WORKING DRAFT

The CLEAR Path:

REWARDING EARLY ACTIONS BY EMERGING ECONOMIES TO LIMIT CARBON

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finding the ways that work

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Executive Summary

The world's collective effort to curb climate change will rely heavily upon the global marketplace — the only force large and strong enough to drive the needed innovation and carry through the necessary reductions in greenhouse gases (GHG). This effort will require serious emissions cuts by industrialized countries and early emissions reductions by many others — including, most importantly, the two dozen or so largest, fastest-growing and most influential emerging economies.

The 2007 Bali Climate Declaration by Scientists stated that the prime goal of any new climate treaty must be "to limit global warming to no more than 2°C above the preindustrial temperature." In order to accomplish this goal, global GHG emissions would need to peak and decline within the next 10 to 15 years and be reduced at least 50% below their current levels by the year 2050.

The stark reality is that, even if emissions from industrialized countries and deforestation were reduced to *zero* by 2050, the climate goal cannot be met unless emerging economies also reduce their emissions. Reductions by industrialized countries and emerging economies are essential if the world is to have a serious chance of preventing a global temperature increase of more than 2°C and the concomitant impacts of climate change.

To ensure that all countries can contribute to the reduction of GHG in ways suitable to their unique natural, economic and human resources based on the principle of "common but differentiated responsibilities", nations will need to forge new mechanisms to help emerging economies participate in carbon trading markets without stifling growth or innovation. This paper sets forth the conceptual structure and dynamics of a powerful mechanism that would accomplish this goal, which we call **CLEAR: Carbon Limits + Early Actions = Rewards**.

Through the adoption of Clean Investment Budgets (CIBs), which provide a measurable, reportable and verifiable mechanism that rewards any developing country making a firm commitment to reduce emissions early, the CLEAR path can help emerging economies fund the technology transfer they need to transition to low- and even zero-carbon economies.

The CLEAR path invites emerging economies to participate in the carbon market by providing them with opportunities to limit their carbon emissions early and to apply the benefits of carbon trading on a scale far greater than a project-by-project basis. The revenues earned from CIBs would be available for financing the rapid transition to a low-carbon economy, freeing national resources for other development needs. CLEAR draws on the power of the fast-growing carbon market, rather than relying on official development assistance, while enhancing the integrity of the core carbon market.

How CLEAR Works

CLEAR invites nations that do not yet have emissions reductions obligations to adopt a multi-year absolute emissions limit — economy-wide or for multiple sectors that together comprise a significant portion of national emissions; this limit would initially be set at a level ***higher*** than that country's current emissions levels. The resulting surplus allowances — equal to the difference between (on the higher end) the allocated allowances and (on the lower end) the country's actual emissions — would serve as a pool of development capital that can be leveraged to finance low-carbon development, and that can generate revenues for financing even more low-carbon development. Nations that adopt CIBs early could also bank or save a portion of their allowances for future use.

Participation by emerging economies would encourage domestic sectors to reduce carbon emissions early, and provide these nations with durable financing for sustainable development during subsequent phases of carbon emissions reduction and trading. With the total pool of carbon allowances set at a level within the constraints implied by a maximum global 2˚C increase and divided into CIBs for emerging economies, CLEAR could, over a ten-year period beginning in 2013, generate on the order of $200 billion for investment in emerging economies' transition to a low-carbon development path. While these estimates are contingent upon a number of factors (including the success of industrialized countries in reducing their emissions), they are at least one order of magnitude larger than existing flows and rank among the highest proposed new funding mechanisms for GHG emissions mitigation in emerging economies. Moreover, with the right set of institutions and market structure, the funds can be leveraged to yield a multiple of these figures, for example by using CIBs for loan guarantees and other flexible financing mechanisms instead of direct carbon grants.

CLEAR also envisions participation by emerging economies that may not be ready to commit to a full emissions limit now but wish to embark on a path toward full participation in the global carbon market. On the CLEAR path, such nations would be able to engage in trading under certain conditions, thereby expanding coverage of the global emissions cap, and increasing the size and power of carbon markets. The environmental and economic benefits of such participation could be significant. Most importantly, allowing increased participation would more quickly re-align markets in favor of GHG emission reductions across all sectors, and speed the transition from high-carbon, non-sustainable development patterns to low-carbon, sustainable economic growth.

But there is little time to spare. Because the availability of CIBs is necessarily contingent upon the gap between existing emission pathways and the point at which the 2˚C threshold is exceeded, every year of delay in signing onto a CIB means fewer CIBs will be available. The most crucial time for embarking on the CLEAR path is the period between 2010 and 2020, at the latest. If the CLEAR path is not implemented by then and there is no progress toward limits on developing countries' emissions, the atmospheric "headroom" to accommodate CIBs will disappear by around 2023 — even with major emission cuts by industrialized nations. And if there is no progress toward emissions limits in emerging economies, progress on emission reductions in industrialized nations is likely to slow, sharply increasing the danger of irreversible, catastrophic consequences from global warming.

This report discusses the design and dynamics of the CLEAR path, options for how CIBs could be sized and allocated, options for implementing CLEAR via sectoral and multi-sectoral approaches, time frames for implementation, options for channeling CIB revenues into low-carbon economic development including leveraging the funds, and issues of compliance and oversight.

In the final reckoning, the verdict is clear: Taking the CLEAR path with CIBs increases the chances of avoiding dangerous climate change by rewarding emerging economies for their early actions to limit emissions. The sooner emerging economies take the CLEAR path, the greater the rewards they will receive, and the sooner they can transition to more sustainable low-carbon economic development. The more they delay, the lesser amount of atmospheric space will be available, and the more difficult it will be for the world to avert dangerous climate change.

1. The Need for Carbon Finance

The world currently faces a dramatic shortfall in carbon finance. Current sources of funding are roughly an order of magnitude smaller than what is required. UNFCCC (2007) provides a comprehensive review of financing needs and derives a global figure in the order of $200 billion per year by 2030, a third of which is needed in developing countries.[1] By comparison, existing multilateral funding is on the order of a few billion dollars per year (Table 1). UNFCCC (2008) summarizes alternative policy proposals, which come closer to filling the gap, but are still not adequate by themselves (bottom half of Table 1).

Table 1 **Current and proposed multilateral funding towards mitigation**

Existing	*per year, in billion $*
Official Development Assistance (ODA)	*‹ 2*
Global Environment Facility (GEF)	*0.25*
World Bank's Climate Investment Fund	*6 (total pledged over 3 years)*
Proposals	*per year, in billion $*
CDM levy (EU, others)	*0.2-1.7*
JI, market levy (Colombia, LDCs)	*‹ 2.25*
AAU auctions (Norway)	*15-25*
CO2 tax (Switzerland)	*18.4*
Air travel levy (LDCs)	*4-10*
Bunker fuels levy (LDCs)	*4-15*

Source (for multilateral funding proposals): UNFCCC (2008), Table 3

The largest current source of carbon finance, the Kyoto Protocol's Clean Development Mechanism (CDM), provided $6 billion in 2006 and $13 billion in 2007 (Capoor and Ambrosi 2008). While the criticisms leveled at CDM often focus on operational considerations such as high transactions costs, concerns about additionality and the fact that CDM only shifts emissions from developing to industrialized countries,[2] two other concerns are even more fundamental here.

First, even in the best of circumstances CDM is a very expensive way to reduce emissions in the developing world: the price paid, which is driven by demand in the European Union compliance market, is far above marginal cost. As a result, CDM cannot achieve the "carbon leverage" crucial to reducing emissions at the required scale. Second, CDM not only fails to reduce net emissions but actively undermines the incentives for participating countries to commit to limiting their own emissions (Hepburn 2007).

Many of the alternatives now under discussion, including intensified CDM, intensity targets, or no-lose sectoral commitments cannot generate the scale of investment or capital necessary for developing countries to sufficiently de-carbonize their economies in the required timeframe — and they do not give

[1] This $200 billion figure assumes a mitigation scenario that achieves global GHG emissions reductions by 25 percent below 2000 levels by 2030. Similarly, IEA (2008) estimated the cumulative need of financing in non-OECD countries in the order of $27 trillion by 2050 to decrease emissions by at least 50% below current levels by 2050.

[2] Under Kyoto's CDM, credits are issued for reductions in uncapped countries below what would have otherwise occurred (the level of "business as usual," or BAU). Those credits can then be transferred to countries with caps on emissions, enabling them to increase their emissions above their caps by the same amount. Very real concerns about additionality aside, such transfers simply shift emissions from developing to industrialized countries, rather than reduce global emission levels overall. (These credits are distinct from trading in reductions below a national baseline or cap, as proposed for Reducing Emissions from Deforestation and Forest Degradation (REDD), which would decrease global emissions.)

major emitting developing nations an incentive to reduce their overall emission levels throughout the duration of the program.

Funding mechanisms part of the CLEAR path could help fill the finance gap without exceeding the 2°C threshold. Our preliminary calculations estimate flows in the order of $20 billion per year for ten years. This is at least one order of magnitude larger than existing flows and ranks among the highest proposed new funding mechanisms.

2. The Role of Emerging Economies in Fighting Climate Change

The world's collective effort to curb climate change will rely heavily upon the global marketplace — the only force large and strong enough to drive the needed innovation and carry through the necessary reductions in greenhouse gases (GHG). This effort will require serious emissions cuts by industrialized countries and early emissions reductions by many others — including, most importantly, the two dozen or so largest, fastest-growing and most influential emerging economies.

Various experts have identified a 2°C increase in global average temperature above preindustrial levels as a threshold beyond which the risk of dangerous climate change increases significantly.[3] According to the United Nations Intergovernmental Panel on Climate Change (IPCC), an increase in temperature of just 1–2.5°C would result in serious impacts upon global economies, including reduced crop yields in tropical areas (leading to greater food insecurity); the spread of climate-sensitive diseases (such as malaria); the possible extinction of 20-30 percent of all plant and animal species; water stresses (including drought); increased flooding from melting glaciers and severe storm events; and rising sea levels.[4]

The 2007 Bali Climate Declaration by Scientists stated that the prime goal of any new climate treaty succeeding Kyoto must be "to limit global warming to no more than 2°C above the preindustrial temperature, a limit that has already been formally adopted by the European Union and a number of other countries."[5]

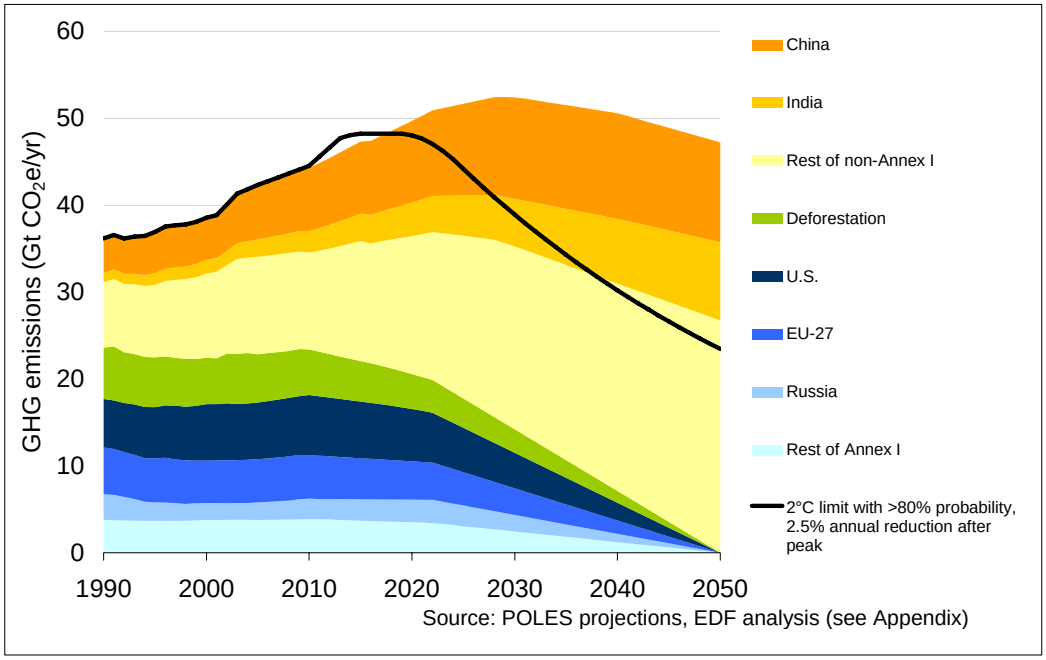
The stark reality is that, even if emissions from industrialized countries and deforestation were reduced to *zero* by 2050 (see Figure 1), unless major emerging economies also significantly reduce *their* absolute emissions, the world will have little chance of preventing a global temperature increase of 2°C and the serious consequences that would follow.[6] Figure 1 demonstrates that even using a "peaking pathway,"[7] the global emissions pathway needed over the next approximately 15 years in order to keep open options for averting warming of more than 2°C cannot be achieved without reductions in the emissions of the larger emerging economies, including China and India.

Every nation can — and, ultimately, most will have to — contribute to shifting the global emissions pathway. Because countries differ in their resources (natural, economic and human) and face different development challenges, some of the most difficult questions on this journey are: who should do how

[3] For example, O'Neill and Oppenheimer (2002) and Oppenheimer and Petsonk (2005).
[4] UNFCCC, "Climate Change: Impacts, Vulnerabilities and Adaptation in Developing Countries." Bonn. 2007.
[5] http://www.ccrc.unsw.edu.au/news/2007/Bali.html/
[6] Figure 1 assumes a middle-of-the-road IPCC SRES projection (B2 MESSAGE scenario) for non-Annex I countries after year 2030 (Grubler et al 2006) and a POLES projection before 2030. The 83% probability corresponds to the upper end of the "likely" range of values for climate sensitivity reported by the IPCC in its latest assessment report. Please see the Appendix for more details on our analysis.
[7] See appendix for details on the science.

much, how quickly, to maximize human development and economic growth while avoiding dangerous climate change, and how can this technology transition be financed?

FIGURE 1: **Projection of developing countries' GHG emissions through 2050, with "Two-Degree Emissions Pathway", and industrialized nations' emissions and emissions from deforestation declining to zero by 2050**



To ensure that all nations can contribute to the reduction of GHG in order to mitigate the worst impacts of climate change, we need to forge new mechanisms to help emerging economies gain access to the technologies they will need to achieve low-carbon sustainable economic growth.

CLEAR aims to fulfill three crucial functions in the fight against climate change:

1. *Provide emerging economies with access to the capital needed to finance the successful transition to low-carbon economic growth*. The only way to promote economic growth without rapid increases in emissions is to deliberately and directly finance low-carbon investment, at a sufficiently large scale. This capital cannot simply be provided: it needs to be employed in a way that will maximize the resulting emissions reductions.
2. *Give emerging economies incentives to commit voluntarily to legally binding limits on a substantial fraction of their emissions.* Such limits — measured in absolute tons, rather than emissions intensity — are crucial to controlling atmospheric GHG concentrations. These limits cannot be imposed upon sovereign nations but need to be accepted voluntarily — i.e., be in the self-interest of emerging economies.
3. *Prepare emerging economies for success as full participants in global carbon markets*. Achieving this goal requires the active development of technical and institutional capacity in order to support credible monitoring, reporting, and verification (MRV) systems.

As we will demonstrate, the CLEAR path offers opportunities for nations that may not be ready to move immediately to absolute emission reductions but that still wish to participate in the global effort to reduce GHG emissions, while advancing their economies toward a future of low- or zero-carbon energy.

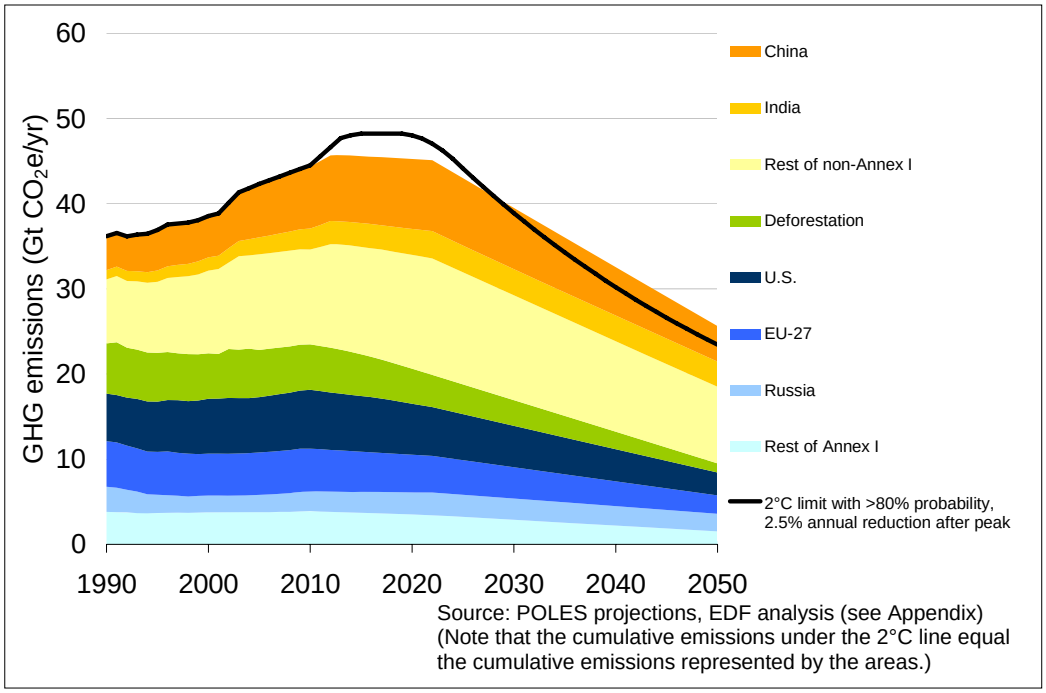
3. The CLEAR Path to Carbon Markets

A properly designed global carbon market[8] is the most efficient way for major emerging economies to create the necessary capital, incentives and investment signals to reorient their development toward a low-carbon future. CDM and other existing funding mechanisms alone cannot accomplish this.

The good news is that, consistent with the principle of "common but differentiated responsibilities,"[9] there is a high probability that the world could avoid 2˚C of warming, as long as *industrialized countries meet strong proposed emissions targets and major emerging economies put emission limits in place by 2020 at the latest*.[10] The earlier reductions begin, the better the prospects for averting dangerous climate change, and the lower the economic burden of doing so.

Figure 2 illustrates how emissions reductions by industrialized countries *and* emerging nations together can lower overall global emissions of GHG, in order to avoid an increase of 2˚C or greater.

FIGURE 2: **Illustrative Scenario of Global Emissions Reduction Pathways to Avoid ›2°C**



Source: POLES projections, EDF analysis (see Appendix)
(Note that the cumulative emissions under the 2°C line equal the cumulative emissions represented by the areas.)

What kind of mechanism can help generate the capital for the technological transformation needed to achieve this?

[8] The six key elements for emissions markets are 1) an absolute cap (limit on total emissions); 2) measurement (quantifying emissions accurately); 3) transparency (publicly available program, including tracking of emissions and transactions); 4) accountability (holding participants accountable for meeting their goals, including enforcement); 5) fungibility (one ton of absolute reductions below a cap is fully tradable with another such ton, with minimal constraints on the transaction); and 6) consistency (governments establish durable programs and refrain from changing parameters except in accordance with previously announced rules). See EDF (1998).

[9] See *United Nations Framework Convention on Climate Change*, preamble and articles 3-4.

[10] Table 2 in the appendix provides details on the illustrative example in Figure 2. FIGURE 7 tests sensitivities around the maximum annual reduction rate after the peak, which result in different peak years (the global peak in emissions occurs between 2016 and 2020).

KEY TO THE CLEAR PATH: CLEAN INVESTMENT BUDGETS

A "clean investment budget" (CIB) provides a measurable, reportable and verifiable mechanism that rewards any developing country that moves early to take a firm limit on its absolute emissions. CIBs can reward emerging economies with the capital necessary to transform their economies while activating innovative low- and zero-carbon technologies.[11]

For a nation that has not ratified an agreement to accept an absolute emissions limit, a CIB represents an alternative means to achieve similar results. It creates a multiyear absolute emissions limit, initially set at a level higher than a country's current emissions levels, with the emissions budget calculated as a percentage of the country's emissions in a historical base year. The resulting surplus allowances — equal to the difference between (on the higher end) the allocated allowances and (on the lower end) the country's actual emissions — would provide a pool of capital that could be used to leverage financing for low-carbon development.

Among the benefits for emerging economies that adopt a CIB to advance toward a sustainable future include: generating financing to be used for accelerating technology transfer to jump-start the transition to a low-carbon economy; encouraging domestic economic sectors to reduce carbon emissions early; and allowing developing nations to profit during subsequent phases of carbon emissions reduction and trading.

Nations that adopt CIBs at Copenhagen could bank or save a portion of the resulting surplus allowances for future use, and use a portion of the surplus as collateral to generate revenue. These funds, in turn, would finance the country's transition to low-carbon economic growth. For emerging economies that choose to adopt a firm emissions limit early, CIBs provide an important opportunity by delivering significant revenue while addressing concerns raised by those nations regarding the need for economic growth and financing of technology transfer.[12] By delivering such financing, CIBs could accelerate and ease a nation's economy-wide transition to a high-efficiency, low-carbon development path.

As the following section illustrates, while CIBs entail greater responsibility on the part of participating nations for measuring and managing their emissions, they also serve as a "gift that keeps on giving," by easing pressure on other parts of a country's economic development while making potentially large sums of revenue available for technology transfer and the transition to a low-carbon economy.

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[11] We are not the first to propose granting developing countries emissions targets that exceed current emissions. "Premium budgets" were first proposed over a decade ago (EDF 1997), and subsequently developed by Oppenheimer and Petsonk (2004), among others. Recently, Frankel (2008) has proposed "growth budgets" with initial allowance allocations based on business-as-usual (BAU) paths for major emitting developing countries. The contribution of this paper is to present a detailed proposal for implementing the approach, show how it can be consistent with a goal of limiting warming to 2°C, discuss the design of financing mechanisms that can provide "carbon leverage," and explore potential measures to enforce compliance. Stewart and Wiener (2003) have also proposed allocating, "major developing countries allowances above their existing emissions. That would provide headroom — not hot air — for future growth and profitable allowance sales that attract investment while also reducing costs to industrialized countries." See also Wiener (2008), and Olmstead and Stavins (2006).
By affording emerging economies clean investment budgets set initially above current emission levels, the CIB concept follows the principles of "common but differentiated responsibility" and equity, as elaborated by Su Wei (2008), who noted the need to assure development space and carbon space for developing countries while promoting the transfer of environmentally friendly technologies from industrialized to developing countries. Zou Ji (2008) has developed one possible institutional design in the form of a body, parallel to the subsidiary bodies of the UNFCCC, that would develop public-private partnerships by linking public finance with carbon markets, capital markets, and technology markets, leveraging larger amounts of private finance by smaller initial amounts of public finance. Pan Jiahua (2008) has elaborated a contrasting convergence model focused on per capita emissions. Similarly, Cao Jing (2008) focuses on developing country participation with a formulaic approached based on Global Development Rights.

[12] See, e.g., "China sets price for cooperation on climate change," Reuters, 28 October 2008.

It is essential that the post-2012 framework give emerging economies strong incentives to act early and voluntarily link up with the global carbon market as soon as possible, even before 2020. The CLEAR path offers this incentive by ensuring that developing nations are rewarded with CIBs if they undertake early action to limit their carbon emissions.

4. Steps to take on the CLEAR Path

1. Adopt a Clean Investment Budget (CIB)

During the negotiations leading up to the Conference of the Parties to the UNFCCC in Copenhagen, Denmark, in December 2009 (or subsequent to that meeting[13]), nations that take the CLEAR path by adopting a CIB would negotiate carbon limits set at a level higher than their current emissions but within the constraints implied by a global 2°C goal. The limits would be established on the basis of a historical (known) base year emissions, with an increment added to address economic growth. CIBs would thus reward early action by emerging economies, providing them with a source of capital to enable a rapid transition to a low-carbon economic development path.

The methodology for ascertaining a country's surplus allowance is described below, with a simple numeric example for the Republic of Turkey. Precedent for such budgets can be found in the Kyoto Protocol itself, which was ratified by Australia with an emissions budget set at 8% above its 1990 baseline, and in the European Union's Kyoto Protocol burden-sharing agreement, with Spain's emissions budget set at 15% above its 1990 levels, Greece at 25% above 1990 levels, and Portugal at 27% above 1990 levels. Precedent for selection of different base years can also be found in the Kyoto Protocol, which afforded countries undergoing the process of transition to a market economy the opportunity to choose different historical base years for their emissions budgets.

ALLOCATION OF EMISSIONS ALLOWANCES ABOVE CURRENT LEVELS

It is useful to think of a CIB as imposing a limit on emissions from a substantial fraction of a country's economy — with that limit initially set above current levels. In an international climate agreement that allows emission trading among countries (as the current Kyoto Protocol does, and as its successor likely will), however, no country truly accepts a fixed limit on its emissions: rather, each country commits itself to holding emission allowances at the end of each compliance period equal to the country's GHG emissions over that period.[14] A country accepting a CIB would take on the same fundamental commitment to cover its emissions with allowances in each compliance period. Note that this

[13] See "Set Up Provisions For Late Arrivals: Docking Stations," below.

[14] We are indebted to Leif K. Ervik for succinctly expressing the nature of country obligations in an international climate regime. To state the matter precisely, Article 3, Paragraph 1 of the Kyoto Protocol commits each Party to emit no more than its allowable level. While Annex B of the Protocol set out specific emissions targets relative to 1990 levels, these did not represent fixed limits: rather, those allowed amounts can be changed by a country's participation in one of the Kyoto flexibility mechanisms — e.g., trading of emissions allowances, joint implementation (JI), or CDM. Crucial to maintaining the integrity of ths system is the corresponding accounting specified in Article 3, paragraphs 10, 11 and 12, under which allowances transferred under emissions trading or JI are added to the receiving Party's allowance account and are subtracted from the transferring Party's allowance account, while certified emission reduction units are added to the receiving Party's allowance account (there is no corresponding allowance account for host countries from which CERs would be subtracted).

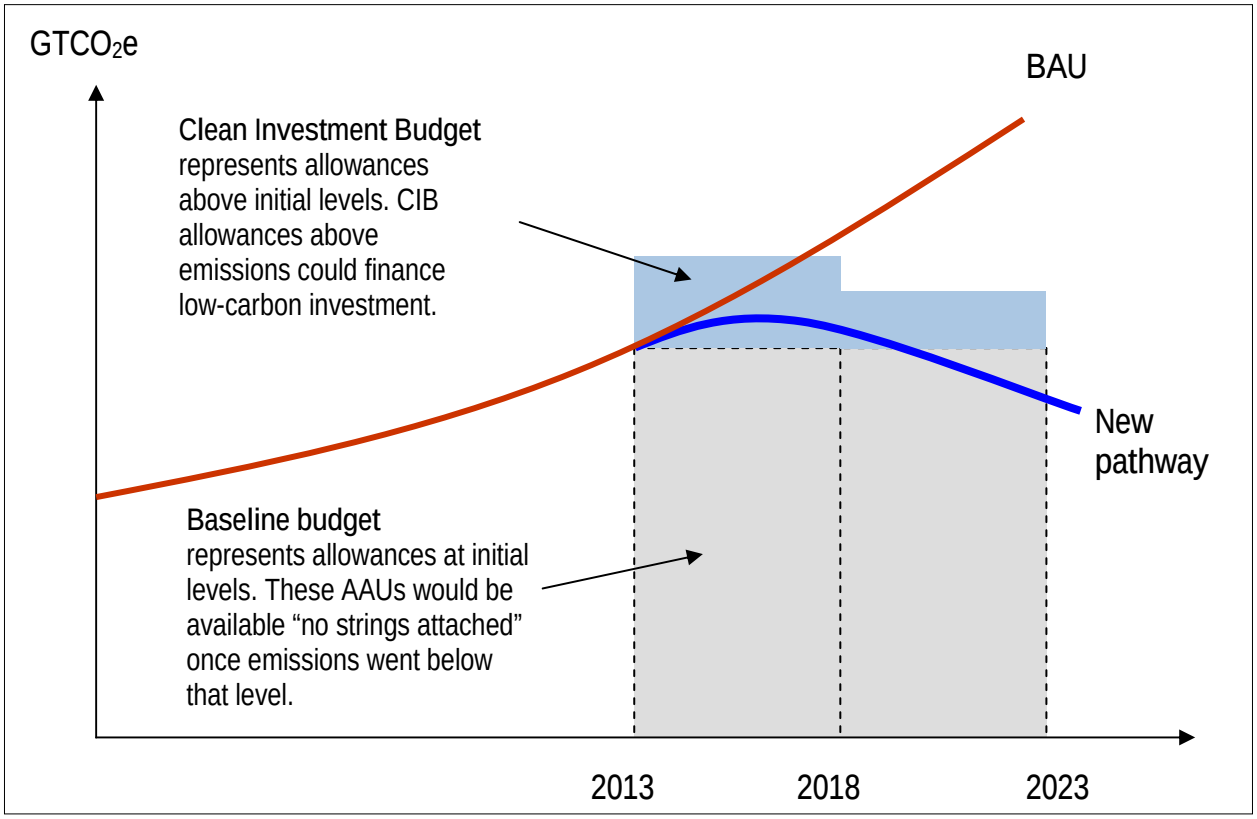
commitment is necessarily denominated in absolute terms — that is, in tons of emissions, rather than as an intensity standard or other rate-based measure.

Two important features distinguish a CIB obligation from those of Annex B countries. First, a CIB country would receive an initial allowance allocation above its current emissions. (As in the Kyoto Protocol, this initial allocation would be expressed as a quantity of "Assigned Amount Units," or AAUs.) Second, a CIB country's obligation could cover emissions from major emitting sectors only, rather than being economy-wide. A multisectoral approach would accommodate the difficulty of establishing a credible MRV system, and allow emerging economies to participate sooner. Of course, the sectors covered by a CIB would have to be chosen to represent a substantial fraction of the country's economy and to minimize the possibility of within-country leakage.

The actual CIB — the assigned allowance allocation — should be determined in advance for at least two successive commitment periods, to strengthen the incentive countries have to comply with their commitments in the first period. The second period's budget could be set at or below the level of the first, to put CIB countries on a path toward a high-technology, low-carbon economy.

Figure 3 illustrates a hypothetical CIB over two five-year commitment periods starting in 2013. The red line labeled "BAU" represents business-as-usual emissions; the blue line represents the emissions path after investments in low-carbon energy sources, energy efficiency, and so on made possible by the CIB. Note that the CIB proper comprises only the allocation of allowances in excess of initial levels. We distinguish this from the "baseline budget" corresponding to initial emissions — represented by the gray rectangles in the figure below. This distinction will become crucial in the discussion that follows.

Figure 3: **Clean investment budgets reward early action**



Taken as a whole, the sum of CIBs must lie within the available atmospheric "headroom" consistent with limiting global warming to 2°C below preindustrial levels — what we refer to as a "2°C global emissions reductions pathway." Environmental integrity must be the utmost goal. Similarly, CIB allowances should not be allowed to flood the core carbon market. While this is unlikely to happen under normal market conditions, additional safeguards might be needed to ensure market integrity, as we discuss in Section 3.

ILLUSTRATIVE EXAMPLE: TURKEY

The concept of CIBs might be best illustrated via a simple numeric example. Suppose Turkey, for example, were to adopt a CIB beginning in 2013, and it negotiated a CIB set at 562 $MtCO_2e$ per year. For simplicity, we keep the CIB constant across two commitment periods of five years each. This ten-year CIB would correspond to an allowance allocation set at 31% above Turkey's 2005 actual emissions (roughly 8% above its expected 2013 level).[15] In this illustration, by joining the global carbon market on this "early action" basis, Turkey would earn a set of surplus allowances equal to roughly 415 $MtCO_2e$ over ten years. At a price of \$20-30/tCO_2e, this CIB could be worth between \$8.3 and 12.4 billion — in the order of \$10 billion over ten years, or \$1 billion per year.

The following sections focus on the physical availability of these surplus allowances, ways to ensure compliance market integrity, some thoughts on allocating the limited physical space, a leverage mechanism to maximize carbon reductions and a discussion of the functioning of the CIB mechanism. To function effectively, CIBs will require a set of well-defined responsibilities and commitments from participating countries, including (as explained more fully below) effective oversight and compliance.

2. CLEAR Provides a "Docking Station" into Global Carbon Markets

A *docking station* is a flexible mechanism to bring nations into a global carbon market framework as early as possible, on terms that promote economic growth and reward countries that agree to cap their greenhouse gas emissions. Yvo de Boer, UNFCCC Executive Secretary, called for such docking stations in his statement at the high-level segment at the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol, Poznan, Poland, 11 December 2008.[16] The CLEAR path, and CIBs in particular, represent a concrete way of implementing the docking station approach for major emitting developing countries. Proposals to allocate emissions allowances to developing nations that reduce emissions from deforestation nation-wide below a historical baseline (REDD) might be seen as another, specifically a docking station for rainforest nations to link to the carbon market. One could imagine other docking stations based on various nations and national conditions.[17]

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[15] While the exact percentage increase over current levels would need to be negotiated, it should be constrained by an absolute emissions "band" within which each country's surplus allowance allocation must fall, as we discuss below. For simplicity, we set it at 31% above 2005 in this example, corresponding to POLES projections for 2016. The "premium" allowances might be spread over two commitment periods, recognizing that a country's monitoring capabilities may not be adequate during the first period to enable accurate determination of emission levels. We propose setting CIBs as percentage increases above historical (known) base year emissions, rather than as percentages relative to projections of BAU emissions, since the former are more readily calculated.

[16] Full statement available at: http://unfccc.int/files/press/news_room/statements/application/pdf/cop_14_hls_statement_de_boer.pdf

[17] A unique but crucial example of a docking station could be a *linkage mechanism* to allow any nation that is not party to the agreement to participate in the global carbon market *if* that nation adopts comparable climate change commitments (such as a national cap-and-trade program). Under such an approach, any non-Party could buy and sell in the carbon market with any Party *if* it enacts comparable national emission caps, even if it has not yet ratified the new climate treaty. There is ample precedent for such provisions in the Convention on International Trade in Endangered Species (CITES), the Basel Convention on Transboundary Movement of Hazardous

To be most effective, docking stations should be built into the international agreement itself. While emerging economies should be encouraged to take the CLEAR path at Copenhagen, not all will be ready to do so. Consequently, it will be crucial to include provisions in the new agreement that would, in the years following adoption, welcome new nations onto the CLEAR path and into the global market.

By welcoming new countries into the cap-and-trade framework, the docking station concept expands coverage of the global emissions cap, reduces concerns over competitiveness, and increases the size and power of carbon markets. Perhaps most importantly, broadening international participation through docking stations would more quickly re-align markets in favor of GHG emission reductions across all sectors, and speed these countries' transitions to low-carbon economic growth. The ensuing environmental and economic benefits would be significant in scale.

3. Acting Quickly to Ensure a Seat at the Table

While the CLEAR path represents a unique chance to meet the twin challenges of emissions reduction and economic growth, it is also a limited-time opportunity. Every year of delay in signing onto a CIB means fewer CIBs will be available, since they are contingent upon the "headroom" — that is, the gap between existing emission paths and the point at which the 2°C pathway is met. This headroom will be available to developing countries – but only for a short period of time.

The ultimate goal of CIBs is to support international action sufficient to limit temperature increases to 2°C. Because CIBs represent a "premium" above current emissions, it is crucial that they be designed with this goal in mind. In particular, the sum of "premium" budgets allotted to developing countries above current emissions must be less than the available "atmospheric headroom." We define "headroom" to be the cumulative future volume of emissions from developing countries, *in excess of emissions in a given starting year,* that is consistent with a global 2°C emissions pathway, after accounting for emissions reductions in industrialized countries and tropical deforestation.

Two features of this definition of "headroom" are worth emphasizing. First, headroom cannot be calculated independently of a specific set of assumptions about emissions reductions in industrialized countries and tropical nations. Because warming depends primarily on cumulative emissions over time, these assumed emissions pathways must be specified over several decades. Second, headroom is a dynamic concept: it is tied to developing country emissions in a specific starting year. This implies that the available headroom will decline over time, as we discuss below.

Figure 4 illustrates this definition of headroom starting in the year 2013.[18] The bold line traces out one emissions path that is consistent with avoiding more than 2°C warming relative to preindustrial levels. The shaded areas depict past and future emissions. Industrialized nations (Annex I countries) are assumed to reduce their emissions to 55 to 60% below 1990 levels by 2050 (with the exception of Russia, which reduces emissions to 30% below 1990 levels). Emissions from tropical forest nations are assumed

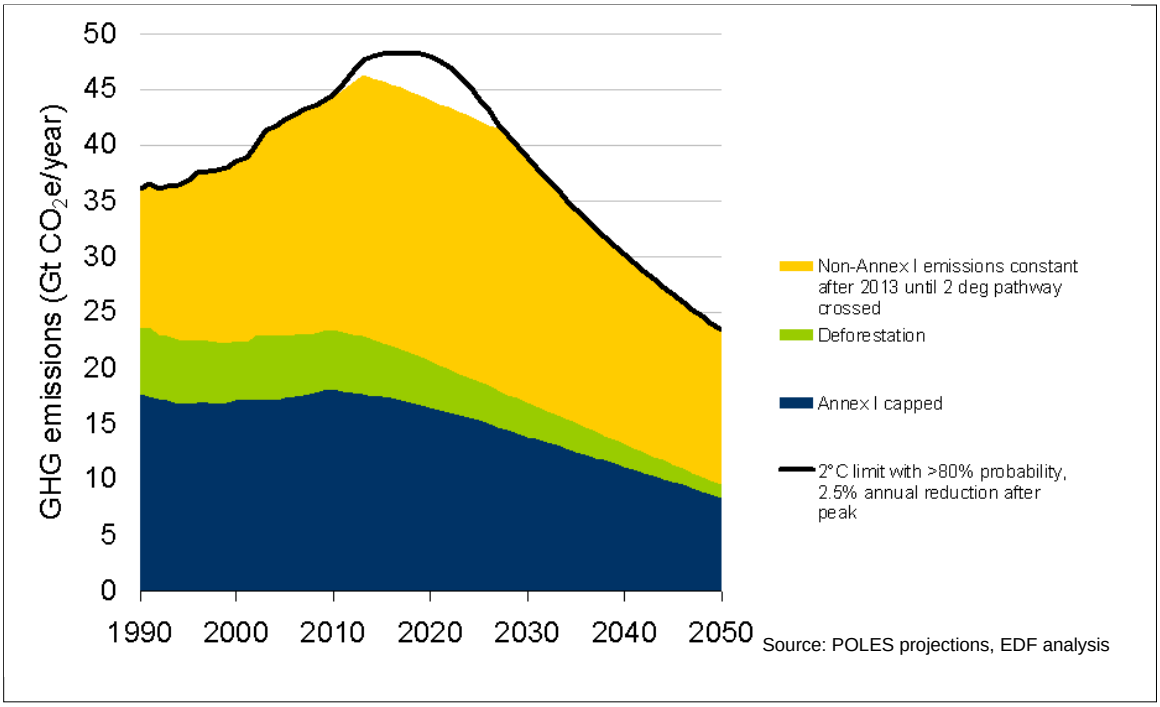
Wastes, and the Montreal Protocol on Substances that Deplete the Ozone Layer. Such provisions, however, are currently lacking in the Kyoto Protocol.

[18] See the Appendix for more detail on the calculations.

to be limited (in line with the REDD proposal), while we keep emissions from developing countries at current, 2013, levels.[19]

Graphically, headroom corresponds to the white space below the bold line. This is the available volume of emissions for CIBs. As Figure 4 shows, if industrialized countries follow these assumed targets, there is sufficient physical headroom to permit sizeable CIBs in the short term. Working backwards from a goal of staying below 2°C of warming,[20] the physical constraint allows for enough "headroom" to enable CIBs through about 2022.

Figure 4: **Headroom available for developing countries in 2013**

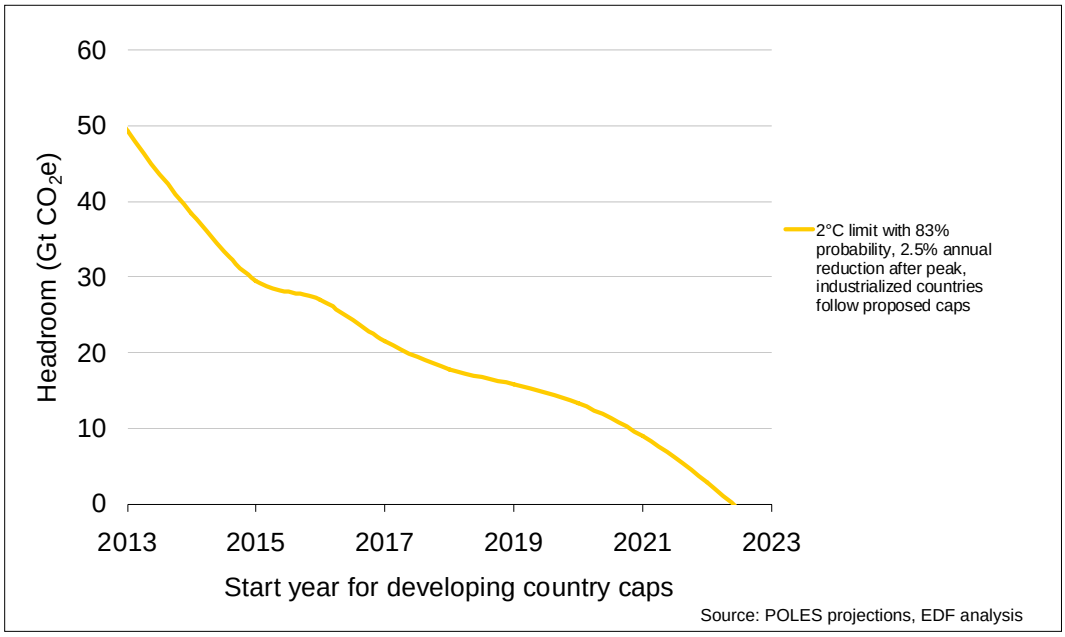


As already noted, the amount of headroom available depends on the starting year: the later the year, the higher are current developing country emissions, and the less headroom is available. Figure 5 illustrates this point. The height of the line corresponds to the headroom left for any given start year. If developing nations begin taking CIBs in 2013, global available atmospheric headroom for their CIBs would amount to 50 $GtCO_2e$. However, because of the long atmospheric lifetime of greenhouse gases, the rapid increase in emissions and consequent rapid buildup of the concentration of the gases in the atmosphere, available headroom diminishes quickly. Headroom falls to 30 Gt by 2015; 13 Gt by 2020; and disappears entirely by 2023 — meaning that it would not be possible to grant CIBs after that date and still limit global warming below 2°C.

[19] In reality, developing countries' emissions would clearly increase above current levels at first, especially since we cannot expect that all would follow the CIB proposal. Potential candidates for CIBs we considered in our estimates, mostly non-Annex I countries, included Bangladesh, Belarus, Brazil, China, Egypt, India, Indonesia, Iran, Kazakhstan, Mexico, Nigeria, Pakistan, Philippines, South Africa, South Korea, Turkey and Vietnam. These 17 countries cover approximately 70% of non-Annex I emissions. That is why we set aside 30% of the atmospheric headroom and allocate only 70% for CIBs.

[20] See O'Neill & Oppenheimer (2002) on "working backwards" from temperatures to atmospheric concentrations to emissions.

Figure 5: **Available atmospheric headroom for developing countries**



4. Maintaining Market Integrity

The calculation of atmospheric headroom reflects an *environmental* constraint on the total size of CIBs available through the CLEAR path. A second consideration is relevant as well: the impact of CIBs on global carbon markets. For CIBs to promote the ultimate goal of preventing dangerous climate change, the volume of CIB allowances, and the rate at which they are released into carbon markets in advanced economies, must be consistent with carbon market integrity.

Several safeguards can help to ensure market integrity, both from the demand and the supply side of carbon allowances. First, on the demand side, the number of CIB allowances available for sale by developing countries will be tied to their progress in meeting performance benchmarks. In particular, nations that lack well-developed emissions measuring and monitoring systems could be required to hold significant portions of their CIBs in reserve to reduce the risk of over-selling; these reserve requirements could be loosened as the nations' abilities to measure and report actual emissions improve. This "metering" of allowances will prevent a sudden influx of allowances into carbon markets, while at the same time providing continuing incentives for developing countries to improve their institutional capacities.

Second, as a practical matter, nations with CIBs might not wish to sell all of their surplus allowances at the outset. Three reasons account for this quasi self-regulation of the supply of allowances that flow into the market. For one, CIB allowances are most valuable when leveraged to generate a multiple of investment potential from the actual value of allowances. Also, countries may wish to bank or save some allowances to cover potential emissions increases in the future, or to sell at a later date when they have reduced emissions even further and allowance prices have risen. The potential for banking to moderate and stabilize allowance markets has been explored in a variety of similar contexts, e.g., REDD markets

and the EU ETS.[21] Lastly, analyses of current CDM transactions suggest that allowances are very much traded in a sellers' market; i.e. demand for allowances now exceeds supply twenty to forty-fold, not counting likely future demand increases (Wara and Victor, 2008). CIBs aim to fill this gap, but it may not be possible to do so right away. This imbalance would, therefore, likely continue for the time being, which by itself would ensure market integrity and prevent the flooding of compliance markets.

Third, since not all emerging economies will adopt a CIB and some participating countries might choose a multi-sectoral rather than economy-wide limit, a certain amount of atmospheric space should be reserved for increasing emissions from non-participating countries and non-covered sectors. This space could be reserved by limiting the size of CIBs or by creating a global reserve of allowances that covers all emissions expected from uncapped countries and sectors, but that could only be tapped for trading by nations that subsequently adopt CIBs themselves.

The result is that the total volume available for CIBs is likely to be substantially less than the available atmospheric headroom. For example, the headroom starting in 2013 is 50 $GtCO_2e$. Taking into account the limitations implied by market integrity as well as nonparticipation, however, a rough estimate of the actual CIBs available is 8 $GtCO_2e$ over ten years, which equals roughly $200 billion for a ten-year CLEAR program, or $20 billion per year — twenty CIBs the size of our Turkey example above.[22] This is clearly a lower-bound estimate of the total value of "headroom" allowances available for CIBs, given that it is based on a conservative estimate of the total carbon market.

5. Allocating Limited Headroom

Various metrics could be used to determine the appropriate allocation of CIBs to a particular country. These metrics might include current GHG emissions; current per capita emissions; projected growth in emissions; or others. It seems unlikely, however, that it will be possible to select a single metric that is acceptable (or appropriate) to all nations. And the primary determinant of the amount available for allocation, given limited headroom that diminishes over time, is how swiftly each nation moves to claim its CIB. Therefore we propose that as soon as possible, and not later than the Copenhagen meeting, nations establish a narrow range, in tons of CO_2e, for the CIBs that will be available for allocation, and that allocations for particular nations to be determined in large measure by how swiftly nations move to the CLEAR path.

The range should be designed so that the total headroom taken by all potentially interested countries falls well within the atmospheric and economic constraints. It is relatively easy to relax initial limits imposed by these constraints, but virtually impossible to tighten them once the process is launched.

Furthermore, since not all emerging economies will adopt a CIB and some participating countries might choose a multi-sectoral rather than economy-wide limit, a certain amount of atmospheric space should be reserved for increasing emissions from non-participating countries and non-covered sectors. This space could be reserved by limiting the size of CIBs and/or by creating a global reserve of allowances

[21] See, e.g., Piris-Cabeza and Keohane (2008) or Ellerman and Montero (2007).

[22] Our lower-bound estimate of the total value of headroom allowances available for CIBs, based on a conservative estimate of the total carbon market and taking into account both atmospheric and economic constraints, shows potential global financial flows to be on the order of $200 billion for a ten-year CIB program. This estimate is based on the following, admittedly back-of-the-envelope calculation: The global mandatory carbon market now largely consists of EU ETS, which accounts for about 2 of 40-45 $GtCO_2e$ emitted globally in 2008. The U.S. would add another 6 $GtCO_2e$. A price of $20-30/tCO2e would imply a value of $40-60 billion for EU ETS, compared to $160-240 billion for the EU plus U.S. carbon markets. If 10 percent of a combined EU-U.S. carbon market consisted of allowances from CIB countries, CIBs could deliver a total of $16-24 billion in a given year or, roughly speaking, emissions of 800 Mt CO2e per year at a price of $20-30/$tCO_2e$.

that covers all emissions expected from uncapped countries and sectors, but that could only be tapped for trading by nations that subsequently adopt the CLEAR path.

One further complication is that countries will be joining at different dates. The available headroom would therefore have to be recalculated each time and the exact level of the CIBs negotiated internationally. A recalculation of available headroom should not lead to adjustment of CIBs that have already been granted, however, even if the headroom is found to be smaller than previously estimated. Once set, an emissions limit should be protected from renegotiation until the end of the commitment period.

Discussion of size and allocation emphasizes the importance and attractiveness of early action. The finite amount of atmospheric headroom available under a global physical constraint vanishes over time. The earlier a country signs on to a global carbon market, the larger its potential CIB and ensuing financial flows.

It also underscores the importance of independent monitoring to ensure environmental integrity of the overall system. The IPCC is not charged with this kind of GHG accounting review work and scientific oversight. A question arises as to whether the IPCC is structured to enable the kind of rapid scientific response that governments will need in order to ensure that CIBs awarded do not exceed the atmospheric constraints associated with avoiding a greater than 2˚C increase in temperature. Among the possibilities that might be explored, would be the establishment of a small team of experts — which might be drawn in part from national academies of science - attached directly to the UNFCCC to carry out analysis on available headroom for CIBs and continuously update the analysis as new information emerges and new countries join the compliance market.

6. Encompassing Multi-Sectoral As Well As Economy-Wide CIBs

What if a country that wishes to follow the CLEAR path has the capacity to initially enroll a subset of its economic sectors, but not its entire economy? On the one hand, starting step-wise with sectors might enable nations to get on the CLEAR path quickly, which would be desirable from the point of view of achieving emission reductions as soon as possible. On the other hand, sectoral approaches entail considerable risk. For example, leakage (or shifting of carbon emissions) from participating sectors to non-participating sectors might vitiate the effectiveness of the sectoral limits, and discourage other sectors from participating in the future. The following suggestions address these concerns.

If nations choose to open the CLEAR path to emerging economies that enroll only sectors (and not their entire economies) in CIBs, at least three criteria would need to be met to ensure environmental and economic integrity:

1. *A multi-sectoral emissions limit should have functional integrity* — i.e., it should cover sectors that together represent a substantial portion (probably a majority) of a country's emissions; are not likely to "leak" to uncapped sectors; and help emerging economies to transition more rapidly to low-carbon economic growth consistent with their national interests;
2. *The approach should be designed with a clear end date*, as a short-term building block towards an economy-wide limit that reduces overall emissions by around 2020 at the latest; and
3. *The approach should not use intensity targets or technology performance standards*, as these by themselves do not yield reductions in total emissions now or in the future. Moreover, no sectoral approach should be used to address the narrow concerns of specific global industrial groups, but rather be implemented on a national level under an absolute emissions limit.

7. Generating Development Capital via a CIB

Based on the principle of "common but differentiated responsibilities," CIBs could most closely be described as *development capital*, where the CIB provides new resources that can help nations break the link between continuing economic growth and carbon emissions over time.

Several options can be envisioned for generating development capital via a CIB. One among many is that a participating nation might choose to use its CIB allowances as collateral to support loans that would finance emission reduction projects that are "no regrets" or of relatively low marginal cost. The return on investment for these projects would enable the nation to repay the loan and use the CIB allowances as new collateral for a further loan, in effect enabling the CIB allowances to serve as a revolving fund. International oversight of the revolving fund would enable the participating nation to attract financing from a wide range of sources. By enabling carbon markets to serve as a source of those financial flows, CIBs can stimulate an investor search for quality, such that CIB nations that provide the most transparent frameworks for ensuring that the financial flows yield real emission reductions will be most able to attract new investment.

These types of arrangements would help ensure that CIBs do not simply result in the trading of "hot air" that either has no beneficial effect upon climate or causes emissions to grow faster than they otherwise would. Quite the opposite: sound implementation of CIBs can be an important way to achieve global climate goals within the limited timeframes available for securing a safe climate, and at the same time give emerging economies a powerful pro-development tool.

Moving away from a high-waste, high-carbon base will pose challenges to all countries. CIBs can help emerging economies cope with those challenges and maintain their progress toward a sustainable future:

- By providing early and valuable experience by encouraging domestic economic actors to learn techniques for reducing carbon emissions early and gradually;
- By generating a stream of revenue that can be used to accelerate high-efficiency, low-carbon energy sources, including energy for those without access to electricity;
- By positioning countries to benefit significantly during subsequent phases of global carbon emissions reductions and trading; and
- By allowing countries to achieve a downward slope on overall emissions earlier than would otherwise be possible, and thus provide the opportunity for being a seller of carbon credits after the CIB period is concluded.

Credible oversight and compliance will be central to the success of any framework that generates financial flows to facilitate technology transfer and cleaner development, whether those flows derive from the market, from ODA, or from other sources. CIBs have the ability to generate development capital rather than "hot air," for several reasons:

First, by linking CIBs to the carbon market, a range of innovative approaches to oversight and compliance become available that can help ensure that revenues from the sale of CIB allowances flow to investments that will contribute towards reductions in national emissions.

Second, by choosing the CLEAR path and voluntarily adopting legally binding CIBs for at least two successive five-year commitment periods, participating nations can ensure the durability of their emission reduction investments and the value of their CIB allowances in the marketplace. We assume in

the example of Turkey above that these two commitment periods span five years each with the first commencing in 2013, thus spanning the years 2013–2017 and 2018–2022. The first limit would be set as a multiple of a historical baseline year or average of years. Depending on the size of the initial allowance allocation, the next one would be set at or below the level of the first limit in order to ensure that CLEAR path participants transition toward a high-technology, low-carbon economy.

Third, by following the CLEAR path and achieving actual emission reductions, emerging economies can motivate industrialized countries to establish even *more* ambitious reduction targets than they otherwise would. For example, the EU has announced that it would increase its cuts from 20% to 30% by 2020 if other major emitters were to take limits as well. One could imagine similar "challenge mechanisms," perhaps including some contingent upon the size of the overall compliance market. Such an approach has the potential to create a virtuous circle, in which all major economies have an incentive to adopt tighter targets to preserve the value of their carbon investments going forward.

8. Achieve maximum emissions reductions through carbon leverage

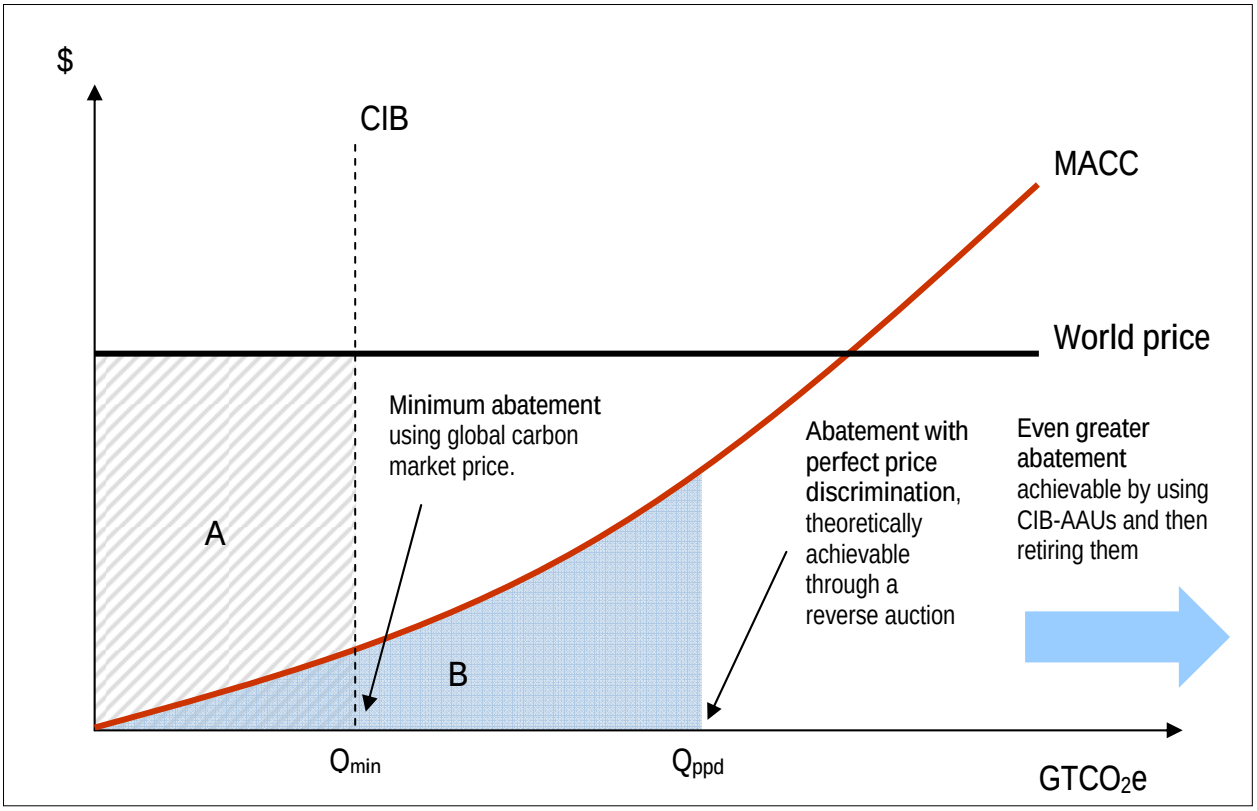
A primary goal of the CLEAR path is to provide a readily available source of capital to help emerging economies finance the transition to a low-carbon economy. Realizing this goal, however, requires more than simply granting these countries a generous allotment of allowances: a framework must be erected to ensure that CIB funding is well spent. This section sketches out the range of financing mechanisms that could be used. First, however, we explore the concept of "carbon leverage" necessary for CIBs to be an effective means of reducing global emissions.

CARBON LEVERAGE

Carbon leverage means achieving more than a ton of emissions reduction for each CIB allowance. To make this concept more concrete, consider Figure 6. The *minimum* abatement that a CIB could finance (setting aside uncertainty for the sake of exposition) would be that achieved on a ton-for-ton basis — i.e., if CIB allowances were simply sold and used to purchase emissions reductions in the CIB country at the world market price. Given the "low-hanging fruit" available in emerging economies, however, the marginal cost of emissions reductions (depicted in the figure by the marginal abatement cost curve [MACC]) is likely to lie well below the world GHG price. As a result, a ton-for-ton approach would transfer a sizeable rent to the CIB country, while failing to maximize emissions reductions.

With greater information about the MACC, of course, more emissions reductions could be purchased with the same amount of money. In the limit, perfect price discrimination would equate the area under the MACC with the value of the CIB at world prices. Such an outcome might be approximated in practice with a reverse auction, or through a form of third-degree price discrimination in which projects were differentiated by sector or other observable characteristics. Finally, even greater abatement could be achieved through financing mechanisms — such as using CIBs as collateral to secure traditional financing that would otherwise not be available (or would otherwise be too costly).

Figure 6: **Carbon leverage to increase abatement**



FINANCING MECHANISMS

One could imagine three broad channels for disbursing CIB funds. First, CIB allowances could be used as collateral to secure traditional financing through private banks or perhaps export credit agencies. Used in this way, CIBs would facilitate financing by alleviating the need for alternative loan guarantees and expanding access to credit. Because the financiers would retain their incentive to assess the viability of projects and monitor performance, this approach would require relatively little oversight by the CIB trustee (the authority holding the CIB allowances) other than to perform due diligence on the banks providing the financing, and to ensure that the contract terms were not too generous. Since CIBs would be used only as collateral, a substantial fraction of them would be returned to the "carbon capital account" after the completion of the underlying loan. Moreover, allowances could be (partially) retired after loan repayment to further strengthen the environmental integrity of the program.

A second option — perhaps less leveraged but also more tightly overseen — could be a system of carbon loan payments or carbon dividends. In this case, the CIB allowances serve as a guaranteed stream of "carbon cash flow." Banks would provide incremental debt or equity financing for emissions reductions projects (in conjunction with other base financing).[23] The host country or project sponsor would repay its debt (or pay out dividends) with CIB allowances. In the meantime, allowances would be held in escrow by the CIB trustee, who would disburse the funds and monitor compliance. The trustee (or another authority) would also be responsible for approving the projects and determining their expected

[23] While incremental cost is an elusive concept in practice, given information asymmetries, it offers in principle a means of leveraging direct funding to supplement traditional sources of finance. For example, traditional project finance might be available to fund a conventional coal-fired power plant; a CIB grant could provide the additional funding needed to drastically improve the plant's operating efficiency or to replace it with a renewable energy source.

yield of emissions reductions. Payments could still be structured to yield "carbon leverage" of greater than ton-for-ton reductions.

Finally, direct grants, funded by the proceeds from the sale of CIB allowances, would be the most tightly overseen and probably least leveraged alternative. A grant mechanism could be modeled after the Multilateral Fund established by the Montreal Protocol to assist developing countries in reducing ozone-depleting substances, which is commonly seen as a success. As in that case, the responsibility of overseeing national action plans could be assigned to one central, international body, while other entities worked on a local level (the "Implementing Agencies" in the Multilateral Fund) to approve funding and monitor projects. Grants could be directed at the incremental cost of emissions reductions.

While carbon leverage would be harder to achieve with grants than with alternative financing mechanisms, it could still be achieved by suitable selection of projects. An ideal mechanism would be a reverse auction. Given the desire of host countries to exercise significant control over investments, however, some sort of negotiated payment scheme might be more practical. For example, the size of a grant could be scaled to the expected emissions reductions, but with an initial payment per ton that was set well below the market allowance price. Or a portfolio of grants could be approved (perhaps at a programmatic or even sectoral level), with total payment tied to an estimate of the average cost per ton of avoided emissions. While there are obvious informational asymmetries, and hence a strong likelihood of significant information rents accruing to host countries, a greater than ton-for-ton reduction would probably be feasible.

None of these financing mechanisms is sufficient on its own; they are complements rather than substitutes. Using CIB-AAUs as collateral could appeal to countries with well-developed capital markets, and would be suited to projects where an incremental investment is easily identified and yields reliable and significant operating cost savings — for example, energy efficiency in commercial buildings. Carbon loan payments or dividends would be more appropriate to finance projects where (i) the incremental cost was fairly well-defined, (ii) the resulting emissions reductions could be accurately estimated and monitored, but (iii) those emissions reductions fail to translate into financial gains. Finally, grants could be used to finance policies or broader projects (e.g., transmission networks to support renewables) that contribute to long-term reductions in emissions but are less suited to conventional private-sector project finance.

9. Functioning of the CIB mechanism: Compliance and Enforcement

Compliance and enforcement are central issues in the design of *any* international regime; climate policy generally, and the CLEAR path specifically, are no exception. In the context of CIBs, two distinct compliance problems can be identified. First, is the country using its CIB allotment to finance clean investment? Second, is the CIB country meeting its obligation to hold allowances sufficient to cover its emissions?

Each of these problems is individually familiar from international environmental policy. Multilateral development banks as well as private financiers face similar challenges in overseeing how grants and loans are spent in the context of economic development. As in that context, robust oversight of financial flows will be necessary to ensure that countries use their CIBs to fund long-term projects that will reduce GHG emissions in the long run. The stringency of such oversight would presumably vary depending on the financing mechanism used. In particular, when CIB allowances are effectively given to the recipient country as grants, the case for stringent oversight (on both normative and practical grounds) is strongest. When CIB allowances are used as collateral, with the prospect of eventually

retiring them rather than releasing them into the market, the potential impact on the atmosphere is much reduced, and thus the need for oversight is as well.

With respect to compliance with emissions obligations, a CIB country could be treated much as Annex B parties are under the current system, once it had put in place an operational GHG monitoring systems. (Recall that a country's incentive to put such a system in place is the prospect of fully accessing its CIB allowances.) In particular, a CIB country whose emissions exceeded allowable levels would be subject to the sanctions applicable to non-complying Annex B parties under the Marrakesh Accords. Of course, the problem with this approach is that the current enforcement mechanism is widely regarded as ineffective. The penalty for noncompliance is a 30% reduction in the allocation for the next commitment period — but since the allocation for that commitment period has yet to be negotiated, the provision is toothless. This problem could be partially addressed by negotiating two compliance periods simultaneously, as we propose for CIBs.

While each compliance problem may be familiar from other settings, it is their combination that distinguishes CIBs from other compliance problems. Paradoxically this may be an advantage — in the same way that "issue linkage" can enhance the potential for enforcement and compliance in other international regimes.[24]

For example, we have proposed that CIB allowances would be held in an "escrow account" in order to allow for oversight. This, in turn, can serve as key incentive for compliance, which ought to be especially effective in the early years of the program: If a country has embarked on the CLEAR path and voluntarily taken on a CIB, presumably it will find it valuable in the first few years to comply with the requirements in order to continue to receive the withheld (escrowed) tons. This logic argues for giving large CIBs, but holding most allowances in reserve and releasing them only slowly over time. In this way the CIB can help solve not only the initial participation problem but also the ongoing dynamic participation (continuation) problem. It is also crucial that the escrow account be held as long as possible.

In theory, the escrow account can grow over time — to the extent that early investments "bend the curve" downward, they will help free up more allowances under the CIB that can be invested in further projects. If the escrow account, however, gets smaller as the date of "full participation" (with a tighter allowance allocation) approaches, the incentive for compliance diminishes.

Ultimately, as in any agreement among sovereign nations, enforcement cannot be imposed entirely from without. The long-run solution to compliance, therefore, has to rest on changing its effective "payoffs" from reneging. CIBs need to finance investments that make it *more* attractive *ex post* to continue along the low-carbon path than to abandon it and renege on commitments.

Again, the two compliance problems can work toward a mutual advantage. If financial oversight can be constructed in a way as to assure proper investment incentives, then the investments made under CIBs will help increase the value from remaining in the international climate regime — akin to a "low-carbon path dependency."

Two analogies may be useful here. The first is the mobile phone network in the developing world. A stylized fact is that many developing countries have "leapfrogged" development of a landline network with a mobile network. Once that happens there is little incentive to go back and develop the landline

[24] See Abrego et al. (2001) and Conconi and Perroni (2002), but see Barrett (2008) for another view.

network. CIBs could help fund investments that leapfrog a high-carbon infrastructure in the same way. The case of distributed solar versus a reliable, national electric power grid comes to mind.

Trade politics provide a second analogy. Participation in international trade agreements must overcome built-in domestic political resistance, because the losers from free trade will be more easily identified and better organized than the winners. However, once established, trade pacts can create an endogenous source of political support, by promoting the growth of export industries with new incentives and resources to engage in lobbying. Those domestic constituencies can then help to sustain the political will to comply with trade regimes going forward. In effect, the act of participating in the regime helps to reshape incentives in favor of compliance.[25]

As the trade example makes particularly clear, the key to long-run compliance is to create the conditions within a country to sustain participation and involvement in a global carbon regime. That means creating domestic political constituencies that benefit from clean energy and from engagement with carbon markets in other countries.

Four Key Elements of the CLEAR Path:

1. Countries voluntarily accept binding caps, set above current emissions levels to generate funds for a smooth transition to a high-technology, low-carbon economy.

2. Sum of Clean Investment Budgets lies within globally available physical headroom and is designed to enhance the integrity of the core compliance market.

3. CIB funds can be used to fulfill the need for quick development of capacity for monitoring and independent verification of emissions.

4. Oversight and monitoring of investments ensures that sale of CIB allowances aids transition to clean technologies and prepares emerging economies for full and successful participation in the global carbon market.

[25] See Gilligan (1997) and McGinnis and Movsesian (2000) for discussions of this effect in the context of U.S. trade policy. Haggard (1988) presents a related institutional view (recounting how the passage of the Reciprocal Trade Act of 1934 favored pro-free-trade domestic interests) while Frieden and Rogowski (1996) provide a succinct summary of how trade policy can affect the preferences of domestic interest groups by altering relative prices.

5. Moving Forward

This paper analyzes clean investment budgets and provides a sample CIB for Turkey as an illustration. The next step will be to expand this analysis to other developing countries and integrate national marginal abatement cost curves to estimate actual emissions based on expected domestic abatement and international financial flows.

Estimates of international financial flows will also enable a second level of analysis centered on projections of expected domestic banking of and international demand for CIB allowances. Further discussion and feedback on these analyses as well as other elements of this proposal will facilitate work on designing mechanisms for oversight and compliance.

In the final reckoning, however, the verdict is clear: Taking the CLEAR path with CIBs increases the chances of avoiding dangerous climate change by giving countries credit for acting early. The earlier they commit to an absolute level on emissions, the greater rewards they will receive, the more competitive they can be in the global market, and the sooner their own development plans will transition to a sustainable basis.

Appendix: Details on the Science

Our analysis of global emissions reduction pathways follows Wang et al. (2007) and Meng et al (2007). We determined emission reduction pathways using the MAGICC model of greenhouse gases and climate (Wigley and Raper, 2002; Wigley et al., 2002; Wigley, 1993), assuming the range of climate sensitivities recommended in the IPCC Fourth Assessment Report. The emissions in this paper include the six Kyoto gases (CO_2, methane, nitrous oxide, HFCs, PFCs and SF_6) and are aggregated into units of CO_2 equivalent ($CO2_e$) using global warming potential values from the IPCC Second Assessment Report. Emissions of other climatically important gases, including SO_2 and tropospheric ozone precursors, are assumed to follow the median of the IPCC SRES scenarios. Through additional simulations, we found that concurrent abatement of these other gases under a global emission reduction pathway would have only a small effect on temperature, as reductions in tropospheric ozone (a greenhouse gas) offset reductions in SO_2 (a climate cooler).

The global emission reduction pathway considered in this paper avoids 2˚C of warming with a probability of 83% and a maximum annual emissions reduction rate of 2.5% after the peak. Various authors, including O'Neill and Oppenheimer (2002) and Oppenheimer and Petsonk (2005), have identified a warming of approximately 2˚C above preindustrial as a threshold beyond which the risk of dangerous climate change increases significantly. The pathway transitions from a peak to the maximum rate of reduction over a period of five years and corresponds to a total budget of 2,337 GtCO2e between 1990 and 2050, with 1,638 GtCO2e remaining from 2008 onwards.

Note that in this analysis we focus on concentration peaking pathways, rather than concentration stabilization pathways.[26] Although stabilization pathways have been more commonly discussed in the scientific and policy arenas, there is no physical basis for ignoring the multitude of other possible pathways that avoid dangerous levels of warming. Frame et al. (2006) have pointed out that concentration stabilization pathways are somewhat artificial and that in practice it would be difficult to maintain a steady concentration level indefinitely. Peaking pathways have the additional benefit of allowing the possibility of bringing concentrations, and eventually temperature, back down to or below today's level.

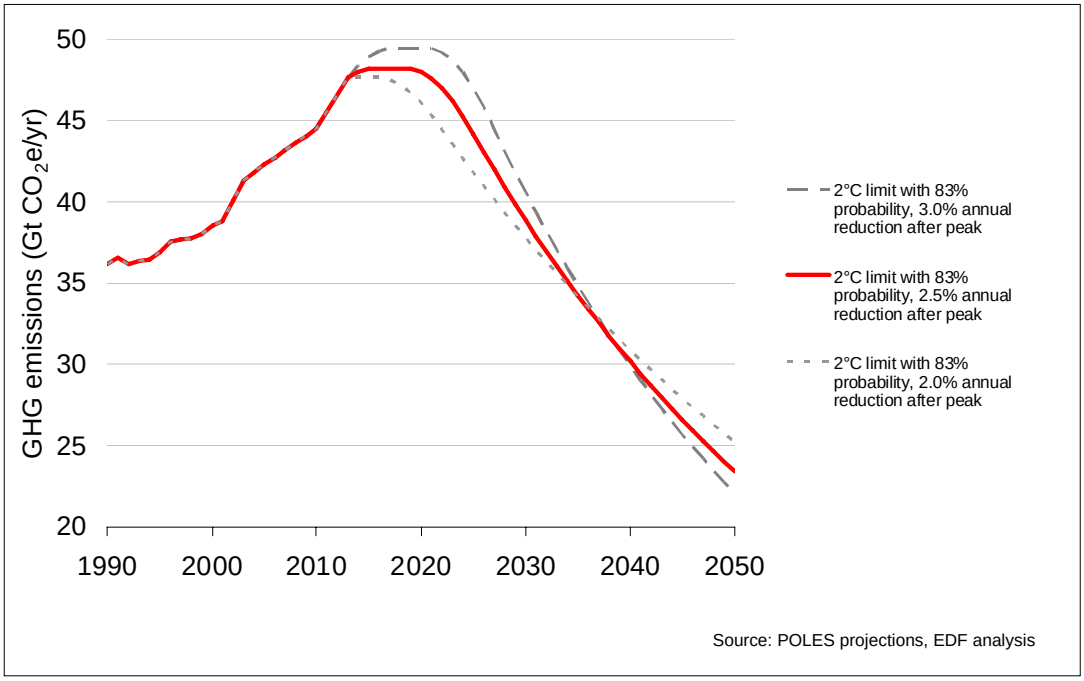
Peaking pathways have been suggested recently by den Elzen and van Vuuren (2007) as a more cost-effective alternative to stabilization pathways. However, care should be taken to avoid an excessively high rate of warming in the near-term from a peaking pathway that may be acceptable in terms of the long-term total warming. Note that the main pathway we consider in this paper, which gives an 83% likelihood of avoiding 2˚C of warming, entails a level of emissions reduction by 2050 equal to about 35% below 1990 levels globally. This is comparable to a concentration stabilization pathway that gives a roughly 50% likelihood of avoiding 2˚C of warming (M. Meinshausen's 450 ppm CO_2e pathway that overshoots to 500 ppm[27]).

We also test sensitivity around the maximum annual reduction rates after the peak (changes in the slope), which corresponds to different levels of banking of emissions allowances (Figure 7).

[26] Similar to Wang et al. (2007) and Meng et al (2007)

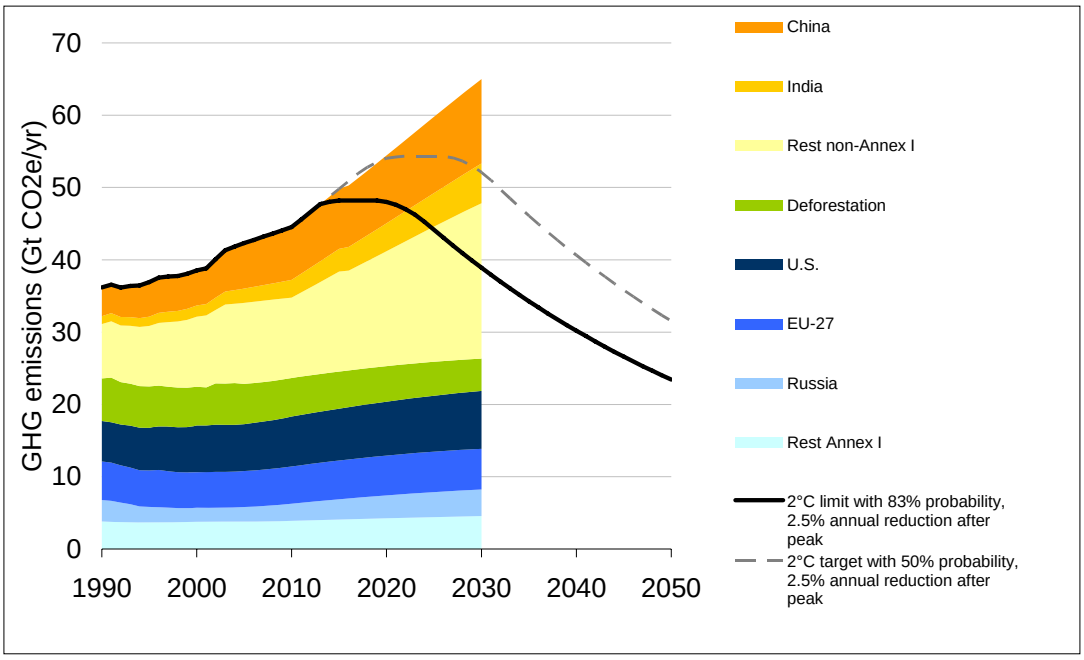
[27] Various citations to M. Meinshausen *et al*'s work available at www.simcap.org.

FIGURE 7: **Global Emissions Reduction Pathways with Different Annual Reductions After The Peak**



We estimated historical emissions through 2000 with emission data from the World Resource Institute's CAIT database, supplemented by newly-available land use change and forestry (LUCF) data by Houghton (2008). CO2 emissions data from 2000 through 2030 come from POLES estimates via WRI's CAIT database, supplemented by EPA data for non-CO2 gases. We take Houghton (2008)'s LUCF through 2005 and then extrapolate linearly through 2030 using the last year's rate of change. Figure 8 displays the resulting BAU calculations for large emitting countries and LUCF.

FIGURE 8: **Global Emissions at BAU Through 2030**



Note that following BAU through 2030 would exceed the 83% 2˚C pathway as well as one that assures warming below 2˚C with only 50% probability.

Table 2 lays out our assumptions for the example emissions pathways under the 2˚C global limit assumed in our scenario analysis in the text.

Table 2: **Emissions targets assumed in example pathways in the text (% difference from base year)**

Country/ Group	*U.S.*	*EU-27*	*Russia*	*Rest of Annex I*	*China*	*India*	*Rest of non-Annex I*	*Deforestation*
Base Year	*2008*	*1990*	*1990*	*2008*	*2012*	*2012*	*2012*	*2008*
Emissions in								
2012	0%	-8%	-20%	0%	0%	0%	0%	-3%
2022	-15%	-20%	-10%	-10%	8%	17%	13%	-30%
2050	-60%	-60%	-30%	-60%	-46%	8%	-23%	-80%

The assumed national emission reduction pathways result in cumulative emissions of 2,348 $GtCO_2e$ — close to the global cap of 2,337 to result in no more than 2˚C of warming. Note that the assumption behind the U.S. path is less stringent than the most recent proposal by president-elect Barack Obama stated at the Governors' Global Climate Summit on November 18, 2008. The goal for the U.S. is to reduce emissions by 80% below 1990 levels by 2050. (Table 2 assumes emission reduction goals of 60% below 2008 levels by 2050.) If the U.S. follows president-elect Obama's stated target and the EU and Rest of Annex I follow suit, available physical headroom would equal 60 $GtCO_2e$, up from 50 $GtCO_2e$ now.

Glossary/Acronyms

Absolute emissions limits	Limits on total emissions, rather than on emissions per unit of economic output
CDM	Clean Development Mechanism
CIB	Clean Investment Budget
CLEAR	Carbon Limits + Early Action = Rewards
CO_2e	Carbon Dioxide Equivalent
Docking station	A mechanism to speed the participation of countries in a global carbon market and smooth the path for them to accepting binding caps on greenhouse gas emissions.
Emerging economies	Transitional or developing economies that have not adopted caps on emissions under the Kyoto Protocol
GHG	Greenhouse gases. For this report, the six Kyoto gases: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6).
Headroom	The remaining space under a 2°C pathway for developing countries to emit above current levels before their GHG emissions need to start decreasing.
IPCC	Intergovernmental Panel on Climate Change
Intensity target	Limit on emissions per unit of economic output, rather than on total (absolute) emissions
Leakage	An increase in emissions outside of a project, sector or country that occurs as a result of an environmental policy relating to that project, sector or country.
LUCF	Land Use Change and Forestry
No-lose sector targets	Provision by which developing countries would not face compliance penalties for failing to meet sectoral targets.
ODA	Official Development Assistance
REDD	Reducing Emissions from Deforestation and forest Degradation

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