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Climates of Change: Sustainability Challenges for Enterprise

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International carbon finance and the Clean Development Mechanism

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I. Introduction

Many of the opportunities to reduce emissions at relatively low cost are located in developing countries. It appears that these opportunities must be seized to keep atmospheric carbon dioxide (CO_2) concentrations from exceeding the 450–550 parts per million (ppm) range suggested by Stern (2007). But poor countries are not immediately capable of taking these opportunities;[1] they have other pressing priorities for their scarce resources. The simple conclusion is that rich countries must provide large-scale flows of 'carbon finance' to poor countries.

The international carbon-finance framework is thus at the heart of the global deal on climate change. The issues are complex. Carbon-finance transfers to poor countries are sometimes seen as compensation for harms caused by the emissions from rich nations. Others see international carbon finance as a 'cost containment' device, reflecting the relatively low-cost opportunities to prevent lock-in of fossil-fuel-based production and consumption. Yet others see carbon finance as an opportunity for low-carbon development. All these perspectives are involved in debates on the appropriate structure of the carbon-finance framework, adding complexity. Nevertheless, it is clear that for a 450–550ppm pathway to be attainable, the carbon-finance flows required to make the necessary emission reductions in developing countries are at least an order of magnitude greater than the flows occurring today.

A global deal on climate change must therefore create a framework to deliver funds efficiently, effectively, and fairly. Three key questions underpin the design of the international carbon-finance

[1] This is not to suggest that developing countries are not taking any action to reduce emissions. There is lively discussion concerning 'nationally appropriate mitigation actions' (NAMAs).

regime. First, roughly how many emission reductions should be paid for by rich nations—what is the scale of the financial flows? Second, what mechanisms should be employed to raise the necessarily funds? Third, how should the funds be allocated. The second and third questions are the main subject of this paper.

The answers are not obvious. The first question, concerning the scale of financial flows, requires both empirical and normative analysis, along with an awareness of political reality. A rough order-of-magnitude estimate might be advanced as follows. In order to reach a 450ppm pathway, it is argued that reductions by developed countries of 25–40 per cent compared to 1990 levels are required by 2020, alongside a slower increase in emissions from developing countries, so that by 2020 emissions are around 15–30 per cent less than business-as-usual (BAU) (IPCC, 2007*d*; European Commission, 2009). Depending on the specific BAU scenario, this involves reductions of up to 10 Gt carbon-dioxide equivalent (CO_2e) per annum to occur in the developing world by 2020 (Höhne and Ellermann, 2008). As noted above, developing countries are only able and willing to pay for a portion of those reductions, and to bridge the gap the rich world would need to provide carbon finance for up to 5 GtCO_2e annually.

The corresponding carbon financial flows are non-trivial. Even allowing for the fact that many of these reductions in developing countries might be secured at relatively low cost, the incremental financing flows required are at least in the order of many tens of billions of euros per annum. Indeed, the total carbon finance required is likely to be in the hundreds of billions of euros annually.[2]

By way of comparison, fossil-fuel subsidies are estimated to stand currently at over US$300 billion per annum, of which US$220 billion per annum is in 20 non-OECD countries (Barbier, 2009).[3] Eliminating these subsidies is difficult because they are often hidden, supported by powerful vested interests, and perceived (often inaccurately) to help the poor and to support energy security. Yet there are some phase-out success stories, and cancelling these subsidies alone would be expected to reduce emissions by 6 per cent (Barbier, 2009) and would raise public funds in the same order of magnitude as the carbon-finance flows required.

So the carbon-finance task is not necessarily impossible: governments intervene in and distort energy markets for alleged social purposes to a much greater extent every year. And nor are we

[2] Stern (2008) estimates that achieving climate stabilization would imply annual flows from developed to developing countries of up to US$100 billion by 2030. Project Catalyst (2009) estimates that €55–80 billion p.a. will be required in incremental financing flows, on top of €130 billion p.a. in incremental capital investment, averaged over the 2012–20 period, in order to achieve eventual stabilization at 450ppm.
[3] Russia alone has US$40 billion in energy subsidies annually, mostly for reducing the consumer price of natural gas, with Iran's energy subsidies at a similar level. China, Saudi Arabia, India, Indonesia, Ukraine, and Egypt each have subsidies in excess of US$10 billion per year.

starting from scratch on climate finance. Several mechanisms are already in place, including one market-based approach and a multilateral fund. By far the largest mechanism for delivering carbon finance from rich to poor countries to date has been the Clean Development Mechanism (CDM), which was incorporated into the Kyoto Protocol at the urging of US negotiators. The CDM operates as a ‘no-lose’ mechanism for poor countries; reductions in emissions from BAU may be eligible for credits, but poor countries are not obliged to make any specific reductions. The mechanism is expected to deliver around 300–400m Certified Emission Reductions (CERs) annually over the 2008–12 period, corresponding to international carbon financial flows of several billion euros annually.[4] This is not a bad start. But comparisons with the necessary reductions and financial flows discussed above indicate that international carbon finance need to be scaled up by at least an order of magnitude over the 2012–20 period.

In scaling up international carbon finance, several important problems need to be addressed. The CDM, while promising, is a long way from being a ‘first-best’ market mechanism, and reform is clearly needed. The problems are relatively clear: setting BAU baselines is dogged by uncertain and asymmetric information, there are potentially unhelpful dynamic incentives, and perverse interactions with national policies. Additionally, the allocation of funds through a market, at market prices, reduces the ‘carbon leverage’ of the system, or the tonnes of emission reductions delivered per euro of carbon finance.

Unfortunately, experience with multilateral carbon funds has been significantly less successful. The UN Global Environment Facility (GEF), for instance, is centralized, donor-dependent, faced with continuing political disputes,[5] and has simply been unable to raise and allocate carbon finance at anywhere near the level of the CDM.[6] Furthermore, poor countries have little reason to feel confident in proposals that rely upon directly raising public funds from rich-country treasuries—the difficulties in extracting resources for Overseas Development Assistance (ODA) for the Millennium Development Goals serves as one warning, but there are many other examples of solemn pledges that are blithely broken when the time comes to deliver.

This chapter addresses the design of an international carbon-finance framework for the 2012–2020 period, with a focus on CDM reform and its complements and substitutes. It does not address financing for adaptation, or research and development of low-carbon technologies, or avoided

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[4] The CDM and Joint Implementation (JI) combined are estimated to have generated annual investment of US$4.5–8.5 billion, and leveraged 10 times as much in overall investment from the private sector, so that overall investment stimulated by CDM and JI is US$45–85 billion.
[5] See Fairman (1996) for some of the early issues, and Carbon Trust (2009).
[6] According to the UN Framework Convention on Climate Change (UN FCCC, 2008*b*), total funding since the establishment of the GEF in 1991 amounts to over US$2 billion, or about US$0.22 billion per year. However, it is estimated that the GEF leverages public- and private-sector financing at a level of US$1.15 billion per year.

deforestation. Section II outlines how the CDM works, and reviews performance to date. Section III assesses the challenges faced by the international carbon-finance framework. It focuses on three key areas where the CDM has been less than perfect: environmental integrity; scale; and the provision of 'carbon leverage' to maximize the carbon 'bang for buck'. Section IV examines possible future directions of the carbon-finance framework. Incremental reform options are examined, such as improvements to staffing, governance, and the rules and functioning of programmatic CDM. More radical options are also considered, including CER discounting a sectoral approaches. Finally, altogether new institutional approaches are briefly discussed. Section V concludes.

II. Review of the Clean Development Mechanism

(i) Overview

The CDM was established under Article 12 of the Kyoto Protocol to support projects that reduce emissions in poor countries (so-called 'non-Annex 1' countries) and contribute to 'sustainable development'. The mechanism allows rich countries (so-called 'Annex 1' countries) or their firms to purchase CERs from projects in non-Annex 1 countries, provided the project employs approaches and technologies approved by the CDM Executive Board (CDM EB), in Bonn, Germany. CERs are only created if the project is approved by the two host countries (one from Annex 1 and one from non-Annex 1) and the CDM EB, whose approval is given after the project has satisfied a number of different procedural stages including 'validation', 'registration', and eventually 'issuance' of CERs (Hepburn, 2006). In particular, the emissions reductions must be judged by an independent verifier to be real, measurable, and 'additional' to any that would occur in the absence of the certified project activity.

Highly technical debates over this last concept of 'additionality' have generated a vast number of 'methodologies' to assess whether reductions would or would not have occurred without the CDM. As of 1 March 2009, almost 300 methodologies had been officially submitted to the CDM EB, and 120 different methodologies had been approved for use. The time and intellectual effort required to develop and agree these methodologies initially caused significant delays and frustration for market participants. Compounding this, the CDM EB was initially badly resourced, and inadequately staffed by part-time government secondees. In more recent times, however, the flow of fees from CER registration and issuance has enabled the CDM EB significantly to increase staff to more than 70 employees, allowing greater delegation of tasks and hopefully also improving consistency and speed of decision-making.

While it is tempting to see the cost of establishing these methodologies as a particular bureaucratic disadvantage of the CDM, the same conceptual issues arise under any 'no-lose' mechanism, where emissions reductions are determined relative to a BAU baseline.[7] Recognizing this, CDM methodologies now often serve as a point of reference for other schemes, including JI (another Kyoto flexible mechanism) and new schemes under development in the USA and elsewhere. In other words, the problematic aspect is the specification of baselines, which under the CDM are defined by BAU. Designing and implementing a comprehensive cap-and-trade scheme would make this problem easier, but does not escape the need to set baselines, which are defined in negotiations over the cap and the allocation of allowances between regulated entities. As we have seen in the EU Emissions Trading Scheme (ETS), this process can be far from straightforward.[8]

(ii) Performance to date

Despite the institutional bottlenecks and the time required to refine the inherently difficult notion of ‘additionality’, the CDM has actually been one of the success stories of the Kyoto regime. As at 1 March 2009, there were 4,660 CDM projects in the system, of which 1,424 had achieved registration with the CDM EB and 473 had issued CERs. Indeed, there has been a veritable explosion of project activity since the Kyoto protocol entered into force on 16 February 2005. Figure 1(*a*) shows projected CERs to 2012 from all projects by technology type. Notable is the market’s initial focus on hydrofluorocarbon (HFC) and nitrous oxide (N_2O) gases, which have a high global-warming potential and provide an extremely cost-effective way to reduce tonnes of CO_2e. By December 2006, however, these opportunities had been all but exhausted, and Figure 1(*a*) shows that attention then moved to renewable energy projects, in particular wind and hydro. Other projects have focused on industrial reductions (e.g. cement, coal-mine methane), energy efficiency, and fuel switching, where the project-level carbon price signal provided by the CDM is well-suited to encouraging changes in firm behaviour. In contrast, the mechanism is poorly suited to more distributed activities in forestry, agriculture, transport, and building efficiency, where there has been hardly any progress under the CDM.

Figure 1(*b*) shows projected CERs by host country. After a slow start, China has now captured over 50 per cent of the CER market, driven by strong institutional support provided through the Chinese National Development and Reform Commission (NDRC), which requires Chinese asset owners to partner with a buyer from an Annex 1 country in the development of the project. Chinese firms have benefitted from this partnership with Western and international firms. By way of contrast, no such requirement is imposed in India, where project owners often attempt to bring projects though the UN FCCC system without outside assistance. Volumes are correspondingly lower. It is also notable that Africa only has around 2 per cent of the projects in the system, which

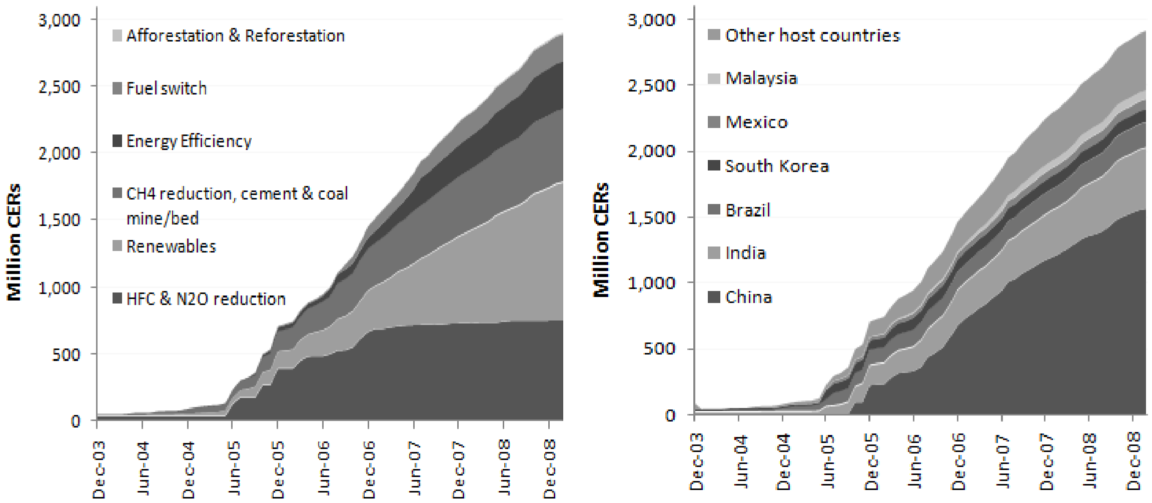
[7] For instance, a multilateral fund allocating finance between projects would also want to assess whether the projects would have happened anyway, without the funding, and hence the same issues of ‘additionality’ arise.

[8] Many economists argue that auctioning the allowances provides a superior solution along several dimensions: Hepburn *et al*. (2006*b*) provide a summary of the arguments, which include avoidance of the ratchet effect identified by Freixas *et al*. (1985).

might be seen to be disappointing, given that the mechanism was intended to promote sustainable development.

Figure 1: Accumulated CERs projected to deliver before 2012 by (*a*) project type; (*b*) host country

(*a*) **(*b*)**



Notes: Charts show the total CERs to be generated to 2012, based on estimates in the Project Design Document (PDD), and include volumes from all projects across all stages of the project cycle, from beginning validation through to issuance. Volumes are included from the date the project began its public-comment period in validation (marked on the horizontal axis).
Source: UNEP Risoe (2009).

Actual deliveries of CERs are anticipated to be much lower than the simplistic estimates from Project Design Documents (PDD) shown in Figure 1. Downward revisions are appropriate to allow for: project delays in construction; optimism bias in performance once the project is up and running; procedural delays; and decisions by the CDM EB to reject more projects than originally anticipated. Indeed, compared with the 3,000m CERs in Figure 1, industry forecasts for delivery between 2008–12 tend to be somewhere in the range estimated by the World Bank of 1,400–2,200m CERs, or roughly 300–400m CERs annually (Capoor and Ambrosi, 2008). By comparison, at 1 March 2009, 250m CERs had been issued.

Overall, the CDM has been surprisingly successful at delivering vast numbers of emission-reduction projects in key countries around the world. It has mobilized substantial amounts of private capital, and even with the various discounts discussed above, it will deliver substantial emission reductions. Furthermore, anecdotal evidence suggests the CDM has stimulated many emission-reduction projects that ultimately never went on to receive carbon finance because, after financial analysis, it turned out that the projects were already profitable without the CDM. However, the CDM has been significantly less successful at 'reputation management' and as the number of projects has grown, so, too, has the criticism in the public press and from parts of the academic community which are examined in section III.

III. Challenges for carbon finance post-2012

Criticisms of the CDM have been varied, but the important challenges tend to have been focused on three areas.[9] First, the environmental integrity of the emission reductions has been questioned, with the suspicion that some proportion of the credited activity would have happened even without the CDM. In other words, critics argue that a proportion of the CERs generated are not ‘additional’. Second, while the private-sector response to the CDM has exceeded expectations, the mechanism is only capable of around 400 project registrations each year, and reductions of 300–400 $MtCO_2e$ annually are an order of magnitude lower than the 5 $GtCO_2e$ annual reductions required in a post-2012 carbon-finance framework. Third, debate continues over the desirability of the fact that early entrants have made substantial profits from cheap projects, such as those destroying HFC-23 gases. Constraints on the willingness and ability of the rich countries to transfer finance to poor countries, particularly in a financial crisis and a recession, imply that rents should be minimized where possible, to maximize funds flowing directly to reducing emissions, and to increase the ‘carbon leverage’ of the finance provided. We consider these three criticisms in turn.

(i) Environmental integrity

Additionality

There is a fundamental asymmetry of information between CER project developers and the market regulator, the CDM EB. The CDM EB is reliant upon the project developer, and the independent verifiers, to provide an accurate assessment of the BAU scenario. The project developer must show that the project is not BAU, because of financial or other barriers to investment. The BAU is always uncertain, but the project developer is likely to have a better grasp of the most realistic BAU scenario than the CDM EB does from Bonn.

The consequences of uncertain and asymmetric information would be expected to be adverse selection (Akerlof, 1970). Non-additional projects are cheaper (since they were going to occur anyway), so the greater the information asymmetry, and the less reliable the verifiers, the higher the proportion of non-additional projects. While the independent verifiers conduct detailed (and expensive) checks of the project data and the plausibility of its baselines, guaranteeing the ‘additionality’ of all of the 4,660 projects in the system is impossible, and few would disagree that CERs have been awarded to projects that would have occurred anyway.

[9] This chapter does not address criticisms that non-Annex 1 host countries are not taking the requirement of ‘sustainable development’ seriously, which are outlined and addressed by Hepburn (2007), Boyd *et al.* (2007), Olsen (2007), and Schneider (2007). See also Wara (2007) and Wara and Victor (2008) for criticisms related to environmental integrity and rents.

In many policy contexts, this is not necessarily considered to be a bad outcome. For instance, feed-in tariffs to incentivize renewable energy, commonly used in the USA, Germany, and other nations, pay generators irrespective of whether their renewable energy is ‘additional’ to what otherwise would have occurred. Payment is made simply for the provision of renewable energy to the grid. By increasing the returns of renewable generation, the policy encourages entry to the industry, and provides a stable price signal that encourages investment.

The CDM is arguably more economically efficient than a feed-in tariff, because in addition to providing payments to encourage provision of a desirable good (emission reductions), the payment is only made if the good would not have otherwise been delivered. However, the CDM is held to a higher standard than a feed-in tariff for the simple reason that it is an offset mechanism. The issuance of CERs allows for an increase of emissions by the (Annex 1) country or firm that purchases the credits. As such, if CERs are issued when emissions have not actually been reduced, the net result is an increase in global emissions.

Perverse policy incentives

Projects mandated by law are arguably not ‘additional’ if the law requires them to occur irrespective of whether they receive carbon finance from the CDM. In theory, therefore, the CDM could create perverse incentives for national governments to delay the introduction of policies to reduce emissions, to ensure their firms remain eligible for CERs. Concerns about these potential policy disincentives have been expressed by many commentators (Samaniego and Figueres, 2002; Figueres, 2004; Cosbey *et al*., 2005; Bosi and Ellis, 2005).

For these reasons, the CDM EB introduced two rules in 2004 to prevent countries from obtaining more CERs by passing bad environmental laws.[10] First, the ‘E+ rule’ states that the CDM baseline should ignore policies or regulations implemented since December 1997 that favour emissions-intensive activity. This reduces the perverse incentive for a host country to increase emissions, and then reduce the same emissions with support from the CDM. Second, the ‘E– rule’ states that the baseline should ignore policies or regulations implemented since November 2001 that favour less emissions-intensive activity. This reduces the perverse incentives for a host country not to reduce the baseline emissions. While the implementation of these two rules has not been perfect (Michaelowa *et al.*, 2008), they do reduce incentives for bad policy.

But there is a trade-off between a strict implementation of the E– rule and the notion of additionality. For instance, China’s renewable energy programmes have helped support a

[10] The Executive Board clarification of the E+/E– rules occurred at their 16th meeting, available at http://cdm.unfccc.int/EB/016/eb16repan3.pdf

significant increase in wind- and hydro-power projects. Under the E– rule, which protects China's incentive to roll out these policies, the renewable energy programmes are ignored for the purpose of determining CDM eligibility. Critics therefore argue that some renewable projects that have received CERs actually would have happened without the CDM, because of China's renewable-energy support policies.

(ii) Scale

As set out above, the post-2012 international carbon-finance framework needs to generate genuine emission reductions in the developing world, paid for by the developed world, of up to 5 $GtCO_2e$ annually. The current capacity of the CDM is around 300–400 $MtCO_2e$ annually. Similarly, the total financial value of activity stimulated by the CDM was estimated in 2008 to be around US $33 billion (Capoor and Ambrosi, 2009), of which only US $7 billion was for primary CER purchases, while the net financial flows required from developed to developing countries are in the tens of billions, if not greater. In other words, the international carbon-finance framework needs to be scaled up by an order of magnitude.

The consequences of the mismatch in scale of the problem and the solution are already beginning to be felt. For instance, the CDM has so far achieved relatively little to stop investment in high-carbon capital assets, which will be locked in for decades. China, in particular, despite its strong renewable programme, is well known to be increasing coal-fired power-generating capacity, most of which is likely still to be operating in several decades, and which may be costly to retrofit with carbon capture and sequestration (CCS) technology.

Scaling up the carbon-finance framework requires consideration of both the supply and the demand side of the equation. There is little point in constructing a mechanism able to supply up to 5 $GtCO_2e$ annually in carbon offsets from developing countries if developed countries do not create demand for the offsets and stand willing to pay for them. Demand for emission reductions (and the money to pay for them) might come through tighter developing-country targets with provision for greater use of offsets, auction revenues from EU allowances (EUAs) or 'assigned amount units' (AAUs), a levy on aviation and/or maritime emissions, or directly from public balance sheets. However, experience suggests that there will be many other political demands placed on publically accessible sources of funds, and that using the market may offer the most politically realistic alternative to create demand and funds to pay for emission reductions in developing countries.

(iii) Leverage and rents

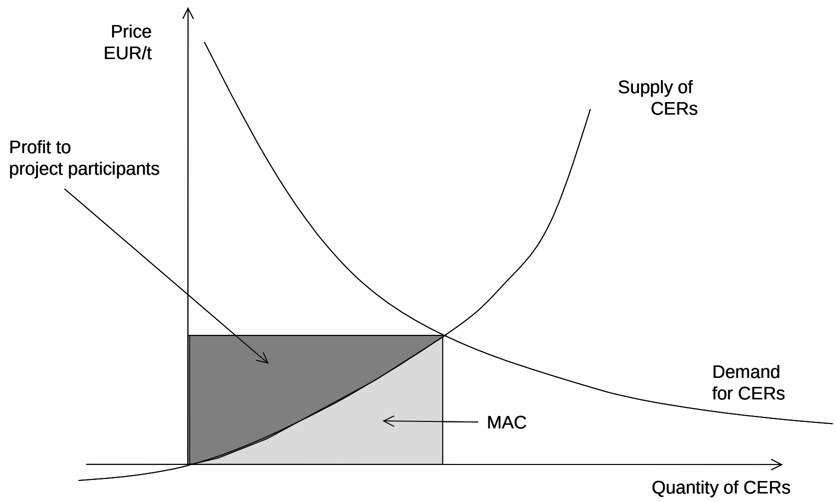
Given the limitations on developed countries' willingness to pay for emission reductions, it is vital that the funds available are spent effectively and are fully leveraged by private sector capital.

Wagner *et al*. (ch. 19) argue that there are two forms of leverage: ‘carbon leverage’, which amounts to price discrimination such that project developers are paid their marginal abatement cost, and ‘financial leverage’, which is traditional leverage of carbon-related assets and expected revenue streams to raise debt and/or equity for emission-reduction projects.

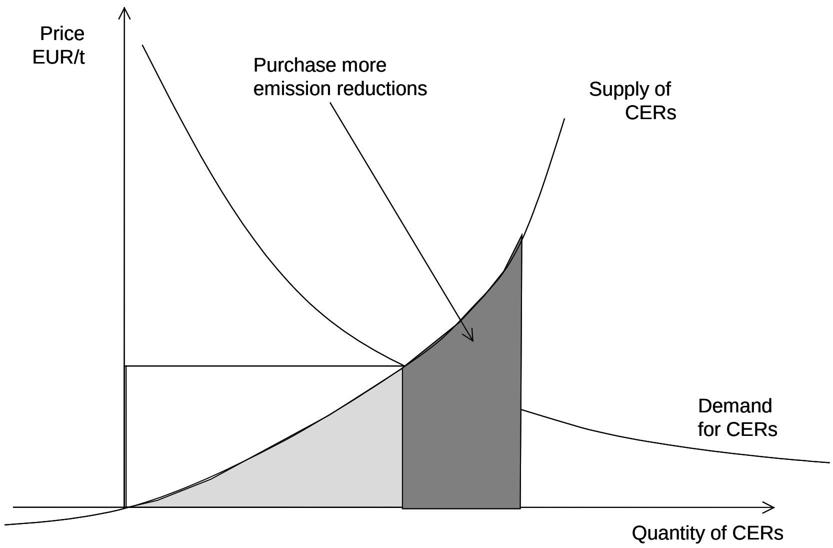
The CDM in its current form does not provide a particularly high degree of leverage. It rewards project developers on the basis of market prices, set through the interaction of supply of CERs, demand for CERs, and government interventions in the market, such as the unofficial Chinese floor price for CERs. As in any market, the market-clearing price can be substantially above marginal cost, creating economic rents, or excess profits, shown in Figure 2. These rents flow partly to project developers in poor countries, but also to financial intermediaries who add value, bear risk, but also profit from information asymmetries.

Figure 2: Price discrimination would reduce rents and increase ‘carbon leverage’

(*a*)



(*b*)



There is nothing particularly surprising about a market generating profits for project developers who are able to reduce emissions. This is how markets work. However, using a market mechanism limits the potential for price discrimination, which is relevant when the funds available to pay for emission reductions are limited. For instance, Annex 1 governments could capture some of these rents, and reallocate them to purchase more emission reductions, as shown in Figure 2(*b*).

To some extent, China already does this. For instance, it has introduced two measures designed to retain the profits from the CDM within the country:

– The ‘unofficial’ CER floor price of €8–9;

– A tax on CER projects at different rates to reflect the size of the rents available to international buyers, on the basis that CERs are ‘national resources’. Tax rates are 65 per cent on HFC and perfluorocarbon (PFC) projects, 30 per cent on N_2O projects, and 2 per cent on renewable and other projects, with the revenues going to promote ‘sustainable development’.

As discussed above, however, governments do not have perfect information on marginal abatement costs, therefore paying just a small amount more than the marginal abatement cost for emission reductions is not possible unless a mechanism were introduced to induce developers to reveal their marginal abatement costs and a buyer’s cartel was formed. This is easier said than done, given the potential for gaming and perverse incentives, as discussed in section IV(iv), *Monopsonist carbon bank/fund*.

Even if perfect price discrimination were possible, it may not be desirable. Allowing rapidly-moving firms to initially make high profit margins does serve several useful functions: (i) it compensates new project developers for the risks involved in attempting to take projects through the (uncertain) CDM EB processes; (ii) it creates publicity and spreading awareness of the economic merits of reducing emissions; and (iii) it induces new entrants who compete away profit margins.

Those concerned by profits under a market-based approach are likely to favour a more centralized multilateral funding approach. An example is the World Bank’s new Climate Investment Funds, which have had over US$6 billion pledged from rich donor countries.[11] The Climate Investment Funds are intended to provide a source of interim funding through which the Multilateral Development Banks will provide additional grants and concessional financing to developing countries to address urgent climate-change challenges. Time will tell whether the Climate Investment Funds succeed, but initial signals are relatively positive. In contrast, experience with the UN GEF is less encouraging. The GEF has been constrained by politics, and the Carbon Trust (2009) concludes that its centralized funding approach is not credible as the primary means for allocating carbon finance on the required scale.

[11] See http://www.worldbank.org/cif

IV. Future directions

Critics of market-based approaches are often unable to propose a credible and politically feasible alternative, lending support to the view that the underlying problem is intrinsically challenging. Indeed, much of the discussion has been focused on reforming, and adding to, the existing CDM, rather than replacing it entirely with some other framework.

Nevertheless, given the challenges experienced to date, it is clear that both CDM reform and additional carbon-finance frameworks will be needed. In particular, the CDM delivers a relatively low degree of 'carbon leverage', although the creation of a tradable asset (the CER) has enabled innovation in traditional forms of financial leverage. As noted above, the CDM in its current form is not particularly well suited to delivering emission reductions in forestry, agriculture, transport, and buildings. Other mechanisms and instruments need to be developed that are better adapted to these challenges.

(i) Criteria

Any new or reformed carbon-finance framework needs to improve upon the CDM's performance on the three issues discussed above: environmental integrity (section II(i)); scale (section II(ii)); and maximizing 'carbon leverage' (section III(iii)). In addition to these three, there are another two criteria to bear in mind.

Economic efficiency: The framework should remain as efficient as the CDM is now, in that the market seeks out the cheapest reductions.[12] Reformed or new schemes should aim to preserve efficiency to the extent possible. As a general rule, the greater the political involvement in decision-making over the allocation of funds, the less likely economic efficiency will be achieved. Similarly, the framework should ensure that the incentives reach the specific people and firms making decisions. Multilateral or sectoral funding scheme are clearly inefficient if funds get lost within corrupt governments, diverted to other purposes, or generate diluted incentives for actual decision-makers.

Transitional/dynamic incentives: Because the current CDM does not generate emission reductions above and beyond developed-country targets, it can only ever serve a transitional function to some other arrangement. At this point, it appears likely that this other arrangement will involve internationally linked cap-and-trade schemes, with political negotiations on allowances substituting for the challenges of establishing BAU counterfactuals. As such, an important aspect of the post-2012 carbon-finance framework must be that it supports the transition from an offset mechanism to the mobilization of global emissions reductions through cap-and-trade schemes.

[12] These six categories are not mutually exclusive—several of the other five categories impinge upon efficiency in one form or another.

The framework should support advanced developing countries to move towards developing their own schemes.

With these five criteria in mind—environmental integrity, scale, leverage, economic efficiency, and transitional incentives—we proceed to examine incremental and radical CDM reform options, and consider the potential role of new carbon-finance institutions.

(ii) Incremental CDM reforms

There is a myriad of small reforms to the rules and the functioning of the CDM that would improve the system. We focus on two of the more important issues here. First, resolving governance problems is central to the future performance of the CDM on the critical criteria of scale and integrity. Second, an important point noted in section II(ii) is that the CDM has largely failed to deliver on emission reductions from sources that are widely dispersed. We therefore briefly consider progress on ‘Programmatic CDM’, which is intended to incentivize distributed emission reductions.

Governance of the CDM EB

The part-time members of the CDM EB simultaneously perform regulatory, executive, and quasi-judicial functions, and preside over a market worth €13 billion in 2007 (Capoor and Ambrosi, 2008). The International Emissions Trading Association (2008) notes that it is ‘unlikely that any other regulatory agency charged with such responsibility and working on a global scale employs such a small workforce, works on such an irregular schedule, and has a board involved in case-by-case decision-making’.

Indeed, the workload required of the CDM EB has been truly enormous, and has only increased in recent months since the board subjected more submitted projects to reviews, and suspended the accreditation of Det Norske Veritas, one of the CDM verifiers. Even without the need to scale up the system by an order of magnitude, it is widely agreed that a wholesale upgrade of the governance and resourcing of the CDM EB was required. Staff numbers have been increased and consistency in decision-making has begun to improve (Michaelowa *et al*., 2008). Various proposals for separation of the different functions are now under consideration, as are proposals for the ‘professionalization’ of the board, and it is to be hoped that these issues are addressed irrespective of whether the more radical reform ideas come to fruition.

Programmatic CDM

Programmatic CDM was intended to allow large numbers of small, distributed projects, which are monitored and verified jointly (rather than on a project-by-project basis) using appropriate sampling of results. This is intended to reduce transaction costs and allow the CDM to support many small, geographically and temporally dispersed activities where there are a large number of project owners (e.g. individual households). Examples of a Programme of Activities (PoA) include distribution of energy-efficient compact fluorescent light bulbs, or efficient or solar-powered cooking stoves to replace biomass cooking. While individually small, the large numbers of units in a programme can sum to significant reductions.

There are several constraints currently restricting the growth of programmatic CDM, and several parties, including the CDM EB and the Conference of the Parties (COP), are already working on removing these constraints to allow Programmatic CDM to make a more significant contribution. Key roadblocks include: the restriction on the use of one methodology per PoA; the low number of appropriate methodologies for programmatic CDM; the requirement of revalidation of the PoA if the baseline methodology is revised; and the problem that third-party validators are unwilling to accept substantial liabilities created by the current system (Michaelowa *et al*., 2008). Efforts to improve Programmatic CDM are clearly welcome, and there is no reason not to continue to expand the possibilities of Programmatic CDM.

(iii) Substantial CDM reforms

There are several more substantial reform ideas that build upon the experience to date with the CDM. We consider two of them. First, discounting CERs from economically advanced and/or high emitting countries, or from technology types that are relatively low cost might provide a form of carbon leverage and generate incentives for transition to wider cap and trade. Second, sectoral approaches, involving industry benchmarks, promise to radically simplify the CDM's 'additionality' requirements, and would simplify the transition to international cap and trade.

CER discounting

The CDM currently functions on a 'commodity' basis, where every tonne of CO_2e reduced yields one CER. Discounting CERs, proposed by Chung (2007), would reflect a move from a 'commodity' to a 'currency' basis, because one CER would potentially represent more than one tonne of CO_2e reduced, providing a clear and direct form of 'carbon leverage'. Discount factors for CERs might be set proportional to the level of *per capita* emissions and *per capita* GDP of a host country, or as a function of specific technology types.

For instance, Michaelowa *et al*. (2008) estimate that discounting CERs from countries with *per capita* emissions and GDP above world average levels could reduce CER supply by around 6 per cent over the 2013–20 period. Discounting CERs from countries above *half* the world average could reduce supply by around 28 per cent.

Some of the possible functions of CER discounting might be the following:

- reduce rents flowing to projects where marginal abatement costs are much lower than the market price, through a technology-specific discount rate (e.g. on HFC projects);
- increase carbon leverage for emission reductions from advanced emerging economies;
- provide a transitional incentive for more advanced developing countries to take on emissions caps (Chung, 2007; Michaelowa *et al*., 2008). As the discount rate on CERs increases, countries would have a stronger incentive to join a cap-and-trade scheme to receive full credit for their reductions.[13]

At the aggregate level, discounting could potentially work to increase environmental integrity of the system. Suppose that only 50 per cent of claimed tonnes of CO_2e are additional. Suppose further that CER discounting requires 2 tonnes of CO_2 in order to receive one CER. Then, in the aggregate, discounting would ensure that the CDM was not increasing net emissions and would guarantee environmental integrity.

At the project level, however, discounting will probably have a negative, or at best neutral, effect on additionality. By definition, non-additional projects do not need the carbon finance (as they would have occurred anyway), and because their incremental costs of reducing emissions are zero, they would be willing to 'sell' their CERs for trivially low prices. As prices fall, the proportion of non-additional projects would thus be expected to increase.[14] Discounting CERs weakens the effective price paid per tonne of CO_2e reduced, which would be expected to reduce the number of additional projects taking place. In contrast, a lower effective carbon price would not be expected to reduce the number of non-additional projects, because these projects were not relying on CER revenue in the first place.

In other words, discounting is likely to increase the proportion of non-additional projects. The greater the discount rate on CERs, the larger the endogenous reduction in the proportion of additional projects. In the limit, as the CER discount rate approaches 100 per cent, the proportion of non-additional projects also approaches 100 per cent. Empirically assessing the scale of this perverse effect is important. For instance, suppose it is believed that the percentage of non-additional projects is 20 per cent, prior to the introduction of CER discounting. From a policy perspective it matters enormously whether CER discounting at a given rate would increase the non-additional percentage to 25 or to 75 per cent, and more research is needed here.

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[13] Whether this incentive was greater than the general incentive to free-ride on others' actions would depend rather strongly on the level of the cap. For a general treatment of related issues, see Barrett (1994).

[14] A counterargument is that, at present, some of the lowest-cost means of abatement (e.g. HFC 23 destruction) are also the most certain to be additional—the CER revenue is the only reason that these projects would be carried out. In contrast, some critics assert that renewable energy projects, which appear to be high-cost projects, are non-additional because they are already profitable after government incentives and revenue flows from power generation.

CER discounting has the advantage that it may be used in combination with several of the other reform options discussed in the following sections. It has the disadvantage that it would require setting specific discount rates, which would presumably be subject to intensely political negotiations.

Sectoral approaches

As of March 2009, the signals from the EU suggest that international carbon finance will most likely be scaled up by moving to a simpler, more ‘wholesale’ framework that is based on sectoral benchmarks (Delbeke and Zapfel, 2009). Under sectoral approaches, firms would receive credits for reducing their emissions intensity per unit output below a particular benchmark. Standardized emissions-intensity factors for specific sectors could speed up the approval and crediting process. In the short term, the framework would remain a ‘no-lose’, or one-sided, mechanism, so that developing countries receive benefits for reducing emissions but do not get penalized for BAU. As such, the benchmarks could be set very ambitiously.

Advantages to a sectoral approach might include (Bodansky 2007):

- broaden participation;
- simplify negotiations;
- target critical areas (e.g. lock in);
- address competitiveness.

There are two main sectoral approaches. The first approach, often called ‘sectoral CDM’, envisages granting CERs to projects/installations which perform better than the ‘additionality benchmark’ defined for their sector. Project characteristics, such as technology choice and whether the plant is old or new build, might be included. Determining eligibility based on a benchmark represents a move away from the strict concept of additionality, and towards an instrument that looks closer to a feed-in tariff, as credits would automatically be given to all those private actors producing more efficiently than the baseline, irrespective of whether the carbon finance was required. Determining the optimal stringency level of the ‘additionality benchmark’ is important. If the benchmark is too difficult to achieve, project developers will not bother to attempt to reduce emissions, while if the baseline is too loose, large volumes of non-additional CERs will be created. A stringent benchmark has the merit of reducing Type I errors (false positives) by rejecting non-additional projects, but it also increases Type II errors (false negatives) by rejecting additional projects.

Although sectoral benchmarks to determine *eligibility* represent a major change from the CDM as we know it, benchmarking *per se* is not unknown in the current CDM. It is already used in the power sector to determine the *quantity* of credits issued to eligible projects. This distinction between a ‘crediting benchmark’ (used to calculate the number of credits to be issued) and an ‘additionality benchmark’ (used to determine eligibility for credits) is important, and there may be advantages to conceptually separating the two. For instance, a tight ‘additionality benchmark’ might be married with a looser ‘crediting benchmark’, to minimize the proportion of non-additional projects, and to ensure that projects clearing the additionality hurdle are paid an adequate incentive.[15] The technicalities referring to baselines, monitoring, and verification, as well as the supervision and approval, would continue to be overseen by the CDM EB, but it would be likely that a relevant international industry association would conduct the analysis to support negotiations on appropriate benchmarks.

The second approach, called ‘sectoral no-lose targets’, envisages sectoral CDM covering a whole sector of a country *as a single CDM project*. CERs would be granted to *governments* for implementing policies and measures to reduce emissions in the sector, provided that emissions fall below the national sector baseline (for example, expressed as the emission intensity of the sector as a whole). Governments would agree sectoral benchmarks at COP level (rather than at the CDM EB level as in the sectoral CDM approach), and governments, not firms, would be granted credits for emission reductions relative to these sectoral benchmarks. This has the disadvantage that the incentives are not faced directly by firms, and it remains up to national governments to implement appropriate policies domestically. If emissions in the sector exceeded the baseline, there would be no legal consequences; however, if emissions were below the baseline, then the state would receive emission-reduction credits that could be traded internationally.

A challenge with any sectoral approach is that confidential data are likely to be required in order to determine the appropriate level of the benchmark. Firms and countries may be reluctant to share these data, and if they do share data, firms with large market shares will have an incentive to inflate their emissions intensity figures to increase artificially the BAU emissions. Agreeing benchmarks is further complicated by the need to account for relevant local circumstances. For instance, production processes prevalent in each country and natural endowments of renewable energy will affect the feasibility of achieving particular benchmarks.

Benchmarks might work for industries that are the most emissions and energy intensive, such as refining, pulp and paper, metals, and cement. In sectors that are particularly subject to international competition, such as aluminium and steel, the benchmarks would probably mirror the efficiency levels expected from firms in industrialized countries (for example, those used in the allocation of

[15] There are also various problems with this idea of ‘double benchmarking’, which is, in fact, just a special case of a more generalized two-part tariff, commonly used as a price-discrimination strategy. Many of the problems arise from the discontinuous incentives created at the point of the additionality benchmark.

allowances in an emissions-trading scheme). In some sectors this might take the form of global sector agreements. Standardized benchmarks would help to reduce the risk of carbon leakage,[16] alleviate competitiveness concerns, and thereby help to preserve free trade in these sectors.

(iv) New carbon-finance institutions

In addition to the more substantial reforms of the CDM discussed in the previous section, there are various proposals for new (and in some cases complementary) carbon institutions. We look at two. First, we consider the notion of a monopsonistic 'carbon fund' or bank, to extract a portion of the economic rents from the CDM and leverage them to pay for further emission reductions. Second, we examine the appeal and feasibility of direct government-to-government deals on climate change.

Monopsonistic carbon bank/fund

Project Catalyst (2009) moots the establishment of a linked carbon bank and 'International Carbon Fund'. The carbon bank, acting under authority of the UN FCCC, would purchase offsets monopsonistically at or near their marginal abatement cost, and then sell the offsets on rich-country markets, capturing the spread between the two prices. The captured rents might be used to purchase yet more reductions (see section III(iii) above) or, as in the Project Catalyst proposal, could be passed to the International Carbon Fund to be allocated to other activities that reduce emissions. Some aspects of the proposal would look similar to the Multilateral Fund of the Montreal Protocol, which was established to pay developing countries to cover the agreed incremental costs of phasing out ozone-depleting substances and complying with the Protocol.[17]

Purchasing CERs at precisely their marginal abatement cost will, however, be impossible to achieve because of the asymmetric information problem discussed in section III(i), *Additionality*, above. A reverse auction might initially seem like a promising way to reveal truthful information on abatement costs.[18] However, auctions are unlikely to be able simultaneously to reveal private information about marginal costs and pay marginal costs.[19] But a formal reverse auction may not be necessary to achieve a rough-and-ready form of price discrimination. Approximate information on average abatement costs across regions and technologies is available through the workings of

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[16] Kallbekken (2007) estimates that the CDM in its current form has the potential to reduce the magnitude of carbon leakage by around 60 per cent.

[17] See DeSombre and Kauffman (1996) and updated information at http://www.multilateralfund.org/. Along similar lines, Wara and Victor (2008) briefly outline the idea of a climate fund for the USA and a cartel of developing countries.

[18] Indeed, reverse auctions and/or tenders are already employed by some national governments as part of their CER procurement processes. EU member states including the Netherlands (see http://www.senternovem.nl/carboncredits/), Austria (see http://www.ji-cdm-austria.at/en/portal/index.php), and Norway (Norwegian Ministry of Finance, 2008), have high-profile CER-procurement programmes.

[19] This is because if winning firms receive the amount they bid for their emission reductions, they face an incentive to bid strategically, rather than truthfully, and the auction design is then not incentive-compatible. See Klemperer (2004) for an overview of this and many other issues relating to auction design.

the existing carbon markets, and the bank/fund could simply procure CERs at a ‘developing world’ clearing price, before selling them on the developed-country carbon markets.

Irrespective of the merits of the specific carbon bank/fund proposal, procurement auctions and tender processes may have a useful role in purchasing emission reductions where current markets do not exist, such as in forestry or, indeed, the Montreal gases that are not currently included within the Kyoto Protocol.

Government deals

Victor and Wara (2008) propose a small number of government-to-government ‘deals’ as an element in a post-2012 regime, focusing on infrastructure development where money alone is inadequate. Jackson *et al.* (2006) provide two brief examples for nuclear technology in India and natural-gas-fired power plants in China. These proposed deals address climate change, energy development, and local pollution needs, and might be undertaken relatively cost-effectively.

However, the funds for these ‘deals’ are proposed to come directly from public-sector balance sheets in the developed world, which, as Hepburn and Stern (ch. 3) note, are already stretched. Rich countries already appear likely to fail to meet the Millennium Development Goal targets of 0.7 per cent of GDP by 2015. The political challenges of raising public funds to finance the growth of future industrial competitors may be insurmountable. Nevertheless, if public funds can be found, a limited number of large-scale government-to-government deals may provide a valuable contribution to reducing emissions.

V. Conclusions

Developing countries must be at the centre of a global deal on climate change. They are neither responsible for creating the problem, nor are they capable of immediately addressing it, given their limited resources. But much of the mitigation potential at low cost lies within developing countries, and unless rich countries provide the necessary carbon finance, substantial low-carbon opportunities will be missed and high-carbon assets will be locked into place, implying that a 450–550ppm pathway will be almost impossible to achieve without a major unexpected technological breakthrough.

Carbon markets, in a reformed form, represent the most feasible model for supporting private financial flows for the developing world to reduce its emissions on the scale required. The CDM has made a promising start, and is already providing carbon finance of several billions of euros to the developing world, contributing to reducing the costs of compliance in Europe and other developed countries. Carbon trading provides a legitimate and coherent rationale for financial transfers on the scale necessary to shift China, India, and other developing economies on to cleaner growth pathways. Leveraging the carbon markets is likely to be more reliable than looking to strained public-sector balance sheets in a context where the politics of transferring resources abroad for aid are difficult, let alone transferring funds to stimulate the low-carbon growth of future competitors.

Nevertheless, the international carbon-finance framework needs reform before it can be deemed ‘fit for purpose’. Five areas are critical—environmental integrity, scale, leverage, economic efficiency, and transitional incentives to international cap and trade. There is little doubt that the CDM, in its current form, performs well at achieving economic efficiency. However, the CDM is unable to achieve all five objectives across all sectors. A reformed programmatic CDM may contribute to providing incentives to reduce widely distributed emissions, it will nevertheless need to be complemented by other mechanisms and/or frameworks, at a minimum, to address forestry, agriculture, transport, and buildings.

Within the core areas of the current CDM, potential reform options range from the incremental to the radical. The four options reviewed here—governance reforms, programmatic CDM, CER discounting, and sectoral approaches—all have important attractions and, indeed, are not mutually exclusive. Governance reforms are required to enhance integrity and contribute to scale objectives. Programmatic CER increases the sectoral reach of the CDM. CER discounting would deliver on the requirements of carbon leverage and contribute to providing appropriate incentives to transition to international cap and trade. If funds are available, which seems unlikely, government-to-government deals on low-carbon infrastructure could sit alongside the post-2012 CDM. Whatever directions are taken at the UN FCCC, it is critical that the resulting carbon financial framework operates at the service of developing countries.

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