in the form of technology, finance and capacity building from developed to developing countries.

The mitigation puzzle is a set of interlocking pieces or, politically, a set of conditionalities. The Kyoto ratifiers amongst developed countries need the USA to make comparable mitigation commitments to any targets that they agree to for the second commitment period. To ensure that Kyoto ratifiers take on commitments for the second period requires that compliance procedures are comparable too. The discussion about comparable effort in paragraph 1b(i) needs to dispel the competitiveness fears of the EU and others.

For the USA, in turn, to agree in multilateral negotiations to binding and quantified emission reduction commitments (QERCs) requires that developing countries that are seen as competitors take binding mitigation actions, with the concept of 'binding' being capable of different interpretations. Judged by their public pronouncements, the agreed outcome for para. 1b(ii), for the USA and Japan, needs to be sufficiently binding on China in particular.

For the G77+China, comparable mitigation commitments by all developed countries are a condition for taking substantially enhanced action, along with adaptation support. Even then, the extent to which nationally appropriate mitigation actions will go beyond existing actions depends on the extent of the support, as outlined in paragraph 1b(ii).

The G5 statement in Sapporo in July 2008 captured this conditionality:

> (we) would increase the depth and range of these actions supported and enabled by financing, technology and capacity-building with a view to achieving a deviation from business-as-usual (G5, 2008).

In the context of the ongoing debate on a long-term goal of halving of global emissions by 2050, the G5 statement called on the G8 to lead with reductions of 80–95% below 1990 levels by 2050. Great emphasis was placed on mid-term targets to give credibility to this pathway, 'toward the upper end of the range of 25% to 40% below 1990 levels by 2020 for all developed countries' (G5, 2008). In setting out this balance between various conditionalities, the point of reference was the ranges and deviations underlying the most ambitious stabilization scenario assessed in the Intergovernmental Panel on Climate Change's (IPCC) Fourth Assessment Report (AR4).

2. Absolute and relative reductions in IPCC AR4

The IPCC in its AR4 considered what mitigation would be needed in Annex I (AI) and non-Annex I (NAI) regions for various stabilization levels. Box 13.7 in IPCC AR4 has been referred to extensively in the negotiations of the Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol (AWG-KP). More broadly, this section of chapter 13 of the Working Group III contribution suggests that pursuing the lowest stabilization level assessed would require absolute emission reductions by AI and relative emission reductions by NAI countries. The IPCC authors based the ranges on an assessment of the literature on allocations. Table 1 shows the absolute emission reduction commitments needed from Annex I (compared with 1990 levels)

TABLE 1 The range of the difference between emissions in 1990 and emission allowances in 2020/2050 for various GHG concentration levels for Annex I and non-Annex I countries as a group[a]

Scenario category	Region	2020	2050
A-450 ppm CO_2-eq[b]	Annex I	–25% to –40%	–80% to –95%
	Non-Annex I	Substantial deviation from baseline in Latin America, Middle East, East Asia and Centrally Planned Asia	Substantial deviation from baseline in all regions
B-550 ppm CO_2-eq	Annex I	–10% to –30%	–40% to –90%
	Non-Annex I	Deviation from baseline in Latin America and Middle East, East Asia	Deviation from baseline in most regions, especially in Latin America and Middle East
C-650 ppm CO_2-eq	Annex I	0% to –25%	–30% to –80%
	Non-Annex I	Baseline	Deviation from baseline in Latin America and Middle East, East Asia

[a] The aggregate range is based on multiple approaches to apportion emissions between regions (Contraction and convergence, Multistage, Triptych and intensity targets, among others). Each approach makes different assumptions about the pathway, specific national efforts and other variables. Additional extreme cases – in which Annex I undertakes all reductions, or non-Annex I undertakes all reductions – are not included. The ranges presented here do not imply political feasibility, nor do the results reflect cost variances.
[b] Only the studies aiming at stabilization at 450 ppm CO_2-eq assume a (temporary) overshoot of about 50 ppm (see den Elzen and Meinshausen, 2006).
Source: IPCC (2007: Box 13.7).

for various concentration levels and, for the most ambitious stabilization scenario, refers to the 'substantial deviation from baseline' needed in some developing-country regions by 2020 and in all developing-country regions by 2050.

The lower the stabilization level, the better chance there is of avoiding the worst impacts of climate change, to which developing countries are particularly vulnerable. The lowest stabilization level assessed by the IPCC AR4 in this regard is 450 ppmv. To achieve this level requires absolute reductions – QERCs – in Annex I in the range of –25% to –40% from 1990 levels by 2020. This range has been referenced in the AWG-KP.

The IPCC AR4 also includes reference to relative reductions in NAI countries as a group. From Table 1 it is clear that, if it was agreed that concentrations should stabilize at 450 ppmv, then deviations in developing regions would be needed (IPCC, 2007). At higher stabilization levels, the associated impacts would become unacceptable to many countries.

The distinction between absolute and relative reductions is fundamental. Developed countries need to reduce emissions in absolute terms, relative to a fixed base year, 1990. The range of the lowest stabilization level assessed by the IPCC therefore provides the opportunity for a different kind of negotiation. The experience with the negotiations in Kyoto was that AI countries reduced the level of ambition by reaching an average of pledges. In the negotiations scheduled to conclude in Copenhagen, the science-based range provides a fixed point, from which principle-based criteria can be applied to derive individual Annex I commitments.

For developing countries, the IPCC assessment assumes emissions avoidance, i.e. reductions relative to what they would have been. While no specific numbers are put to the substantial deviation from baseline, the concept is that absolute emissions in developing countries may

increase, but they should increase at a slower rate than they would have done without action on mitigation. The difference is avoided emissions; in other words, relative emissions reductions. These would be expressed in relation to a baseline, rather than a base year.

No goal or target can be assessed by its form alone. Absolute reductions against a base year are not, by definition, harder to achieve than relative reductions. Even leaving aside the fact that developing countries are seeking to avoid emissions in the context of resource constraints and overwhelming development priorities, the point is simple. It depends on the numbers.

3. Top-down definition of deviation below baseline

The IPCC AR4 reported no numbers for 'substantial deviation from baseline' for NAI countries (IPCC, 2007: ch. 13). They are, of course, implicit in the calculations – you cannot know that an unspecified action leads to a certain stabilization level. Nonetheless, unlike the explicit numbers for AI countries, no specific numbers were reviewed by governments in the process of accepting the IPCC recommendations. This has great political significance in the ongoing negotiations.

The European Union (EU) has since specified numbers for developing countries as a group. On 2 March 2009, EU Environment Ministers noted:

> that recent analysis indicates that such deviation will need to be of the order of 15 to 30% below business as usual by 2020 (CEU-EM, 2009).

As far as the peer-reviewed literature goes, these numbers are based on a single journal article (den Elzen and Höhne, 2008a).[1] The methodology is based fundamentally on the review of allocation studies, as for the IPCC assessment reports, but the authors also considered studies published after the cut-off date for the IPCC's AR4. They summarize their numbers on this matter:

> From the studies analysed, this article specifies the 'substantial deviation' or 'deviation from baseline' in the box: emissions of non-Annex I countries as a group have to be below the baseline roughly between 15% to 30% for 450 ppm CO_2-eq, 0% to 20% for 550 ppm CO_2-eq and from 10% above to 10% below the baseline for 650 ppm CO_2-eq, in 2020. These ranges apply to the whole group of non-Annex I countries and may differ substantially per country (den Elzen and Höhne, 2008a: 249).

The EU Environment Council conclusions focused on the range of 15–30% for 450 ppm CO_2-eq, which is the most stringent in the journal article and the lowest assessed by the IPCC to date.

The EU has proposed a relative target for developing countries as a group. From a tactical viewpoint, this top-down approach may not have elicited the intended response. The EU has, by implication, made political assumptions about business-as-usual (BAU) emission trajectories in developing countries, which necessarily requires judgement on future economic growth rates and development pathways. In effect, the EU proposal not only sets caps on emissions growth in developing countries, but by implication also economic growth.

For these reasons, developing countries were always likely to reject those particular numbers, regardless of whether they consider the precise numbers reasonable or not. A unilateral definition of ranges for developing countries by AI countries has proved politically unacceptable. An engagement with developing countries on the numbers, after having already stated them and claiming a scientific basis for them, was not likely to elicit a positive reaction. Indeed, during

the Convention and Protocol AWG meetings in April 2009, many developing countries severely criticized this range, presented during a technical briefing. In the case of ranges for AI countries, these were discussed extensively in the AWG-KP – and had a clear scientific basis in the IPCC AR4.

A different political approach would have been to create the space for developing countries to come forward with their own estimates of possible relative emissions reductions. The analogue in the AWGLCA (Ad Hoc Working Group on Long-Term Cooperative Action under the Convention) would have been analysis of mitigation potential and clarity on the means of implementation before attempting to agree multilaterally on an indicative range. No doubt this would have been an iterative process. An analysis of the national programmes and scenarios produced by developing countries themselves would have provided a much better basis for generating different ranges; arguably higher for some and lower for others.

Political and tactical considerations aside, the journal article (den Elzen and Höhne, 2008a) makes it clear that different ranges could be derived. Not only are different studies considered, but four factors influencing the deviation from baseline are analysed: choice of baseline, treatment of avoided deforestation, global emissions limits, and Annex I reductions.

For single factors, the variation is much wider. The second part of the analysis in the article uses another methodology to show the trade-offs. The factor giving the widest range for NAI deviation below baseline is the choice of global emission baseline. Deviations could range from –5% to –35%, with the most stringent reduction resulting from a pathway defined by Sheehan (2008). For other factors, the range is much narrower – on the treatment of avoided deforestation, –9% to –17%; and the choice of global emissions limit (but keeping a stabilization goal of 450 ppmv) might imply –13% to –27% (den Elzen and Höhne, 2008a: 270, fig. 6).

Using central estimates (rather than outliers), Figure 2 of the journal article shows that for 450 ppm CO_2-eq and a 40% emissions reduction for AI countries, what would be required from NAI countries would be 'a 7% to 22% deviation from the baseline, for a maximum and minimum global emission limit, compared to a 12% deviation for the default global limit' (den Elzen and Höhne 2008a: 270, fig. 6). These ranges are all narrower than those proposed by the EU.

4. Implicit formula: who picks up the remainder?

In a binary world, if one group does less, the other has to do more. If the journal article (den Elzen and Höhne, 2008a) made some implicit numbers more explicit, a presentation by the same authors made a critical assumption even more explicit (den Elzen and Höhne, 2008b). The implication of the mathematical trade-off of allocations is that NAI countries would pick up the remainder. We would argue that this political implication is not consistent with the first principle stated in the Convention, of equity and common but differentiated responsibilities and respective capabilities, and that 'the developed country Parties should take the lead in combating climate change' (UNFCCC, 1992: Art. 3.1).

The journal article takes an analytical approach with far-reaching policy implications. It takes a global stabilization level as its pivotal point. Most of the analysis is focused on the lowest stabilization level assessed by the IPCC, which is also the level that would help to avoid the worst climate impacts. In order to derive an overall picture, the analytical approach is to calculate an unknown from more readily defined parameters. While the Annex I range depends on political assumptions, a range was found from scientific studies. Since setting numerical targets for developing countries is more fraught, the authors take the approach of calculating the unknown

from two other factors. The equation is made explicit in the presentation, to enable 'simple calculations' (den Elzen and Höhne, 2008b):

$$\text{NAI} = \text{global} - \text{AI} \quad (1)$$

In this configuration, the equation assumes that a certain global effort to achieve a specified global stabilization level is desirable and that Annex I ranges are fixed.[2] The resulting requirement for the combined effort by NAI countries is the unknown to be calculated. In political terms, however, it means that NAI countries pick up the remainder. If AI countries, in practice, only achieve –25% below 1990 levels by 2020, NAI countries must do more. If the USA were to succeed in its insistence that anything beyond a return to 1990 levels is beyond its capabilities (i.e. a 0% reduction compared with 1990 by 2020), AI countries will be hard-pressed to even achieve the lower end of the range of –25 to –40% below 1990 levels by 2020. Mid-term targets pledged so far by individual AI countries are mostly below the bottom of this range. The implication of the simple political formula in Eqn (1) is then clear – to keep temperature increases at relatively safe levels, NAI Parties would have to do even more to compensate to the extent that AI Parties fall short of the IPCC targets. Judged by their responses, this would be unacceptable to the G77+China.

From the perspective of developing countries and in line with the principle of equity, the formula should be turned around:

$$\text{AI} = \text{global} - \text{NAI} \quad (2)$$

Turning around the formula is still challenging, but would provide a better basis for an equitable burden-sharing paradigm that also addresses distributional issues. Turning the formula around is a political matter – the numbers remain the same whichever way you calculate them. Turned around, it would still require that the deviation below baseline in NAI countries be quantified. But rather than defining the latter top-down, it could be calculated bottom-up, from the nationally-appropriate mitigation actions reported by developing countries through their national communications and/or against a registry held by the UNFCCC. Operationalizing this turned-around formula is premised on political will by all developed countries to achieve the –25 to –40% range domestically, *and possibly more*, and by developing countries to add up their bottom-up actions to generate an order of magnitude for their deviation from baseline.

In a situation where the rationale underpinning Eqn (1) is unacceptable to developing countries and Eqn (2) equally so to developed countries, the world clearly faces a political dilemma. There is a large mitigation gap (Baer, 2008; GCN, 2008) which no-one seems willing to fill. If political will is lacking on all sides to pick up the remainder, then dangerous climate change seems inevitable. Assuming that the impacts of higher stabilization levels are again unacceptable, where do we look for solutions? We suggest that a more bottom-up approach to developing countries' mitigation and supporting finance are key elements. But first we consider how much needs to be done by developed countries domestically in this zero-sum game.

5. Domestic reductions and the zero-sum game of offsets

For an overall stabilization level to be achieved, a certain amount of domestic emissions reduction has to occur in AI countries, and another level of effort domestically in NAI countries. Flexible mechanisms that transfer credits carrying the right to emit elsewhere do not add to the overall effort. Trading mechanisms might change who pays for mitigation and reduce the global costs, but do not increase the reductions at a global level.

Den Elzen and Höhne (2008: 263, see also 271) state that the emissions reductions in each group, Annex I and non-Annex I, are assumed to be domestic. Clarification through discussion with the authors indicates that this should be understood as a two-step process – first, pure allocation studies assume that emissions reduction have to be done either in AI or NAI countries, physically. The short-hand way of describing this would be 'domestic', but this becomes misleading if one considers emissions trading in a second step. The second step relates to payment for mitigation, through the carbon market.

Another way of putting this is that mitigation under a flexible and cost-effective regime is a zero-sum game. Box 13.7 of the IPCC AR4 illustrates this. It is not a matter of either/or. Both the absolute emission reductions by Annex I and the reductions relative to baseline for NAI are needed.

Beyond what each group does at home, it is important to distinguish between offsetting mechanisms and other mechanisms. The existing CDM is a well-known example of offsetting, explicitly designed to 'assist Parties included in Annex I in achieving compliance with their quantified emission limitation and reduction commitments' (UNFCCC, 1997). Annex I Parties can achieve their targets more cost-effectively, as emission reductions in developing countries are often cheaper. The second objective was the promotion of sustainable development in developing countries, although the record in achieving this is uneven (Ellis et al., 2007). The implication of offsetting for the future, when developing countries seek to achieve a deviation below baseline, is illustrated in the following figures. Figure 1 shows a situation in which Annex I overall reductions are –40% below 1990 levels in 2020, of which 5 percentage points (i.e. one-eighth of the reduction) can be purchased elsewhere. The graph in the centre shows that Annex I reductions are mostly

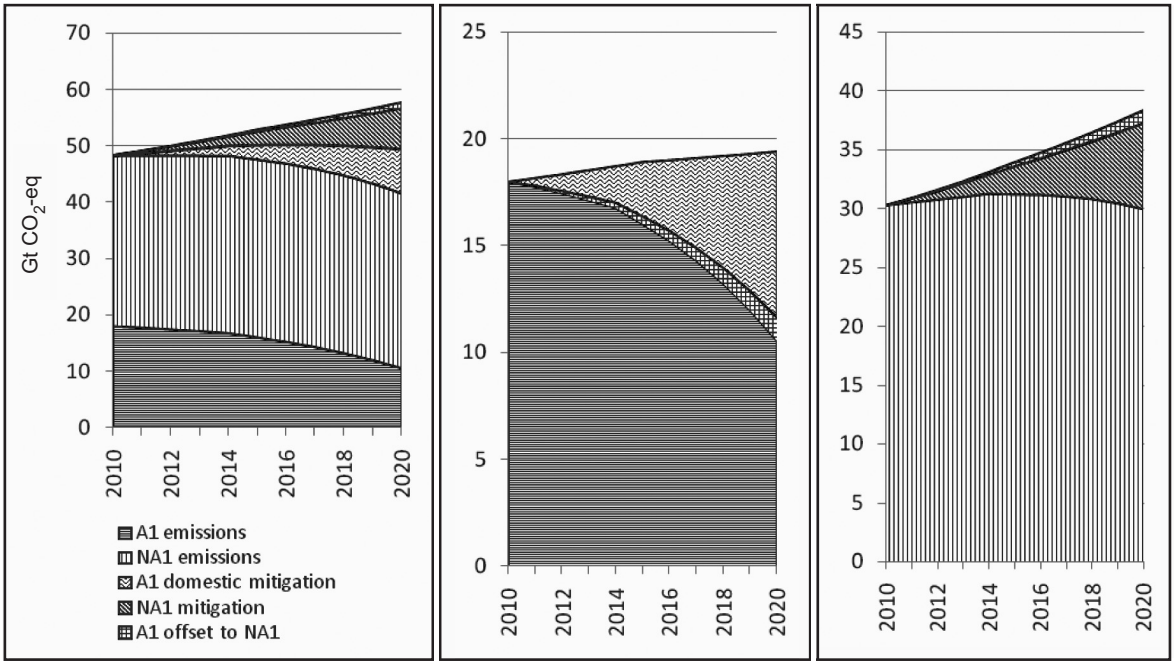

FIGURE 1 Annex I mitigation in the range of 40%, of which 5% can be offsets

domestic, with a thin sliver elsewhere. The right-hand graph shows the deviation below baseline in NAI; the left-hand graph shows all aspects together.

Figure 2 shows the results assuming the same level of ambition by AI countries, but allowing 35% of the 40% (seven-eighths of the reduction) to be purchased through offsets. The switch from one pattern to another in the middle band of each graph shows this clearly. Of particular interest is the effect for developing countries (shown in the right-hand graph): the band of domestic reductions has simply shifted downwards. Much more mitigation occurs in NAI countries, although some of it is offset from AI countries (the top band in the right-hand graph, and the middle band in the central graph). In the overall graph (left-hand side), Annex I domestic mitigation is barely visible.

Figure 3 shows a situation in which Annex I overall reductions are at the bottom of the IPCC's range, –25% below 1990 levels in 2020, and with 20%, or four-fifths, being able to be purchased through offsets. The middle graph shows the lower level of ambition by Annex I, and the direct result that more has to be done in NAI countries – the hatched band representing NAI mitigation widens and the overall deviation below the baseline is greatest. Given this set of assumptions, the left-hand graph shows that almost all mitigation is taking place in developing countries.

This series of illustrative figures shows that the greater use of offsets by AI countries implies that more mitigation has to happen in developing countries. Or, as den Elzen and Höhne put it,

> The ranges given in the box and in this article are assumed to be achieved domestically by both groups of countries. If Annex I countries plan to achieve a part of their emission targets outside of their territory, through credit transfer mechanisms such as the CDM, then first the ranges presented in the box and in this article would have to be achieved and the credit transfers would have to occur in addition (den Elzen and Höhne, 2008a: 271).[3]

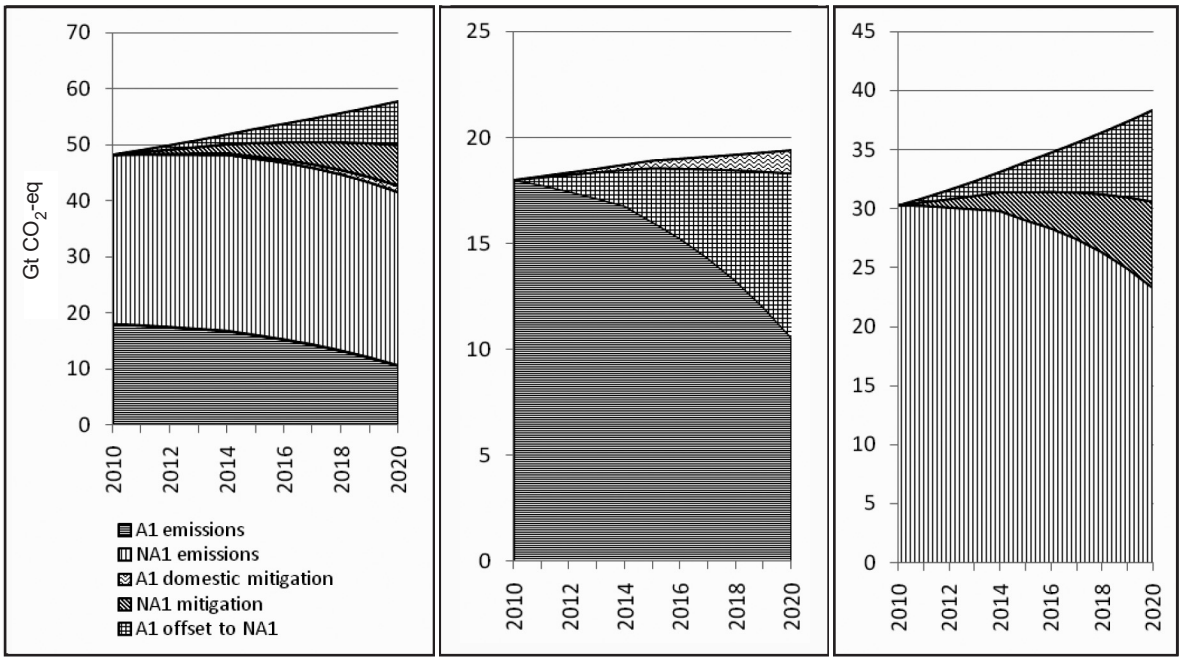

FIGURE 2 Annex I mitigation in the range at 40%, of which 35% can be offsets

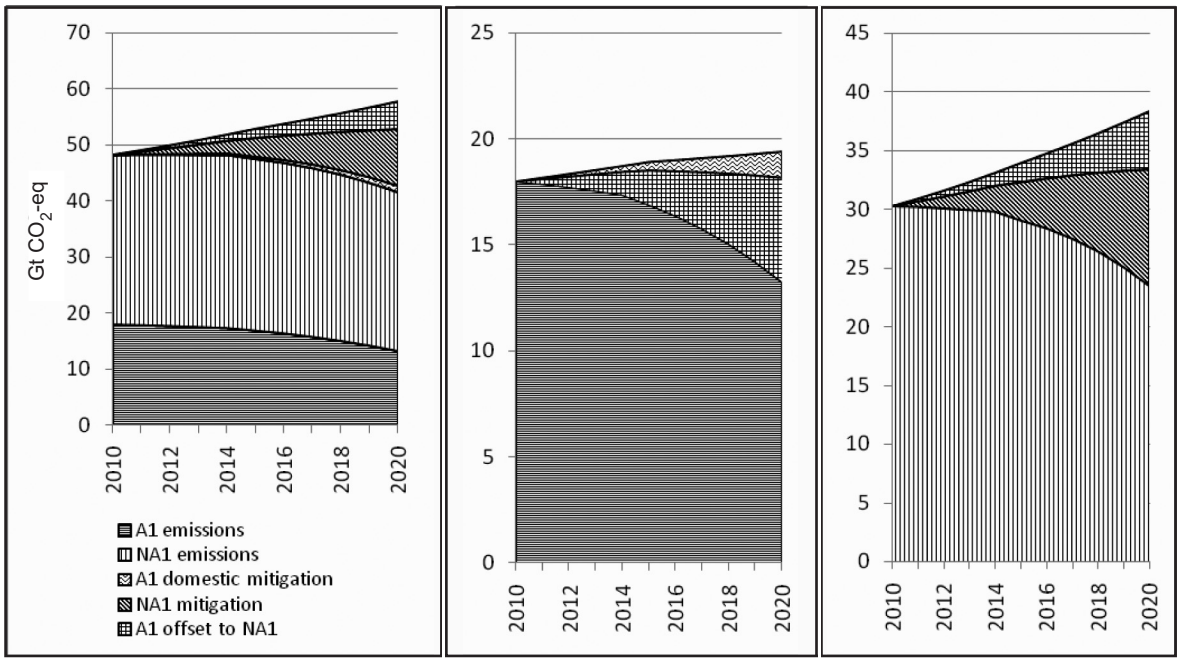

FIGURE 3 Annex I mitigation at the bottom of the range 25%, of which 20% can be offsets

The analysis in the present article makes clear that lower levels of ambition by Annex I simply imply that most of the overall mitigation effort physically takes place in developing countries, as assumed in allocation studies. Offsets essentially shift the *place* where mitigation takes place and *who pays*.

The overall effort, however, remains a zero-sum game for the atmosphere. We argue that, as a matter of equity, the remainder must be picked up by developed countries – whether through domestic emissions reductions or through international public funding for non-offsetting emissions reductions in developing countries. If that were the case, the conditions for a greater level of ambition in mitigation actions by developing countries would become much better.

6. Bottom-up definition of deviation below baseline

The question of interest in this framing becomes: If NAI countries were to achieve substantial deviations below baseline, and the lowest assessed stabilization levels are to be achieved to avoid worse impacts, then how much do AI countries have to reduce their emissions from 1990 levels?

Instead of attaching a top-down number to 'deviation below baseline' by developing countries, it would be more helpful to understand how much national actions, sets of actions or programmes can contribute to relative emissions reductions. Many developing countries appear to be saying that they will make a unilateral contribution through nationally appropriate mitigation actions, but could do more with international support. Some avoided emissions are built into implementation of existing policy – which is independent of multilateral negotiations – but further deviation below baseline can be achieved if developed countries deliver on the second part of paragraph 1b(ii) in the Bali Action Plan in a measurable, reportable and verifiable manner.

In June 2007, China published a National Climate Change Programme (NCCP), prepared under the auspices of the National Development and Reform Commission (NDRC, 2007). It outlined a target of reducing energy intensity by 20% as early as 2010. The goal of building a resource-conserving society was formalized further in the White Paper noting that 'carbon dioxide emissions will consequently be reduced' (China, 2008).

Brazil in its National Climate Change Action Plan specified an objective of 'reduction of 40% in the average deforestation rate by 2006–2009 period in relation to the average rate of the ten years reference period used in the Amazon Fund (1996–2005)' and another 30% reduction in 2014–2017 (Brazil, 2008: 14).

South Africa has also conducted its own long-term mitigation scenario study (LTMS) (SBT, 2007; Winkler, 2007) and has agreed to 'a strategic policy framework for our emissions to peak between 2020 and 2025, and then stabilize for a decade, before declining in absolute terms towards mid-century' (Motlanthe, 2009). Three strategic options were modelled. An option called 'Start Now' includes extensive energy efficiency measures, providing savings that could be invested into some positive cost options. This particular combination shows potential for '*relative* reduction in emissions, with an average of about 230 Mt CO_2-eq avoided each year' (SBT, 2007: 14). A package of modelled options called 'Scale Up' would increase the deviation below baseline by 520 Mt CO_2-eq by 2050. This option could be interpreted as using regulatory instruments to guide public investment. The third strategic option, 'Use the Market' achieves similar results through economic instruments, but pushes the potential relative reductions further, because the price signal is applied more widely than the mitigation potentials examined in Scale Up. International support would be needed to realize the potential for additional emissions avoided and for the extent of deviation to be known. This article assumes purely notional levels of deviation.

A first scenario assumes 10% deviation below baseline by developing countries, using their own resources (labelled DBB-10 in Table 2). The approach in this article is to use the average of the IPCC SRES (scenarios from the Special Report on Emission Scenarios). Another notional 10% is added in the second scenario, paid for with public funding from developed countries; that is, with the assumption that there is no transfer of carbon credits for this funding, but a contribution to incremental costs of mitigation in developing countries (DBB-20). The third scenario goes beyond deviation below baseline by adding carbon market offsets; that is, mitigation actions

TABLE 2 NAI deviations below baseline, and resulting Annex I emission reductions through domestic reductions or offsets

	DBB-10	DBB-20	DBB-20 plus C-10
Notional deviation below baseline in NAI countries, plus carbon market offsets			
% deviation below baseline, NAI with own resources	–10	–10	–10
% deviation below baseline in NAI with public funding by developed countries		–10	–10
% carbon market offset, in NAI but counting towards AI targets			–10
Resulting emission reductions and obligations for Annex I countries			
Remaining emission reductions in AI countries, % below 1990 levels	–69%	–52%	–35%
AI emissions obligation (own reductions plus offsets paid for in NAI), % below 1990 levels	–69%	–52%	–52%

physically taking place in developing countries, paid for by developed countries and counting towards Annex I commitments through offsetting mechanisms (DBB-20 plus C-10).

In an approach starting from NAI deviation below baseline, that choice of baseline matters. This is illustrated in Figure 4, replicating similar figures in den Elzen and Höhne (2008a). The shaded box indicates the IPCC ranges for Annex I reductions and the deviations suggested in the journal article.

If the world evolves in a more sustainable manner, as SRES B1 assumes, less mitigation would be required. In a more fossil-intensive world (SRES A1FI), greater effort is needed on all sides in terms of explicit climate policy.

To quantify the required emissions reductions (and obligations to purchase offsets) in Table 2, we assume a global emission increase by 10% above 1990 levels by 2020 (see, for example, Höhne et al., 2007); that is a relatively stringent point assuming that Annex I emissions peak well before this year and that emissions in developing countries continue to grow. It is a point that would still have some chance – with later reductions – to avoid the worst damages for developing countries. For NAI countries, we use an average of the full range of SRES baseline families (IPCC, 2000).

The results in Table 2 show that, if developing countries made a unilateral contribution to the atmosphere as in DBB-10, Annex I would need to do much more than the IPCC range, reducing emissions 69% below 1990 levels by 2020. Adding publicly funded mitigation (DBB-20), still leaves a large remainder and requires Annex I reductions of –52% from 1990 levels by 2020. Introducing an additional 10% through carbon markets in DBB-20 plus C-10 shows that domestic efforts of 35% emission reductions are required. However, the total emissions obligation by Annex I remains

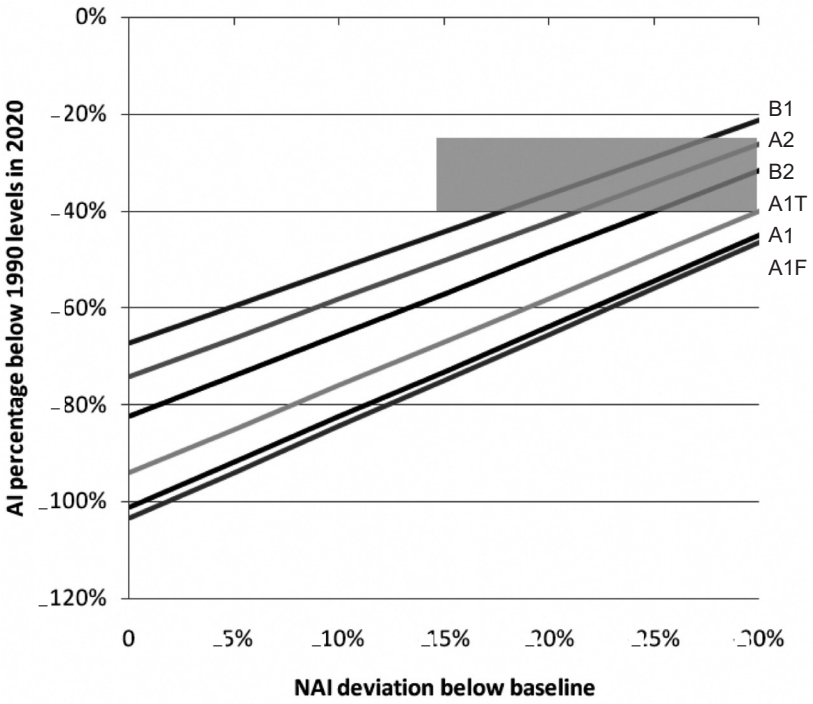

FIGURE 4 Variation in baselines and ranges

at 52% (own reductions plus mitigation paid for in developing countries to meet their reduction commitments).

Turning around the formula – if it were possible to fix NAI deviation politically – would require emissions reductions from AI countries above the IPCC ranges. For the three scenarios outlined here – 10% with own resources, 10% with international public funding, and 10% through carbon market offsets – the range for Annex I is –35% to almost –69% below 1990 by 2020. The pledges put forward by AI countries, e.g. –30% by the EU under certain conditions, 0% by the USA's return to 1990 levels, and Australia's –15% from 2005 levels, which is a 5% increase above 1990 levels) are well below the levels required in this formulation.

The exact numbers depend to a considerable degree on the choice of baseline, as shown in Figure 4. These also depend on the choice of the global emissions objective for 2020, as illustrated in Figure 5. The bottom solid line assumes a global emissions objective of +10% from 1990 levels by 2020, and the resulting absolute reductions for Annex I and reductions relative to baseline for NAI, using the average of the SRES scenarios in each case. The dotted line shows the same, for a global objective of +25%. This in itself is the median within a band from +15% to +30%, used in den Elzen and Höhne (2008a). These are objectives for single year, and assume an overshoot scenario; that is, that emissions would increase in the near term but would be reduced to correspondingly greater extent at a later stage.

This would beg the question of who takes on the greater reductions later, which is why the present article mostly reports results for +10%. For higher baselines and more stringent global emissions objectives in 2020, the line moves downwards, i.e. requires more effort. The implications for Annex I reductions below 1990 levels in 2020 and NAI deviation below baseline are reported in numerical terms in Table 3.

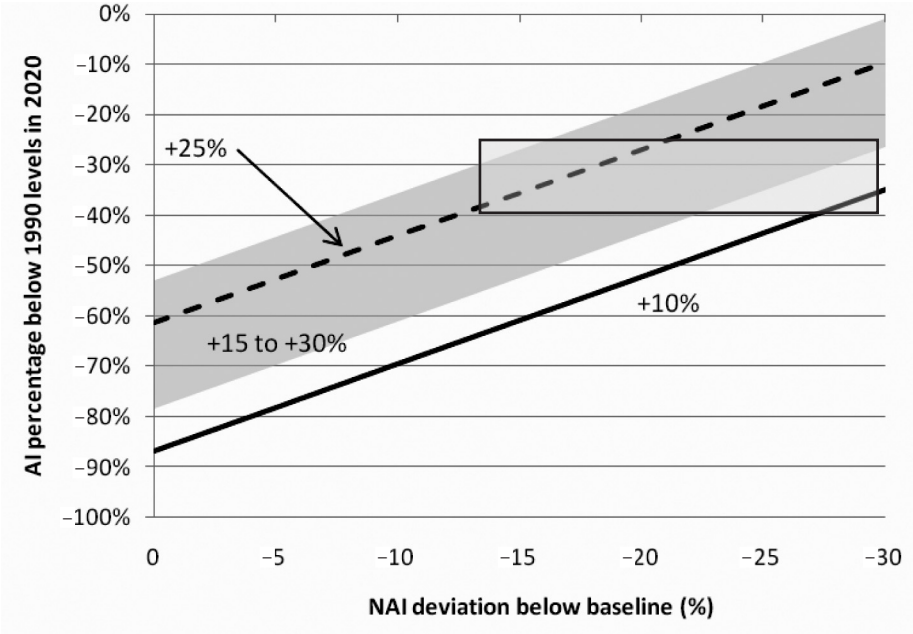

FIGURE 5 Variation in the global emissions objective for 2020

TABLE 3 Annex I emission reductions for different global emissions objectives in 2020 and levels of NAI deviations below baseline

Global emissions objective – increase on 1990 emissions in 2020		+10%	+15%	+25%	+30%
Remaining emission reductions in AI countries, % below 1990 levels	DBB-10	–69%	–61%	–44%	–36%
Remaining emission reductions in AI countries, % below 1990 levels	DBB-20	–52%	–44%	–27%	–18%
Remaining emission reductions in AI countries, % below 1990 levels	DBB-20 plus C-10	–35%	–26%	–9%	–1%
AI emissions obligation (own reductions plus offsets paid for in NAI), % below 1990 levels		–52%	–44%	–27%	–18%

To operationalize the approach of turning around the formula, it is even more important to recognize mitigation actions by developing countries and identify the support required.

7. MRV of deviation and support in a registry

What institutional mechanism might be created to recognize the action being taken by developing countries? Who measures, reports and verifies, how often, and where is it reported? South Africa has proposed a register of nationally appropriate mitigation actions by developing countries (RSA, 2008), including sustainable development policies and measures (SD-PAMs) (RSA, 2006; Winkler et al., 2002). Rather than defining a percentage in a top-down manner, it suggests that developing countries should be motivated by incentives to go beyond what they are already doing.

The proposal is that a register would be established, possibly in a chapter of another legal instrument under the UN Framework Convention, separate from the mitigation commitments by developed countries. Developing countries would voluntarily register NAMA (nationally appropriate mitigation actions). They would pledge to implement NAMAs in the context of sustainable development and linked to support by developed countries. Eligibility would be limited to developing countries. The register would not create any new categories of countries, but developing countries with different capabilities and national circumstances might decide to register different types of actions. The actions would need to be measurable, reportable and verifiable (MRV) in terms of arrangements negotiated to implement the Bali Action Plan paragraph 1b(ii).

If sufficient actions were registered and implemented, and supported with sufficient technology, funding and capacity-building from developed countries, the actions would contribute to a substantial deviation below BAU emission trajectories. The provision of the means of implementation would also have to be MRVed, in terms of different kinds of finance; technology development, commercialization and transfer; and the further development of institutional capacity. To match MRV support to the MRV actions, a linking mechanism has been proposed (RSA, 2008) to match actions with commensurate incentives.

Measurement will be important in all cases, which can build on existing methodological work on inventories but must also develop specific approaches (Winkler et al., 2008a; 2008b). Verification might best be achieved by national entities working to internationally agreed guidelines for voluntarily registered unilateral actions (those undertaken with developing countries' own resources), and independent third-party verification of multilaterally supported actions. Developing countries might self-select to voluntarily measure the deviation below baseline resulting from the

sum total of the unilateral and supported mitigation actions above, and report both the baseline and emission reductions in their national communications.

At least as important as establishing the deviation below baseline is making support measurable, reportable and verifiable.

8. MRV to ensure support

The gap between the investment and funding needed by developing countries and what is currently being provided under the Convention and its Protocol is large. The additional investment and financing flows needed to return global GHG emissions to current levels by 2030 has been estimated at between US$200–210 billion per year by 2030. Of this, 46% is expected to be spent in the developing countries. This is at least one order of magnitude greater than current flows (UNFCCC, 2007b).

Bridging the financial gap in a legally binding and measurable, reportable and verifiable manner will be a prerequisite for closing the mitigation gap, and to achieve a meaningful agreed outcome in Copenhagen. Various kinds of financial flows need to be considered to ensure adequate and predictable financial flows to developing countries, including private and public money, as well as the potential and limitations of carbon markets and offset mechanisms.

8.1. Carbon markets: tipping the balance

Carbon markets are seen by some observers as the primary source of finance for mitigation. There is good evidence that carbon markets can achieve the goal of reducing emissions more cost-effectively. But it also has its limitations, not least in terms of equity. The distributional implications of a global carbon market need careful consideration.

Developing countries incur additional mitigation costs with a carbon market – although revenues are projected to outweigh the costs. Recent analysis by the European Commission suggests that a 'perfect' carbon market actually increases costs in developing countries, while decreasing them in developed countries. More specifically, the net losses from carbon trade to developing countries are €23 billion, and the net gains to developed countries are €47 billion (in general, the calculations are for 2020) (CEC, 2009: 73–75).

For developing countries, the EU analysis finds that the increase in (gross) mitigation costs of €23 billion is outweighed by revenues of €38 billion, so that the net gains of carbon trade are €15 billion. The EU argues that this 'rent' should be used to fill the remaining gap, paying for a part of 'appropriate own action' in developing countries. But given total estimated mitigation costs of €48 billion in developing countries, €33 billion remains unfunded after this 'rent' is subtracted. This means that two-thirds is 'to be paid for by developing countries themselves or through other additional support mechanisms' (CEC, 2009: 76). All of this assumes that the market mechanisms do not default to the lowest possible price, but to a marginal abatement cost in a developing country region, i.e. a higher price but still lower than the cost of abatement in developed countries.

The converse is true for developed countries, whose mitigation costs are cut in half by the carbon market. Overall, '[d]eveloped countries benefit substantially from this trade with developing countries. Even though the acquisition of the credits costs them €38 billion, they reduce their mitigation costs by €85 billion from €166 billion in case of no trade at all … to €81 billion in case of trade. This represents a net gain of €47 billion' (CEC, 2009: 75).

This massive cost reduction for developed countries is then not counted as 'rent' in the EU's analysis, but is seen as a global benefit. Developing countries, of course, would benefit from

avoided damages resulting from climate change, but the same argument should be made for the mitigation carried out with carbon revenues in developing countries. What will be needed is a structured way of tipping the benefit of carbon trading to *developing countries*.

The most promising options that will enable us to start tipping the scale revolve around proposals for tapping net gains from developed country carbon markets as a source of multilateral climate funding. Two options, namely international auctioning of emission allowances (Norway, 2008) or an extension of the share of proceeds at issuance of assigned amount units to fund adaptation, hold much potential. Yet, they are still well short of the US$28–67 billion/year that has been estimated will be required for adaptation alone in developing countries by 2030 (UNFCCC, 2007b).

8.2. Binding public finance

Markets alone will not be adequate to fill the price gap between business-as-usual and low-carbon, climate-resilient development in developing countries. The role of public investment and finance will be critical. Climate change is a problem of sustained overuse of a public good, and the role of governments should remain primary. Certainly public money should leverage private finance and investment. Even in that respect, private money comes not only in the form of carbon markets, but also in the form of market-linked levies. In the end, the largest sums invested will be through non-carbon private investment, with foreign direct investment being smaller than domestic investment flows. The challenge is to change the patterns of financing and investment, addressing both climate action and equity.

Direct financial support by developed countries for mitigation actions in developing countries would take us out of a zero-sum world based on the purchasing of emissions allowances or other forms of carbon credit. Mechanisms are needed that add to the overall global effort, for example positive incentives for sustainable development policies and measures (SD-PAMs) and reducing emissions from deforestation and degradation in developing countries (REDD).

Both the funding and mitigation gaps can best be filled if Parties agree on quantified legally binding commitments by developed countries to support action by developing countries. These developed-country commitments to new and additional funding could best be expressed as a percentage of GDP, or as formula-based assessed contributions.

Binding would mean that the transfers of technology and finance must be not only measurable, reportable and verifiable in a multilaterally agreed system, but also that there should be consequences for non-compliance. One form of compliance could be the withholding of emission rights in future compliance periods. To achieve a binding and predictable outcome may require that the means of implementation to developing countries is provided for in another legal instrument under the UNFCCC. This will address the concern of developing countries that the 'soft law' of COP decisions on finance and technology has historically not delivered the flows at anywhere near the scale required.

9. Conclusion: turning around the formula

At the heart of the political agreement to be reached in Copenhagen will be mitigation and its funding. These will be central to an agreed outcome for a fair, effective, flexible and inclusive regime. On mitigation, a complex set of conditionalities will need to be navigated, informed by science and requiring political vision.

The IPCC ranges have laid the basis for broad agreement that developed countries need to reduce emissions in absolute terms, while emissions for developing regions would be relative

'deviations below baseline'. Deviation was not explicitly quantified in the IPCC report. The numbers of –25% to –40% from 1990 levels by 2020 for Annex I countries bear re-examination in terms of equity.

Implicit in these ranges is a formula that implies that non-Annex I countries would pick up the remainder, being the difference between a global emissions pathway that avoids the worst impacts and the quantified range for Annex I. This article critically examines this framing, the way in which the IPCC's assessment of allocation studies has been used in the politics of negotiations, and the numbers that have been put on 'deviation below baseline' by the EU and a journal article.

Using notional deviations below baseline, this article considered scenarios in which developing countries deviate 10% using their own resources, and another 10% with multilateral public funding. Annex I would have to reduce emissions by 69% and 52% from 1990 levels by 2020, respectively. Only if another 10% of deviation through offsets is considered is an AI reduction in the IPCC ranges adequate, and even then substantial payments through the carbon market will be required.

Under such scenarios, the IPCC ranges for Annex I may not be adequate. Politically turning around the implicit formula provides a better basis for an equitable burden-sharing paradigm that also addresses distributional issues, and we can then fully understand the real requirement for AI as a group's absolute reductions. If this appears politically unacceptable to AI, the zero-sum nature of mitigation burden-sharing between AI and NAI implies that NAI countries would have to pick up the remainder. That would be unacceptable and inequitable, as would be higher levels of impacts on developing countries, who are the most vulnerable. The mitigation gap is wide. Funding enhanced mitigation in developing countries from international sources seems to be the only hope for bridging that gap. This article explores an approach that starts from the 'deviation below baseline' that is possible given developing countries' national programmes and appropriate international support.

We conclude that an equitable approach to burden-sharing would have to consider higher ranges for developed countries and address the question of 'who pays?'. This article examines the potential for funding, both from the carbon market and binding public finance. The carbon market provides larger net gains for developed than developing countries. And as long as mechanisms are offsetting in nature, they do not add to the overall effort.

We argue that this implies that market-related finance is a critical source, drawing on the 'rent' gained by developed countries in more than halving their mitigation costs through a global carbon market. Given the nature of climate change mitigation as a public good, multilateral public funding for mitigation in developing countries will remain an essential component. Making support for mitigation in developing countries measurable, reportable and verifiable will be an essential part of any solution.

Notes

1. These authors were contributing and lead authors to IPCC AR4 chapter 13.
2. In the journal article, den Elzen and Höhne report an analysis that uses the formula turned around, although it is not reported as a formula but described in the text (den Elzen and Höhne, 2008a: 270, fig. 6).
3. Correspondence from the authors indicates that they regard their original phrasing of 'domestic' as being capable of misunderstanding (M. den Elzen and N. Höhne, 2009, personal communication). After allocations of physical reductions, Annex I countries could undertake reductions abroad in NAI countries, but this would be in addition to 15–30% in the NAI countries. Consistent with that reinterpretation of their article, we reflect our understanding in the following paragraph – it is helpful to consider where mitigation occurs, and a distinct second step of who pays.

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