The Bali roadmap and North-South cooperation: the right to development in a climate-constrained world

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1. Introduction

The COP-13 negotiation in Bali can be celebrated as a major step and a welcome success. It has delivered a Roadmap, guidelines for negotiating, a two year deadline for an agreement, and the earnest involvement of all Parties. This is indeed what many observers hoped for as the best possible outcome of the COP.

Yet, at the same time, we have to concede that the Bali consensus was portentously indistinct and rather fragile. It included no explicit guidance on a global emissions objective. It referred to "commitments" for industrialized countries only coupled with the compromising phrase "or actions," (although we can have faith that most Annex I countries interpret "commitments" in the sense of binding reduction requirements). And, on the critical matter of developing country actions, Bali was a vital step forward, but it moved the negotiations only as far as the edge of a veritable minefield, and it pointed only vaguely in the direction by which it must be crossed.

That minefield is the phrase "Nationally appropriate mitigation actions by developing country Parties in the context of sustainable development, supported and enabled by technology, financing and capacity-building, in a measurable, reportable and verifiable manner" [1(b)(ii), Decision 1/CP.13]. This dry clause embodies the very nexus of contention of the Bali talks. It is this clause that brought the negotiations to a tense overtime confrontation that ultimately saw the United States negotiators reverse an initial position that would have blocked a unanimous recognition of historical necessity[1].

The reason that "technology, financing and capacity building" are so critical and so contentious is that the control of emissions in the South is an undeniable scientific necessity, yet, at the same time, the South justifiably takes as its utmost priority its ongoing struggle against poverty. The South is thus understandably apprehensive of any climate agreement that would require reductions, without at the same time ensuring that those reductions will not impede its development. This tension – between the demands of our threatened climate and the development of the South – is at the very

[1] That is, a historical necessity that is already clearly embodied in the UNFCCC, most clearly in Art. 4.7.

center of the global climate negotiations predicament. The charged clause 1(b)(ii) of the Bali roadmap, in linking reductions in the South to support from the North, offers the only plausible resolution of this tension[2].

2. A thought experiment

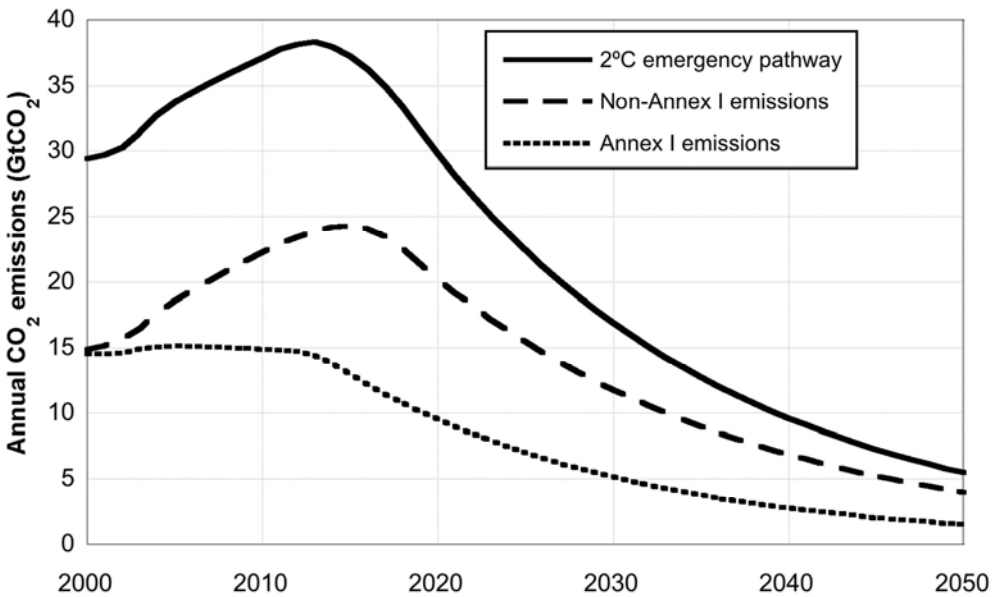
Figure 1 below illustrates the centrality of this tension to the climate problem. The figure conveys a simple "thought experiment" consisting of a bit of science, bit of conjecture, and a bit of arithmetic. The **solid line** in Figure 1 is the science; it shows a global emission trajectory which declines rapidly and deeply enough to preserve a reasonable likelihood of keeping global temperature rise within the widely endorsed 2ºC threshold for maximum tolerable warming (Meinshausen, 2006; Baer and Mastrandrea, 2006). It is labeled "Emergency pathway" because it requires extremely rigorous mitigation indeed, sufficient to force global emissions to peak before 2015 and to fall by at least 80% below 1990 levels by 2050[3]. Still, even this ambitious trajectory might not be enough. It subjects the earth to a worrisome 15-30% risk of exceeding the 2ºC threshold[4], which, in the language of the IPCC, means it is "likely", but not "very likely" to keep warming below 2ºC (IPCC WGI, 2007; Box TS.1, p. 23). Moreover, recent science suggests that stabilizing the climate and avoiding catastrophic climate disruption may require an even more stringent course, one sufficient to return emissions ultimately to zero (Matthews and Caldeira, 2008) and to stabilize atmospheric CO_2 concentrations no higher than 350 ppm (Hansen et al., 2008).

[2] This clause is further strengthened by clause 1(e)(i), which in the context of both mitigation and adaptation calls for "Improved access to adequate, predictable and sustainable financial resources and financial and technical support, and the provision of new and additional resources, including official and concessional funding for developing country Parties."

[3] This trajectory falls within the "Category I" range of scenarios considered by the IPCC. (IPCC, 2007a; Table 3.5, p. 198).

[4] In the language of the IPCC, it is "likely", but not "very likely" to keep warming below 2ºC. (IPCC WGI, 2007; Box TS.1, p. 23).

Figure 1. A thought experiment, showing the global emissions budget that entails a 15-30% risk of exceeding 2ºC (solid line, top), the Annex 1 trajectory assuming an aggressive reduction of 90% below 1990 levels by 2050 (dotted line, bottom), and the remaining carbon budget available to the non-Annex 1 (dashed line, middle).



The **dotted line** ("Annex 1") in Figure 1 reflects a simple conjecture. It shows the emission trajectory that would result if all Annex 1 countries quickly adopted an ambitious program that forced their emissions to drop to 90% below 1990 levels by 2050, by falling nearly 6% annually from 2015 onward. It would require intense and concerted effort, and is just barely within the bounds of what can be considered politically plausible today. Indeed, it exceeds the objectives of the even the strictest of the bills now in play in the US Congress (the House of Representative's *Safe Climate Act* and the Senate's *Global Warming Pollution Reduction Act*) and the various aspirational targets put forward by EU members states. As such, this line does not represent the maximum rate of emissions reductions that may be technically feasible; it is merely a reflection of what level of Annex I reductions can be considered politically plausible today, though just barely.

The **dashed line** ("Non-Annex 1") in Figure 1 is the arithmetic. It shows, simply by subtraction, what is left of the global budget (solid line) after Annex 1 has consumed its indicated proportion (dotted line). It is, in other words, the remaining space within which non-Annex I countries would be constrained to develop, and it is quite bracing. It peaks well before 2020, and is soon racing downward at nearly 6% annually. It is this Non-Annex 1 line that captures the truly daunting nature of the climate challenge. It is an ambitious trajectory in any event, but especially so in light of the fact that developing countries need to continue to expand energy services in order to meet basic development goals (World Bank, 2000; UNDP, 2002; UNDP; 2005). In the less than fifteen years between now and 2020, incomes in developing countries will hopefully grow substantially; but even assuming optimistic growth rates, incomes will still be only one third of *current* developed country levels on average. In other words, the developing world will still be struggling to eradicate endemic poverty, even while its emissions will need to be rapidly declining.[5]

This brings into stark focus the true nature of the climate challenge, and the source of the current negotiating predicament. *The climate crisis calls for a regime that can rapidly curb emissions globally, without impeding the prospects for developing countries to grow economically, to expand access to energy services, and to earnestly combat poverty.* In other words, what is needed is a climate regime that, by its very design, preserves a *right to development*. Unless a climate regime preserves a right to development, it can not engender the necessary scale of developing country engagement, and is therefore not politically or practically feasible.

One can delineate, in fairly straightforward terms, the three objectives that would need to be met for a regime to plausibly preserve a right to development. The first objective is of course mitigation that is sufficiently rapid and global to avoid dangerous climate change, which itself would seriously undermine development. The second objective is adaptation, at a depth and extent that will keep gains in development from being lost in the face of the climatic changes that are now unavoidable. And the third

[5] The flexibility in this trajectory is minimal, insofar as there is not much more environmental space that could possibly be made available for the South. The North could conceivably cut emissions by even more than 90% – perhaps 100% – and reduce emissions to zero by 2050, or even earlier, say 2025. But it would not increase the amount of available space very significantly. And, relaxing the "Emergency pathway" – taking yet greater risks of exceeding 2ºC – only makes a difference if it is relaxed so much as to give up on preserving a reasonable likelihood of keeping warming below 2ºC.

objective – equal in import to the first two – is to achieve the first two objectives in a manner that does not itself undermine the development aspirations of the poor.

In other words, this third objective demands that a climate regime that preserves a right to development must not impose costs on poor communities and nations nor constrain the expansion of energy services in any manner that would impede human development and poverty eradication. It is this sentiment, of course, that is the basis of the hard-won agreement in Bali that developing countries would undertake mitigation actions only "in the context of sustainable development", and "supported and enabled by technology, financing and capacity-building, in a measurable, reportable and verifiable manner".

Table 1. Estimates of total costs for mitigation and adaptation span a wide range, but tend to come out in the range of hundreds of billions to perhaps trillions of dollars annually. The following table below cites some such estimates.

Source	***Annual Cost (billions)***	***Notes***
Adaptation		
World Bank (2006)	*$9 - 41*	Costs to mainstream adaptation in development aid
Oxfam International (2007)	*> $50*	Costs of adaptation in developing countries in immediate term
UNFCCC Secretariat (2007a; 2007b)	*$49 - 171*	Costs of adaptation in 2030 (summarized in Table 65, p. 198)
UNDP (2007)	*$86*	Costs of adaptation in developing countries in 2015
Mitigation		
UNFCCC Secretariat (2007a;2007b)	*$380*	Costs in 2030 to return emissions to 2007 levels. (summarized in Table 64, p. 196)
IPCC AR4 (2007) (SPM Table 7)	*<3%*	Costs as percentage of Gross World Product in 2030 for stabilizing in 445 -535 ppm CO2eq range
Stern (2007)	*1% (±3%)*	Costs as percentage of Gross World Product through the 2050 for stabilization in the 500-550 ppm CO2eq range

3. Burden sharing: what's on the table?

One can then ask, what do the various climate regime proposals on the table imply with regard to ensuring that national mitigation actions in developing countries are "supported and enabled by technology, financing and capacity-building, in a measurable, reportable and verifiable manner" by developed countries? To what extent do the various proposals provide frameworks within which resources that are "adequate, predictable and sustainable" could flow?

The first observation to make is that few frameworks explicitly highlight and transparently quantify the issue of support from North to South. It is therefore not really possible to do a framework-by-framework comparison on consistent and comparable grounds, at least not without making numerous additional quantitative assumptions, and some such analyses have been attempted (Höhne, 2006, Höhne et al., 2007; den Elzen, 2002). In this section, we will simply provide a capsule review of several well-known frameworks with regard to the question of international support. In the succeeding section, we elaborate on one of these frameworks – the Greenhouse Development Rights framework – in further quantitative detail.

3.1. Emissions rights approaches

There are several approaches that are premised on allocating emission allowances based on the concept of equitable emission rights. Six of these that are broadly representative of the proposals on the table are: Equal Per Capita Emission Rights, Global Climate Certificate System, Contraction and Convergence, One Standard/Two Convergence, Common But Differentiated Convergence, and the Vattenfall proposal.

- *Equal Per Capita Emission Rights* is a straightforward approach premised on the equal rights to the atmospheric commons. All countries would be awarded emission allowances in proportion to their population, and would be free to trade them. The total number of allowances granted globally would steadily decrease along a path consistent with an agreed climate stabilization goal (Agarwal & Narain, 1995).

- *Global Climate Certificate System (GCCS)* is a variant of a per capita

approach, in which trades are price controlled, so as to artificially limit the total revenues passing from allowance purchasing countries to allowance selling countries (Wicke, 2005).

- *Contraction and Convergence (C&C)* is a hybrid framework combining grandfathered emission rights with per capita emission rights, with a gradual transition from the former to the latter over a specified number of decades. Countries whose emissions start above the global average would receive allowances that gradually trend down to the global average, while countries whose emissions start below the global average would receive allowances that gradually trend up to the global average (GCI, 2008).

- *One Standard, Two Convergence* is a proposal by Chen et al. (2005), further elaborated by Gao (2007) which is based on the principle that countries should have access to equal per capita cumulative emissions, in order to allow sufficient space for development. It extends the principle of equal per capita emission rights to historic emissions. The name of the proposal refers to the fact that when the standard of equal per capita cumulative emissions is consistently applied across countries, then developing countries' emissions will rise above the global average (and above the emissions of some developed countries) before converging downward. Chen proposed some further adjustments to account for geographic circumstances, national energy endowment, economic structure, and international trade.

- *Common But Differentiated Convergence (CDC)* is a variant of Contraction and Convergence, in which nations starting below the global per capita emission level are permitted to exceed the global average for a limited time. Also, the poorest developing countries are exempt from the emission allowances system (and thus have no excess allowances to sell) (Höhne et al., 2006). This proposal reproduces some features of One Standard, Two Convergence, without explicitly taking equal per capita cumulative emissions as its foundation.

- *Vattenfall's proposal* is an emission rights proposal premised not on per capita emission equality at all, but on per unit of GDP equality. Based on this foundational principle, three main modifications are then introduced. First, poorer countries below a specified threshold are

exempt from the emission allowances system. Second, poor countries above the threshold receive a modest "cross-subsidy" of allowances from wealthier countries to account for the general observation that poorer countries tend to have higher carbon intensity. And third, Annex 1 (but not non-Annex 1) countries have maximum and minimum required rates of emission decline (Vattenfall, 2006).

In all of these frameworks, the primary means through which the "measurable, reportable and verifiable" and "adequate, predictable and sustainable" support would flow is the mechanism of market-based allowance trading. Countries whose emissions exceeded their allowances would purchase allowances from countries whose allowances exceeded their emissions. One key question, then, is whether this *type* of support is adequate, or if further mechanisms would be needed to ensure that in addition to the availability of finances, there were also technical assistance and capacity building needed to bring about the transition to a low-carbon economy with the necessary adaptation implemented.

The second key question is whether the *scale* of support is adequate, i.e. whether the flow of allowance revenue would provide sufficient support to enable developing countries to undertake the necessary scale of mitigation (and adaptation!) without compromising their development efforts. Roughly speaking, the proposals can be ranked in terms of the scale of the allowance revenue flow (assuming the same global climate objectives): Equal Per Capita Cumulative Emission Rights (One Standard, Two Convergence) leads to the greatest flow of allowance revenue, then Equal Per Capita Emission Rights, then CDC, then C&C, and finally Vattenfall's proposal, with the ranking of GCCS among the others depending on details regarding the fixed trading price compares to the actual mitigation costs.

3.2. Multi-stage proposals

Multistage proposals categorize countries into different groupings, and assign them qualitatively different sorts of commitments. Generally, the richest and highest emitting countries (i.e., those with the greatest responsibility and capacity) are assigned the most stringent and legally binding commitments (such as emission reduction targets), while the poorest and lowest-emitting countries generally have no binding commitments.

- *Climate Action Network's "Viable Framework"* is a multistage proposal with three tracks, to which countries are assigned based on responsibility and capacity. The "Kyoto Track" has legally binding reduction commitments, the "Decarbonization Track" have various other forms of less rigorous commitments, and the "Adaptation Track" is for key vulnerable countries (such as LDCs) who would focus on adaptation. Convergence toward equal per capita emission is a stated objective. "Where technical or other assistance is required… this needs to be made available from the industrialized countries." (CAN, 2003).

- *South-North Proposal* is a multi-stage proposal with six stages, based roughly on responsibility and capacity, including OECD countries (with stringent binding targets and requirements to provide funding), economies in transition (with binding targets), newly industrialized countries (quantified targets and access to partial funding), rapidly industrializing countries (quantified targets contingent on funding), other developing countries (non-binding targets and partial funding), and LDCs (with nonbinding targets and full funding) (Ott et al., 2004).

Both of these multistage frameworks explicitly refer to the requirement that technical and financial resources would be made available from wealthier countries to enable developing countries in certain stages to meet their commitments. Whether these resources are sufficient, then, will depend on how the frameworks were actually operationalized, and in particular on the criteria upon which graduation from one stage to the next were based (which determines which countries are eligible to receive support), and the nature and scale of the support.

4. Greenhouse Development Rights

Here, we examine one specific framework – the Greenhouse Development Rights[6] approach – in detail. It has been elaborated at a sufficient degree of detail elsewhere (Baer et al, 2007) that it is able to provide some useful indicative results as to what the Bali Roadmap might imply with the words "measurable, reportable and verifiable" and "adequate, predictable and sustainable".

[6] See Baer et al. (2007) for a full explication of the GDR framework. SK, PB, and TA are its developers, and BK has provided valuable input.

4.1. A "development threshold"

The GDR framework, starts from a fundamentally different premise than the emission rights frameworks. It takes as its central principle the *right to development*, rather than a right to emissions. Emissions are taken as merely instrumental, as having importance only insofar as they contribute to development.[7] The right to development, on the other hand, is fundamental. It is, as Pan (2005) stressed, a right to a certain level of welfare beyond the mere satisfaction of basic needs, but well short of today's levels of 'affluent' consumption.

At this level of welfare, the GDRs framework defines a 'development threshold'. Individuals below this level are not expected to share the burden of mitigating the climate problem, as they have little responsibility for the climate problem and relatively little capacity to invest in solving it. Indeed, they have development as their rightful priority, and should not be saddled with the costs of keeping society as a whole within the starkly limited global carbon budget. Above the development threshold, on the other hand, individuals are expected to help shoulder the burden of solving the climate problem, including both the mitigation and adaptation costs. And, the further above the threshold, the larger their fair share of the burden.

The level at which such a development threshold would best be set is a matter for debate, but the key principle is clear: it should differentiate the global poor, who have pressing and legitimate unmet development needs, from the 'global consuming class,' which has reached a level of consumption that yields an appreciable contribution to the climate problem, and has similarly acquired enough capacity to help bear the costs of managing that problem.

Consistent with this principle, for the purposes of this indicative calculation, we set the development threshold at 125% of a global poverty line. This particular level is, of course, somewhat arbitrary, but its appropriateness is supported by the many other contexts in which a figure such as 125% of a poverty line is taken to define the upper boundary of 'exempt' or 'lifeline' income. These include starting points for income tax calculations, eligibility

[7] Another approach that takes a development rights perspective is the proposal of Pan Jiahua (2005). Several key features that Pan's proposal shares with the framework presented in this paper will be highlighted below.

thresholds for social services, and criteria for defining 'economically vulnerable' or 'near-poor' populations. Thus, while it might be an underestimate, it is a plausible basis for a development threshold, and a valid starting point for discussion.

As a global poverty line, one can discard the typical figures of $1 per day or $2 per day (World Bank, 1990) as being too low; many people with incomes much higher than $2 per day still face pervasive exposure to the plagues of poverty: malnutrition, high infant mortality, short life expectancy, low educational attainment, high relative food expenditures. A defensible global poverty line above which these plagues of poverty are greatly diminished can be investigated empirically. The evidence suggests that a global poverty line can reasonably be approximated by $16 per day (PPP adjusted), or, equivalently, $6,000 per person per year[8] (Pritchett, 2003; 2006). Taking this figure as a reasonable approximation of a global poverty line, we then have (multiplying by 125%) an indicative development threshold of $20 per person per day, or $7,500 per person per year (PPP).

4.2. Burden-sharing

Having defined a development threshold, we can next define a consistent burden-sharing system, and use it to make an indicative calculation of national obligations under a climate regime. This allows one to examine in an explicit and quantitative manner the question of the international support raised by the aforementioned clauses 1(b)ii and 1(e)i in the Bali roadmap.

The GDR framework is based on the same two principles that underlie the UNFCCC: capacity and responsibility. The idea that burden sharing should be based on a systematic treatment of responsibility and capacity is reflected in most if not all contemporary burden-sharing proposals.

[8] Pritchett concludes that the use of this line 'is justifiable, more consistent with international fairness, and is a better foundation for the World Bank's organizational mission of poverty reduction' and that 'If the poverty line were defined as the level of income at which people typically achieve acceptable levels of the Millennium Development Goal indicators (such as universal primary school completion), it would be set at about [$16] a day'. Note, these figures are on a purchasing power parity (PPP) adjusted basis, and therefore convert to a lower income level in a local developing country currency than if converted at market exchange rates. Different development thresholds are explored via a sensitivity analysis in Baer et al. (2007).

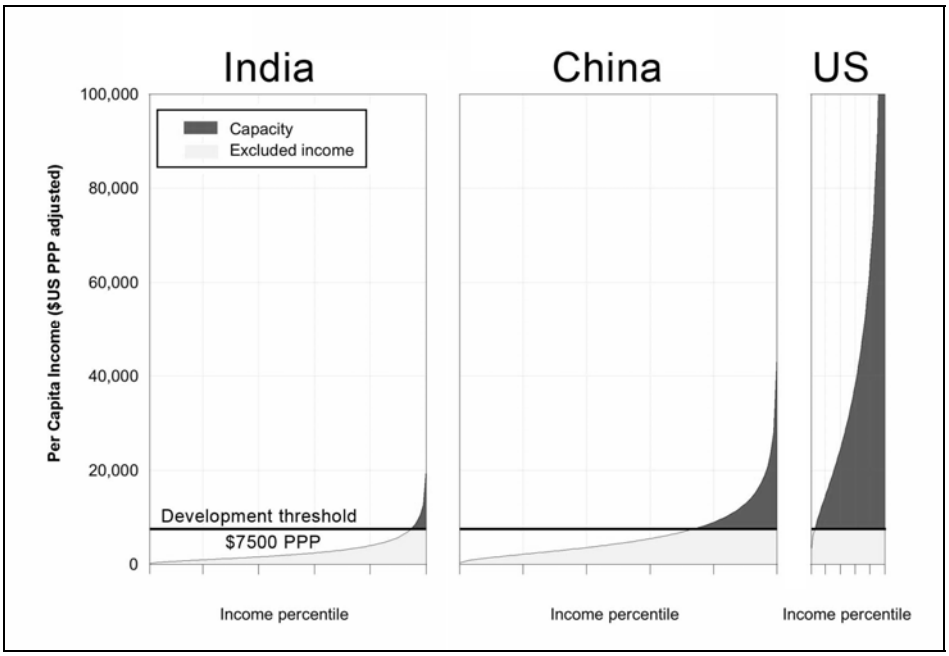
Capacity in this context means having the financial resources to deal with the climate problem without sacrificing necessities. We calculate it as the aggregate sum of individual income in excess of the development threshold, summed across all the individuals in a country. Figure 2 illustrates this calculation for three countries: India, China, and the United States. It shows the income distribution for each country, estimated on the basis of national per capita income and Gini coefficient (a measure of national income inequality)[9]. These charts array each person along the X-axis from poorest (on the left) to wealthiest (on the right), and plots their (PPP adjusted) income. The development threshold at $7,500 is shown, cutting through each country's income distribution curve and thus dividing total national income into a fraction (light shade) below the development threshold, and a fraction (dark shade) that the wealthier portion of the population earns in excess of the development threshold. The dark area thus graphically reflects our estimate of each country's capacity. As it turns out, nearly 7% of India's population earns more than $7,500. These are the members of that burgeoning "Indian middle class" that has so captured the attention of the media. In terms of shear numbers, they comprise a large and growing consuming class, one that is roughly the size of the population of the consuming class in, say, the United Kingdom or France[10]. But this is there where the similarity ends. For these Indian consumers have a much lower aggregate income, and the amount of India's income in excess of the $7,500 development threshold is less than one-sixth as large.

Similar observations can be made about the approximately 27% of China's population that comprises its consuming class and is comparable in size to the US population, nearly all of which is above the development threshold. However, China's income above the development threshold is less than one-sixth as much as the US's.

[9] We approximate the national income distributions as lognormal distribution using two country-specific parameters: the mean per capita income and the Gini coefficient. To provide results that are more relevant to a burden-sharing arrangement agreed in the near future, we based our calculations on incomes, populations, etc. that are the projected values in 2010. The charts have been scaled so that the length of the x-axis is proportional to population, and thus the areas of the different sections – e.g., the dark portion representing capacity – can be directly compared in absolute terms. For a full explanation, see the technical appendix in Baer, Kartha, Athanasiou (2007), although note that the calculations here have been updated using World Bank PPP income data released in 2008.

[10] This estimate is consistent those produced by other analyses, e.g., NCAER (2005) and McKinsey (2007).

Figure 2. Capacity. The curves are income distributions for India, China, and the United States, with the dark area representing income above the $7,500 (PPP) development threshold, or national "capacity".



Responsibility, of course, is the central concept behind the 'polluter pays principle', and is interpreted in terms of the greenhouse gases that nations have cumulatively contributed to the atmosphere. We define and calculate responsibility in a manner precisely analogous to capacity, i.e. with respect to the development threshold. Specifically, we calculate a country's responsibility as cumulative emissions *excluding* emissions corresponding to consumption below the development threshold. This definition is a recognition of the distinction between emissions arising from meeting basic needs, and emissions corresponding to discretionary consumption, and reflects the premise that these different types of emissions are of fundamentally different natures: in essence, basic emissions do not imply responsibility, whereas discretionary consumption does. Again, the intent is to preserve a right to development in the sense of allowing people to strive toward the development threshold unencumbered by the need to meet emissions constraints. (Note, there are indeed emissions constraints, and these must be met, but not at the expense of those below the development

threshold.)

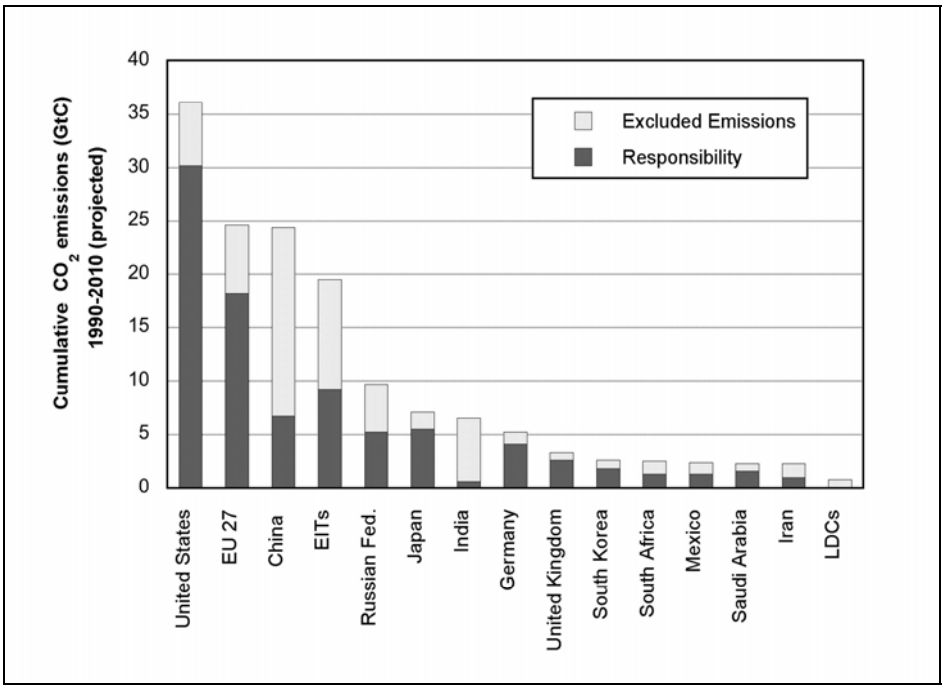
A detailed calculation of emissions by income class for each country is beyond the scope of our analysis, although it is possible and such analyses have indeed been done for some countries (See, for example, Metcalf (2007) for the U.S., Brenner et al. (2007) for China, and Ananthapadmanabhan et al. (2007) for India). We make the simplifying assumption that (within any given country) emissions are proportional to consumption, which is in turn proportional to income.[11] One can then straightforwardly generate national responsibility graph analogous to the Figure 2 graphs of national capacity. To show more countries, however, we present in Figure 3 a condensed graph that shows several nations and regions, with the total height of each bar reflecting the cumulative emissions since 1990. The light portion shows the emissions corresponding to consumption below the development threshold, and the dark portion the aggregate responsibility. (These are analogous to the light and dark portions of the graphs in Figure 2, except that they are not presented as a full distribution across the national populations.) Although our indicative calculation of responsibility takes 1990 as the start year, one can certainly argue that an earlier start year would be more appropriate. All else equal, it would increase the relative responsibility of the Annex 1 nations, which began the process of industrialization much earlier, compared to non-Annex 1 nations.

Capacity and responsibility can now be combined in a straightforward way to yield a combined indicator that can be used as the basis of a burden-sharing allocation. We refer to this as a "Responsibility-Capacity Indicator" or RCI,[12] and amounts in essence to a progressive income/emissions tax. (Pan suggests a structurally similar approach, based on a "basic needs threshold" and a progressive emissions tax above the threshold. Not coincidentally, his detailed bottom-up calculation for a basic needs threshold for China comes out very similar to the emissions level implied by our development threshold.)

[11] See the technical appendix of Baer, Kartha & Athanasiou (2007) for further discussion.

[12] The RCI is constructed in a simple and generic manner that allows responsibility and capacity to be weighted differently: $RCI = R^{a} \bullet C^{b}$. The exponents *a* and *b* sum to 1, so that, as the paired weights go from *a=1* and *b=0* at one extreme to *a=0* and *b=1* at the other, the *RCI* goes from being exactly equal to responsibility (*R*) to being exactly equal to capacity (*C*). In our reference calculations we set a = 0.4 and b = 0.6, which is to say that we weigh capacity somewhat higher than responsibility. Again, this choice is subject to discussion. A different weighting, will not change the results dramatically.

Figure 3. Responsibility. The total height of each bar gives the cumulative emissions since 1990, the light portion is the emissions corresponding to consumption below the development threshold, and the dark portion is emissions corresponding to consumption above the development threshold, or national "responsibility".



It is worth stressing here that this burden-sharing framework allocates obligations at the national level, but that it derives these from information at the intra-national level regarding the distribution of wealth and emissions. As emphasized by Pan (2005), this need to look at intra-national disparities is a logical consequence of the premise that a viable climate regime must preserve a right to development, which is itself a right that adheres to individuals, not to countries.

5. Results

The results are not altogether surprising, as shown in Table 2 for a representative set of countries and regions. The US has slightly less than

one-third (31.8%) of the total global obligation (see rightmost column labeled "Obligation"), and the EU-27 has a bit less than one-quarter (24.8%). China, despite being relatively poor, is large enough to have a rather significant 6.6% share, which puts it not far behind Japan with its 7.4%. India is also large but even poorer, placing it far behind with a 0.8% share. The 500 million citizens of the Least Developed Countries (LDCs) have less than 0.1%.

Table 2. Global percentage shares of population, income, capacity, cumulative emissions, responsibility, and obligation (RCI) for selected countries and groups of countries.

	Percentage share of Global Total					
	population	**income**	**Capacity**	**Cumulative emissions (1990-2010)**	**Responsibility**	**Obligation (RCI)**
United States	4.6	20.7	**29.7**	23.3	**33.9**	**31.8**
EU (27)	7.2	21.6	**27.9**	15.9	**20.5**	**24.8**
United Kingdom	0.9	3.1	**4.2**	2.1	**2.9**	**3.7**
Germany	1.2	4.1	**5.6**	3.4	**4.6**	**5.2**
Sweden	0.1	0.5	**0.7**	0.3	**0.3**	**0.5**
Japan	1.9	6.1	**8.1**	4.6	**6.2**	**7.4**
Russia	2.0	3.2	**2.9**	6.3	**5.9**	**3.9**
Brazil	2.9	2.8	**2.3**	1.4	**1.2**	**1.8**
China	19.7	12.5	**5.9**	15.7	**7.5**	**6.6**
India	17.2	5.2	**0.8**	4.2	**0.7**	**0.8**
South Africa	0.7	0.7	**0.6**	1.6	**1.4**	**0.9**
LDCs	12.5	1.5	**0.1**	0.6	**0.0**	**0.1**
Annex 1	18.8	57.2	**75.1**	56.5	**73.4**	**74.6**
Non-Annex 1	81.2	42.8	**24.9**	43.5	**26.7**	**25.4**
All high income	15.1	55.2	**75.6**	50.9	**71.4**	**74.3**
All middle Income	46.7	36.4	**23.4**	42.2	**27.8**	**24.8**
All low Income	38.2	8.5	**1.0**	6.9	**0.9**	**0.9**
World	100	100	**100%**	100	**100%**	**100%**

While we have made various specific assumption in generating this indicative quantification (e.g., setting the development threshold at $7,500 (PPP), and choosing 1990 as the starting year for calculating responsibility) we argue that any system that quantifies responsibility and capacity in a

manner that is premised on the need to preserve a right to development, will not yield dramatically differing results.[13]

These results help illuminate what might be implied by the phrases "measurable, reportable and verifiable" and "adequate, predictable and sustainable" international support. Consider, for example, an international climate fund that resembles in nature a greatly expanded version of the Multinational Climate Change Fund proposed by Mexico at the Bangkok UNFCCC meeting in April 2008. A reasonable benchmark for each Party's contribution as a percentage of the total required funding would be its share of the global RCI obligation (rightmost column in Table 2). For instance, if the annual funding requirement amounted to one trillion dollars (about 1.5% of Gross World Product, which is well within the range of published estimates of the cost of a global climate transition; see Table 1), the US, with its 31.8% of the global RCI, would be obligated to pay $318 billion. Similarly, the EU's share would be $248 billion (24.8% of the global RCI). China's share would be $66 billion (6.6%), India's share would be $8 billion (0.8%), and so on. The RCI, in effect, serves as the basis of a progressive global "climate tax" – not a carbon tax, per se, but a responsibility and capacity tax.

These calculations of national obligation explicitly account for the wealth and poverty in each country. They reflect presence in each country (each Annex-I country, China, even the LDCs) of a sub-population that is part of the global consuming class and that rightfully has obligations under an international climate regime. They also reflect the presence in each country of individuals (for many developing countries they comprise the majority) who have not yet attained a decent standard of living, and who thus contribute nothing to their country's obligations.

6. Implications

A second way of looking at national obligations, which has up to now been at the center of the UNFCCC process, expresses them in terms of national emission reduction commitments and Kyoto-style targets. This is done by considering the total volume of mitigation required globally, and allocating it to countries in accordance with their share of the global obligation (as

[13] See Baer, Kartha & Athanasiou (2007) for sensitivity analyses.

shown in Table 2). The global mitigation requirement is defined as the volume of emission reductions needed to fully shift from a business-as-usual scenario, for which we take the recent *World Energy Outlook 2007* global energy scenario (IEA, 2007), to the 2ºC Emergency mitigation pathway presented in Figure 1. We show this graphically in Figure 4, where the topmost line (the one rising above 50 $GtCO_{2\text{-}eq}$ per year in 2020) is the WEO business-as-usual emission trajectory, the bottommost line is the same 2ºC pathway presented in Figure 1.

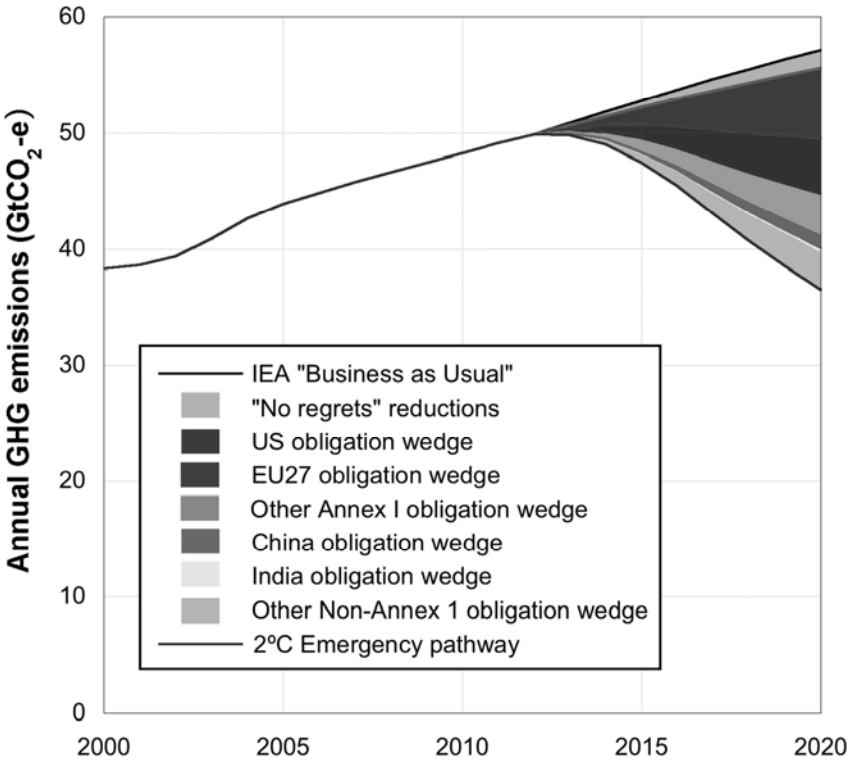
We first note the thin topmost wedge, labeled 'No-Regrets', which is an estimate of the negative- and zero-cost emissions reductions available globally[14]. Thus wedge, in other words, represents free and profitable reductions – such as cost-effective energy efficiency – which are large, though not by any means large enough to bring emissions all the way down to the 2ºC path. From the perspective of a global burden-sharing framework, these reductions should be treated differently from positive-cost options. Because countries can in principal exploit these opportunities to their benefit, one might argue that all nations should be responsible for capturing their own no-regrets reductions, and that only further reductions – those that actually have positive costs – should be considered part of the global mitigation requirement to be allocated among nations within the broader burden-sharing framework.

However, in practice, one cannot ignore the barriers preventing countries from achieving all their no-regrets reductions. These barriers are broad and high, and encompass structural, institutional, technological – and even financial – obstacles to otherwise cost-effective options. And while some no-regrets options might face barriers that can be overcome domestically, for example through institutional changes and policy reform, others face barriers that might well be insurmountable without external assistance such as concessionary financing and technological cooperation. Recognizing these two fundamentally different cases, the GDRs framework obliges developing countries to only achieve the more accessible fraction of their no-regrets options, and folds the remainder into the global burden-sharing arrangement. The precise fraction of any country's no-regrets opportunities that might plausibly be achieved through domestic efforts will have to be determined on a country-by-country basis, in a manner that reflects differing national circumstances. For the purposes of our indicative analysis,

[14] This is estimated from the global abatement cost curves compiled by McKinsey and Company (2007).

we crudely estimate that the more accessible no-regrets opportunities amount to 50% of the total for non-Annex 1 countries. These are included in their national reference trajectories, and the remainder are added to the global mitigation requirement. (For Annex 1 countries, 100% of the estimated no-regrets opportunities are included in the national reference trajectories.) This apportioning of the no-regrets opportunities is reflected in Figure 4.

Figure 4. Global mitigation requirement, divided into 'reduction obligation' wedges that reflect national / regional shares of RCI.



The global mitigation gap is allocated to nations according to their proportion of global obligation[15] (as shown in Table 2). Accordingly, the

[15] It is worth noting that this general approach is not novel. It is a direct descendent of the so-called "Brazilian Proposal," although in that case national percentage shares of a global mitigation objective

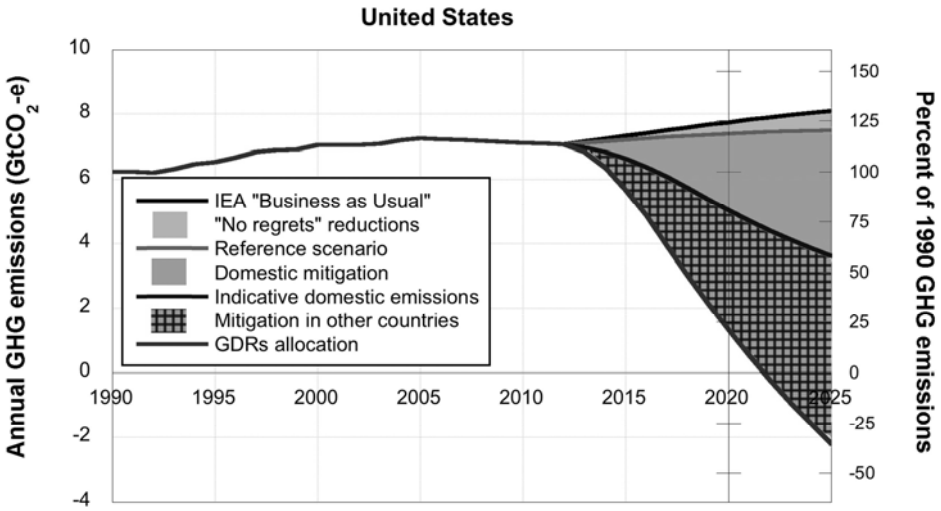
US' reduction obligation amounts to approximately 32% of the mitigation gap (the larger dark wedge); the EU's is 25% (the slightly smaller dark wedge); China just under 7% (the thin dark wedge); and India less than 1% (thin light line, barely visible).

The implications of this burden-sharing allocation are best revealed by "zooming in" on individual countries. Doing this, it becomes evident that, using the quite reasonable assumptions modeled in this study, wealthy and high emitting countries will very quickly come to have emissions reductions obligations that are larger than their projected domestic emissions. We demonstrate this with the case of the US.

Figure 5 shows the US business-as-usual path, along with three wedges of reductions. The first is the light grey wedge, which corresponds to the no-regrets reduction opportunities available in the US, which it is required to aggressively exploit. The other two wedges (the solid and hatched) together comprise the US' reduction obligation (the dark grey wedge shown in Figure 4 that is equal to 32% of the global mitigation gap). The US' reduction obligation is divided into these two wedges to represent the fact that the US would choose to discharge some of its mitigation obligation through reductions *domestically*, and others would be undertaken *internationally*. The GDRs framework makes no intrinsic assumptions about the relative proportion of *domestic reductions* and *international reductions* that a country will choose in seeking to fulfill its mitigation obligations. With international purchases managed via a global cap and allocate system, say, a country would, at least in theory, be free to make any portion of its reductions domestically, and the remainder internationally, based on any nationally salient economic or political considerations. What is clear and striking is that even assuming very ambitious domestic reductions (about 6% annually, corresponding to a path heading toward 90% reductions by 2050, as shown by the "Annex 1" line in Figure 1), there is a need for substantial international emissions reductions concurrently.

were to be divided among the Annex I countries alone, in proportion to their contribution to global temperature increase. That proposal would have produced a graph analogous in form to Figure 4.

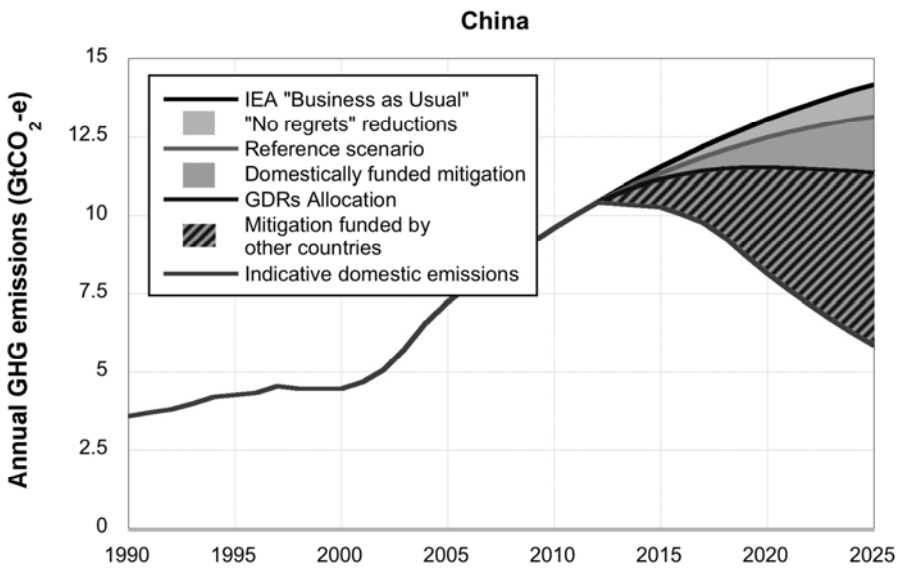
Figure 5. US allocation, showing no-regrets reductions (light grey, at top), domestically discharged reduction obligation (solid grey, in middle), and internationally discharged reduction obligation (hatched, at bottom).



The developing country complement to the situations illustrated in Figure 5 is well illustrated by the case of China, shown in Figure 6. Again, the top path corresponds to China's business-as-usual path, and the light grey wedge to a portion of its no-regrets opportunities. The solid wedge corresponds to China's reduction obligation, (about 7% of the global mitigation requirement). The large striped wedge shows a large additional set of emissions reductions made within China, but financed by countries (such as the US) seeking to discharge their own reduction obligations. The striped wedge is, in essence, the converse of the hatched wedge shown in Figure 5.

These reductions are a natural and expected outcome of the GDRs framework, and a necessary feature of any climate regime that can possibly solve the climate problem. China's emissions are large, and fully exploiting its mitigation potential is essential if we're to keep within the emergency 2ºC trajectory. Recalling Figure 1, we reiterate that aggressive mitigation in the South is a scientific necessity, but will only occur if it doesn't conflict with the South's urgent development needs.

Figure 6. China allocation, showing no-regrets reductions (light grey), reduction obligation (solid grey, in middle), and further reductions supported and enabled by countries whose reduction obligations exceed their domestic mitigation potential (striped, at bottom).



7. Institutions and mechanisms

Though we have illustrated above the implications of a GDRs allocation operationalized as a trading system, this is just a simplified example. In reality, much remains to be determined about how countries would actually pay their bills, or how their payments would be productively directed toward their objectives. Adaptation presents even greater challenges in this regards than mitigation.

The only thing that can be said for sure is that the scale and nature of the required financial assistance and technological cooperation is unprecedented, and that it will call for the expansion of existing institutions and mechanisms, as well as the creation of new ones that have not yet even been envisioned. Some of the adaptation funding could presumably be linked to conventional ODA, though not all of it. And some of the mitigation funding could presumably flow through market-based

mechanisms like today's carbon trading systems, though not all of it. Any number of schemes might be called upon: progressive carbon and income taxes, trade-related levies, sectoral agreements, IPR concessions and so on. Beyond these, new as-yet unnamed channels for both international resource transfer and accounting would need to be conceived and implemented, inevitably posing an impressive set of challenges: How to scale-up? How to build absorptive capacity? How to ensure efficiency and avoid waste? How to institute credible governance?

These questions and others will be hotly debated, and this analysis provides no answers. Suffice it to say that the problems here are inadequately understood and extremely daunting, but that they are not faced by the GDRs approach alone. In fact, they are shared by any climate regime that purports to actually do something meaningful about mitigation and adaptation. In any case, the intention of this analysis is simply to draw attention to the enormity of the international cooperation that the climate problem demands, and to the magnitude of the financial assistance and technological cooperation that it implies for each country. By so doing, our hope is that a new discussion about international mechanisms can begin, one that is in line with the scale of the actual challenge.

8. Final Comments

The scientific evidence is bracing and demands a break with "politics as usual". The rapid rate at which reductions are needed globally means that carbon-based growth is no longer an option, neither in the North nor in the South, and our response to the climate crisis must recognize that and make the alternative a reality.

A major commitment to large North-to-South assistance – financial and technological – is an inevitable part of that reality, as was agreed in Bali and codified in para 1 (b) ii of Decision 1/CP.13. Domestic reductions by the developed world, in other words, fulfill only part of its obligation. To be sure, the environmental community – and increasingly other stakeholders such as the private sector, civil society, and forward thinking politicians – have done a spectacular job of putting the need for real *domestic* emission reductions onto the political agenda. But there's been precious little attention given to the underlying structure of the global climate-

development problem, and to the consequent *international* responsibility of the industrialized countries to enable a rapid transition to a low-carbon world.

This will require a fundamental rethinking of many issues, be they political, social, or economic. However, societies both in the North and in the South have grown accustomed to rather rapid and radical structural change in the past, and will certainly be able to do so also in the future. This is all the more important, since national societal enabling conditions are required to formulate negotiation instructions that will lead to robust and implementable international agreements

For political reasons, if not alone for ethical reasons, a commitment from the wealthy of the South is also necessary. It is unlikely that the working consensus to pay a large proportion of the total mitigation and adaptation costs could ever emerge in the North if "wealthy" minority among the Indian and Chinese populous were not also paying their "fair shares."

One can certain ask whether such a framework, which makes the daunting climate challenge even more overwhelming by conflating it with developmental equity, is at all politically realistic? Well, as has been said by many others, the outer bound of what is politically realistic today is far shy of the inner bound of what is scientifically necessary. Political realism is rather labile, and it is much more likely that political realism will redefine itself (as climate impacts become more acutely felt) than that the science will fundamentally change. It is obvious that without an unprecedented level of global cooperation, an emergency program simply can't be implemented. The alternative to a solution along these lines is probably a weak regime with little chance of preventing catastrophic climate change.

This will require a fundamental rethinking of many issues, be they political, social, or economic. However, as Einstein said, "The significant problems we face cannot be solved at the same level of thinking we were at when we created them." Indeed, societies both in the North and in the South have undergone many times rather rapid and radical changes, and will certainly be able to do so also in the future. Indeed, the negotiators who we are tasking with the design of a viable and effective climate regime can only reasonably be expected to succeed if the necessary societal enabling conditions have been put in place (Kjellén, 2008).

Since efforts will be demanded by all of us, fairness, equity and justice, real and perceived, are essential prerequisites for success. But the core of the issue is about politics. As nicely as a right to development may accord with one's innate sense of justice, this is really a matter of hard-nosed politics. Climate change is a problem ...perhaps humankind's first problem of this kind, where poor and wealthy begin to understand that we all share a small planet and that we are all interdependent. It also gives a new dimension to the word solidarity: the survival of the wealthy depends on their solidarity with the poor. And intra-generational equity is a necessity for the inter-generational equity we are striving for. We are all responsible, but the responsibility is indeed differentiated. The climate regime ultimately has to ensure the rights of the billions of people far away from the conference halls: the unseen poor of the planet to-day, and the unborn, future generations. Therefore, in order to ensure our common survival through success in extremely difficult negotiations, the North will have to engage with the South in a way that recognizes and honors its entirely legitimate development needs on this shared, finite planet.

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