The Clean Development Mechanism in the future Climate Change Regime

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THE CLEAN DEVELOPMENT MECHANISM IN THE FUTURE CLIMATE CHANGE REGIME

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More detailed documents on several of the specific proposals were prepared by the authors, as referenced in the text and published as:

- Implementing the Bali Action Plan: What Role for the CDM?
  Authors: Benito Müller and Prodipto Ghosh

- Additionality in the Clean Development Mechanism: Why and what?
  Author: Benito Müller

- Subsidies for CDM: past experiences with capacity building
  Authors: Yuri Okubo and Axel Michaelowa

- Would preferential access to the EU ETS be sufficient to overcome current barriers to CDM projects in LDCs?
  Authors: Paula Castro and Axel Michaelowa

- Discounting of CERs to avoid CER Import Caps
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- The impact of CER discounting on the competitiveness of different CDM host countries
  Authors: Paula Castro and Axel Michaelowa

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Abstract

The Clean Development Mechanism (CDM) has exceeded all expectations with regards to the sheer number of projects – almost 5000 - and the volume of emission reduction credits (CERs) mobilized – more than 2.5 billion are estimated to accrue by the end of 2012. However, this impressive numerical success has also highlighted severe challenges that need to be tackled if the CDM is to play a significant role in the post-2012 climate policy regime. To date, CDM reform needs have always only been analyzed from an industrialized country viewpoint. To balance the discussion, we provide an African, an Indian and a Chinese perspective to CDM reform, each focusing on a different question. The African team has assessed the reason for the under-representation of Africa in the CDM and discusses various policy instruments that might improve participation of poor and Least Developed Countries. As India has been the leader of unilateral projects organized and financed by Indian business, the Indian team collected the grievances of Indian business regarding current CDM rules and their wishes for reform. China, the number one in the CDM market, has witnessed a massive emissions increase in the last years and thus is pressed in the negotiations to take up sectoral targets. The Chinese team thus assesses different types of sectoral CDM and uses the Chinese iron and steel sector to illustrate their advantages and disadvantages. Moreover, on a cross-cutting level key conceptual questions such as additionality and the design of a mechanism that retires CERs to achieve a contribution of the CDM to global reductions are discussed.

We find that neither discounting of CERs nor preferential CER sales conditions will enable Africa and LDCs to substantially increase their CDM market share. Therefore all attempts to introduce special rules for those countries will essentially be futile. Programmatic CDM will improve the situation but a necessary condition for any CDM take-off is the availability of domestic finance and the existence of entrepreneurs willing to take risks and understanding the technology. Thus a dedicated financing vehicle for CDM projects in LDCs would make a substantial difference.

The Indian study shows that unilateral project developers see the international regulations set up to safeguard the environmental integrity as obstacles to project implementation, particularly the additionality rules. There is a fundamental unease with the procedures and the continuous changes in rule interpretation by the regulators.

According to the Chinese team, sectoral approaches are not the magic bullet to solve all problems of the CDM but can selectively be applied to heavy industry. There are substantial challenges in data collection, definition of the sectoral target / baseline and allocation of revenues from CER sales due to the fact that the revenue does not directly accrue to the entity that reduces emissions.

Regarding the cross-cutting themes, the requirement of additionality is seen as unnecessary under the assumption that developing countries should be granted a surplus of emissions allowances if they took up an emissions target. Our analysis also shows that industrialized country mitigation at negative costs causes carbon leakage and therefore additionality testing should also be introduced in industrialized countries. This goes against the conventional wisdom that additionality testing is not necessary for projects done in capped countries. An approach to achieve a contribution of the CDM to global reductions is by requiring industrialized countries to retire a certain percentage of acquired CERs.

In a next phase of research, research teams from industrialized and developing countries should assess the necessary conditions for a successful design and use of sectoral mechanisms. Moreover, the possibilities for a contribution of the CDM to global emission reduction should be assessed, going beyond CER acquisition and retirement. Last but not least the requirements to shift financing from the unilateral to the bilateral solution envisaged when the CDM was invented would warrant an in-depth study.

The CDM will survive into the post-2012 climate regime. But we have it in our hands whether it contributes to development or whether it just benefits those who develop anyway.
1. Project setting

Axel Michaelowa

The purpose of this Climate Strategies project is to evaluate the record of the Clean Development Mechanism (CDM) to date and to consider ways it might be improved in the future international climate policy regime. It addresses experiences with and shortcomings of the CDM’s present project-based form. On this basis, proposals for improvement of the project-based CDM are made. Moreover, the potential for reform through programmatic or other enhanced forms of the CDM is assessed. A key feature of the project is trust building through active integration of project teams from key advanced developing countries and LDCs, as much too often CDM reform proposals are developed in the North without listening to those people implementing the CDM on the ground. Our project features three teams in regions that are key for the long-term success of the CDM, each focusing on a different aspect of the CDM relevant regarding the region’s circumstances. Africa, which has essentially been sidelined by the CDM to date is represented by Francis Yamba (Center for Energy, Environment and Engineering, Zambia). Indian private sector experiences are brought in by the Federation of Indian Chambers of Commerce and Industry (FICCI, represented by Prodipto Ghosh and Rita Roy Choudhury). China, the world market leader of the CDM, features Duan Maosheng (Tsinghua University). The project which started in mid-2008 is fully integrated in the pre-Copenhagen negotiation schedule. Side events were held at COP 14 in Poznan in December 2008 and the Carbon Markets Insights fair in Copenhagen in March 2009 to interact with negotiators and carbon market participants.

A novel feature of this project is a matrix structure, with looking at challenges in implementing the Clean Development Mechanism (CDM) in each region/country and deducting possibilities for reform in the context of the negotiations about the future climate policy regime. The African section assesses the reasons for the low participation of Africa and Least Developed Countries (LDCs) in the CDM and discusses policy instruments to improve their participation. As India has excelled regarding the participation of private sector entities who provide their own financing for CDM projects, the Indian team collected the grievances of the companies active in the CDM. China is currently in the focus of the move towards sectoral forms of the CDM. Thus, the Chinese team has looked at advantages and disadvantages of different forms of sectoral CDM against the backdrop of the Chinese iron and steel sector.

The industrialized country partners Oxford Institute for Energy Studies (Benito Müller) and University of Zurich (Axel Michaelowa and Paula Castro, with support from Kerstin Dietrich) provided input for overarching questions such as the role of additionality, incentives for CDM in Least Developed Countries (LDCs) and improving CDM management. A possible contribution of the CDM to the Bali Action Plan was elaborated jointly by Prodipto Ghosh and Benito Müller.

This final report consists of three major sections reflecting the different levels of aggregation of the CDM reform debate, followed by a section on overarching issues. The first section looks at the project-based CDM. It consists of five chapters. Chapter 2.1 gives a numerical analysis of CDM performance on an international level. Chapter 2.2 discusses why CDM has not been able to achieve a breakthrough in Africa. Chapter 2.3 shows the challenges Indian industry has faced in development of CDM projects. Chapter 2.4 analyzes possible incentives to promote CDM projects in LDCs, whereas chapter 2.5 discusses proposals for improvement of project-based CDM. The second section looks into programmatic CDM. Its chapter 3.1 assesses the current obstacles for CDM programmes whereas chapter 3.2 shows the challenges for CDM programmes in Africa, looking at dissemination of efficient stoves in Senegal and a biogas programme in Kenya. The third section covers sectoral CDM, a proposal which has become famous due to the EU request to replace the CDM by a “sectoral crediting mechanism”. Its first chapter 4.1 assesses the theoretic properties of four variants of sectoral CDM, while chapter 4.2 uses the Chinese iron and steel sector to illustrate the impact of each variant.

The final cross-cutting section consists of two chapters. Chapter 5.1 critically assesses the principle of additionality. A proposal to retire CERs and thereby achieve a contribution of the CDM to global reductions is developed in chapter 5.2.

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1 Any views about policy issues expressed are entirely those of the authors, as Climate Strategies does not take positions on policy issues
2. Project CDM — successes and shortcomings

The Clean Development Mechanism (CDM) has been operational for somewhat more than five years. The CDM is an unprecedented international market mechanism with a novel form of regulatory governance by a UN-based Executive Board (EB) which is supported by independent auditors (Designated Operational Entities, DOEs). The DOEs validate project documentation with regard to conformity with the CDM rules and verify emission reductions achieved by CDM projects. Once Certified Emissions Reductions (CERs) have been issued by the EB, they can be used by industrialized countries as compliance tools for the emissions commitments defined in the Kyoto Protocol. What has been achieved by the CDM?

This report discusses the performance of the CDM on an international level before turning to the presentation of the three regional studies from Africa, Indian and China. Possible push and pull incentives for CDM projects are scrutinized before proposals for improvement of the current project-based CDM are put on the table.

The CDM is like the elephant touched by a blind man – it has many different aspects that at first seem to be difficult to reconcile.

2.1. Performance of project CDM over time

Axel Michaelowa

At first glance, the CDM is an unmitigated success, having mobilized thousands of projects. However, the attrition of projects throughout the project cycle is significant (see Figure 1).

Figure 1 Number of CDM projects at different stages

![Figure 1: Number of CDM projects at different stages](image)

Data source: URC (2009)

The CDM has seen a period of “gold rush” between late 2005 and late 2008. During this period, on average more than a hundred CDM project design documents (PDDs) started the validation process every month. Since the record submission of 200 projects in October 2008, a clear downward trend has started to emerge.

The huge inflows have strained the regulatory system. Delays have considerably increased. Figure 2 shows several key delays:

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2 All data in this section are per end of February 2009.
- it is currently impossible to get registration of a project within less than 9 months
- even after 18 months from submission of the PDD, less than half of the submitted projects have achieved registration. A non-negligible share of projects has not achieved registration even after 3.5 years
- Only after two years from submission of the PDD, the first CER issuance is achieved

Figure 2 Inflow of projects into the validation pipeline

Source: URC (2009)

Despite the length of time projects spend in the CDM process, the quality of project documentation has not improved substantially. The capacity of validators has been insufficient to process the large numbers of validations. Moreover, validation reports have frequently been of low quality. Therefore, the share of projects being scrutinized by the EB has risen from less than 10% to more than half of the submissions and over 10% are now rejected (see Figure 3). During that period, the EB has introduced two new layers of scrutiny beyond validation / verification.

Figure 3 Shares of projects scrutinized by the EB

Source: URC (2009)

The CER volumes to be generated before the end of the commitment period in 2012, at different steps of the CDM project cycle, are shown in Figure 4.
Data sources: URC (2009)

Current average performance of the CDM compared to the estimate of CER volumes when the project was submitted for registration is at 99.1%. This figure seems to indicate a very good performance. However, it hides a wide variation between project types with regards to their performance (see Figure 5). Only three out of 12 project types have achieved an over-performance. As these categories are much larger than average in terms of CERs issued, they compensate for the low performance of other project types.

Note: Only project types with at least 5 projects that have achieved issuance are included. WHR= Waste heat recovery.
Data sources: URC (2009)
While 76 countries host CDM projects, the bulk of projects is concentrated in the three countries China, India and Brazil (see Figure 6).

**Figure 6** Country shares in the CDM (%)

Data sources: URC (2009)

China accounts for a third to half of the CDM depending on the parameter. It has significantly larger projects than other countries, mainly in the industrial gas sector. India covers a fourth to a fifth, with a significantly higher share of rejected projects. Brazil covers about a tenth with no big variation according to parameter.

From the offset, there were different interpretations to mean that the private sector from developed countries will actually come and invest in developing countries. However, this did not turn out to be the case, since the local private sector has been expected to undertake the investments and developed countries buy only carbon credits. Although the CDM is said to provide a number of benefits (such as emission reductions, latest technologies, generation of additional streams of revenues through CERs, etc.) to implementing parties, such benefits have not been realised in many developing countries to date.

### 2.2. Performance of project CDM in Africa

*Francis Yamba*

Africa, particularly its sub-Saharan part, has so far been largely sidelined by the CDM (see Figure 7). Out of 1406 projects registered by end of February 2009, only 29 projects have been registered in Africa representing only 2.1% of the total registered projects. In none of the CDM parameters, the African share surpasses 3.5%. Most of this is due to projects in South Africa, Egypt and Morocco. Sub-Saharan Africa reaches 1.5% at best and this is only due to two large gas flaring reduction projects in Nigeria. No CER has so far been issued for any project in Sub-Saharan Africa.
Despite the low current greenhouse gas emission volume of many African countries, their theoretical CDM potential is significant. In 2008, the World Bank assessed a large, diversified range of CDM opportunities across Sub-Saharan Africa’s energy sector (de Gouvello et al. 2008). For 44 countries and 22 technologies considered, a technical potential of more than 3200 projects with an electricity generation capacity of 170 GW was found. Total CER potential would reach 740 million per year, more than Sub-Saharan Africa’s current annual greenhouse gas emissions. Besides the energy sector, there is an enormous potential in the forestry and agriculture sector, which has only been assessed superficially. Walker et al. (2008) estimate the area of land available for afforestation in Sub-Saharan Africa at 625 million ha, which could sequester over 30 billion t CO$_2$ in a period of 10 years. Methane reduction opportunities in the agricultural and waste management sectors are also significant.

Questions have been asked why the uptake of the CDM in Africa has been so slow if there is such a host of opportunities? One of the arguments advanced for this low participation in the CDM market in Africa is the complexity of modalities and procedures of CDM, others argue that a variety of barriers exist which contribute to the low CDM participation.

Realising the low CDM participation in Africa, efforts have been done by different UNFCCC institutions such as the EB to make light handed procedures such as introduction of simplified procedures for small scale projects intended to stimulate development of CDM projects because of relatively smaller CDM projects in Africa. The simplified procedures for small scale projects were intended to stimulate development of CDM projects because of small size of projects generated in Africa. Further, the procedures provided a number of key incentives to include simplified methodologies, lower registration and validation costs and bundling. Despite these incentives, of the 611 small scale projects registered by end of February 2009, only 9 were attributed to Africa covering 1.5% of total projects registered (URC 2009). A number of factors have been identified for this low performance to include non interest from carbon purchasers who preferred larger projects, even bilateral carbon purchasers insisted on high CER volumes, for example more than 30,000 tonnes per annum by the World Bank Community Development Carbon Fund. Further, studies have shown that transaction costs are still too high to make small scale LULUCF projects economically feasible (Wiskerke 2008). Other stakeholders have expressed the concern that additionality arguments for small scale projects are almost the same as for large projects (Lesolle 2008).

The low participation of Africa in the CDM is due to several barriers that could not yet be overcome despite reinforced capacity building activities in Africa since the setup of the Nairobi Initiative in late 2006 (see De Gouvello et al. 2008, and presentations made at the Africa Carbon Forum in Dakar, September 2008). Although DNA offices exist in most African countries, they lack resources for infrastructure and capacity development to expand their mandates to include provision of CDM promotional services. However, besides their existence, there is still yet no integrated institutional
arrangement at policy, agency, and corporate levels to mainstream CDM in their vision and development implementation strategies, investment promotion, and business investment decision processes, respectively. Beyond this, governments in Africa have not yet realized or seen the vision and have not yet communicated the policy signal of CDM potential. This is required since the private sector cannot get involved or react to CDM as long as there is no clear Government Policy signal due to high risks associated with CDM (Zhou 2008).

Private and public sector companies lack awareness about the technical and financial benefits offered by the CDM, such as CER prices on the international market (Satnam 2007). Industry has limited capacity to undertake surveys and observations for baseline elaboration and does not have the monitoring equipment required for data collection for the same. It lacks capacity to undertake baseline and environmental additionality and sustainable development assessments, as well as to prepare bankable proposals. There are only very limited examples of successful CDM projects that could serve as “lighthouse” (see Table 1).

Table 1 Registered CDM projects in Africa

<table>
<thead>
<tr>
<th>Focal Area</th>
<th>Number of projects</th>
<th>Countries</th>
<th>Total CERs Expected</th>
</tr>
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<tbody>
<tr>
<td>Energy industries (RE/non-RE)</td>
<td>13</td>
<td>Egypt, Kenya, Morocco, South Africa</td>
<td>1,569,959</td>
</tr>
<tr>
<td>Energy distribution</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Manufacturing industries</td>
<td>3</td>
<td>South Africa</td>
<td>304,733</td>
</tr>
<tr>
<td>Chemical industries</td>
<td>5</td>
<td>Egypt and South Africa</td>
<td>2,455,780</td>
</tr>
<tr>
<td>Construction</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Transport</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Mining</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Metal Production</td>
<td>1</td>
<td>South Africa</td>
<td>55,044</td>
</tr>
<tr>
<td>Fugitive Emissions</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Solvent Use</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Waste Handling</td>
<td>5</td>
<td>Egypt, Morocco, South Africa, Tunisia, Tanzania</td>
<td>1,550,451</td>
</tr>
<tr>
<td>Afforestation and Reforestation</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Agriculture</td>
<td>1</td>
<td>South Africa</td>
<td>32,660</td>
</tr>
<tr>
<td>Energy demand</td>
<td>1</td>
<td>South Africa</td>
<td>6,580</td>
</tr>
</tbody>
</table>

Source: Website www.cdm.unfccc.int/projects/projsearch.html

On the average, the project size is small to medium confirming a concern on the character about project types and sizes in Africa. It is surprising to note that in focal areas where one would have expected Africa to be active such as transport, energy distribution, afforestation and reforestation, and agriculture - there were few projects, which is a worrying feature (Lesolle 2008). There is no local expertise on application of the CDM rules and development of PDDs and only limited resources for specialized support services for economic and financial analysis of CDM projects. A low level of knowledge regarding the legal issues to be considered under the CDM translates into a lack of ability to negotiate an emission reduction purchase agreement. A key difference to the successful CDM countries China, India and Brazil is the lack of domestic capital that could be invested in CDM projects. This is the case since carbon finance alone will not solve the investment financing gap. For typical renewable energy projects to include hydro, wind, and biomass, carbon contribution to financing range from 5% up to 50% depending on the type of projects (Pfeifer and Stiles 2008). Several project developers, investors and buyers have emphasized that generally unattractive investment frameworks for conventional energy projects are a major obstacle to CDM project development, including access to project finance. At the local/regional level, financial institutions perceive energy related projects as risk, and therefore are reluctant to invest in them. There is a weak financial base for local companies to implement CDM projects, non inclusion of CDM investment of traditional, national/regional financial institutions on their lending portfolio, and lack of institutional setup for performing CDM project cycle functions.
2.3. Challenges for Indian industry in implementing CDM projects

Rita Roy Choudhury, Nimisha Pandey, Suchismita Mukhopadhyay

Indian companies are very active in the CDM market and have been able to propel India to the second place in CDM supply (see Figure 6). Presently, the total number of CDM projects approved at the host country level stands at 1114 with the cumulative potential of 536 million CERs up to 2012. It has brought into its ambit diverse sectors of the economy, with not only conventional and large sectors known to be energy intensive, such as cement, iron and steel, etc., but also a vast array of industries and sectors that are perceived to be un-conventional but hold tremendous potential for greenhouse gas emissions reductions through energy efficiency measures. In addition, renewable energy projects account for a significant share of the total. The sheer diversity of the Indian portfolio of projects indicates the tremendous interest in CDM as well as the potential for a large reduction in greenhouse gas emissions.

In some ways, CDM has performed well. However, in several respects, CDM has not yielded the desired results. Strengthening the current CDM framework will play a significant role in nurturing the carbon market in the future, and in ensuring that the benefits of CDM have a trickle-down effect. In spite of all shortcomings, CDM has been the most effective market based instrument to address GHG mitigation. CDM has mobilized interest of corporates, governments, and technology providers towards GHG mitigation. It has enabled partnerships between stakeholders of different countries. Most importantly, CDM has mobilized action on the part of industry and key sectors of the economy. Apart from all the numbers, the real success of CDM is that it has mobilized businesses to think about clean technologies, and the need and potential to reduce emissions across all sectors of the economy. It has created a significant impact on the ground level. To assess the view of industry, FICCI organized a wide consultation process spread over 5 months in mid-2008, covering over 70 companies from 16 sectors. The companies that were part of this consultation represent around 120 CDM projects at different stages of the CDM process, 60% being registered projects. The sectors that have given their views are cement, chemicals, hydropower, iron and steel, oil and gas, pulp and paper, wind energy, thermal power generation, power transmission and distribution, fertilizers, sugar, textiles, transport, ceramics, and renewable biomass power generation.

Despite the growth of the Indian project pipeline, there have been difficulties along the way for Indian project developers due to the cumbersome, lengthy approval process for CDM projects. In spite of the size of the Indian project portfolio, the scale and size of projects under CDM remains below the actual potential. As per FICCI’s analysis of the project pipeline, 41 sectors have projects under CDM in India. That is a vast economy wide representation. However, several sectors remain underrepresented, many of those being small and medium sized companies. Transaction costs and duration of the project approval process at the international level have been some of the considerations that have deterred many companies from engaging in CDM.

Issues of operational policy framework have created a bottleneck for projects. Stringent additionality requirements for projects have crippled the progress of new entrants, and the existing governance structure has led to inefficiencies, lack of transparency, time and cost overruns for projects, resulting in a logjam at registration stage for several hundred projects. In India, there are less than 10 DOEs with local presence, making the validation and verification process very time consuming and lengthy for project proponents. Under the current CDM rules, similar amount of work needs to be done to validate and verify both small and large projects. Thus there is a need for a simplification of procedures and modalities for small-scale projects as compared to large-scale projects. After a project has been thoroughly screened and reviewed by DOEs at the validation stage, it is again reviewed at the EB level. At this stage there are chances of the project being sent for a second review or even suffer rejection. This leads to huge time loss of the project proponents. Moreover, the role of RITs in the CDM process virtually results in a duplication of the validation process undertaken by DOEs. Thus on the one hand this indicates a lack of faith in the validator’s role and on the other hand it results in time overruns in the CDM cycle. Even after all theses screening processes, the number of projects rejected at the top regulator level is significant. The lack of a direct interface between EB and project developers makes the approval process non-transparent. Currently, the interface between EB (including Meth Panel and technical staff) and the project developers is indirect and at long intervals making the process less transparent. As a result of all this, the transaction costs involved in the CDM process are huge, thereby limiting the entry of small players/projects and resulting in loss of
enormous GHG mitigation opportunity. The transaction costs are prohibitive unless supported by other arrangements.

Getting a new methodology approved from the Methodology Panel is a time consuming, exhaustive and tedious process, usually taking almost 18 months. As a result, many potential sectors remain untapped because getting new methodologies approved is particularly difficult. One such example is the transport sector, which has immense GHG mitigation potential but there are no projects registered because of the uncertainties involved in getting new methodologies approved. Moreover, a large number of methodologies are revised by the Methodology Panel and in some cases these are revised in such a way that they are never used any more. The approach of the Meth Panel is very conservative and very little discussion is held with the project developers and eventually the methodologies are no longer useful for application. Addition of technical clauses in the approved methodologies by the Meth Panel without keeping in mind the ground realities makes the implementation and further expansion of projects more difficult. For example, in the methodology ACM0013, many new clauses have been added related to definition of project boundary, etc. which is infeasible in practice, and acts as a deterrent for project developers. There are so many changes in most cases that some methodologies when applied retroactively are no longer useful. This also leads to high transaction costs to develop CDM projects, higher than it would otherwise have been. Sudden EB decisions on methodologies/policies/measures/technologies or revision of various critical parameters impact the baseline and lead to failure of many potential projects.

Lack of technical understanding (especially sector specific issues) at the EB level creates serious constraints for many potential projects. For example, in the cement sector where direct measurement of energy efficiency is not possible and estimates are derived from primary, monitored data, projects are rejected at the EB level without consideration of this fact. The EB does not appreciate this limitation inspite of this sectoral limitation being a technically accepted fact. Also, in case of projects which have CER delivery in excess of or below the projected amount due to changes in environmental / meteorological parameters (for example, change in wind velocity/direction/amount of rainfall, etc.) than what has been specified in the registered PDD, such projects are held back at the verification or issuance stage. Under practical situations, such exogenous changes are difficult to predict and mitigate, especially in sectors like wind, hydro, biomass, etc.

Proving financial additionality is in contradiction with the real business policies and requirements of companies. Whether a project is financially additional or not does not impinge upon the carbon additionality factor of the project. In the larger interest of emissions reductions, the financial additionality should be done away with, in order to enable more projects to qualify. The 16% IRR benchmark of CDM projects is not justified for all kinds of projects, since IRR is based on risk perception and risk appetite of an entrepreneur. Risk profile of projects and risk appetite of an investor has to be factored in to arrive at a benchmark IRR. Even in cases where two entrepreneurs may have the same risk perception, their IRR expectations may vary depending on their capacity to manage the risk and differences in risk-appetite. IRR is dependent on many other factors, such as technology. If the technology in question is an established one, the entrepreneur may be satisfied with the benchmark IRR or even below the benchmark, but if the technology is new and untried in local conditions, IRR expectation may be higher, since risk perception would be higher. Many Indian companies perceive a bias against Indian projects at the UNFCCC level with respect to additionality. Since most Indian projects are unilateral, they are deemed to be viable and thus are considered non-additional. Experience of several Indian project developers demonstrates that companies adopting the route of technical barriers for additionality testing have to face much greater stringency at the EB level screening. In view of the stringency, companies resort to the investment route, which in turn makes it difficult for them to get approval for the CDM project at the top management/Board level of the company. In this context, there is a lack of understanding at the EB level of the functioning of certain sectors, where two types of organisations exist, one in the public sector (government owned units) and the other in the private sector. This lack of understanding is demonstrated in the uniform treatment of such sectors in some cases, where in fact the uniqueness of the sector in the context of a particular country needs to be taken into account. This is also one of the key reasons for the insignificant role of Indian public sector units (PSUs) in the CDM sector. Proving financial additionality is in contradiction with the (government mandated) management requirements of the Indian PSUs because only a financially viable project can be undertaken in the PSUs. As a result many large projects from the public sector get eliminated from the CDM ambit, because project developers do not wish to risk rejection by the Board of the entire project in case the CDM specific components are not accepted by the Board. Another example of country specific constraint arises in the context of a
requirement of the CDM process, wherein the project IRR should be more than 16% (including CDM revenue). However, the long-standing working modalities of the financial institutions do not allow extending loans to projects having IRR more than 16%. This counters the CDM financial additionality requirement, and also impedes financing opportunities for CDM projects.

Slight deviations in the monitoring plan for projects that undergo expansion during the project implementation phase but do not result in changes in CER calculations, are in most cases rejected or stalled for approval. In such projects where minor changes in monitoring plan takes place as a result of capacity addition, the plan is either rejected or stalled for an indefinite period of time.

The current uncertainty related to the status of CDM market after 2012 with there being no agreed international arrangements beyond the end of first commitment period of the Kyoto Protocol is making the financial sector even more averse to the idea of investing in this market. The absence of any certain long-term price signal for CERs is making alternative investments towards low-carbon economies even less attractive. Presently, most contracts are done through ‘pay on delivery’ - where no funds flow into the project until the project is complete and becomes operational. In the absence of such a mechanism, projects that have upfront capital or budget constraints are most affected. Unfortunately, this ‘cash constraint’ is very often the case with projects in new sectors - for example wind, solar, biogas and renewable energy projects or community projects or projects based in rural/semi-urban/poor settings. This further aggravates the issue of lack of finance. In projects using new technologies/methodologies, the risk factor gets enhanced (besides the traditional risks) related to viability of projects (from a funding agency’s point of view) and thus leads to lack of funds for the first movers. The newer types of CDM projects require long gestation times and high capital costs, but current uncertainties about whether the CDM will continue after 2012 makes it difficult for worthwhile projects to monetize the emission reductions they could make post-2012. As a result, projects are heavily skewed towards sectors and large project sponsors that already have capital and/or have access to investments from external sources. Increasing volatility of the carbon market and the rising rate of rejections of projects at the EB level is further limiting the regular flow of finance (throughout the project cycle) or initial investments in projects by FIs. Also the cumbersome nature and time and cost overruns in the entire CDM process is another deterrent for the financial institutions. Lack of buyers who are willing to share project development risk is another constraint the project developers and the FIs are facing. The common practice currently is that the buyers watch until the projects are complete and carbon credits are delivered. This puts most or all of the project risk and financial burden on the project developers and the FIs involved. Another consequence of this trend has been that the market has been predominantly dominated by relatively easy projects with quick returns. And since the "low hanging fruits" have been exhausted, unless we see buyers who are willing to share some of the project development burden, it is unlikely to see significant growth in CDM projects in additional sectors or among smaller, newer project entities. Moreover this trend is contrary to the original vision for CDM.

2.4. Incentives for CDM projects in Least Developed Countries

Paula Castro, Axel Michaelowa, Yuri Okubo

2.4.1 Discounting of CERs

As the CDM project portfolio is very unevenly distributed across potential host countries, there have been discussions about policy instruments to promote a more equitable distribution. Discounting the value of CERs according to host countries has been proposed as a possible approach for addressing several shortcomings of the CDM, such as compensating for fictitious reductions from non-additional CDM projects, increasing the incentive for advanced developing countries to move from the CDM to own mitigation commitments; and improving the competitiveness of LDCs as hosts for CDM projects.

Discounting CDM emission reductions means that not all reductions generated by a project enter the carbon market, so that part of the effort is not used to offset emissions elsewhere, but provides real global GHG emission reductions (Schneider, 2008). There are basically two approaches for discounting. Supply-side discounting implies that only a certain fraction of the verified emission reductions leads to issuance of CERs. This type of discounting would require an agreement at the UNFCCC level, but would have the advantage of being applicable to the whole carbon market. Demand-side discounting means that a percentage of the issued CERs is retired from the market by the buyers, sending it for example to a cancellation account (see also section 5.2). Discounting was
first proposed by Greenpeace (2000) as a measure to safeguard overall additionality of the CDM. Using discounting to safeguard additionality is a complex task, as it would imply knowing the share of non-additional CERs being issued despite all quality checks, and modifying the discount factor over time to reflect possible changes in this share. This would deter investors and, more importantly, penalise both non-additional and truly additional projects. Chung (2007) proposed discounting as contribution of developing countries to global emission reductions without having to resort to country-specific commitments. This idea could be developed into a system where discounting provides an incentive for advanced developing countries to take up emissions reduction commitments. At present, advanced developing countries have no incentives to leave the CDM, which provides a financial subsidy for each tonne of GHG reduction, and take up own reduction commitments, which represent only costs. Discounting would build such an incentive, as taking up a commitment means that reductions achieved through domestic reduction projects count 100%, whereas under the discounting scheme, they would be valued less. The incentive would increase if the discount factor was progressively linked to the level of development of the host country. This approach is used here. Discounting by countries could also be used to promote CDM project development in African and Least Developed Countries by applying lower or no discount rates (or even granting more credits than reductions actually achieved) for projects in these countries, which would provide an economic incentive to develop more projects in these regions (Schneider, 2008).

Discounting CERs will have an impact on the value and the amount of emission reductions from different CDM host countries. The higher the discount rate, the less CERs are issued or traded for the project, and thus the higher the abatement cost. At the same time, the higher the discount rate, the less emissions reductions are credited, so the more the mitigation potential is penalised. Increased costs and reduced potentials are likely to lower the competitiveness of the CDM host countries affected by discounting.

The competitiveness or attractiveness of individual CDM host countries depends on several general and CDM-specific factors. Following Silayan (2005) and Michaelowa (2003), important general considerations are:
- An enabling business environment: stable and transparent general institutional framework, stable and predictable investment laws
- The existence of relevant financial incentives, such as tax reductions for renewable energies, import tariff reductions for CDM technology, etc.
- Reduced ownership restrictions for foreigners
- Undistorted energy pricing policies
- Local technical capacity and awareness of the CDM as a project financing option
- Availability of underlying project finance, especially through local financial capacity
- Availability of large and cheap CDM project options, whose value can offset the transaction costs of the CDM pipeline; this is coupled to the country’s emissions mitigation potential
- Other country or project-related risks that render the performance of the project uncertain.

CDM-specific criteria are:
- Existence of CDM-related institutions: Kyoto Protocol ratification and establishment of an operational DNA
- Clear, capable and effective CDM policy framework: clear rules for DNA approval, timely and simple procedures, low national transaction costs, experience and continuity of DNA staff
- Existence of CDM promotion offices
- CDM awareness in government, industry, consultants and financial intermediaries
- Existence of baseline data for project design
- Existence of applicable CDM methodologies for the desired project type
- Constraints on eligibility of specific project types – for example by the EU ETS or other major CER buyers
- DOE capacity in the relevant region
- Temporary credits for certain project types, which have lower value in the market.

Discounting will clearly have no effect on the host country’s business environment, on the institutional framework or on technological and methodological capacity. It could contribute to address project-specific and cost-related factors by shifting the financial incentives of the CDM towards more backward countries, and could thus contribute to fostering CDM development in, for example, Sub-Saharan Africa or the Least Developed Countries.
As discounting will not have an impact on the institutional criteria but rather on the value of emission reductions from different countries, we will focus our subsequent analysis on the host country potential for specific abatement technologies, and their abatement cost.

Right now, some individual CDM host countries or regions have sufficiently large CDM project portfolios to be able to empirically estimate CER generation costs for specific project types, and possibly, regions. In addition, assessments of GHG mitigation potentials in different regions, including Africa, are available from the literature (e.g., Bakker et al., 2007; Wetzelaer et al., 2007; de Gouvello et al., 2008).

On the basis of these empirical abatement costs and potentials for specific regions, we can estimate how different discounting schemes could affect those regions’ competitiveness in the CER market, if we assume that abatement costs and potentials are the main criteria for locating CDM projects. Overall abatement costs provide a measure of the profitability and attractiveness of the project – if the costs are negative, the project is profitable even without the CDM profit; if they are low enough, they can be compensated through the sale of CERs; and if they are too high, the project is not profitable even with CER sales. However, not only this overall profitability is relevant for the decision to undertake a project, but also the upfront costs, since they need to be covered by financial resources that are frequently scarce, risky and difficult to access in developing countries. We have done abatement and investment cost estimations for a sample of 108 projects from 17 project subtypes in 16 countries, as can be seen in Table 2.

Table 2 Project sample

<table>
<thead>
<tr>
<th>Project subtype</th>
<th>Sample size</th>
<th>Project financial discount rate(s) (%)</th>
<th>Median project lifetime (years)</th>
<th>Min and max lifetime (years)</th>
<th>Host countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biogas power</td>
<td>7</td>
<td>7, 8, 10, 15, 16</td>
<td>10</td>
<td>7, 21</td>
<td>China, South Africa, Guatemala, Honduras, India</td>
</tr>
<tr>
<td>Biogas flaring</td>
<td>4</td>
<td>10</td>
<td>8.5</td>
<td>7, 10</td>
<td>Brazil, Armenia</td>
</tr>
<tr>
<td>Biomass energy</td>
<td>8</td>
<td>7, 8, 10, 15</td>
<td>20</td>
<td>10, 25</td>
<td>South Africa, Kenya, China</td>
</tr>
<tr>
<td>Cement blending (*)</td>
<td>2</td>
<td>-</td>
<td>25</td>
<td>25</td>
<td>India, Indonesia</td>
</tr>
<tr>
<td>Coal mine methane</td>
<td>5</td>
<td>8, 11.8, 13.5</td>
<td>15</td>
<td>7, 20</td>
<td>China</td>
</tr>
<tr>
<td>Energy efficiency own generation</td>
<td>8</td>
<td>8.5, 10, 12, 13, 15</td>
<td>19</td>
<td>10, 20</td>
<td>China</td>
</tr>
<tr>
<td>Fugitive gases</td>
<td>4</td>
<td>10, 15</td>
<td>15</td>
<td>10, 21</td>
<td>Qatar, India, Indonesia, Nigeria</td>
</tr>
<tr>
<td>Hydro existing dam</td>
<td>6</td>
<td>4, 8, 12, 14, 15</td>
<td>25</td>
<td>21, 40</td>
<td>China, Brazil, South Korea, Peru</td>
</tr>
<tr>
<td>Hydro new dam</td>
<td>6</td>
<td>8, 10, 12</td>
<td>26</td>
<td>20, 50</td>
<td>China</td>
</tr>
<tr>
<td>Hydro run of river</td>
<td>5</td>
<td>8, 10</td>
<td>27</td>
<td>20, 30</td>
<td>China</td>
</tr>
<tr>
<td>Landfill gas composting</td>
<td>7</td>
<td>8, 8.5, 10, 12, 15</td>
<td>10</td>
<td>7, 30</td>
<td>China, Bangladesh, Indonesia, Malaysia</td>
</tr>
<tr>
<td>Landfill gas flaring</td>
<td>4</td>
<td>8, 10, 13.75</td>
<td>10</td>
<td>7, 15</td>
<td>China, South Africa, Indonesia, Malaysia</td>
</tr>
<tr>
<td>Landfill gas power</td>
<td>9</td>
<td>8, 8.5, 10, 12</td>
<td>15</td>
<td>10, 21</td>
<td>Bangladesh, China</td>
</tr>
<tr>
<td>N2O (adipic)</td>
<td>4</td>
<td>0 - 15</td>
<td>26</td>
<td>21, 30</td>
<td>China, Brazil, South Korea</td>
</tr>
<tr>
<td>N2O (nitric)</td>
<td>10</td>
<td>0 - 15</td>
<td>21</td>
<td>7, 30</td>
<td>Brazil, South Africa, Colombia, China</td>
</tr>
<tr>
<td>New efficient gas power plant</td>
<td>6</td>
<td>8</td>
<td>20</td>
<td>20, 21</td>
<td>China</td>
</tr>
<tr>
<td>Wind</td>
<td>13</td>
<td>8</td>
<td>21</td>
<td>20, 25</td>
<td>China</td>
</tr>
</tbody>
</table>

(*): Data from cement blending projects are used only for investment cost calculations.

Two important factors in the abatement cost calculations of a project – also shown in Table 1 – are its expected lifetime and the financial discount rate used for obtaining its present value. We do not
homogenise project lifetimes, but take the lifetime that most likely informed the investment decision by the project proponent: the CDM crediting period, in the case of projects with only income from CERs, or the whole operational lifetime, in the case of projects with other revenue streams. In order to have comparable information and to avoid the possible effect of discount rates being manipulated by project developers to obtain more convincing financial figures⁴, we homogenise the discount rates in each host country. The choice of discount rate is guided by the rates proposed by most CDM projects in the respective country. In countries where the PDDs do not supply this information, a default 10% has been taken. See Table 3 for an overview of host countries, financial discount rates used in them, and standardised discount rates.

Table 3 Host countries and financial discount rates

<table>
<thead>
<tr>
<th>Host country</th>
<th>Number of projects in sample (*)</th>
<th>Range of financial discount rates used in PDDs</th>
<th>Standardised financial discount rate for abatement cost calculations</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Armenia</td>
<td>1</td>
<td>10%</td>
<td>10%</td>
<td>PDDs</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>2</td>
<td>12%</td>
<td>12%</td>
<td>PDDs</td>
</tr>
<tr>
<td>Brazil</td>
<td>7</td>
<td>0 - 25%</td>
<td>10%</td>
<td>PDDs</td>
</tr>
<tr>
<td>China</td>
<td>68</td>
<td>7 - 13.5%</td>
<td>8%</td>
<td>PDDs</td>
</tr>
<tr>
<td>Colombia</td>
<td>1</td>
<td>not available</td>
<td>10%</td>
<td>By default 10%</td>
</tr>
<tr>
<td>Guatemala</td>
<td>1</td>
<td>7%</td>
<td>8%</td>
<td>PDDs</td>
</tr>
<tr>
<td>Honduras</td>
<td>2</td>
<td>not available</td>
<td>10%</td>
<td>By default 10%</td>
</tr>
<tr>
<td>India (*)</td>
<td>4</td>
<td>14.72 - 16%</td>
<td>15%</td>
<td>PDDs</td>
</tr>
<tr>
<td>Indonesia</td>
<td>4</td>
<td>10 - 18%</td>
<td>10%</td>
<td>By default 10%</td>
</tr>
<tr>
<td>Kenya</td>
<td>1</td>
<td>15%</td>
<td>15%</td>
<td>PDDs</td>
</tr>
<tr>
<td>Malaysia</td>
<td>5</td>
<td>8 - 10%</td>
<td>10%</td>
<td>PDDs</td>
</tr>
<tr>
<td>Nigeria</td>
<td>1</td>
<td>20%</td>
<td>15%</td>
<td>Adjusted to 15% for comparability</td>
</tr>
<tr>
<td>Peru</td>
<td>2</td>
<td>12 - 14%</td>
<td>12%</td>
<td>PDDs</td>
</tr>
<tr>
<td>Qatar</td>
<td>1</td>
<td>10%</td>
<td>10%</td>
<td>PDDs</td>
</tr>
<tr>
<td>South Africa</td>
<td>4</td>
<td>10 - 13.75%</td>
<td>10%</td>
<td>PDDs</td>
</tr>
<tr>
<td>South Korea</td>
<td>4</td>
<td>0 - 15%</td>
<td>8%</td>
<td>PDDs</td>
</tr>
</tbody>
</table>

(*): The project sample has been constructed to be balanced by project types and not necessarily by host countries. For example, there are very few projects from LDCs with reliable financial information. Similarly, Indian projects have a tendency to exclude the investment analysis from their PDDs, and in those projects with investment analysis, the variance of the resulting costs is very high and thus we preferred to leave these data out of the sample.

Only CERs from the first crediting period are considered in the calculations, as it is not sure whether the renewal of the crediting period will be accepted for all projects, and as it is likely that most projects calculated their profitability on the basis of just the first crediting period CERs⁴. CDM transaction costs have not yet been included in the estimations. Even though transaction costs represent a significant sum, especially for small-scale projects, we have opted for simplifying the calculations in this assessment.

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³ Project developers have an incentive to manipulate their figures and try to show low revenues, so that the project appears financially unattractive, which is a requisite for being considered additional.
⁴ Decision-making could also be based just on CERs expected to be credited before 2012, due to the uncertainties related to a post-2012 climate agreement. In fact, most purchase agreements are limited to CERs from the first crediting period. On the other hand, however, CDM projects continue to enter the pipeline even in 2009, suggesting that there is an expectation that CERs will continue to be issued and purchased after that date. Additionally, cash flows shown in PDDs usually take at least all credits from the first crediting period to show the effect of the CDM on the profitability of the projects.
Another important consideration in the abatement cost calculations is the treatment of the baseline costs. The baseline is generally conceived as the situation without project. This situation without project may imply a different investment or the continuation of the current situation without a new investment. Many energy-related CDM projects argue that their baseline is the status quo, the continuation of the present situation without investment. In some cases, this implies expenses, such as buying energy from the grid or buying coal. In these cases, avoiding or reducing these expenses is considered as a revenue for the project and is included in the abatement cost calculations. But in some other cases, the baseline situation does not imply costs for the project owner, and thus is not included in the calculations. In very few cases, the baseline represents a new investment, e.g. in a new fossil fuel-based power plant. Avoiding this investment is again considered as a saving achieved by the project.

Figures 8 and 9 show box plots of the estimated abatement costs of the projects in the sample, both with the original financial discount rates and with the discount rates standardised by us, respectively.

Figure 8 Abatement cost per CER by project subtypes with original financial discount rates ($)
Based on projects’ Net Present Value and CERs expected for the first crediting period

In these results, it is clear that even within project subtypes there is still a high variability in cost estimations, and that thus these estimations need to be taken with care. However, even with this high variability, our results reproduce very closely the range and ranking of costs we would expect in theory. The abatement costs of most of these CDM projects are below 20 $, which is an indication that the CER income could make them attractive. Methane and industrial gas reduction projects are cheaper than CO₂-reduction projects, basically due to the higher global warming potential of these other gases. Renewable energy projects, specifically wind and hydro projects including the construction of dams and also natural gas power plants are among the costlier ones. All this is consistent with the theory and supports our results.
The variability of costs within project subtypes stems from various factors. Above we have already discussed the impact of project lifetimes and financial discount rates on the cost estimations, and these figures can be manipulated easily to make projects appear non-attractive. However, there are also large differences in the technologies used within project subtypes. For example, biogas power projects can consist of a sophisticated bioreactor, or just of a plastic membrane covering the already existing anaerobic lagoons, which allows to capture the methane. Further, biodigesters can be imported or can be manufactured domestically, which will also have an impact on costs. Biomass projects include energy generation from rice husks, bagasse, palm oil residues, forest residues, and a variety of other agricultural or industrial by-products. Energy efficiency projects take place in cement, steel, chemical, petrochemical and other industries and can encompass different efficiency measures. Hydroelectric projects have very different sizes, and smaller ones (among those including a dam) typically imply higher abatement costs. Finally, different countries can have different cost structures, with differing energy prices, taxes or financial incentives for specific technologies that may have an impact on overall abatement costs. Ideally, we should have a different project sample for each host country and estimate country-specific CDM abatement costs, however, due to time constraints and to the fact that most countries still have too few registered CDM projects, this has not been possible.

Another important point to discuss in these results is the existence of CDM projects with net negative abatement costs. If we consider the financial discount rates used by the project proponents in the PDDs, these negative-cost projects are only two, just one biomass energy and one energy efficiency project. The biomass project substantiates its additionality through a barrier analysis, but includes an annex showing the cash flow of the project with a positive Net Present Value. The energy efficiency project substantiates additionality through the comparison with an alternative project: even if the CDM project activity has a positive NPV, the alternative has an even better one, so that it would be the preferred course of action.

If we take country-standardised discount rates, also some other projects have negative costs, and surprisingly, run-of-river hydroelectric projects and own-generation energy efficiency projects even have a mean negative cost. Our whole sample in these project categories is from China, where most projects originally used 8% as financial discount rate, while some hydro projects used 10% and energy efficiency ones even higher rates. We standardised all Chinese discount rates to 8%, on the grounds that most energy-related projects in this country use this figure. But then, half of the energy

---

Figure 9 Abatement cost by project subtypes with standardised financial discount rates ($)

Based on projects’ Net Present Value and CERs expected for the first crediting period
efficiency projects and all hydro projects that originally took 10% discount rate become financially attractive.

One of the main barriers for investing in infrastructure in LDCs and Sub Saharan Africa is the availability of up-front financing. The main costs of renewable energy projects are investment costs, as they do not bear annual fuel costs. Whether CER revenues can cover a substantial amount of the up-front investment costs could constitute an important factor in the decision to undertake a project or not. For these reasons, and for allowing comparability with the results from De Gouvello et al. (2008), who have made an analysis of CDM potentials and costs in Africa based only on investment costs, we have repeated our empirical estimation using total investment costs per CER. The results are shown in Figure 10.

Figure 10 Investment cost per CER by project subtypes (USD)
Based on projects’ total investment costs and CERs expected for the first crediting period

Wetzelaer et al. (2007) estimate the total abatement potential for the whole non-Annex I region in the year 2010 at about 2 Gt CO₂eq/yr at a price of 50 $/tCO₂eq or less. Roughly 0.7 Gt/yr out of this potential is expected to be achievable at negative or zero incremental costs. Approximately 1.7 Gt CO₂eq/yr appear feasible at costs of up to 4 $/tCO₂eq, including transaction costs. 66% of the total abatement potential was found in China (37%), India (23%), Brazil (4%) and South Africa (2%).

Building on the above-mentioned study, Bakker et al. (2007) updated and completed the abatement cost curves, by including information from new country studies, extrapolating them from 2010 to 2020, and adding new technology options (CCS and forestry) and non-CO₂ GHGs. Accounting for the uncertainties related to eligibility decisions, additionality criteria, programmatic CDM and technology adoption, the market potential for CDM projects was estimated at 1.6 - 3.2 GtCO₂eq/yr at costs up to 20 €/tCO₂eq in 2020.

Combining the information on standardised abatement costs for CER generation and CDM potential in different countries or regions, we obtain our basis for the comparison of CDM competitiveness:

---

5 In this context, again the consideration of which CERs are considered in the cost calculations (just pre-2012 CERs, those expected from the first crediting period, or those from all crediting periods) is critical for investment decisions. For similar reasons as above, we consider again that all CERs projected for the first crediting period are used in these calculations.
investment cost curves. Figure 11 shows abatement cost curves for China, India, LDCs, and a group of selected high-income high-emissions Asian countries (Qatar, United Arab Emirates, Singapore, South Korea, Israel) without discounting CERs.

**Figure 11 Standardised abatement cost curves without CER discounting**


As abatement costs we use the median standardised abatement cost obtained for each project subtype. The abatement potential is estimated simply by summing up all emission reductions projected to be achieved by all projects in the CDM pipeline as of end of 2008 (URC, 2009). This is a very approximate estimate. On the one hand, it does not include CDM projects not yet submitted for validation, so the potential may increase over the following years. On the other hand, it includes projects that may fail validation or registration, whose potential will thus not materialise. Finally, this estimation does not take into account the fact that CER issuance is for most project types actually less than the estimations in the PDDs. However, as these sources of bias are present in CDM projects over all host countries, we deemed these figures to be precise enough for our comparison.

For the group of Least Developed Countries, we include two estimations. The first one (“LDCs existing”) is, as above, the sum of all emission reductions projected from the current CDM pipeline in this region. The second estimation (“LDCs potential”) additionally includes the abatement potential estimated by De Gouvello et al. (2008) for the LDCs in Sub Saharan Africa, excluding the potential from biofuel projects, which so far do not have any approved methodologies. This provides an optimistic estimation of the abatement potential in these countries, which could be achieved if the technical, financial and institutional conditions are substantially improved.

---

6 It should be noted that these curves include project types without cost information. These appear at present at the left end of the curves, as having zero abatement costs. The projects without cost information represent 1.7% of the abatement potential in China, 8.6% in the advanced host countries, 7.3% in LDCs existing, 7.9% in LDCs potential and 26.5% in India. In the Indian case, about one third of this potential comes from supply-side energy efficiency projects, for which abatement costs should be similar to those in own generation energy efficiency projects, which have net negative costs when standardising the financial discount rates (see Table 4). Unfortunately, the financial information for supply-side energy efficiency is either non-existing or not very credible in the PDDs analysed. While this inclusion might provide the wrong impression of a large quantity of low-cost (or
Even with these limitations, Figure 11 shows a clear picture: the existing CDM potential from LDCs is dwarfed in comparison with the one in China, India and other Asian countries. Even an enlarged CDM in LDCs is still just comparable to the Indian potential and only one third of China’s potential under current CDM rules. This graph also reveals the existing barriers to CDM development in LDCs: if such potential is there, why has it not materialised so far?

If we base CER discounting on an index composed of per capita GDP and per capita emissions, taking as basis the world average of both indicators. This index is taken to reflect capability to pay and responsibility towards climate change of each country. Discounting starts from an index level of 1. See Michaelowa (2008) for a further description of this discounting scheme. In this case, of our selected countries only those in the “Other Asia “ group (Qatar, United Arab Emirates, Singapore, South Korea, Israel) are affected by CER discounting. As can be seen in Figure 12, their abatement cost curve shifts to the left and upward as a result from the increase in costs per CER and the reduction in CER generation potential.

With this discounting scheme, all project subtypes in the current CDM pipeline for these advanced countries would still be feasible with CER prices up to 20 $ on average. While projects in advanced countries become less competitive, current projects in LDCs are still non-significant at a global level, and future potential is still small compared to the Chinese pipeline.

We now look at a more stringent CER discounting scheme, which now starts from an index level of 0.5, in order to be able to include China among the countries affected by discounting. Overcrediting is again not possible. Now both China and Other Asia are affected by CER discounting. Figure 13 shows the result: while the potential in the Asian tigers is greatly reduced and the costs rise sharply, making a large portion of its abatement potential uncompetitive (mainly from fugitive gases, wind energy and hydro existing dam projects), still most of China’s potential – albeit reduced and more expensive – remains competitive with CER prices below 20 $. Under these conditions, all CDM projects in the current pipeline in LDCs have smaller abatement costs than those in advanced countries. Their volume is however still unimportant. There is some hope if we look at the “LDCs potential” curve: assuming the barriers are overcome and these projects are implemented, their potential reaches half of the Chinese one, with costs below 5 $/CER.

_zero-cost) project options, we opted for not omitting these data from the curves as they allow for a more realistic picture of the overall abatement potential.
Figure 12 Standardised abatement cost curves with discounting scheme 1


Figure 13 Abatement cost curves with stringent discounting scheme

Even under the optimistic scenario, where the financial, technical and institutional barriers in these countries are overcome and a larger potential becomes feasible, the larger abatement potential and the cheap abatement costs in China and other more attractive host countries will be harvested first. Thus, discounting would only marginally contribute to enhance the competitiveness (in terms of abatement potential and costs) of LDCs within the CDM market.

2.4.2 Preferential access to the EU ETS

A classical policy to support LDCs has been the granting of trade preferences. The new EU climate package gives a clear signal that credits from LDCs will be preferred, providing a specific demand for about 80 million CERs from LDCs and small island developing states over 2013-2020. If no international climate policy agreement is reached, initially only those post-2012 CDM projects located in LDCs will be allowed to deliver to the EU emissions trading scheme (EU ETS). Some questions remain as to the extent to which these measures can boost CDM development in LDCs: Are other Annex I countries going to match the EU initiative, and to what extent? Will the financial and technical barriers for CDM development in LDCs be overcome through these measures? And even if they are, will LDCs be able to match this demand with an adequate supply?

In order to assess the effect of possible preferential access for LDCs and other policy scenarios for the future CDM, we create carbon credit demand and supply scenarios with and without an international agreement for the period 2013-2020. For the demand scenario without agreement, we take the EU 20% case, and current greenhouse gas reduction targets announced by other individual Annex I governments, which are not contingent on an international agreement. For the scenario with agreement, we take the 30% target for the EU and tighter targets for other Annex I governments, which we expect could be agreed during the coming negotiations. We thus build 3 demand scenarios, as described in Table 4.

Table 4 Carbon credit demand scenarios 2013-2020: assumed emission reduction targets

<table>
<thead>
<tr>
<th>Country / Group</th>
<th>Scenario 1: No agreement</th>
<th>Scenario 2: International agreement</th>
<th>Scenario 3: Financial crisis</th>
</tr>
</thead>
<tbody>
<tr>
<td>EU-27</td>
<td>20% below 1990, credit import up to 50% of reduction effort</td>
<td>30% below 1990, credit import up to 50% of reduction effort</td>
<td>Same as in Scenario 2, but emissions during first two years are 3% less than in the base case</td>
</tr>
<tr>
<td>US</td>
<td>Back to 1990 emission levels</td>
<td>10% below 1990 levels</td>
<td></td>
</tr>
<tr>
<td>Canada</td>
<td>Back to 1990 emission levels</td>
<td>10% below 1990 levels</td>
<td></td>
</tr>
<tr>
<td>Japan</td>
<td>10% below 1990 levels</td>
<td>20% below 1990 levels</td>
<td></td>
</tr>
<tr>
<td>Australia</td>
<td>5% below 2000 levels</td>
<td>15% below 2000 levels</td>
<td></td>
</tr>
<tr>
<td>Russia</td>
<td>20% below 1990 levels</td>
<td>30% below 1990 levels</td>
<td></td>
</tr>
<tr>
<td>Belarus and Ukraine</td>
<td>20% below 1990 levels</td>
<td>30% below 1990 levels</td>
<td></td>
</tr>
<tr>
<td>Other Annex I</td>
<td>20% below 1990 levels (including Turkey with 5% below 2012 levels)</td>
<td>30% below 1990 levels (including Turkey with 10% below 2012 levels)</td>
<td></td>
</tr>
</tbody>
</table>

As baseline emissions we use the figures taken by the EU Parliament in their calculations for the climate package described above; European Environmental Agency (EEA) projections for non-EU European countries (EEA, 2005); energy-related CO₂ emissions from the Energy Information Administration (EIA) of the US Department of Energy and extrapolations of UNFCCC inventories for forestry and non-CO₂ emissions for the USA, Canada and Russia (EIA, 2008a; EIA, 2008b; UNFCCC, 2008); projections from the Australian Government for Australia (Australian Government, 2008); and extrapolations of UNFCCC emissions inventories for the years 2000-2005 for other countries (UNFCCC, 2008). We only assume that CERs are required to be supplementary to domestic emissions reductions in the EU-27 case, as this group has already announced that only 50% of the effort may be covered from emissions credits. For the other countries, we assume that up to 100% of the required reductions could be covered through the CDM. We choose, where available (Australia and other European countries), the low emissions path projections, which would account to some extent for some domestic mitigation action. The resulting demand scenarios are shown in Table 5.
Table 5 Carbon credit demand scenarios 2013-2020: Projected demand for CERs/ERUs

<table>
<thead>
<tr>
<th>Country / Group</th>
<th>Scenario 1: No agreement</th>
<th>Scenario 2: International agreement</th>
<th>Scenario 3: Financial crisis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Demand for CERs/ERUs 2013-2020 (Mt CO₂eq)</td>
<td>Demand for CERs/ERUs 2013-2020 (Mt CO₂eq)</td>
<td>Demand for CERs/ERUs 2013-2020 (Mt CO₂eq)</td>
</tr>
<tr>
<td>EU-27</td>
<td>1704</td>
<td>3124</td>
<td>3101</td>
</tr>
<tr>
<td>US</td>
<td>2603</td>
<td>5038</td>
<td>4677</td>
</tr>
<tr>
<td>Canada</td>
<td>3302</td>
<td>3520</td>
<td>3457</td>
</tr>
<tr>
<td>Japan</td>
<td>205</td>
<td>736</td>
<td>668</td>
</tr>
<tr>
<td>Australia</td>
<td>740</td>
<td>976</td>
<td>939</td>
</tr>
<tr>
<td>Russia</td>
<td>-1462</td>
<td>116</td>
<td>-29</td>
</tr>
<tr>
<td>Belarus + Ukraine</td>
<td>-553</td>
<td>-120</td>
<td>-154</td>
</tr>
<tr>
<td>Other Annex I</td>
<td>762</td>
<td>916</td>
<td>882</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>7301</strong></td>
<td><strong>14306</strong></td>
<td><strong>13540</strong></td>
</tr>
</tbody>
</table>

How will CDM project submission develop in the future? As in the past, start-up of new project types such as supercritical coal power plants, carbon capture and sequestration and forestry could lead to rapid changes in the composition of the inflow. Moreover, the interpretation of additionality by the EB and changes in baseline methodologies can have sudden and massive impacts. Supply would decrease if a project category is suddenly deemed non-additional as happened with cement blending. Supply might increase as two non-renewable biomass methodologies were approved by the Bali COP, resolving an issue that had prevented such projects with high development benefits for two years. However, in Bali no decision on new HFC-23 projects could be taken and, as expected, no decision on carbon capture and storage (CCS) was made. It is of note that India, which has a high CCS potential, opposed to the inclusion of CCS in the CDM stating that “sustainable development is the primary objective of the CDM.” Another key influence is the development of post-2012 negotiations, including present Annex B countries pressing for increased mitigation actions by developing countries, and, as outlined above, possible limitations on the import of CERs on the basis of “quality” considerations.

Due to these manifold influences, it is extremely difficult to forecast the total CER volume. Besides the inflow of new project types and projects of types that are already in the CDM pipeline, the key parameters influencing supply are the delay of project implementation, non-validation rate of submitted projects, the rejection rate of validated projects and the performance rate of registered projects. We therefore derive our supply scenarios based on the projected 2020 CERs from UNEP Risoe Centre’s CDM Pipeline (URC, 2009), modified in order to account for these parameters. We use the following formulae to project CER supply volumes (see also Michaelowa 2007):

Formula 1 Total CERs projected up to 2020 from CDM projects registered until 2012:

\[
CER_{\text{sum} \ 2020} = ((CER_{\text{subm}} + \sum_{2008}^{2012} CER_{\text{infl},y}) p_{\text{valid}} \ast (1 - p_{\text{rej}}) + CER_{\text{reg}}) \ast p_{\text{perf}}
\]

Where:

- \(CER_{\text{subm}}\) = CER volume by 2020 listed in PDDs of currently submitted projects
- \(CER_{\text{infl},y}\) = CER volume by 2020 listed in PDDs of projects to be submitted in each year between 2008 and 2012
- \(p_{\text{valid}}\) = probability of validation of projects currently submitted and submitted until 2012
- \(p_{\text{rej}}\) = probability of rejection of validated projects by the CDM EB
- \(CER_{\text{reg}}\) = CER volume by 2020 listed in PDDs of currently registered projects
- \(p_{\text{perf}}\) = CER issuance rate in % of \(CER_{\text{reg}}\)
We do not include possible delays in this formula because for projects with a 10-year crediting period starting before 2010, any delay will not change overall CER volumes. Only for projects with 7 year periods renewed, delay matters.

Formula 2 Additional CERs projected up to 2020 from projects registered between 2013 and 2020:

\[
CER_{\text{add}2020} = \left( \sum_{2013}^{2020} CER_{\text{ad}1,y} \cdot d_{\text{delay},y} \right) p_{\text{valid}} \cdot (1 - p_{\text{rej}}) \cdot p_{\text{perf}}
\]

Where:

\( CER_{\text{ad}1,y} \) = CER volume by 2020 listed in PDDs of projects to be submitted in each year between 2013 and 2020

\( d_{\text{delay},y} \) = percentage of pre-2021 CERs remaining due to delay of project implementation, for each year, calculated according to equation (3)

\( p_{\text{valid}} \) = probability of validation of projects currently submitted and submitted until 2012

\( p_{\text{rej}} \) = probability of rejection of validated projects by the CDM EB

\( p_{\text{perf}} \) = CER issuance rate in % of CER\(_{\text{reg}}\)

Until recently, it was unknown which projects have failed validation as validators did not publish their rejections. In January 2008, the head of the DOE Forum stated in the context of the 38th EB meeting that the five largest DOEs had rejected 369 projects during validation. About two thirds of the rejections were due to a lack of additionality. If one puts the number in relation with all projects registered and submitted for registration by January 2008, the share of rejections would be 32%. Thus, for the probability of validation of projects we assume, for a business-as-usual case, 70%. Our assessment of 288 projects which had achieved CER issuance by early 2008 shows an average performance of 98.2% of predicted CER generation. We use this figure for the CER issuance rate in the business-as-usual case. However, issuance performance varies greatly across project types, so that the median performance is only 82%. We use this median for modeling stricter CDM supply scenarios. Delays in development of projects lead to loss of CERs before a certain date (2012 or 2020), even if not all of them lead to an overall loss of CERs if the CDM continues afterwards\(^7\). The effect of this delay on estimated CER volumes depends on the remaining crediting period of a project and would thus theoretically have to be summed up project by project. This also applies to those registered projects whose crediting period only starts in the future. Therefore, the impact of the delay depends on the shape of the CER inflow over time. Assuming that the crediting period of all projects coming in during a year would on average begin in the middle of this year, the discount of CERs due to delay can be quantified in the following functional form:

Formula 3 Project delay function:

\[
d_{\text{delay},year} = \frac{\text{duration}_{\text{pre-2021}} - \text{delay}}{\text{duration}_{\text{pre-2021}}}
\]

Where:

\( d_{\text{delay,year}} \) = share of pre-2021 CERs in terms of projected CER level for projects submitted during this year remaining due to delay of project implementation

\( \text{duration}_{\text{pre-2021}} \) = number of months between July of year until end of December 2020

\( \text{delay} \) = delay of project implementation (months)

We assume, for all projects, that the delay in project implementation averages 6 months.

\(^7\) If a project suffers a delay in its registration while its operations have started already, it will lose the CERs for the emission reductions achieved before the date of registration. As project developers can change the start date of a project’s crediting period once after registration by simple communication to the CDM Executive Board, a delay of implementation of an already registered project does not lead to an overall loss of CERs during the crediting period, but a loss compared to the quantity estimated to accrue by a specific date.
So far, 87 projects out of 1753 that have requested registration have been rejected by the CDM EB, which results in an average 5% probability of rejection. However, rejection rates have increased over time, from less than 2% in 2005 to 10% in 2007 and early 2008 (UNEP Risoe Centre, 2009). As there is no indication of falling rejection rates, we take 10% as input for our business-as-usual projection of CDM supply in 2013-2020. Using the formulae and parameters described above, we generate six CER supply scenarios for the period 2013-2020. In a very strict scenario, only the credits generated from projects registered up to 2012 would be accepted in the global carbon market (Scenario A). In a status quo scenario, the CDM would continue with the same rules, stringency and host countries as today, continuing to increase the credit supply beyond 2012 (Scenario B). Following a “high quality CERs” demand by the EU, Annex I countries could agree to no longer accept credits from industrial gas projects, which builds the basis for our Scenario C. Following an equity-based cap on CERs, Annex I countries could agree to only accept CERs from LDCs for projects registered after 2012 and to create appropriate incentives that promote CDM development in this region (Scenario D). Stronger pressure by developing countries to accept REDD (reduced emissions from deforestation and degradation) and CCS (carbon capture and storage) projects and clarify rules for programmatic CDM could lead to a larger CDM supply (Scenario E). Finally, a stricter “high quality” scenario would allow CERs from post-2012 projects with stricter additionality considerations and again without industrial gas projects (Scenario F).

Table 6 provides an overview of these scenarios, their assumptions and calculations. In all cases, from the overall CER supply for 2008-2020, we deduct the CER demand projected for 2008-2012, which we have previously estimated will total 3300 Mt CO$_2$eq (Michaelowa, 2008). Taking into account the current geographical distribution of CDM projects, we estimate supply from following five regions: LDCs, Latin America, Europe and Middle East, Asia-Pacific other, Africa other. For scenario D, where only credits from LDCs are accepted from projects registered after 2012, we assume that CDM will be actively promoted in LDCs. To account for this, we take 50% of the theoretical potential estimated by a World Bank Study for LDCs in Sub Saharan Africa (De Gouvello et al., 2008) and add it to the CERs projected from the CDM pipeline.

Table 6 CER supply scenarios 2013-2020: assumptions

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Description</th>
<th>Values for parameters</th>
</tr>
</thead>
</table>
| A - Only CERs up to 2012 | Only CERs generated from projects registered up to 2012 are considered for supply up to 2020 | $p_{\text{val}} = 70\%$  
$p_{\text{rej}} = 10\%$  
$p_{\text{perf}} = 98\%$  
$\text{supply} = \text{CER}_{\text{sum}2020} - \text{demand}_{2008-12}$ |
| B - CDM same  | CDM continues with same rules, same stringency and same countries           | $p_{\text{val}} = 70\%$  
$p_{\text{rej}} = 10\%$  
$p_{\text{perf}} = 98\%$  
$\text{supply} = \text{CER}_{\text{sum}2020} + \text{CER}_{\text{add2020}} - \text{demand}_{2008-12}$ |
| C - No new industrial gases | CDM continues with same stringency and countries after 2012, but without industrial gas projects | $p_{\text{val}} = 70\%$  
$p_{\text{rej}} = 10\%$  
$p_{\text{perf}} = 98\%$  
$\text{supply} = \text{CER}_{\text{sum}2020} + \text{CER}_{\text{add2020}} (\text{w/o ind gases}) - \text{demand}_{2008-12}$ |
| D - After 2012 only LDCs | For projects registered after 2012, only CERs from LDCs are accepted. Promotion measures to incentivise this supply are in place. | $p_{\text{val}} = 70\%$  
$p_{\text{rej}} = 10\%$  
$p_{\text{perf}} = 98\%$  
$\text{supply} = \text{CER}_{\text{sum}2020} + \text{CER}_{\text{add2020}} (\text{only LDCs}) + \text{CER}_{\text{LDC additional}} - \text{demand}_{2008-12}$ |
| E - CDM enlarged | CER generation between 2013 and 2020 with 50% higher potential each year    | $p_{\text{val}} = 70\%$  
$p_{\text{rej}} = 10\%$  
$p_{\text{perf}} = 98\%$  
$\text{CER}_{\text{add}}$ is multiplied by 150\%  
$\text{Supply} = \text{CER}_{\text{sum}2020} + \text{CER}_{\text{add2020}} - \text{demand}_{2008-12}$ |
THE CLEAN DEVELOPMENT MECHANISM IN THE FUTURE CLIMATE CHANGE REGIME
AXEL MICHAELOWA - BENITO MÜLLER

Scenario | Description | Values for parameters
---|---|---
F - CDM strict rules | From 2013 onwards stricter additionality, no industrial gases: less validations, more rejections, smaller CER issuance rate | Up to 2012:
\[ p_{\text{val}} = 70\% \]
\[ p_{\text{rej}} = 10\% \]
\[ p_{\text{perf}} = 98\% \]
After 2012:
\[ p_{\text{val}} = 50\% \]
\[ p_{\text{rej}} = 15\% \]
\[ p_{\text{perf}} = 82\% \]
supply = CER_{\text{sum}2020} + CER_{\text{add}2020} (w/o ind gases) - demand_{2008-12}

The results of our projections are shown in Table 7:

<table>
<thead>
<tr>
<th>Scenario / Region</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Only CERS up to 2012</td>
<td>4124</td>
<td>6382</td>
<td>6297</td>
<td>4753</td>
<td>7511</td>
<td>5350</td>
</tr>
<tr>
<td>Africa other</td>
<td>107</td>
<td>166</td>
<td>167</td>
<td>107</td>
<td>196</td>
<td>141</td>
</tr>
<tr>
<td>Asia-Pacific other</td>
<td>3342</td>
<td>5211</td>
<td>5136</td>
<td>3342</td>
<td>6146</td>
<td>4355</td>
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<tr>
<td>Europe and Middle East</td>
<td>74</td>
<td>113</td>
<td>112</td>
<td>74</td>
<td>133</td>
<td>96</td>
</tr>
<tr>
<td>Latin America</td>
<td>560</td>
<td>810</td>
<td>799</td>
<td>560</td>
<td>935</td>
<td>695</td>
</tr>
<tr>
<td>LDCs</td>
<td>41</td>
<td>81</td>
<td>82</td>
<td>671</td>
<td>101</td>
<td>64</td>
</tr>
<tr>
<td>Total supply 2012-2020 (MtCO(_2)eq)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The combination of our CER supply and demand scenarios is shown in Table 8. It should be noted that in this analysis we have disregarded the potential supply form JI projects, on the grounds that this instrument has not yet really taken off due largely to delays in host country approval and that it also constitutes mitigation effort from the side of Annex I countries.

<table>
<thead>
<tr>
<th>Scenario / Region</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Only CERS up to 2012</td>
<td>3177</td>
<td>10182</td>
<td>9416</td>
</tr>
<tr>
<td>CDM same</td>
<td>919</td>
<td>7924</td>
<td>7158</td>
</tr>
<tr>
<td>No new industrial gases</td>
<td>1004</td>
<td>8009</td>
<td>7244</td>
</tr>
<tr>
<td>Only LDCs after 2012</td>
<td>2548</td>
<td>9553</td>
<td>8787</td>
</tr>
<tr>
<td>CDM enlarged</td>
<td>-210</td>
<td>6794</td>
<td>6029</td>
</tr>
<tr>
<td>CDM strict rules</td>
<td>1951</td>
<td>8956</td>
<td>8190</td>
</tr>
</tbody>
</table>

These figures indicate that under most scenarios, the CDM would not provide sufficient credits to cover the potential demand during 2013-2020. The resulting balance provides an idea of the domestic effort that Annex I countries (except the EU, which is already accounted for in the model), would have to make in order to comply with the targets assumed in the scenarios.

It should be noted that several of these combinations are not likely. Under a scenario with no agreement, for example, it is unlikely that the CDM will be significantly enlarged, as Annex I countries will not be willing to finance further project development in developing countries. It is also unlikely that all Annex I countries agree to only accept high quality CERs if they do not agree on a new
common framework for climate change mitigation, but some parties or groups (as the EU) could decide to implement these limitations unilaterally. Thus, while not completely realistic, the combination of scenarios shows an overall picture of the range of possible balances in the future carbon credit market from the most optimistic to the most pessimistic possibilities, provided that our assumptions are sufficiently accurate.

More interesting is to look at how the supply would be spread across regions, which is shown in Figure 14. The graph shows again the large difference that might arise between demand and supply of carbon credits. But it also shows that under most scenarios, LDCs remain unimportant in the market.

We expected that specifically the scenarios without industrial gases, with strict rules or with CERs only from LDCs after 2012 could have an impact on supply from LDCs. However, industrial gases are no longer so important in the CDM pipeline. In 2004, 2005 and 2006, CERs projected to be supplied by industrial gas projects amounted to 44%, 57% and 39% of the whole CDM supply, respectively. In 2007 and 2008, new industrial gas projects represented only 8% and 4% of the new supply (in terms of amount of CERs). Thus, our estimations assume that new industrial gas projects decrease in the future, so that a limitation on these types of projects will not have a large impact in the market. The scenario with strict rules is similar. As our assumptions on rejections, validation success and issuance success are constant across all project types and host countries, these strict rules do not provide for further supply from LDCs. Further work could refine our projections to include some degree of differentiation across project types, which would then be reflected in the shares of host countries according to their project portfolios.

Finally, the scenario with preferential access for LDCs after 2012 does show some improvement for these countries, but still, the supply from all other countries up to 2012 is much larger. We should also remember that this supply from LDCs will only materialise if the existing barriers for CDM project implementation in these countries are overcome.

Figure 14 Supply demand balance 2013-2020

In the world trade system, there is a case that could be used to illustrate the effect of preferential access options for a specific group of countries. The Lomé Convention, first signed in 1975 and renewed three times afterwards, is a trade and aid agreement between the European Union (at that time the European Community (EC)) and 71 so-called ACP (African, Caribbean and Pacific) countries. It establishes the basis for trade and development cooperation between these two groups of
countries, on the one hand out of Europe’s interest to guarantee supply of raw materials, and on the other out of their wish to support ACP countries’ sustained development. The Lomé agreements set preferential access quotas for agreed agricultural products that could then enter the EC market free of duty. While these agreements are no longer in place due to their incompatibility with World Trade Organisation rules, they are still an interesting case study that could illustrate the limitations of preferential access policies.

According to Cosgrove (1994), ACP exports to Europe accounted for 3.4% of total EC imports in 1975, when the first Lomé Convention was signed. Due to the large growth in EC trade, ACP exports declined to 3.2% of EC imports by 1985 and further to 1.5% in 1992. While ACP exports to the EC did grow, they could not keep pace with the growth in the European market. Cosgrove concludes that the Lomé Convention did not provide sufficient support to enable ACP countries to keep their market share, and that it therefore failed its goals.

The preferences generated by Lomé for ACP exports were highly dependent on the barriers that the EC placed for trade in general. For agricultural products, the general rule is that the more processed the product is, the more barriers it faces. Thus, ACP countries would have benefited most from adding value to their raw materials and exporting them to Europe in processed form. Trade also depends on the current prices of commodities. During the 1980s and 90s, the prices for agricultural products have mainly fallen, which had also a negative impact on ACP trade. Finally, the increase in trade from the preferred country group will also depend on the elasticity of demand for the product. The elasticity of demand for most ACP products in Europe is low, so that a lower price for them (offered by ACP countries) would have little effect on their export volume (Cosgrove, 1994).

Some success non-traditional products have been identified as benefiting from the Lomé Convention, among them canned tuna, leather and leather products, fresh flowers, some vegetables, textiles and garments. Many of these products were subject to levies from the European common agricultural policy (CAP), and thus profited from comparative advantage under Lomé. In the case of Mauritius, the strong specialization on sugar exports to the EC enabled to build up the funds that were then used to embark on development of industry and services. Despite these successes, the main barriers inhibiting ACP export performance could not be overcome by a trade agreement: climatic conditions (droughts and desertification), crop and livestock diseases, lack of infrastructure leading to high transportation and communication costs, oil price increases, AIDS continued to restrict development and integration of ACP countries in the world market (Cosgrove, 1994).

The Lomé experience provides lessons for the climate regime. Through Lomé, not just access to a market was secured, but access with less costs (no tariffs or levies). In the climate regime, CDM projects from LDC countries benefit from zero registration fee. However, registration is only a small fraction of the CDM transaction costs, where the bulk of the investment is directed towards PDD development, if needed methodology development and validation.

In the EU climate package, some degree of preferential access for CDM projects from LDCs has been secured, but no provisions are yet in place for further supporting the implementation of these projects. As seen in the Lomé experience, the underlying causes of poor countries’ lack of competitiveness need to be addressed. Further, in Lomé, success was observed for special types of products with added value. A parallel could be made here to CDM project types with added value (sustainable development benefits or stricter additionality, for example), but only if this added value is transformed into some kind of financial incentive that supports these projects. This kind of differentiation between project types is not yet in place in the climate regime.

2.4.3 Experiences from capacity building subsidies

So far, there has not been any analysis of the effectiveness of capacity building subsidies in African countries and LDCs with regard to the mobilization of projects, which could serve as an indicator for the performance of a CDM project subsidy programme. Based on the CDM capacity building programmes that have been implemented so far, we define different types of programmes:

1. Awareness raising: Workshops to share information on the CDM project cycle, carbon markets in general and successful projects
2. Institutional capacity building: Training of public sector, development of sustainable development (SD) criteria, establishment of Designated National Authorities (DNAs) and procedures for project approval by the DNA.
3. Project development: Potential assessment, methodology development and feasibility studies to overcome technical barriers, private sector training, PIN and PDD development.

Awareness raising was a common feature of many early capacity building programmes. When the CDM was agreed at the Kyoto conference, many Parties and people were unsure how the mechanism would work. Even after the agreement on the Marrakech Accords it took countries a while to understand the whole procedure. In fact, many programmes developed brochures on the project cycle and the role of stakeholders and different institutions and organized information sharing workshops in different regions within the host country. More recently, workshops focus on sharing experiences of successful projects with other countries that have not been successful within the same region.

As there is no internationally set standard for sustainable development in a CDM project, each country needs to define its own criteria underpinning the decisions of its DNA. All countries have different challenges, priorities and objectives. Therefore, they must undertake exercises of defining exactly what constitutes sustainable development in a project setting. Institutional capacity building programs were established to support these needs and help design procedures for project approval. Often, workshops were held with ministries and private sector representatives to understand the role of the DNA.

For those host countries that have set up their DNAs, the challenge is to get project proposals developed. Many capacity building programs assessed the country's mitigation potential and did feasibility studies in some particular sectors of the economy. They then assisted project developers to write specific PINs. Usually, the most attractive and feasible PINs are selected and followed up. These are then developed to PDDs.

We assess CDM capacity building programs in 51 African countries and 48 LDCs that have been implemented from 1998 onwards. Among the 51 African countries, 32 countries are LDCs as well. Therefore, we assess a total of 67 countries. The data has been extracted from Michaelowa (2005), Silayan (2005), from submissions of the Parties and international organizations to UNFCCC (UNFCCC, 2007, Germany 2007), a UNEP report on CDM capacity building (UNEP, 2006), different programme websites and reports from development organizations available online. Sometimes, different sources reported different numbers of workshops, countries involved, and money spent. In these cases, we used the figures provided by the organization that implemented the programme. There is no organization that compiles all the information on capacity building programmes and the quality of reporting and accessibility of the reports on the websites differed greatly among organizations and governments. Therefore, our data shown in Annex I may not include all capacity building programmes that have been implemented. Given the interest of donors to advertise their activities, we however do not think that many programmes have been omitted.

The budget of to capacity building programmes involving at least one LDC or African country that have been identified amounts to 83 million €. We estimate that at least 43 million € have been allocated programmes in LDCs and Africa in the last 10 years.

Capacity building in Africa started already in 1998 directly after the agreement on the Kyoto Protocol for a limited number of countries. At this stage, most capacity building focused on awareness raising, information sharing and CDM potential assessment and feasibility studies. Such awareness raising and information sharing workshops, however, are still being implemented from time to time. Donors increased the institutional capacity building to set up DNAs in Africa and LDCs after the Marrakech Accords were signed. By this time, the targeted number of countries had doubled to 21. The Climate Protection Program (CaPP) funded by Germany, for example, helped host countries to formulate sustainable development criteria and assisted institutional capacity until the DNA could be established. In 2006, 34 countries had had experience with CDM capacity building. From 2006 onwards, however, the donors have shifted their interest, as they lost interest in establishing new DNAs, and increased institutional capacity building programs for those countries with established DNAs. For example, after the DNA establishment in Tunisia in 2005, Germany provided 0.75 million € from 2006 to 2009 for the actual implementation of the CDM activities. The United Kingdom (UK) and European Community in collaboration with Ireland and Denmark started institutional capacity building in South Africa after its DNA was established in 2005. The World Bank started its Carbon Finance Assistance (CF-Assist) in

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8 It should be noted that generally there are no data available on how the donors allocate project funds to each of the targeted countries. Therefore, we have assumed that within the same programme, funds are distributed evenly between all target countries.
Botswana, Cambodia, Mozambique and Uganda around 2006/2007. At this stage, many donors also started to increase their funds in actual project development, especially since CDM methodologies for reduction of the use of non-renewable biomass had been approved in early 2008. Most of the programmes focused on a specific sector. The UK funded the Development of a Pilot Programmatic CDM project in South Africa for energy efficiency in industry, German Development Co-operation (GTZ) started Energy sector CDM capacity development for Francophone Africa from 2007 and France in collaboration with UNEP began Carbon Finance for Agriculture, Silviculture, Conservation and Action against Deforestation (CASCADE) and CDM in forestry and bio-energy in 2006. The share of forestry projects within the submitted projects in the pipeline is significantly higher in Africa than in other regions. It accounts for 6% of the 77 projects in the pipeline. As forestry projects need complex analysis and calculations, the project developers need to undergo intense training. Additional capacity building programs started after 2007, after the problem of the uneven distribution of the CDM projects and the lack of CDM projects in Africa had been highlighted at the UNFCCC Conference of the Parties in Nairobi, in December 2006. The African UN Secretary-General, Kofi Annan, announced during the opening of the high-level segment of the Nairobi conference that there would be a framework launched to enhance CDM projects, especially in the sub-Saharan Africa. This "Nairobi Framework" was initiated by the United Nations Development Program (UNDP), United Nations Environment Program (UNEP), World Bank Group, African Development Bank, and the Secretariat of the UNFCCC with the specific target to improve the level of participation of Sub-Saharan African countries in the CDM. The initiating agencies agreed on five objectives, which are considered to be key priority to move the CDM forward in the beneficiary countries:

- Build and enhance capacity of DNAs to become fully operational
- Build capacity in developing CDM project activities
- Promote investment opportunities for projects
- Improve information sharing/outreach / exchange of views on activities / education and training
- Inter-agency coordination.

The donors, mostly from European countries, offered funds and started additional capacity building programmes. Finland, Sweden and Spain were the three first governments that declared a support of 1.5 million $ for the Regional capacity building project for sub-Saharan Africa, implemented by UNEP and UNDP. Its objective is to enhance public and private sector capacity to access carbon finance, and to overcome project barriers in Ethiopia, Kenya, Mauritius, Mozambique, Tanzania and Zambia. The World Bank, which is one of the initiating agencies of the Framework, started to assist Kenya, Mozambique, Uganda and Yemen through the CF Assist Program and Carbon Finance for Sustainable Energy in Africa (CF-SEA, 1 million $) from 2007. The Green CDM Facility for Africa funded by Denmark (3 million $) targeted Benin, Burkina Faso, Ghana, Mali, Niger and Zambia, and the CDM in Africa Initiative funded by Austria (0.3 million €) focused on Uganda, Tanzania, Ghana and Ethiopia, starting in 2007 as well. All of them aim to increase the number of registered projects through assessment of project potential, feasibility studies and concrete drafting of PINs and PDDs and thus chose the countries that had already established DNAs by that time. Some countries, like Ghana, Tanzania and Mozambique received similar programmes from other donors and agencies. 24 African countries and LDCs have not been targeted by any of the programmes, although they have ratified the Kyoto Protocol.

Evaluation of awareness raising workshops is difficult to evaluate as no countries have been identified to have had only such workshops in our data. However, 5 countries have had only awareness-raising and project potential assessment and/or feasibility studies, which were a common feature of capacity building programs when they had started. These countries are Algeria, Congo, Ethiopia, Gabon and Gambia. All of these countries, except for Gambia had such capacity building programs before 2002 and had been neglected from then until recently. None of these countries have submitted PDDs until recently, but Congo and Ethiopia managed to submit their first PDD in 2008. This might partly be a result of capacity building programs that started in 2007. However, as we have few of such cases in our data it is difficult evaluate the effect of awareness raising workshops.

9 African and LDC DNAs received support for the DNA establishment. All of the capacity building programmes that focused on the establishment of the DNA seem to have been successful, although the time and effort given by agencies differ by countries (see Figure 15). By 2005, only 4 African countries had a fully functioning DNA office, approved by the national legislative body, with fully drafted and approved sustainable development criteria. These capacity building programmes therefore...
contributed to increase the number of DNAs in the region and supported elaboration of sustainability criteria and in some cases the set up of DNA websites.

Figure 15 Institutional capacity building and establishment of DNA

As has been discussed before, donors have not been much interested to establish new DNAs in the last 3 years, but shifted their focus to the institutional capacity building for those countries with already established DNA (see Figure 16).

Figure 16 Number of institutional capacity building programmes by year

Unfortunately, although the number of DNAs has increased as a result of these initiatives, only a few DNAs seem to have capacity to attract project developers. For the project developers it is important that the information about the procedures and sustainability criteria are easily available to develop their project. So far, 27 countries have received subsidies for the institutional capacity building. However, 35 of the DNAs in Africa and LDCs do not provide any link to their website in the UNFCCC list of DNAs, or the links are outdated, though 17 countries of them had received institutional capacity building. Further, only 8 countries in the region have DNA websites that explain the CDM and the role of the DNA. All of these 8 countries had institutional support and have submitted at least one PDD to the EB in the past. Investigating these websites more in detail, it is clear that they have often been updated during the capacity building programme period, but that there is not much continued effort to keep the site updated. The most recent updates in the 8 websites appear to have been done in the
beginning of 2008. On the other hand, it might be sufficient if the website gives a clear guideline on the criteria and the procedure for project developers, and in this case no further update is necessary. The effectiveness of the project development capacity building programmes can be analyzed by comparing it to the quantity and quality of the CDM projects submitted and registered in the host countries. Until now, at least 27 million € have been spent for programmes that include project development capacity building in 32 countries.

From our data, some relationship can be observed between the number of programmes implemented in different countries, and the submitted and registered CDM projects (see Figure 17).

Figure 17 Trends in project development capacity building, submitted and registered CDM projects in Africa and LDCs

Note: In this graph, the capacity building initiatives are counted per programme and per receiving country. So, for example, if the UNEP CD4CDM program promoted PDD development in 5 African countries in the year 2006, this is counted as 5 initiatives in 2006. If it continued providing assistance to these 5 countries during 2007, this is again counted as 5 initiatives for 2007.

However, only 35 projects have been registered in these countries, and most of these are located in South Africa (14), Egypt (4) and Morocco (4), so that only 9 projects are actually in LDCs. Compared to the amount of money dedicated to the programmes, registered projects seem to come with a high price tag. Moreover, examining the programmes by countries, only a few countries have been successful in submitting and registering CDM projects. 70% of those countries that received project focused capacity building do not have any registered project, and half of them have not submitted any PDD yet. In addition, not much relationship can be seen between the number of capacity building programmes and registration of CDM projects. Among the 12 countries that have benefitted from the largest number of such programmes, only 5 have been successful in registering a CDM project. Although Benin and Ghana are among the countries with the highest number of those programmes, they have never submitted any project. Mozambique and Zambia were slightly better and have each submitted one project, but these have not (yet) been registered.

The quality of the African/LDC projects in terms of share of rejections and registrations seems to be similar to that of the whole world. While 111 projects have been submitted from Africa and LDCs, 35 have been registered (31.5%). This is a bit better than the average for the whole world, which is currently 29%. In addition, if one compares the percentage of rejected projects in Africa and LDCs with the percentage of rejected projects in the whole world, Africa fares slightly better than the average.
In terms of the GHG emission reduction, the registered African and LDC CDM projects reduce 45 million t CO\(_2\) whereas the whole registered projects will reduce 1.34 billion t CO\(_2\) (UNEP Risoe Center, 2009). Therefore, the share of CERs from these countries accounts for only 3%. Taking into account the subsidies spent so far, the first objective of the CDM to reduce GHG emissions has not been achieved effectively. The CDM might have provided some benefits for their sustainable development, but these cannot be easily measured as there is no monetary value for the contribution to sustainable development. It can be observed that those countries which had all three types of capacity building are more successful in submitting and registering CDM projects than those which had just two types. Among 14 countries that received all types of programs, which include 5 LDCs, 6 countries submitted PDDs and another 6 countries had registered CDM project. Among 6 countries that received project development capacity building but no institutional ones, only one county had registered CDM. Similarly, only one county had registered CDM project among 5 countries that received institutional capacity building but no PIN or PDD support.

The overall result of the effectiveness assessment suggests that the CDM capacity building helped to remove some obstacles in several countries, but it does not help to overcome all of the problems that LDCs face regarding development of CDM projects. While 27 million € have been spent for project development support, only 35 projects have been registered so far – an implicit subsidy of almost 1 million € per project! Expressed as a share of the current CDM market volume of about 460 million € in Africa and LDCs, capacity building activities cost around 10%.\(^9\)

### 2.5. How could project CDM be improved?

**Rita Roy Choudhury, Nimisha Pandey, Suchismita Mukhopadhyay, Francis Yamba**

Over 70 member companies of the Federation of Indian Chambers of Commerce and Industry (FICCI) covering 16 industrial sectors, have provided a set of proposals for CDM reform, which is based on the challenges identified in section 2.3. Moreover, the African module team has provided suggestions for improvement. The suggested reform measures look at attaining the following objectives:

- reducing transaction costs and project risks
- enhancing / broadening the coverage of CDM to include underrepresented sectors and project types
- strengthening the governance of CDM
- ensuring regulatory certainty

Country specific, as opposed to project-by-project, baselines should be developed because viability of projects depends on the circumstances of the country. Country specific baselines for certain types of projects / sectors would help in reducing transaction costs. There could be technical, investment, manpower, administrative constraints due to which many otherwise viable projects cannot be undertaken. Any project which goes beyond this business-as-usual scenario (country specific baseline) should be considered under CDM. These country specific baselines can be shifted and modified at specific intervals in time.

Prototyping of CDM projects should be allowed to fast track the CDM process. Similar projects (under similar environmental conditions, using same technology, same methodology, similar socio-economic settings, etc.) should be cleared on fast track mode and should not be required to go through the process of validation.

Approval of projects/methodologies/monitoring plans by CDM EB/Meth Panel should be time-bound and transparent. All total processes within the EB must be time bound and define a finite time frame for decisions related to different stages (registration, verification, issuance).

The EB decision of separate DOEs for validation vis-à-vis verification stage for larger projects should be amended to allow the same DOE to perform both tasks. This will reduce project risks, transaction costs and time overruns for companies. In allowing DOE1 to also operate as DOE2, the process can be

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\(^9\) The expected CERs from 35 registered projects by 2012 are 45.6 million CERs (UNEP Risoe Center, 2009). The price per CER is estimated at 10 €.
strengthened by building in a system of checks and balances through periodic/surprise audits of the DOE and the project site.

A larger number of DOEs should be allowed to enter the market, through modification of financial criteria for accreditation. Moreover, the local DOE offices should be empowered to take decisions. Capacity building and awareness of financial institutions is important to bring more financial instruments into the market to support upfront financing and securitisation of CERs for small and medium companies. This would also take care of the transaction cost issues for SMEs.

Methodologies are an imperative for enabling growth in the project pipeline as well as broadening the coverage of CDM by bringing new projects and sectors into the CDM pipeline. The multilateral framework should incentivise the process of methodology development, as low-hanging opportunities slowly dry up, through creation of an international methodology development fund, which would help in providing grants to methodology developers and support a ‘first mover advantage’ for them. Two suggestions to provide an impetus to methodology development are:
- Creation of a fund to finance the cost of methodology development
- In order to retain the public good nature of CDM methodologies as well as to provide a ‘first mover advantage’ to methodology developers, some incentives / waivers in registration fees, and in-kind benefits such as award of recognition, etc. should be provided.

Development of suo-moto methodologies (i.e. which do not ride on specific projects) would act as a barrier removal. In addition, technical assistance from Government or multilateral organizations for development of suo-moto methodologies would not put the burden of first mover costs on managing entities. Thus, one way to provide impetus to programmatic CDM/ bundling would be to disentangle methodology development from projects.

The CDM process and modalities for RE projects needs to be simplified, so that these projects can be accorded greater degree of impetus. Also, the threshold size required for bundled RE projects should be reduced to make management of such projects easier and reduce margins of error. In the case of renewable energy projects that have intrinsic carbon additionality, the additionality requirement should be done away with.

The following measures proposed would lend greater transparency, efficiency and credibility to EB and strengthen governance of CDM.

Direct access to EB would enable project developers to provide clarifications without need for repeated reviews. Clear guidelines must be issued by EB regarding the expected action in case of deviations with respect to CER projections/project size/project output. Deviations in methodologies submitted to EB for approval should be discussed directly with methodology proponents. This would lend greater transparency and remove misgivings on either side, making the process more efficient, unbiased and equitable. Changes in EB decisions should be done periodically after specified intervals of time, and not on ad-hoc basis, and should not impact projects on a retrospective basis (i.e. projects submitted before the change in EB decisions). The requirement of financial additionality should be completed eliminated. The EB members should be made full-time to reduce time delays at various stages and enhance efficiency, objectivity and transparency in the entire CDM process. The composition of EB needs to be reviewed to reflect a mix of policy, regulatory, technical and regional expertise in order to make the entire CDM process more transparent and representative of all stakeholders. The UNFCCC and EB should have sector specialists to look into sectoral methodologies and projects. This would aid in addressing sector specific issues/limitations and would reduce the number of reviews and rejections and in turn loss of many potential projects. A typical example is that of the transport sector. The EB/Meth Panel should consider the robustness of calculations submitted in a project document and not insist on accuracy based on second decimal places, which has no implications for CER calculations.

DOE eligibility criteria needs to be re-looked and capacity building initiatives should be undertaken to enhance their confidence and know-how in order to reduce time delays and make the process more efficient and transparent. All DOE personnel, before they are accredited, must compulsorily attend a capacity building course by which they are exposed to the UNFCCC guidelines and given the authoritative interpretation of what the guidelines mean and must be re-certified periodically after undergoing updating courses. The qualification requirements for DOE staff should be made more stringent. The DOEs should compulsorily recruit candidates with technical background (with specific sectoral understanding) and field experience. A standard protocol or checklist needs to be developed against which the DOEs would check each and every project and the guidelines will be available to the
consultant and the project proponents as well. The system of validation and verification should be standardized globally to make it more transparent and consistent across similar project types or sectors.

The CDM EB should provide proper monitoring and verification guidelines for the transport sector. Also, the CDM EB demands at least 95% level of confidence for transport projects, which is difficult to accomplish. Monitoring for transport sector is complex, unlike in the case of industrial projects, which are fixed in one location. Transport projects involve monitoring emissions from mobile units, thus making monitoring and verification a difficult exercise. The emission profile of a vehicle changes as it moves. Patterns of driving cycles could be complex to determine. Therefore, for such projects, the level of confidence should be reduced to 90% to make it more pragmatic.

The CDM enhancement in Africa requires reform of operational CDM policy framework in order to accelerate CDM project development and carbon finance. The reform can be divided into two categories pre-2012 and post-2012.

As part of pre-2012 reform, the following measures are recommended (i) The EB needs to make a special effort and case to streamline the CDM process, reduce all costs of CDM project preparation and registration without compromising environmental integrity, (ii) facilitate the development of simplified methodologies which encompass regional baselines to enable small scale projects feed into regional electricity grid, For example, the Southern African Power Pool (SAPP), and Western and Eastern African Power Pools, (iii) development of simplified methodologies for LULUCF based projects to include forest management, agro processing, improved charcoal production techniques etc,(iv) need for relaxation of validation and monitoring protocols without losing environmental integrity and also relaxing of additionality testing rules for example of eliminating restrictions that become common practice,(v) further, to increase the threshold for small scale projects beyond 60,000 tonnes per annum to enable increased bundling.

Post 2012 reform will require to rectify the skewed distribution of CDM projects by negotiating for improvement in CDM rules to enable Africa take advantage of funds from carbon market to support sustainable development and transfer of climate friendly technologies (UNEP/AMCEN 2008). As part of the 2012 negotiations, sustainable development should be the point of focus in order to really achieve the objective of the convention, since to date experience has shown that CDM has tended to award prominence to emissions reduction (Lesolle 2008).

Further, it is recommended that consideration be made to support the ongoing post 2012 negotiations for sectoral CDM, since it has potential to incentivize CDM and achieve emissions reduction more cost effectively (Pfeifer 2008). However, it is advisable that implementation of sectoral CDM not be at country level but regional/continental levels in view of small number of some industries per sector in each individual country. Further, this would serve as an opportunity to include underrepresented sectors such as agriculture, forest and transport.

In view of the vast opportunities in agriculture and forest activities, which serve as main economic occupations of most poor people in Africa, it is recommended that eligibility of CDM avoided deforestation and land degraded projects to include charcoal production and bio energy projects, and corresponding methodologies be seriously included. In particular, it is essential to consider harnessing a large flow of carbon finance to agriculture development aimed at improving the lives of poor farmers in Africa.

According to FAO (FAO 2008), few agriculture CDM projects are being considered to reduce GHG emissions despite it being a leading source of emissions - contributing 30% at global level when land use changes and the intensive livestock sectors are included. It has been stated that when land is tilled in traditional farming systems, the CO₂ stored there is released into the atmosphere, contributing to GHG build up and hence climate change. However, when conservation agriculture (through no tillage farming methods) is applied, it has been stated that it in fact removes significant quantities of CO₂ from the atmosphere and store it in the soil.

In fact, consensus among Common Market for East and Southern Africa (COMESA) to have a common stand is emerging as part of the post Kyoto negotiations on the need to have a link between reduced deforestation and forest degradation (REDD) and AFOLU activities which include a broader range of project types from agricultural and forestry sector (Comesa Consultative Meeting 2009). “This should be the case in view of the extent of agriculture as the main economic activity”. The meeting stressed that Africa stands to gain from such a comprehensive approach as it represents the only way for many
people and communities to participate in and benefit from the carbon market arising from such a scheme.

As part of expertise development, African governments need capacity to promote and encourage CDM and work with the private sector to stimulate project development. African businesses need increased awareness of CDM, its benefits and role in accelerating investment and bringing in new technology. In particular, there is need for provision of support and resources to develop local expertise in key related CDM services to help project developers prepare business plans, and PINs and PDDs. Capacity activities should involve learning by doing targeting the right group to include engineers/economists/financial analysts from industry, consulting firms, and research organizations/ academia. In this regard, one important aspect of realizing sufficient capacity is developed, is to ensure that capacity building is sustainable. In other words, it must involve local expertise and experience take place in a framework that is sufficiently robust and flexible to retain the new learning it attains.

As part of institutional/policy development, CDM should be core in the investment decision process required in most sub-Saharan African countries as they tackle energy security of supply challenges, particularly for electricity, since demand has stripped supply in most African electricity networks in SADCC, EAC, and ECOWAS. Similarly, there is need for CDM mainstreaming and integration in various African vision and implementation strategies, and programmes addressing millennium development goals (MDGs), and integrate further CDM sensitising and promotion in the portfolios and functions of investment promotion agencies, and business and farmers associations. Further, the enactment of fiscal incentives by governments for RET implementers such as tax breaks and accelerated depreciation of capital equipment could result in increased development of RETs and hence CDM.

Aggressive CDM awareness and information programmes are essential to remove various policy, technical, financial and legal barriers identified. There is need to conduct awareness programmes amongst companies on CDM objectives, its project cycle and benefits of CDM in business, especially involving high level meetings among CEOs. Further encourage provision of key data to private sector on technology (renewable energy, energy efficiency, etc) characteristics, investments and O&M costs through creation of websites by various DNAs for widespread dissemination. To increase CDM portfolio development requires provision of specialised support service providers with resources to enable them work with the private sector to develop PDDs.

A rigorous awareness programmes must be further conducted on legal issues, arrangements and requirements during CDM project implementation. The other approach would be to involve qualified personnel in on-going CDM projects who could acquire knowledge during project development cycle under "learning by doing“ philosophy.

As regards financing, the private sector intending to develop CDM projects should be sensitised on the risk and transactions costs associated with CDM implementation, and impacts of CERs on project economics. Local financing institutions should be sensitised to remove the perception that renewable energy and efficiency power projects carry high risk characteristics in particular considerations should be made to use insurance mechanism to reduce risks for project participants. Further consideration can be made to use Export Credit Guarantees Schemes to reduce perceived risks.

Potential RET investors need to be sensitised on the opportunities for obtaining finance from local and international sources such as the Global Environment Facility (GEF) and recently created financing frameworks to include World Bank Climate Investment Funds, Carbon Partnership Facility and Japan’s Cool partnership. For the post 2012 financing, consideration has to be made to introduce innovative financing mechanism to support CDM projects emanating from agriculture and forestry based activities.
3. Programmatic CDM

Programmatic CDM was introduced to help very small projects overcome the CDM project cycle transaction cost barrier. Programmes of Activities (PoAs) allow combining a number of project activities (called CDM Programme Activities, CPAs) under a joint "umbrella". In general PoAs are measures that are coordinated and implemented voluntarily by private or public entities leading to GHG emission reductions. The idea is to find a measure that opens sectors that were so far almost untouched by the CDM. With this, PoAs are regarded as a climate policy instrument with a high potential to promote an environmental friendly development and with a high potential for emission reductions. A PoA has a duration of up to 28 years and can use any approved baseline and monitoring methodology. The key difference from the possibility of “bundling” projects, which has existed for several years, is that the number and timing of projects developed under the PoA is completely flexible. An important advantage of PoAs compared to the option of bundling projects is the fact that small-scale methodologies can be applied without any limit on the size of the PoA. Since small-scale methodologies are much simpler and more standardised, small-scale PoAs (SSC-PoA) have a comparative advantage over large-scale PoAs.

The experience with PoAs to date is relatively limited because the instrument is still new. By end of December 2008, 10 PoAs had been listed at the UNFCCC website, of which seven under the CDM and three under JI. The PoAs under the CDM are hosted by Bangladesh, Brazil, Honduras, Mexico, Senegal, South Africa and Uganda. Three PoAs apply distributed renewable energy (solar home systems; solar water heating, small hydro), two use energy-efficiency measures at the household level (distribution of efficient light bulbs), one sets up biogas flaring (methane capture from animal waste), and one aims to install a waste management system (municipal waste composting). Under JI, all three programmes registered are hosted by Germany, which introduced a simplified regulatory framework that is attractive to PoA operators. The German programmes comprise energy efficiency at the industry level (replacement and refurbishment of low efficient heating boilers) and at the household level (introduction of heat pumps).

PoAs will find their natural niches in the fields of small to medium sized projects which are geographically and/or temporally dispersed and have a large number of project owners unknown before the start of the PoA.

3.1. What are the current obstacles for implementation of programmatic CDM and how could they be overcome?

Axel Michaelowa

Despite having been possible for almost 2 years, not a single Programme of Activities (PoA) has been registered to date. This is due to several important obstacles:

- A PoA is restricted to one baseline methodology. Especially small-scale projects frequently use a combination of methodologies. This excludes those project types that most urgently need the CDM.

- At any time after inclusion of a project under the programme (CDM programme activity, CPA), a PoA can be challenged by one EB member. The EB then decides whether the CPA should be excluded. The DOE that validated the PoA has to provide CERs to cover all CERs issued for the excluded CPA. This liability is very tough, given that a challenge could come many years after the inclusion of a CPA. Subsequently, a DOE reviews the entire PoA and checks whether other CPAs should be excluded as well. So far, validators have not been willing to take up this liability or asked PoA developers to provide insurance coverage.

- If a PoA uses a small-scale methodology, the debundling rules apply. They require to leave a strip of 1 km width between two CPAs. Especially for PoAs that disseminate energy-efficient appliances in urban settings, the potential CER losses and cumbersome monitoring requirements are a major hurdle.
A PoA has to be revalidated every time its baseline methodology is revised. Given the high frequency of baseline revisions, this will lead to an enormous workload for PoA coordinators, validators and the EB.

These obstacles to PoAs can be addressed as follows:

- The rule that only one methodology is to be used should be scrapped. There are no valid arguments for maintaining that rule, as there are sufficient DOEs that can validate all possible scopes. Sampling requirements that differ according to methodologies can be taken into account by increasing the sample size to cover both sub-samples.
- The liability of the validator could be limited by allowing the EB to challenge each CPA for a limited period after its addition (e.g. 6 months). This makes it likely that no CERs have been issued for a CPA that was excluded due to a challenge, while retaining the reputational incentive for the validator to do a good job.
- The debundling rule could be waived for PoAs.
- A PoA should be allowed to use the baseline methodology version that was in force when it was submitted for registration at least for the first 7 years of its duration. This would be consistent with the need to update baseline methodologies for single projects at the time of renewal of their crediting period. The baseline revision would have to be validated and would only be valid for CPAs added after the 7 year. After each subsequent 7 years, this procedure would be repeated.

3.2. Programmatic CDM in Africa – a case study

Kerstin Dietrich,
Axel Michaelowa,
Francis Yamba

3.2.1 Programmatic CDM - advantage Africa?

Due to relatively smaller economies in most African countries, most of the CDM projects are smaller in size and dispersed in nature. Whilst small scale projects are able to contribute significantly to improving living conditions and the welfare of the local energy end users, in many cases the size of emissions reductions for these small scale projects have proved unattractive for investors, and sometimes the costs associated with registering small projects makes it uneconomically viable for the local project developer.

Additionally, the African Ministerial Conference on the Environment (AMCEN) (UNEP/AMCEN 2008) resolved to ensure that African priorities on climate change programmes are implemented in such a way as to achieve sustainable development. In particular, to alleviate poverty, and achieve MDGs with emphasis on vulnerable groups will spur development of projects in productive use of renewable/clean energy for income generating activities. Such activities will benefit the people at the grassroots. Such projects will be smaller in nature and dispersed across each country /region, and cannot be easily accommodated into traditional CDM project modalities.

For these reasons, it is broadly agreed that one of the most promising areas for the future CDM activities is programmatic CDM where the normal project- by project approval process is aggregated into a broader programme including many individual activities (Hinostroza et al. 2007). The PoA approach has been described to provide the opportunity to achieve economies of scale, reach a wider group of stakeholders and achieve emission reductions in sectors that are too small for the project based mechanism (Chassard 2008).

The benefit of PoA can be summarised by a statement recently made by the UNFCCC Secretary Yvo de Boer “Programmatic CDM is expected to enormously enhance the chances of small and poor countries getting access to CDM. In such countries, single projects are often too small to be commercially attractive. As a consequence, many small and poor countries are not benefiting from CDM at the moment. The programmatic approach could drastically change this”.

Experience has shown that the traditional structure of the CDM encourages stand-alone projects. The introduction of PoA will lead to development of projects that involve a large number of implementers.
in different sites over a period of time. This will ultimately lead in the meaningful participation of developing countries especially Africa in global climate policy (Hinostroza et al. 2007).

Another opportunity for greater participation in PoA for Africa is the existence of small scale methodologies involving typical households and income generating activities at the rural grassroots to include solar cooker and PV, improved efficient stoves, biogas, small hydro and biomass based electricity generation and brick making. Implementation of such projects will significantly contribute to poverty reduction and promote sustainable development. Equally greater opportunities exist at the industry, energy supply, agriculture/forestry and waste sectors to develop programmatic CDM projects involving fuel switch from coal and diesel boilers to biomass fuels and biodiesel operated boilers; energy efficiency related to improved electric motors and automatic load control; supplying electricity to isolated rural areas with diesel baseline from renewable energy sources; methane recovery in agriculture activities at household/farm level for cooking; thermal heating and electricity generation and replacement of inefficient lighting with efficient lamps in households.

Further, there are also large scale methodologies with potential for PoA application to include energy demand and distribution, and transport projects, which are relevant to Africa’s solution of energy security problems, and transport, respectively. Overall, because of its inclusion of a number of projects in the programme, PoA has potential to lower transaction costs and other costs associated with CDM.

Despite its potential and greater opportunities to maximize sustainable development benefits through inclusion of numerous small scale business opportunities for SMEs, and benefit for households, PoA does have challenges. Two challenges are vivid from the start. The first one involves identification of sustainable managing entity, which can survive the crediting period of 28 years, without it being extinguished due to various barriers to include expertise and financial resources. The second challenge is related to the restriction to one baseline single methodology on technology/or several technologies. This restriction does not take advantage of maximizing the potential of PoA through application of multiple technologies and multiple methodologies as shown in the case study conducted in Peru (Hinostroza et al. 2007). This case study demonstrated by applying a comprehensive programme of three lines of technologies and application of several existing methodologies reduced more energy consumption and GHGs.

As of June 2008, only one PoA has been proposed in Africa. This appears discouraging despite the great potential which proponents of PoA have expressed. Of the 10 projects registered worldwide, the concentration is under small scale projects embracing solar, biogas, energy efficiency, small hydro, biomass based electricity generation and mechanical energy.

As has been for the stand alone projects, de Gouvello et al. (2008) identified a good number of projects which could be considered under PoA. These included electricity generation from biodiesel for decentralized micro grids at the rural grassroot level in the range 50-500 KW resulting in generating potential of 1.5 GW and an emission reduction estimated at 8.5 million t CO\textsubscript{2}equiv per year from the estimated 168 CDM projects in this category.

The above category is followed by use of PV in isolated rural areas under the framework of rural electrification for SHS and pumping system, so much required for irrigation purposes for enhanced income generating activities. This measure would result in emission reduction potential of 439,000 t CO\textsubscript{2}equiv per annum.

The third category is improved industrial energy efficiency, particularly for Sub-Saharan Africa whose national grids are characterized by fossil fuel generation capacity. This would result in 20 PoA projects with an annual reduction of 1.5 million t CO\textsubscript{2}equiv. In the same vein energy efficiency at the household level would involve switch to CFL –compact fluorescent lamps resulting in 49 projects with an annual saving of 13.27 million t CO\textsubscript{2}equiv per annum.

Related to energy savings are household improved appliances. With 30 projects, estimated emission reduction potential is 7.4 million t CO\textsubscript{2}equiv. Per annum. Finally 8 projects under improved charcoal production were identified with an emission reduction potential of 20.2 million t CO\textsubscript{2}equiv per annum.

### 3.2.2 Efficient stove programme in Senegal

Despite all efforts to extend the reach of modern forms of energy, still almost 50% of the world’s population and a large majority of African people prepares their food on small stoves fired by biomass
or solid fossil fuels. The traditional three stone cooking device has an efficiency of less than 10% while metal stoves achieve 10-15%. Improved stoves reach an efficiency of 25–40%.

Improved cook stoves contribute to reduction of pressure on native forest and scrubland, which are frequently degraded by biomass collection. They reduce indoor pollution and can lead to substantial savings in fuel costs for urban households having to acquire their fuel on the market. They free time for productive activity for rural households collecting fuel in forests or scrubland. Replacement of biomass/fossil fuel stoves by renewable energy-operated stoves such as solar cookers can reduce biomass use even further, but has encountered cultural barriers (cooking is done before sunrise or after sunset, unwillingness to cook outdoors). No solar cooker programme has been able to achieve penetration rates comparable to efficient biomass cookstove programmes.

Despite their undeniable health benefits and formal payback periods as short as 3 months, the penetration rate of improved stoves is still very low, especially in rural areas. The initial costs of 6-15 € per stove have been the single biggest barrier to efficient stove dissemination, particularly for poorer sections of the community. Coupled with the initial cost barrier, the poor performance of first generation improved stoves (e.g. cracking of ceramic components, tendency to fall over, overheating of pots) created user distrust in the technology. Trust can only be built by introducing (semi-) industrial manufacturing of stoves, which would also bring costs down due to scale effects. Furthermore, lack of consumer awareness of the energy savings potential and the difficulty of altering cooking habits also is a barrier to efficient stove dissemination. The CDM could help overcome these barriers.

In order to claim CERs from an efficient stove programme, the fuel savings from the programme have to be calculated first. In the African situation, stoves will almost exclusively be fired with wood or charcoal. Savings of renewable fuel do not generate CERs. So only if a high share of non-renewable biomass is used, an efficient stove programme becomes attractive in the African context. A survey has to show that non-renewable biomass has been used since 31 December 1989. Then the baseline methodology AMS-II.G can be used. The baseline is based on the assumption that in absence of the CDM project, the fossil fuel (kerosene, LPG or coal) most typical for cooking applications in the region/host country would have been used. The CO₂ emissions factor of that fuel is multiplied by the energy content of the non-renewable biomass used before the project start and the total use of non-renewable biomass by the project. To determine the use of non-renewable biomass, its share in total biomass used before project start has to be determined by survey methods or through historical data. For calculation of total biomass use before project start, the number of pre-project stoves has to be multiplied by the estimated average annual consumption of biomass per stove. The difference in efficiencies between baseline stove and project stove is a key parameter, which is to be determined using representative sampling methods or referenced literature values. The CER potential depends on several key factors. A project implemented in an area with a low share of non-renewable biomass will have a low CER generation rate. Likewise, the baseline biomass utilization can vary widely. Stove efficiencies can vary widely, even among stoves of the same design. The emissions factor of the baseline fossil fuel is another important parameter. Altogether, the CER potential can vary by more than an order of magnitude.

In Senegal, two decades of stove-related development cooperation have led to the distribution of about 50,000 efficient stoves, currently organized in the context of the PERACOD programme. These are mainly produced by blacksmiths using recycled iron sheets. Quality is very variable. However, in neighbouring Mali, a modern stove factory with an annual output of 50,000 stoves has been set up, which is selling stoves briskly. Under the assumption that two such factories would be set up in Senegal, a CDM PoA in Senegal could distribute 1 million stoves within 10 years. The CER volume crucially depends on the share of non-renewable biomass. As the Senegalese data do not yet allow a detailed calculation, we assume 35% (see Table 9).
Table 9 CER estimation of efficient stove PoA in Senegal

<table>
<thead>
<tr>
<th>Number of efficient stoves to be distributed</th>
<th>Share of non-renewable biomass</th>
<th>Annual biomass usage (t/stove) in baseline</th>
<th>Stove efficiency (%)</th>
<th>Energy use (GJ/stove)</th>
<th>Fossil fuel emission factor (tCO₂/GJ)</th>
<th>Annual amount of CERs per stove</th>
<th>Annual amount of CERs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 million</td>
<td>35%</td>
<td>1.2 wood</td>
<td>Baseline: 16</td>
<td>Baseline: 93</td>
<td>0.06</td>
<td>0.7</td>
<td>0.7 million</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.5 charcoal</td>
<td>Project: 25</td>
<td>Project: 60</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Data provided by PERACOD, CERER (2006), own calculations. The baseline fossil fuel would be LPG.

As the critical element of the PoA is quality control and monitoring, the success depends on integration of these two items in the PoA structure, as shown in Figure 18.

Figure 18 Setup of a stove PoA in Senegal

Notes: ASN: Senegalese Standards Association. ENDA: reputed NGO on energy and environment. CERER: Centre for renewable energy research.

Improved stove distribution in general only allows for one main revenue stream coming from the sale of CERs (otherwise, additionality would be difficult to demonstrate due to the low life-cycle cost of efficient stoves). Depending on the programme design, additional minor revenue streams might occur (e.g. when distributing the efficient stoves for a fee below the current market price). Indeed, free distribution of stoves might lead to careless handling and low utilization rates, as shown in stove dissemination programmes in the past. However, increase in non-CER revenues may endanger the additionality of this project type as efficient stoves lead to substantial fuel cost savings, and due to the resulting short payback period can be seen as a financially attractive option.

The lesson from past stove programmes is that giving stoves away for free is unlikely to be effective. Programmes that focused on support to stove suppliers to expand production and utilize scale effects
coupled with quality control of stove production have been the most effective ones. This generates a challenge for CDM/JI, as PoAs that support scale-up of production and sell stoves at a reduced price compared to the current market price might face challenges in additionality determination, given that improved stoves are financially attractive already at current market prices.

3.2.3 Biogas programme in Kenya
Kerstin Dietrich

Kenya's population is about 34.7 million, of which approx. 74% is rural. The majority of rural Kenyans derive their income principally from farming. Cook stoves and firewood are the primary combination for cooking and heating. Over 50% of the population use firewood, generally in small quantities alongside with other cooking fuels such as charcoal and kerosene. According to findings of a Shell Foundation research in 2006, the above mentioned consumption patterns have not much changed in the past 5 years though there has been a 4 percent drop in the use of firewood with a shift towards charcoal and kerosene.

Uncontrolled firewood cutting results in a decrease of forest cover; the distances to collect firewood are increasing, which leads to fuel poverty related to a number of economic, social and environmental problems. There is an urgent need to develop alternative sources of energy and the conditions found in various regions in Kenya are suitable for biogas utilisation. The main barrier for the dissemination is the high up-front cost.

The biogas project is feasible for the following reasons:

- Zero-grazing practices exist in Kenya; Kenyan milk consumption is amongst the highest in the world and more that two-thirds of the dairy cattle in eastern and southern Africa can be found in Kenya. Zero-grazing practices are common and are thus providing a necessary prerequisite for the introduction of biogas technology.

- Micro-finance can be used to finance the investment cost of the biogas plants: The micro-finance sector is fast-growing and represents a trusted source of local financing for small-scale businesses. People in rural areas are increasingly turning to Micro Finance Institutions (MFIs) to access loans since the formal credit institutions tend to consider them as "high risk" customers. 80 percent of the dairy farmers are smallholders; they are usually organized in cooperatives which provide affordable and diversified financial services to their members.

The Savings and Credits Cooperatives (SACCO) have access to a large number of farmers; only the Githunguri Dairy Farmers Rural SACCO for instance consists of 3500 members currently. According to the Githunguri SACCO, their farmers are interested in the biogas technology and 500 have already expressed their interest. The farmers are even prepared to apply for a loan to cover the main part (app. 70 %) for the plant if they can get the remaining (app. 30%) amount from other sources e.g. the revenue stream from the sale of the emission reductions.

The Kenyan Union of Savings and Credit Cooperatives (KUSCCO) is the umbrella organisation of the SACCOs. Besides the financial services education and training forms an integral part in the promotion of the Union services and relevant issues in the management of the SACCOs. They have a window for special projects which can be utilised; they already cooperate with the Shell Foundation in the dissemination of solar technology.

- Existing structures can be scaled-up for the distribution of the technology: The dairy cooperatives have reliable structures in place which can be scaled up. But this is only one option, besides the dairy cooperatives, the Kenyan Federation of Agricultural Producers (KENFAP) is an appropriate partner for awareness raising and training.

A number of challenges have been identified for the implementation of the project.

- One challenge of the project will be to stimulate and facilitate construction of a huge number of biogas plants in a considerable short period of time. There are strong collaboration opportunities with the existing GTZ programme “Private Sector Development in Agriculture (PSDA)”. So far,
PSDA has trained about 40 masons and 20 construction companies to manufacture biogas plants in the context of its waste and wastewater treatment from agricultural production activities. In the frame of an EU funded project additional masons will be trained until the end of 2009. However, there is still a need to train additional masons, establish quality criteria, institutionalise the training to meet the demand which will be created through the project in 2009 and the coming years and find sources to finance these activities.

- Micro Finance Institutions (MFIs) and/or commercial banks will play an integral part in the project set-up. Cooperation with them is crucial to provide finance for the biogas plants and could provide avenues for channelling the carbon credit revenue. Here, the challenge is to identify the most suitable organisation/institution.

- It is planned that the farmers cover the costs for the biogas plant through a cash component and/or a loan. The revenues from the sales of the emission reduction credits could be used to lower the interest rate or to provide a subsidy, thus providing incentives to the farmers and encouraging them to invest in a biogas plants. Loan agreements have to be made with 500 farmers prior to the start of the project.

- To calculate the baseline it is required a.o. to determine the fraction of non-renewable biomass which is used by the households. In addition, it needs to be demonstrated that non-renewable biomass is use since 1989.

Initially the objective was to develop a PoA to replace the commonly used wood stoves with clean and sustainable biogas for cooking purposes. Target areas are districts where households keep between 3 and 10 cattle: Kisii, Kiambu and Meru South. The initial plan was to distribute 2000 biogas plants in the first year in the area with the highest potential. The revenues from the sales will be used to lower the financial burden of the farmers either in form of a lower interest rate or in form of a subsidy.

In course of planning it was realised that (a) such an approach would require at least 200 trained masons to construct the plants which are not available and (b) only one methodology can be used to calculate the emission reductions. Methane avoidance will not be taken into account in the selected baseline methodology AMS-I.E. “Switch from non-renewable biomass for thermal applications by the user” and thus the CER yields will be lower.

Due to the political situation in Kenya, all activities had come to a standstill after December 2007 and have started again in October 2008. A feasibility study has been conducted to assess the biogas potential in the three districts. The study has provided information concerning the districts with the highest potential, but an implementation partner for the project still needs to be determined. It is planned to conduct a workshop in February/March to identify an appropriate institution/organisation and to reach a cooperation agreement.

Against this background it was decided not to develop a PoA. The development of a PoA has additional requirements and the approach is already facing a number of problems. Due to the different barriers for a PoA, it is planned to start with the distribution of 500 plants in 2009 and develop the project not as a PoA but as a Gold Standard voluntary emission reduction (VER) project and combine different methodologies. At a later stage the project can be up-scaled as a CDM project provided that sufficient CER volumes can be achieved that make the project viable.
4. Sectoral CDM

To achieve a reduction of global greenhouse gas emissions by half by 2050, which is seen as necessary to stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system, the efforts of industrialized countries alone are not enough. It is the industrialized and developing countries who should make efforts together. However, developing countries are not yet willing to take up a country-wide emissions target. Sectoral mechanisms have become fashionable in the UNFCCC negotiations to provide a contribution of developing countries to global emissions reduction, but have a very wide range of interpretation. Recently, the EU Commission proposed a sectoral mechanism based on a no-lose target for a set of industrial installations in advanced developing countries. The group of installations, ideally covering a whole industrial sector, would have an emission target that is below its business-as-usual emissions. If it reduces emissions below the target, it will be given credits equal to the difference between the target and actual emissions. But there will be no penalty if the targets are not met. The targets would most probably be set through benchmarking and the EU sees the power, cement and steel sector as the most likely candidates for such sector crediting. As is the case for CERs today, the sectoral credits generated could then be used for compliance with targets under the Copenhagen Agreement and sold to companies covered by the EU ETS. The EU’s position will lead to an increased intensity of the discussion of sectoral mechanisms.

4.1. Proposals for sectoral CDM in the international negotiations

Duan Maosheng,
Rita Roy Choudhury

4.1.1 Reasons for sectoral policies in the negotiations

Para 1(b) (iv) of the Bali Action Plan talks of enhanced national/international action on mitigation of climate change including, inter alia, consideration of cooperative sectoral approaches and sector-specific actions in order to enhance implementation of Article 4(1) [c] of the Convention which says that “All parties shall promote and cooperate in the development, application and diffusion, including transfer of technologies, practices and processes that control, reduce or prevent anthropogenic emissions of greenhouse gases not controlled by the Montreal Protocol in all relevant sectors, including the energy, transport, industry, agriculture, forestry and waste management sectors”. Using this provision of the Bali Action Plan the developed countries are attempting to impose mandatory globally harmonized GHG emissions and/or energy efficiency standards on advanced developing countries such as India, China and Brazil. The arguments being given in favour of the sectoral approach are:

- Sectoral measures will be based on analysis of reduction potential and cost, taking into account the sector-specific circumstances.
- It is a useful tool for setting ambitious and feasible national emission targets.
- It will facilitate the identification of the best practices and the best available technologies for each sector.
- Major developing countries should have sectoral efficiency indicators which should be reported, verified and measured.

A number of sector specific international organizations and associations are working on similar lines to rope in companies from the developing countries to take up such sectoral benchmarks and standards. But, there are a number of issues which need to be considered before taking up a sectoral approach, which are:

- Energy intensive sectors such as cement, power, iron and steel etc. have a great amount of diversity in terms of the scale of operations, technology pathways, inputs and end products etc. The point to be taken under consideration in this whole concept of a sectoral approach is that - standard energy consumption norms cannot be set in such a heterogeneous set up.
- Strong monitoring and verification protocols need to be in place for sectoral approaches to really work effectively which in itself can be a cost issue besides being highly intrusive in not just the international but also the domestic context.
• The technologies that will enable a company to follow and attain certain globally harmonized standards would be held by a few firms typically in Europe, Japan, EU and these firms may not transfer the technologies without payment of unreasonably high license fees. The cost of the plants and equipment will therefore rise and the local manufacturers of these products will not be able to compete in the markets. Besides, some technology which is optimal for a particular region or country may not be applicable to another due to the variations in the local conditions.

• The industry can therefore not go for this kind of sectoral harmonization if the additional costs are not borne and neither can the norms be generalized across the sector on account of the diversity in plant operations, raw materials used, technologies used and also the scale and age of the plant.

• The sectoral approaches under the Bali Action Plan seem to be very much at variance with the fundamental principle of the international environmental law set by Principle 11 of the Rio Declaration which clearly says that “standards applied by some countries may be inappropriate and of unwarranted economic and social cost to other countries, in particular developing countries”. It recognizes that standards and norms are relevant in a particular national, historical and sectoral and cannot be applied universally.

Beyond the general discussion of sectoral approaches, there are different proposals for sectoral actions in the context of CDM which are being discussed nationally and internationally to arrive at a consensus on the most feasible approach for sectoral climate change mitigation:

• Voluntary Sectoral Initiatives: Voluntary project based sectoral actions taken by developing countries could qualify for the CDM

• Sectoral crediting: The sectoral baseline would represent emissions and removals that would occur in the absence of the proposed project activity, in either fixed or intensity terms, and would be determined through new methodologies requiring approval by the Executive Board. Such project activities would be subject to all applicable CDM rules, including the demonstration of additionality (at a sectoral level). A project activity could be coordinated by an industry or government body, which would be responsible for all aspects relating to the development, registration and implementation of the project activity and for appropriately distributing issued CERs among individual facilities in the sector.

• Nationally Appropriate Mitigation Actions (NAMAs): Nationally appropriate mitigation actions at the national level in terms of sustainable development policies and measures could also qualify for CDM

• Global sectoral standards approach: This approach is being pushed by the developed countries especially Japan which says that in the major developing countries the sectoral efficiency indicators can be utilized for measurable, reportable and verifiable mitigation actions.

• Technology oriented approach: This approach emphasizes on collaborative R&D supported by a global venture capital fund with concessional working of intellectual property rights in the developing countries and involves the payment of royalties by multilateral fund on technologies needed by developing countries to implement their national action plans.

4.1.2 Reasons for sectoral CDM

Some challenges encountered with the project-based CDM might be addressed through a sectoral CDM. It happens very often that similar projects are submitted to the EB, while some are registered without even a request for review, while some others have been reviewed or even rejected. Currently, more than 70% of the projects requesting registration will go through the request for review process, making the registration outcome unpredictable. Similar problems exist at the CER issuance stage. This will strongly affect the confidence of the project participants in CDM. CDM also provides a limited contribution to technology transfer. For most of the projects, a very significant part of the claimed technology transfer relates to import and equipment and thus should not be attributed to the CDM.

A key problem for industrialized countries is the competitiveness and leakage issue. In countries with emissions commitments, implementation of greenhouse gas emission mitigation activities would significantly increase the production costs in many sectors, especially in the sectors whose products
are traded internationally. Due to the lower competitiveness brought by the increased costs, there is a risk that industrialized country companies transfer production plants with high energy consumption and high GHG emissions to countries without an emissions commitment. Such transfer of energy-intensive production would lead to high leakage. Under the CDM, a good project boundary can prevent leakage. There are two points which should be paid more attention to, coverage of the sectors and sub-projects. We can adopt a flexible approach to decide which sector should be included in sectoral CDM. It could be the traditional sectors (such as transportation, energy), sub-sectors or trans-sectors, even geographic regions. A boundary set inappropriately could cause several problems. For example, a company may transfer its installation with high emission intensity to region where has no emission constraints.

4.1.3 Proposals for sectoral CDM

There are different proposals regarding sectoral CDM, some of which already have characteristics going beyond the CDM. Developing countries can evaluate the emission potential of their sectors and decide which sectors should be integrated:

- An absolute no-lose target could be set for sector greenhouse gas emissions or energy consumption. If the sector reduced emissions or energy use below the target level, the difference – in the case of energy multiplied by the emissions intensity of energy production - would be issued in form of CERs. If the sector was unable to achieve the target, the country will not face any sanctions. In such a mechanism, developing countries can freely decide which sectors would participate.
- An intensity target could be defined in terms of greenhouse gas emissions per physical output or in terms of energy consumption per value added. If the actual intensity is lower than this intensity index, the difference – in the case of energy again multiplied by emissions intensity of energy production - will be issued as sector CERs.
- A policy-based approach would define a sectoral policy. Compared to a baseline without policy, the introduction of the policy would lead to greenhouse gas reductions which would be credited in form of CERs.
- Technology-based CDM would be based on technology list based on best available technology, and the projects using technology in the list can prove their additionality automatically. Baselines would be based on business-as-usual plants, differentiated into greenfields and retrofits. National authorities should propose technologies to be included under this mechanism and corresponding baselines with specific justifications.

4.1.4 Absolute target-based sectoral CDM

The major concepts of the absolute target proposal are shown in Table 10.

<table>
<thead>
<tr>
<th>Concept</th>
<th>Main meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>Generally, the sector emissions on future year need to be estimated ex-ante, the sector baseline will depend on forecast sector energy consumption and GHG emission</td>
</tr>
<tr>
<td>Data requirements</td>
<td>For the baseline estimation, a national sector historic emission inventory and good knowledge about future sector growth is required.</td>
</tr>
<tr>
<td>Additionality</td>
<td>Defined by the target</td>
</tr>
<tr>
<td>Institutional requirements</td>
<td>Prior to implementing, an international decision and consideration on the following items is required: Can trading take place during crediting period or will only ex-post trading be permitted? – Otherwise credits could be sold in an early phase of the crediting period before it becomes clear that the target will not be reached.</td>
</tr>
<tr>
<td>CER monitoring and validation</td>
<td>Under this mechanism, the national government should be responsible to assess compliance with the sectoral target and issue CERs.</td>
</tr>
<tr>
<td>CER allocation</td>
<td>Main participants: government and sector enterprises, but the government should play the key role to implement this mechanism. It remains to be decided whether sector enterprises directly receive CERs. Sector enterprises should get benefits by selling surplus emission reductions. If the particular sector is composed of state-owned groups or the baseline is difficult to identify, CERs will not be allocated in the sector, here national government has to</td>
</tr>
</tbody>
</table>
The baseline identification process is theoretically simple. Although the methodologies or sector historic data applied to every country are diverse, the baseline will not need special consideration once confirmed. However, the experiences of the EU ETS show that forecasting sectoral emissions developments is a notoriously difficult exercise. If the final CERs will not be allocated at the company level, the national government should be in charge of the real emission reduction implementation, but it does not require the regulations or laws to promote or assure. Because the company under particular sector cannot assure that the emission reduction could be generated by energy efficiency, moreover the emission reductions generated by company improving efficiency will be offset by the companies emit more baseline.

The key issues arising/to be addressed are as follows:

How to identify the baseline target by historic data? Different methodologies by using historic will lead to varying baselines, for example by using recent 3 year average data, or minimum or maximum value in some year. Because such index is negotiated at the international level, the historic period selection will have different meanings to each country. The characters of development stage or speed in sector have great differences.

For some sectors, data collection requirements are heavy, because for some sources there will not be reliable data on fuel consumption or greenhouse gas emissions. Data collection will require expert estimation and judgment, and results will create some subjective disturbance.

For identification of baseline consumption or baseline emissions, there are several choices to select historic data to estimate future emissions by using simple formulas or complex formulas. Differences in technical lifetime of plants, and processes, will lead to differences of data requirements. At the same time, uncertainties of future resources availability, other sector output changes, future technology efficiency development will impact on baseline identification and additional uncertainty analysis is required.

The baseline will not change once confirmed, but this principle will not reflect structural sector output changes. Meanwhile, if domestic products from the sector will be substituted by import goods, the incremental import will cause carbon leakage.

### 4.1.5 Intensity-based sectoral CDM

The major concepts of the intensity-based approach are shown in Table 11.

Table 11 Elements of sectoral CDM based on intensity targets

<table>
<thead>
<tr>
<th>Concept</th>
<th>Main meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>If the sector emission intensity will be lower than the baseline set in advance, the difference will be issued as CERs. The baseline intensity index will be emissions per unit sector physical output or emissions per unit of sector monetary output. The baseline identification needs to consider the best technology performance. Current project-based CDM will provide the sector baseline cases.</td>
</tr>
<tr>
<td>Data requirements</td>
<td>The sector intensity index can be expressed in many units, such as emissions per unit of sector physical output, emissions per unit of sector monetary output or other feasible units. It could be designed to relate whole sector index or specific new built installation or weighted average. Data requirements: reliable sector emissions, sector products, GDP and other undated info or data which should reflect sector technology or industry efficiency.</td>
</tr>
<tr>
<td>Additionality</td>
<td>Defined by the sector baseline intensity standard.</td>
</tr>
<tr>
<td>Institutional requirements</td>
<td>Sector intensity-based index requires intense participation of the national government with policy monitoring function, establishment of institutions and regulations for sector CDM participants. On the international level, the national government should report operational conditions.</td>
</tr>
<tr>
<td>CER monitoring and validation</td>
<td>The national government should monitor strictly to avoid not selling emission reductions when the index is higher than baseline index.</td>
</tr>
<tr>
<td>Operability</td>
<td>The sector intensity-based index will be attractive as it covers uncertainties</td>
</tr>
</tbody>
</table>
In the international negotiation or political implementation, the intensity-based approach will be attractive: it defines a relative concept, and considers many uncertain factors and variables, for example, GDP, which is a variable whose future development is difficult to estimate. Meanwhile, this approach will allow the GHG increase with the growth of economic development for example based on GHG emissions per unit of GDP. Philibert and Willems (2003) argue that intensity-based emission targets may offer greater political feasibility for countries that currently do not have any emissions obligations under the Kyoto Protocol and thus have better prospects to broaden participation in a future climate negotiation regime. The cost of this approach will be easier to control than the sector absolute target-based method. If the specific emission reduction technology cost is provided clearly, the incentive will be assured to generate emission reductions. Compared with sector absolute-based methods, this approach will much more concentrate on uncertainty such as growth uncertainty and the risk of emission reduction over-estimation. This approach is much more applicable in the sectors exposed to international competition. All the companies will face the same baseline and thus competitiveness loss and leakage risk will be eliminated.

Although this approach has attractiveness, there will not be a unified standard, because the sector data requirements and sector energy consumption and GHG emission level will determine the index selection. Once the intensity index is confirmed, those companies which obviously emit more or less than the baseline index are ranked, it will be difficult to agree in the international negotiations. A special solution could be to soften the differences by, for example, using a performance index instead of the benchmark index. The current country-specific power grid emission factor methodology is regarded as method which could be applicable for each country.

Retrofit and greenfield plants should be differentiated. For example, some zero-emitting electricity generation technologies would be encouraged under the intensity-based index. However, given that many are already in place and others are planned under BAU, it should be justified to ask whether they all deserve to be able to generate credits that can be used to offset higher emissions elsewhere.

The intensity index should be updated regularly on the basis of changes of the underlying variables, but the timing of update should be published in advance so as to give appropriate information to investors, particularly in context of long-lived capital investments.

4.1.6 Policy-based sectoral CDM

The major concepts of the policy-based approach are shown in Table 12.

Table 12 Elements of sectoral CDM based on policies

<table>
<thead>
<tr>
<th>Concept</th>
<th>Main meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>The baseline would reflect a business a usual policy scenario.</td>
</tr>
<tr>
<td>Additionality</td>
<td>Any policy beyond business-a-usual is automatically additional</td>
</tr>
<tr>
<td>Data requirements</td>
<td>Sector emission projection with baseline policy, sector emission effects and</td>
</tr>
<tr>
<td></td>
<td>projection based on sector policy implementation, sector boundary division</td>
</tr>
<tr>
<td>Institutional requirements</td>
<td>The CERs generated by policy based sector CDM belong to the national</td>
</tr>
<tr>
<td></td>
<td>government which should allocate these credits to companies achieving good</td>
</tr>
<tr>
<td></td>
<td>practice according to the sector conditions. One could either</td>
</tr>
<tr>
<td></td>
<td>(i) Follow the current CDM process</td>
</tr>
<tr>
<td></td>
<td>(ii) Establish a new sector CDM management institution based on multi-</td>
</tr>
<tr>
<td></td>
<td>international negotiation</td>
</tr>
<tr>
<td></td>
<td>The host country should play a key role in applying sectoral CDM where the</td>
</tr>
<tr>
<td></td>
<td>key responsibilities lie in baseline assessment, providing a GHG emission</td>
</tr>
<tr>
<td></td>
<td>inventory, and deciding on the approval process.</td>
</tr>
<tr>
<td>CER monitoring and validation</td>
<td>Assessment methodology should be identified in advance, including</td>
</tr>
<tr>
<td></td>
<td>implementation data, not including the demand side policy, because as for the</td>
</tr>
<tr>
<td></td>
<td>demand side, sector product has little effect on it.</td>
</tr>
<tr>
<td>CER allocation</td>
<td>CER calculation would be based on separation of policy consequences from other</td>
</tr>
<tr>
<td></td>
<td>factors. The CERs calculation could also be simplified, assuming the whole</td>
</tr>
<tr>
<td></td>
<td>sector emission reductions are all caused by policy effects. The difference</td>
</tr>
<tr>
<td></td>
<td>between sector baseline and real sector emissions would be issued as CERs.</td>
</tr>
<tr>
<td>Barriers</td>
<td>This approach has to assess the emission reductions ex post, and distinguish</td>
</tr>
<tr>
<td></td>
<td>the actual policy effects.</td>
</tr>
</tbody>
</table>
A clear boundary of sector CDM will avoid leakage. It also comprises physical boundary and sector/industry boundary.

The policy-based approach has a lot of uncertainties, and would primarily be applicable to sectors dominated by state-owned companies.

It is difficult to operate this approach because it should distinguish the real effects caused by policy. Model, generic forecasting problems and data limits make an objective determination difficult. A Gordian knot solution would be to leave the full decisionmaking power to the host country approval and not to do a second check on the international level. The main barrier is that national government sometimes could not check the industry or sector thoroughly. A simple method is to baseline emissions minus model estimation based on policy implementation, but it will bring much uncertainty and is unlikely to be accepted on the international level. Some researchers even suggest a very simplistic reduction of baseline emissions by a certain percentage.

4.1.7 Technology-based sectoral CDM

Technology-based sectoral CDM draws on the concept of Best Available Technology (BAT). The core idea of this proposal is the definition of a technology list that embodies BAT, and the projects using a technology from the list do not need an additionality test. As there is an incentive for more energy efficient and cleaner technologies, technology-based sectoral CDM can significantly promote the technology transfer from industrialized countries to developing countries, and developing countries can achieve sustainable development as a result of environmental friendly technologies.

When building the technology list, we must evaluate the costs and profits brought by each technology. Also we should consider the situation of each country, such as resources constraint and political factors. The list should be dynamic and updated periodically.

Regardless of which technology is to be covered, two options exist on the coverage of projects, i.e. covering only new sub-projects or both new and existing sub-projects. A reasonable solution could be that: 1) all projects will be covered; however, 2) different emission baselines should be developed for existing and new sub-projects using the same technology and located in the same region/country.

An appropriate emission baseline is very important, and it is necessary to review the emissions performance of relevant sectors in which the technologies are used. As new technologies are continuously improving, we must consider the technological progress curve when building a baseline. It is proper to build a dynamic baseline and update it periodically.

Whether to set a unified baseline or separate baselines for technologies under the same sector depends on the circumstances. Generally speaking, technologies under the same sector will bring different greenhouse gas emission reduction benefits owing to different efficiencies. Building separate baseline for each technology should be suggested.

Different countries have quite different characteristics, so building a unified international baseline for the same technology under the same sector may not be cost-effective. In defining the baseline, we should consider the specific circumstances of each country, e.g. resources constraints, capacity building, local customs. In some countries coal power plants will be the baseline technology for baseload power generation, in other countries gas power plants.

If the performance of a project using the appointed technology within the list is better than the baseline, CERs will be generated. For example, a renewable energy technology on the list could be compared to a baseline fossil fuel power technology. Once the baseline has been determined, it will be clear for the project developers on whether their projects would be eligible under the mechanism and how many emission reduction benefits could be generated.

CERs could be allocated to specific companies adopting appointed technologies, also could be hold by the host government. If the baseline is complex and it’s hard to allocate the CERs to the companies, the government can retain the generated CERs. Although the government must promise that the benefits from the CERs should be used in making incentive for company to adopt environmental friendly technologies.

To make this mechanism operational, institutions need to be set up for its management. The management structure could be very similar to the current one: an international governing body (including any supporting technical group), national authorities, and independent entities.
National authorities should propose technologies to be included under this mechanism and corresponding emission baselines with specific justifications; the governing body should access and approve the proposals; the independent entities would assess and ensure the correct calculation of emission reductions. National authorities would also be responsible for the update of list of eligible technologies and the emission baselines. Compared to the current CDM regime, technology-based sectoral CDM strengthens the roles of national authorities. We could organize the management structure with minimum costs by enhancing the roles of government and industry associations within the regime of current CDM.

If technologies with less cost-effectiveness are excluded from the list, the proposal sets no incentive for these technologies, which will hinder future innovation in a long term. In order to promote R&D of new technologies, we must evaluate the new technologies periodically and let the technologies with cost-effectiveness be in the list in time.

Since the government has limited knowledge on technologies, the technology list proposed by government may be less cost-effectiveness. It will add emission reduction costs compared to market-based instruments. In the new mechanism we can make the industry associations to take the leading roles, and government plays a supporting role. The technology list builds by government and industry associations together.

As the quality of management varies among companies, energy consumption and greenhouse gas emissions will vary widely even if the same technology has been adopted. We will thus face the risk of free riding using the general baseline to allocate CERs for all company unless company-specific project emissions are calculated.

4.1.8 Criteria for evaluation of sectoral CDM proposals

When assessing a proposed sectoral CDM approach, it is important that following general criteria could be taken into consideration.

1) Additional emission reductions
Since CDM is an offsetting mechanism, the first requirement and assessment criteria is whether the emission reductions generated under this mechanism are additional. This is a fundamental criterion.

2) Transaction cost
As discussed above, high transaction is one of the main barriers for CDM project development under the current regime, therefore, possible transaction cost should be one of the priority issues to be considered when improving or updating the mechanism.

3) Data availability and credibility
Data availability and credibility is closely related to the additionality of the credits to be generated under the mechanism and the transparency of the crediting generation process.

4) Uncertainties for crediting
To promote effectively through CDM mitigation, it is essential that uncertainties related to the crediting and thus the revenues could be reduced as strongly as possible.

5) Distribution of projects
Uneven distribution of CDM projects among different sectors/technologies as well different regions is also one of the concerns many people currently have. Whether the sectoral CDM could help to improve the distribution is a key issue to be considered.

6) Promotion of technology transfer
CDM so far has not met the high expectation by the international community on technology transfer and the sectoral CDM should promote technology transfer more effectively than the current CDM.

Besides the above general issues, some others related to the smooth operation of the sectoral CDM should also be considered seriously.

1. Review, approval and update procedure for target
Under the current regime, the baseline scenarios and corresponding baseline emissions of project activities are identified on a case-specific basis and there's no need to set a common emission baseline for all relevant projects. However, under the sectoral CDM, it is important that a clear macro and common target is defined for all projects as the baseline. The review, approval and update procedures for such a target are of essential importance.

2. Coverage

Under the current regime, some projects have already been registered and are qualified to generate credits. If sectoral CDM is implemented in the same sector where these projects locate, there will be the risk of double counting and it is thus necessary to consider the coverage of the new approach to avoid possible double accounting. Furthermore, coverage choice will have great impacts on the equity, efficiency, transparency and transaction costs of the sectoral approach. Decision needs to be made on whether the cover the whole sector or only part of the sector (for example, only new facilities or large-scale ones), and whether or not to cover current CDM projects.

3. Verification of the emission reductions

Under the current CDM, the emission reductions of CDM projects are verified by the DOE based on the monitoring of the project operation on a case-by-case basis. Under the sectoral CDM, the emission reductions may need to be verified at the sectoral level and not on the project-by-project basis and thus a practical, reliable and transparent corresponding procedure should be established.

4. Ownership and distribution of the CERs and incentives

Currently, the ownership of the CERs by a specific project is very clear, i.e. it belongs to the project owner. Under the sectoral CDM, since the emission reductions may be verified based on the performance of the whole sector, for example the total emissions of the sector, and thus all facilities in the sectors contribute to the outcome, it is not clear who owns the CERs generated. However, to promote the emission reductions by specific project activities and thus the emission reductions in the sector, it is necessary that some incentives are provided to the project owners within the sector. The distribution design from the sectoral coordinator to the companies that actually achieve emission reductions will thus become a central issue.

5. Linkage with the current system

This issue is closely related to the coverage issue. If the sectoral approach is to cover already registered CDM projects, what rules will be established to ensure that no double accounting will happen and if not, how to factor out the impacts of the CDM projects on the performance of the whole sector.

6. Free rider risk

To ensure environmental integrity, it is important to reduce free rider risk in the system as much as possible. For example, if a sectoral emission intensity baseline is established, it is necessary to consider whether such an approach could lead to significant amount of emission reduction credits generated by projects that have are already in operation. The transaction costs associated with the avoidance of free rider also need to be considered.

4.2. Sectoral CDM in the Chinese iron and steel sector

Duan Maosheng

The different options discussed in chapter 4.1 are assessed for the iron and steel sector in China.

4.2.1 Absolute-target based sectoral CDM

A quantified total emission standard is set as reference for the iron and steel sector. The amount below the standard in the actual total emission generated is considered as the emission reduction and can be transferred to industrialized countries. It is critical for the whole iron and steel sector's guaranteeing the absolute target emission reduction additionality to specify a quantification total emission standard and treat the amount below total emission standard as the emission reduction obtained. But it is difficult to set an absolutely quantitative total emission baseline of iron and steel sector for the following reasons:

a. For many developing countries, the iron and steel industry, as one of the most important basic
industries, will develop at a certain speed, so it is obviously unsuitable and unacceptable for developing countries to set an upper limit of absolute CO\textsubscript{2} emission.

b. Steel output may be greatly influenced by the economy (the relation between supply and demand on the market), society and environment. At present, it is impossible to accurately estimate the steel output of the world, a country or region in a concrete period. Before the economic crisis, there was a large fluctuation of the global crude steel production differing between -0.5%/a and +5.7%/a. It is difficult for even the experts in iron and steel sector to predict the crude steel production of China accurately. For example, the crude steel production of China reached 350 million t at the end of 2005. In the situation, Shan Shanghua, the President of Iron and Steel Planning Institute, predicted that the crude steel production of China would increase to 400 million t by 2010 based on the changes on steel product consumption intensity, steel product variety and quality requirement in the market. However, 420 million t were produced already in 2006. Moreover, 460 million t of crude steel production in China was predicted by the National Development and Reform Commission in 2006 for 2007. However, the 2007 crude steel production of China was 489 million t.

The specific CO\textsubscript{2} emission of unit product in iron and steel industry varies worldwide, so it is very difficult to set a fair and reasonable absolute target. Two kinds of basic production routes have been established in the iron and steel industry:

- The BF-converter-hot mill-downstream processing route taking iron ore and coal as the raw material, i.e. conventional flow route;
- The EAF-refining unit-caster-hot mill route, i.e. compact flow route.

The EAF route uses scrap as the incoming material and then has lower material and energy consumption and less gaseous and solid emissions than the BF-converter route using iron ore. For the BF-converter route, the energy consumption is 2 times of the EAF route. In 1996, the International Iron & Steel Institute (IISI) conducted the LCI study “from the cradle to the gate” and discovered that the CO\textsubscript{2} emission of blast furnace-converter process is about as large as 3.5 times of that of electric furnace process.

The main energy-demand process in iron and steel industry includes: coke plant, sinter plant, converter, EAF and rolling mill. The energy consumption of processes in 2005 is shown in figure 19, in which the consumed energy includes coal, petroleum, natural gas and electrical power. Based on the emission factor of greenhouse issued by IPCC, the emission factor of coal is higher than that of petroleum and natural gas (the emission factor of coal, petroleum and natural gas are 25.8kg CO\textsubscript{2}/GJ, 20 CO\textsubscript{2}/GJ and 15.3 CO\textsubscript{2}/GJ respectively).

Figure 19 Energy consumption of processes in major iron and steel enterprises

![Energy consumption of processes in major iron and steel enterprises](image)

Taking the iron and steel industry of China as an example, the CO\textsubscript{2} emission of China’s iron and steel industry is characterized by the two important features as follows: First, the proportion of coal in the energy structure of China’s iron and steel industry is much higher than that of other major steel producing countries. As shown in figure 20, in the energy structure of the iron and steel industry of
China in 2004, coal accounted for 69.9%, higher than that of the other countries (the data of Japan, Germany and the United States is 56.4%, 55.8% and 60.0% respectively). The lower energy efficiency and large CO$_2$ emission of coal utilization are inevitable when coal is compared with the clean energy like natural gas and petroleum. In the meanwhile, the CO$_2$ emission factor of China’s power grid is high because China’s power grid is mainly supplied by thermal power (the emission factor of the power grid in China is 0.228-0.286kgCO$_2$/MJ), which leads to high overall CO$_2$ emission of the iron and steel industry in China. Second, China only has limited scrap resources (60-70 million t p.a.), so the iron and steel production mainly uses the BF process, which results in high specific CO$_2$ emission.

For the reasons above, it is very difficult to set a baseline (absolute upper limit) for the total CO$_2$ emission of iron and steel industry and then it is also very difficult to confirm the additionality of a proposed project.

For a sectoral CDM based on absolute targets, the transaction cost shall include various expenses related to the transaction objective of emission reduction in the whole project period, such as cost of project search (CSER), cost of project document design (CPDD), cost of negotiation (CNEG), cost of validation (CVAL), cost of registration cost (CREG), cost of monitor (CMON), cost of verification (CVER) and share of proceeds administration (SOPA). In addition, for successful execution of sectoral CDM in the iron and steel industry, many basic data collection efforts are required at the preparatory phase. For example, International Iron and Steel Institution shall work out the data collection method; the Chinese governmental authority and Chinese Iron and Steel Association (CISA) shall jointly work out the regulation and supply the supervision to the execution of the CDM; and the iron and steel enterprises participating in the project shall record and regularly issue the CO$_2$ emission for being subject to the supervision of all the society and the authorized organization. The government authority, international or iron and steel sector can play an important role, which include: IISI, APP (Asia Pacific Partnership for Clean Development and Climate), CISA, etc. And also, the cost of evaluation (CEVA) will be incurred accordingly. Moreover, the CDM can be referred to many iron and steel enterprises and then the coordinating/management organization shall be responsible for development of SCDM representing all the enterprises, contact with DNA and distribution CERs, after being authorized by the iron and steel institute, DOE and EB, which can lead to coordination/management cost (CMEC).

Thus, the total transaction cost of a project can be calculated with the following formula:

$$CTRN=CSER+CPDD+CNEG+CVAL+CREG+CMON+CVER+SOPA+CEVA+CMEC$$

In a word, transaction cost increases compared to the project-based CER because more special consulting service and work load, more special verification service and more complicated supervision scheme and method are necessary. The total cost is higher but the specific cost per CER depends on the scale of sector CDM, the specific cost for per CER can be also lower than that of existing CDM project when the quantities of CERs increase to a certain extent.
The validation-related transaction cost of sector CDM based on absolute target is higher. However, the validation and verification of emission reduction can be performed based on the whole sector and also only the total CO\textsubscript{2} emission are required to be validated and verified, so the transaction cost in the verification phase is lower than that of the intensity-based, policy-based and technology-based projects.

4.2.2 Data availability

In order to learn about the CO\textsubscript{2} emission of China’s iron and steel industry, the statistical data of energies, CO\textsubscript{2} emission factors of major energies and others shall be acquired in the ways below:

(1) The statistical data of energies of China’s iron and steel industry come from 2 major sources, i.e. Chinese Iron and Steel Association and National Bureau of Statistics of China. Every year, Chinese Iron and Steel Association publishes Chinese Statistics of Iron and Steel that reports the quantities of the production of crude steel, pig iron, steel products and the quantities of the consumption of carbon bearing crude fuel by national key large and medium iron and steel enterprises, etc. The report only refers to the major large and medium enterprises so the data do not represent the condition of the entire iron and steel industry of China. The association also publishes China Steel Yearbook that reports the policies, laws and regulations newly issued in China, the advance of science and technology, the output of steel products and the main equipments etc. Annually National Bureau of Statistics of China issues China Energy Statistical Yearbook that reports the actual energy consumption of ferrous metal smelting and extrusion. The data available is continuous and can indicate the condition of the whole country. However, the “iron and steel industry” defined in the yearbook includes the iron and steel producer and ferroalloy producer, which differs from the international statistical definition. In addition, for steel melting and rolling sector, the self-provided power has not been taken into consideration and shall be deducted from the actual power consumption. And also with the progress of energy saving and emission reduction in China, the ratio of self-provided power has been increasing annually in iron and steel producer. The ratio of self-provided power of nationwide major large and medium iron and steel producers was increased from 10% to ~30% in 2000-2005. The CO\textsubscript{2} emission per ton steel can be reduced by 70kg/t if calculated based on 10% of average value of the whole country in 2005. In spite of that, the “China Energy Statistical Yearbook” is the most reliable and complete data source for calculating overall CO\textsubscript{2} emission of the iron and steel industry of China.

(2) Only the data issued by IPCC are available for the CO\textsubscript{2} emission factors of major energies, and the power CO\textsubscript{2} emission factor may be obtained according to the national situation of China, while the CO\textsubscript{2} emission factors of other energies and carbon bearing materials may be obtained in reference to IISI data;

In 2002, the World Steel Association formulated the sustainable development policy for the world iron and steel industry. In order to provide a set of systematic method for this industry to assess the progress of this industry in performing the sustainable development commitment, the member companies of World Steel Association formulated sustainable development indicators under the help of external institutions to assess their performance in economy, environment and social responsibilities. In Oct. 2003, the Council of World Steel Association identified such indicators concerned with 11 aspects, thereof, the 6th indicator is greenhouse gas emission, and the CO\textsubscript{2} emission of per ton crude steel would be issued accordingly. After the World Steel Association announced that a series of carbon emission reduction measures would be taken, more and more iron and steel companies have been collecting and sharing their CO\textsubscript{2} emission data, e.g. some iron and steel companies in Europe have started to record their CO\textsubscript{2} emission, so the World Steel Association is sure of that all members of the association will also start to record their CO\textsubscript{2} emission once the association formulates data collection method, as will be quite a long procedure.

The generation of emission reduction shall be evaluated clearly and then the state governmental authority and the institute of the sector shall jointly work out regulation and supervise the execution of projects. The state government, international organization or iron and steel institute can play an important role, which include European Union, IISI, APP and CISA. It is difficult to set the baseline for the sectoral CDM based on the absolute target and then the domestic and international organizations shall jointly make efforts to set up a fair, rational and accurate baseline as well as update, review and approve it (which shall be performed by a competent special organization). The calculation tool and related data source for overall emission of iron and steel industry shall be also subject to the review.
and approval of international organization. In theory, the sectoral CDM of iron and steel sector can cover all the facilities and the detail can be defined depending on the actual operation.

Based on “Calculating Greenhouse Gas Emissions from Iron and Steel Production” issued by International Iron and Steel Institute, the greenhouse gas emission from each process step including transportation is calculated to obtain the emission reduction. The supervision and evaluation methods can be set up with the help of International Iron and Steel Institute, in which some essential parameters can be subject to open evaluation to ensure the reliability of data. The existing project-based CDM supervision system can be applied for clear and in-time data issuance. The applicable procedure is that the overall emission reduction of Chinese Iron and steel industry is verified by the international institution and then the government, domestic institution or coordination/management institution is responsible for the CER distribution. The distribution is performed based on the CO₂ emission reduction, contribution to the society, environmental benefit and investment of an enterprise, considering both fair and profit aspects.

There is some comparability between sectoral system and the existing CDM system and then some advantageous factors, such as methodology, operating means and supervision system of the existing CDM system can be used for reference. On the other hand, at present, International Iron and Steel Institute and the organization (like APP) and Chinese Iron and Steel Association play very important role in data collection, technical share and effect on iron and steel industry, which is convenient to the execution of sectoral CDM in iron and steel sector.

Moreover, the measures shall be taken to prevent all the sub-item of sectoral CDM from being registered as single CDM project or included in other sectoral CDM registered, which can be verified by DOE. The steel production has great impact on the overall CO₂ emission of iron and steel industry. Thus overall CO₂ emission of iron and steel industry can be also lowered when the steel production is decreased due to the market factor. However, the emission reduction is not additional. Some iron and steel producers are subject to production decrease and closed down and then the overall CO₂ emission of the industry is lowered. However, the emission reduction is not additional.

4.2.3 Intensity-target based sectoral CDM

The basis for calculating the emission reduction is the intensity baseline of iron and steel sector, e.g. GHG emission of unit product (tCO₂e/t steel, etc.). When the sector emission is below the baseline, relevant emission reduction may be additional, and the sector can acquire GHG emission reduction and sell such emission reduction on the international market.

Annual emission reduction = (baseline - sector intensity of current year)× product yield

The baseline may be determined according to the aspects as follows:

(1) Energy consumption of unit product equivalent to CO₂ emission
   a. Energy consumption per ton steel equivalent to CO₂ emission
   b. Energy consumption of unit product equivalent to CO₂ emission in major processes (energy consumption of unit product, equivalent to CO₂ emission, of coking, sintering, blast furnace, converter and electric furnace processes, and energy consumption of unit similar rolled steel product, equivalent to CO₂ emission)
   c. Energy consumption of industrial value added (Energy consumption per output value)

(2) CO₂ emission of unit product
   a. CO₂ emission per ton steel
   b. CO₂ emission of unit product of major processes

The average energy consumption of unit product/CO₂ emission of unit product (in major processes) in major large and medium enterprises (based on conservatism and data availability) in a particular historic period is taken as sector datum line, and the part below the baseline in the emission reduction crediting period (e.g. a period synchronous with China’s 5-year planning) is counted as emission reduction.

Arguments are conducted in the aspects such as the statistics, calculation method and comparability of the data of China’s iron and steel industry for determining the feasibility of the possible baseline setting methods mentioned above.
At present, the energy consumption data in iron and steel sector is available but the CO\textsubscript{2} emission data is not available.

(1) Setting of baseline according to energy consumption of unit product equivalent to CO\textsubscript{2} emission

Chinese Iron and Steel Association (CISA, a department of the former Minister of Iron and Steel Industry) was responsible for the statistics of iron and steel sector. However, the energy statistic data of the whole sector has been not available since 1999 due to the organizational reform but only the data of the member companies, i.e. large and medium iron and steel enterprises is available. In addition, the ratio of enterprises, of which the energy statistic data is not available, has been increased. As a result, the uncertainty on data collection and statistic is one of the difficulties of sector CDM analysis for iron and steel sector.

Based on the statistic data in "2006 China Iron and Steel Yearbook", in 2006, there were 6686 productive enterprises in iron and steel industry of China, including 83 major large and medium iron and steel enterprises, which account for 1.2% of companies. The total crude steel production of China was 355.79 million t. The crude steel production of major large and medium iron and steel enterprises was totally 283.9 million t, accounting for 79.8% of the total in China. It can be seen that major large and medium iron and steel enterprises account for small ratio in quantity but the steel production is close to 80% of total in China. The major large and medium iron and steel enterprises can represent the advanced level of iron and steel production of China. Therefore, it is conservative and feasible theoretically to take the energy consumption data equivalent to CO\textsubscript{2} emissions of the enterprises as the baseline.

a. Setting of baseline according to energy consumption per ton steel equivalent to CO\textsubscript{2} emissions

The energy consumption per ton steel is of two indicators, i.e. comprehensive energy consumption per ton steel and comparable energy consumption per ton steel.

Comprehensive energy consumption per ton steel means the net energy consumption calculated according to per ton qualified crude steel yield for iron and steel production in the report period of an iron and steel enterprise.

The comparable energy consumption per ton steel means sum of the energy consumption essential for the production of per ton steel from coking, sintering, iron making, steel making to final production of steel products, the energy consumption of fuel transport and locomotive transport as well as the energy consumption allocated for per ton steel under energy loss, exclusive of the energy consumption of an iron and steel enterprise in mining, dressing, production, auxiliary production and non-productive links of ferroalloy, refractory product, carbon product, coal chemicals, etc.

According to the energy consumption data per ton steel of national key large and medium iron and steel enterprises, the average energy consumption per ton steel of national key large and medium iron and steel enterprises can be calculated accordingly, and the data is converted into CO\textsubscript{2} emission and taken as the baseline, which is feasible.

Taking the energy consumption per ton steel (comprehensive energy consumption and comparable energy consumption per ton steel) as the baseline, from the view of iron and steel sector, the sector can obtain the emission reduction if the indicators of the sector are lower than the baseline. However, it can be uncertain for an actual enterprise which participates in the sector CDM project generating emission reduction to get the emission reduction.

There are different process routes, i.e. conventional process routes (and compact process routes, i.e. EAF process routes) in iron and steel production and then there are some problems on comparability and maneuverability (check method) of energy consumption indicators among the enterprises, of which the factors are shown as below:

(a) Process structure: There is a large difference between converter and process routes. Based on the theoretical calculation, the comprehensive energy consumption per ton steel of a 8 million t enterprise with conventional process route is 670–730kgec/t and that of a enterprise with compact process route is 340–400kgec/t. Moreover, for EAF process route, there is some difference between the operations with and without hot metal charging.

(b) Completeness of process step: The difference on comparability of energy consumption per ton steel can be caused by the following factors for an enterprise: it is a complex or separate rolling plant and whether it is provided with mine, ferroalloy system, coke plant and chemical system; whether the
iron making system is equipped with complete process steps; and whether externally supplied hot metal and coke are used.

(c) Product mix: There is low energy consumption for long product producer and high energy consumption for flat product producer. Moreover, for flat product production, the energy consumption will be increased with the elongation. For the high value-added products, additional refining, finishing and heat treatment are required, which can also make the energy consumption increased.

(d) Social responsibility of enterprise: Whether the enterprise is equipped with environment protection facility or not and out into operation. In Shougang Steel, 25% of power consumption is used for de-dusting. Power consumption can be reduced if not provided with environmental protection facility. There is high difference on power consumption between with and without solid waste utilization, cement factory and non-steel products.

From the statistic information of 2005, the advanced iron and steel enterprises making effort for energy saving and emission reduction obtained lower energy consumption per ton steel. At the same time, an enterprise with low energy consumption per ton steel was not necessarily the model of enterprises.

The sorting of energy consumption per ton steel for conventional steel enterprises of China in 2005 is shown in figure 21.

Figure 21 Sorting of energy consumption per ton steel for conventional steel enterprises of China in 2005

From the above figure, in 2005, Baosteel was ranked at the 18th place, Shougang Steel at the 35th place and Anshan Steel at the 60th place but a steel pipe plant in some province was at the top of list. Therefore, from the view of energy consumption indicator, it is very likely that the enterprise having highest emission reduction per ton products is not the enterprise having highest contribution to emission reduction.

In the sorting, the trouble may be avoided with specific energy consumption of process step and product.

b. Setting of baseline according to the energy consumption of unit product of major processes (energy consumption of unit product of coking, sintering, blast furnace, converter and electric furnace processes, and energy consumption of unit similar rolled steel product) equivalent to CO₂ emission

It is relatively fair that different emission reduction can be obtained based on the different contributions of energy consumption of process steps to the average energy consumption of the unit.

However, for process step energy consumption indicator of different enterprises, there are some incomparable factors, such as impact of environmental protection facility. For example, a sinter plant equipped with desulfurization process, the energy consumption of the step will be higher than that of other similar plants. In rolling process, the energy consumption is different due to the different products, as shown in figure 19. It is relatively fair that the product energy consumption of process step is used as the baseline for calculating the emission reduction if the energy consumption data of different products in rolling process can be obtained.

For national key large and medium iron and steel enterprises, Chinese Iron and Steel Association makes statistics regularly for the energy consumption of major processes, e.g. coking, sintering, converter, electric furnace and steel rolling; but no energy consumption data based on final product
statistics are available for the steel rolling procedure, such as cold rolled plate and coil, hot galvanized sheet and electric steel, etc.

The simulation structure of several procedure energy consumptions in energy consumption per ton steel is shown in Figure 22.

Figure 22 Allocation of energy consumption per ton steel to different process steps

As shown in Fig. 22 the share of energy consumption per ton steel differs greatly for different processes; the energy consumption per ton steel is mainly concentrated in coking, sintering and iron making processes (accounting for 76% to 84% of energy consumption per ton steel); the energy consumption of steel rolling also differs for one-rolling-process steel products and two-rolling-process
steel products (one-rolling-process steel products: 10% to 12%; two-rolling-process steel products: 20%). Therefore, it is reasonable theoretically to set the baseline according to step-based energy consumption equivalent to \( \text{CO}_2 \) emission.

The average energy consumption of every major procedure of national key large and medium iron and steel enterprises can be calculated according to the statistical data of Chinese Iron and Steel Association. It's conservative and feasible to take the average energy consumption of national key large and medium iron and steel enterprises as baseline.

(2) \( \text{CO}_2 \) emission of unit product

Chinese Iron and Steel Association (CISA, a former government department under Ministry of Metallurgical Industry) has never reported the \( \text{CO}_2 \) emission of China's iron and steel industry yet. Hence the baseline setting according to this indicator depends on the availability of official statistical data.

At present, there is energy management department in almost all the major large and medium enterprises of China, which is responsible for data statistic on consumption of primary and second energy sources of the enterprises. It is possible to calculate specific \( \text{CO}_2 \) emission of a product or products in a process step based on the list of energy consumption in iron and steel production flow or a step.

However, there are some incomparable factors on setting the baseline based on specific \( \text{CO}_2 \) emission of product due to the reasons same with the condition based on energy consumption per ton steel equivalent to \( \text{CO}_2 \) emission. However, it is more rational to set the baseline based on the specific \( \text{CO}_2 \) emission of product in a step.

For the intensity based sectoral CDM, no emission reduction revenue is resulted for the whole sector when the emission can't be lower than the baseline. And also some enterprises fail to get the emission reduction revenues even if the emission of the enterprises participating in the CDM is lower than the baseline and the sub-baseline. This means the uncertainty of emission reduction revenue. Moreover, there is still the uncertainty even if the emission of the sector is lower than the baseline and enterprises participating in the CDM can't obtain the emission reduction revenues because there are some incomparable factors on energy consumption per ton steel, specific energy consumption of product in a process step, \( \text{CO}_2 \) emission per ton steel and specific \( \text{CO}_2 \) emission of product in a process step among the enterprises. For example, an enterprise only produced cold rolled flat products ever before. However, the enterprise will adjust its product mix and produce high value-added electric steel so as to meet the market demand. If the enterprise can't set the baseline based on the energy consumption of products, the energy consumption of rolling process has to be higher than the last year, even can be higher than the sub-baseline. In this way, the enterprise can't obtain the emission reduction.

Finally, the actual emission reduction can be changed and greatly differ from the expected value due to some reasons on project execution, etc. The uncertainty factors include fluctuation of greenhouse gas emission from the project, reliability of emission-reduction equipment operation and the supervising equipment and means not coniformity with the regulation.

Setting the baseline based on the energy consumption per ton steel equivalent to specific \( \text{CO}_2 \) emission/\( \text{CO}_2 \) emission per ton steel will cover all the facilities of enterprises taking part in the sectoral CDM. Setting the baseline based on the specific energy consumption equivalent to specific \( \text{CO}_2 \) emission of product in a process step/carbon emission of product in a process step will cover the process step of enterprises taking part in the sectoral CDM.

Transaction cost is the same as for absolute target based sectoral CDM. In addition, high pre-registration cost is required for intensity based sector CDM like setting of baseline. However, the study on \( \text{CO}_2 \) emission performed in the sector will provide powerful support for setting baseline for sector CDM. CDM is performed in the whole sector, and the overall emission reduction is a result of actions – sometimes inconsistent ones – by different enterprises. The setting of baseline and the evaluation of addiibility are performed by an organization (government authority or an organization authorized by the government). The verification cost may be born by the government or from public funds but not born by an enterprise. Therefore, for enterprises, the verification cost is high but not a holdback.

For the enterprises participating in the sector CDM, some cost is required for the monitoring. However, the enterprise is required only to carry out the regulated procedure because the energy
measurement and statistical work are almost the routine work of an enterprise, which can't lead to excessive additional work. And also the enterprise only invests the cost that shall be invested for routine work.

The check on emission reduction is referred to the whole sector. The expenses to be paid in the check stage are similar to that in the baseline setting stage. For an enterprise participating in the sector CDM, only supervision record is required for the check without higher cost if routine monitoring work is proper.

The review, approval and updating of targets shall be taken in charge by relevant authority of the government and the relevant international sector CDM authority. The government or the government authority (CDM expert team established by the verification organization designated by the relevant international authority) is responsible for setting the baseline of the department and submits it to international authority for approval. And also it is responsible for setting the sub-baseline of related enterprises. The enterprises taking part in the sector CDM are responsible for the execution of sector CDM. The verification organization designated by the relevant international sector CDM authority and the governmental authority (or the Iron and Steel Association) form verification team for checking annual CER generation of sector CDM, which will be issued by the relevant international sector CDM authority.

For the baseline of sector, the government or the government authority (CDM expert team designated by the Iron and Steel Association) applies for the updating and then submits to the relevant international sector CDM authority for approval. For the sub-baseline of enterprise, the government or the government authority (CDM expert team designated by the Iron and Steel Association) applies for the updating and then submits to the relevant government authority for approval.

Government department in charge or CDM expert team established by designated iron and steel association compiles monitoring report each year and submits it to the international sector CDM authority. The verification organization designated by the relevant international sector CDM authority, government department in charge or designated iron and steel association will form verification team to check the emission reductions. Priority should be given to the verification of sector's ERs, plus that for part enterprises' ERs (e.g. in the form of random sampling).

The method of verification can be supplemented with the monitoring and computation methods released by relevant authoritative departments. Some important data may be subject to the supervision mechanism receiving public evaluation to ensure the trueness and reliability of the data.

To achieve emission reduction is depended on the condition of baseline and the accuracy of energy measurement input and output annually in the emission reduction crediting period.

Mass of natural energy source like coal and petroleum consumed in iron and steel enterprises is called as primary energy source. During steel production, large amount energy is consumed, and at the same time, mass of waste energy is generated, such as coke oven gas, BF gas, converter gas, waste steam from sinter plant, steelmaking plant and reheating furnace for rolling mill and BF pressure difference, which are called as "secondary energy source".

The primary energy consumption in the iron and steel industry of China is coal based. The statistic information indicates that, in 1999, the energy source structure of iron and steel industry in China is as below: coal: 70% (in which coking coal: 48%, power coal: 22%); power: 26.8%; heavy oil: 3%; and natural gas: 0.2%. In 2004, the coal consumption accounted for 69.9% of total energy consumption, the power consumption accounted for 26.4%, petroleum accounted for 3.2% and natural gas accounted for 0.5%. In the coal consumption, coke and pulverized coal accounted for 47.9% and power coal accounted for 22.0%. The energy source structure was basically same as that in 1999.

Only the data of primary energy consumption is to be taken into consideration for setting baseline based on the energy consumption per ton steel. The secondary energy is generated during the utilization of primary energy. The calculation will be repeated if the consumption of secondary energy is added in the calculation.

For setting the baseline based on the specific energy of product in a process step, both primary energy and secondary energy of a process step shall be taken into consideration.

It is very important to monitor the consumption of energies for emission reduction. The unified industrial standard is required for the measurement device for the mentioned data and the data
source (including the method of converting fuel consumption into CE value and CO₂). The iron and steel sector shall carry out the prevailing regulations on energy measurement and energy measuring device calibration, such as the General Guideline on Energy Measuring Device Installation and Management for Energy Consuming Unit (GB17167-2006), shall additionally establish a unified energy measurement specification applicable for iron and steel industry. Effect data source on energy sources will not be available if the measuring device and instrument get in failure in the monitoring, which leads to the uncertainty of emission reduction.

At present, large and medium enterprises are provided with the measurement on primary energy and secondary energy respectively. However, the measuring and statistic methods are to be further standardized for the whole sector.

The owners of emission reductions are the enterprises or enterprises and government (to counteract as management expenses and prophase cost). In order to stimulate enterprises to participate in and contribute to the emission reductions, the emission reductions should mainly attribute to the enterprises. As playing a role in charge of sector CDM, the government shall share a small quantity of the emission reductions.

The enterprises participating in the sector CDM cannot obtain the emission reductions directly. Instead, some organization will allocate the sector’s total emission reductions obtained to the participant enterprises according to certain rule. Therefore, the acquisition of emission reductions closely relates to the allocation mechanism. And the effects of allocation mechanism in stimulating enterprises to participate in the sector CDM become especially important. It is recommended to have government or non-stake holders (such as the verification organization designated by the relevant international sector CDM authority) designated by government take the lead and organize industrial experts to form a steel sector CERs allocation team and work out allocation plan.

There are some uncertainties on energy consumption per ton steel/specific CO₂ emission of product in a process step for iron and steel enterprises as described above and then it is fair to set separate sub-baseline for each enterprise who take part in sector CDM project. When a sector gets emission reduction, the enterprise can obtain the emission reduction if the energy consumption is lower than the sub-baseline. However, it is generally not practical to set the sub-baseline individually if there are scores of or about hundred enterprises participating in the sector CDM project. The whole industry will be graded (e.g. grade I, II and III, etc.) according to enterprise scale, output or present actual energy consumption/emission reductions (10 million tons or above, 5-10 million tons and below 5 million tons, etc.) by the experts of the sector, who can set sub-baseline for different grades of enterprise groups. Grade I or II enterprises have advanced technology, equipment and strong technical strength, or have been attaching importance to emission reduction, they generally have lower specific energy consumption/CO₂ emission of product. More input will be needed to reduce emission on the basis of the present level. When the specific energy consumption/CO₂ emission of the enterprise is lower than the sub-baseline, the emission reduction can be obtained.

Considering in a conservative way, for the purpose of good connection with current system, the emission reductions of CDM project should be deducted from that of sector CDM based on intensity.

To meet market demand, enterprises may change the product structure or production process, e.g. reduce the production of deeply processed products in a period of time or increase the production line of some rolled steel product with outsourced raw material etc., which will result in the drop of energy consumption per ton steel/specific CO₂ emission of product accordingly and more emission reductions, which has a risk of picking-up. The risk may be avoided if setting the baseline based on specific energy consumption of product in a process step.

CERs’ re-calculation among sector CDMs: to illustrate from different perspectives, the CERs of the technology-based sector CDM and that of the intensity-based sector CDM may be re-calculated. For instance, in some year within the crediting period of emission reduction, an enterprise adopts some advanced excess energy utilization technology, which has had a consideration of emission reductions from the perspective of the technology-based sector CDM. Meanwhile, the enterprise’s annual intensity is lower than the baseline, and also, no evidence can prove whether the drop of intensity is relevant to the technology. Provided the emission reductions are applied from the perspective of intensity, there will be probably a repeated computation. Thus, the uncertainty of emission reductions occurs arising from the definition of the emission reductions generated based on different perspectives of sector CDM.
4.2.4 Policy based sectoral CDM

It is very difficult to analyze the additionality of sector CDM based on a policy. Therefore, the following two newly released policies in favor of GHG emission reduction are deemed to have had a full consideration of additionality at the time of policy making. The aim of the policy establishment is for GHG emission reduction and then the additionality has been taken into consideration in the policy. Such policy-based GHG emission reduction shall be credited as the emission reduction of sector CDM. For policies not specially established for GHG emission reduction, but can promote GHG emission reduction practically it is very difficult to analyze and determine how to consider sector CDM in policy establishment. However, the policy can lead to GHG emission reduction of the sector. Therefore, the GHG emission reduction based on the policy shall be taken into the emission reduction of sector CDM. However, consideration of sector CDM could differ from the condition mentioned above when policy establishment and then the emission reduction shall be deducted properly when crediting the emission reduction based on this sort of policies. The deducting coefficient shall be defined according to the actual condition.

The policies currently implemented in China iron and steel industry include:

a. Access for Calcium Carbide, Ferroalloy and Coking Industries (Bulletin No. 76 issued in 2004 by National Development and Reform Commission);
b. Guiding Catalogue of Industrial Structure Regulation (Decree No. 40 issued in December 2005 by National Development and Reform Commission);
d. Circular on Opinions Concerning Checking up on Projects in Steel, Electrolytic Aluminum and Cement Industries (NDRC-Industry [2004] No. 1791);
e. Circular on Controlling Total Output, Eliminating Backwardness and Quickening Structural Adjustment of Iron and Steel Industry (NDRC-Industry [2006] No. 1084);
f. Circular of the General Office of the State Council of the People’s Republic of China, on Transmitting and Issuing Several Opinions of National Development and Reform Commission and Other Departments on Strengthening Regulation and Control of Fixed Assets Investment and Strictly Controlling New Projects (State Council [2006] No. 44);
g. Circular of the General Office of the State Council of the People’s Republic of China, on Transmitting and Issuing Several Opinions of National Development and Reform Commission and Other Departments on Curbing Irrational Investment in Steel, Electrolytic Aluminum and Cement Industries (State Council [2003] No. 103);
h. Development Policies for the Iron and Steel Industry
i. An Outline of China’s Policies on Energy-saving Technologies (2006 version) (guiding policy);
j. Cleaner Production Standard. —Iron and Steel Industry;
k. Cleaner Production Standard –Iron and Steel Industry -Sintering;
l. Cleaner Production Standard. - Iron and Steel Industry - Iron making;
m. Cleaner Production Standard –Iron and Steel Industry -Steelmaking;
n. Emission Standard for Pollutants from Iron and Steel Industry.

After China’s entry into WTO, the iron and steel industry is facing a severe competition in the domestic and foreign markets, which mainly represents in terms of product quality, price and after-sale service. Energy saving, consumption reduction and cost reduction are one of the most important means used by iron and steel enterprises to enhance market competition. According to the analysis released at the information conference of China Iron & Steel Association, China is quickening up the building of economic and environment-friendly society, and meanwhile, market, law and administrative means will add to the pressure on iron and steel enterprises. Enterprises are facing a new challenge of accelerating energy saving and consumption reduction as well as improving environment. The enhancement of enterprises’ autonomous innovation ability should be regarded as the central link of structural adjustment and transformation of growth mode. Thus, in the future, the
iron and steel industry may have policies issued to promote structural adjustment, energy saving and consumption reduction as well as GHG emission reduction.

(a) Policies to be issued recently

a. The Norm of Energy Consumption per Unit Product of Procedure of Crude Steel Manufacturing Process (Draft Standard for Approval): China Iron & Steel Association and Central Iron & Steel Research Institute shall complete the draft standard for approval.

b. Code for Energy Conservation Design of Iron and Steel Enterprises: Capital Engineering & Research Incorporation Limited (original Beijing Central Engineering and Research Incorporation of Iron and Steel Industry) shall complete the opinion soliciting draft.

Taking “Limitation of specific energy consumption of product in a process step for crude steel production (submitted for approval)” as example, the policy is applicable for the calculation and examination of specific energy consumption of product in sintering process (not including pelletizing process), BF process, converter process and EAF process in iron and steel enterprises and also applicable for energy consumption control of new equipment, which mainly includes:

The limitation of specific energy consumption of product in a process step for existing crude steel production means the limitation of specific energy consumption of product in existing sintering, BF converter and EAF processes during operation of the iron and steel enterprises.

The limitation of specific energy consumption of product in a process step for new crude production means the limitation of specific energy consumption of product in sintering, BF converter and EAF (conventional EAF and special EAF) processes newly built or expanded in the iron and steel enterprises.

The advanced limitation of specific energy consumption in crude steel production process defines the advanced energy consumption limitation of sintering, BF, and converter processes achieved with energy saving technological modification and intensifying energy saving management.

The advanced value of main energy recovery for crude steel production process defines the TRT capacity of BF, waste heat recovery of sinter process and gas and steam recovery of converter.

The aim of policy is to control the energy consumption of iron and steel enterprises and can promote the GHG emission reduction. Based on the condition and the analysis on the current GHG emission reduction situation at home and abroad, the policy is related to the global condition of GHG emission reduction even if it is not meant specially established under considering sector CDM. The policy can result in lower energy consumption and intensify the effect of GHG emission reduction.

(b) According to the trend of energy saving and emission reduction in the world, China and iron and steel industry, the issued polices may be adjusted in future for the purpose of GHG emission reduction.

The following examples show the policy currently executed in China and the future trend of adjustment. "Policies on iron and steel industry development” was issued by the National Development and Reform Commission in July 2005. One of the aims of the policy is to improve the environment protection and comprehensive resource utilization level and realize energy saving and consumption reduction according to the concept of sustainable development. The policy is composed of industrial development plan, industrial distribution adjustment, industrial technical policy, industrial organizational structure reform, raw material policy and steel product saving.

"General policy outline on energy saving technology of China (2006)” was issued by the National Development and Reform Commission and Minister of Science and Technology in January 2007, which is revision and supplement to “General policy outline on energy saving technology of China (1996)”. The aim of the policy is to promote the energy saving technology development, improve the energy utilization, promote energy saving and industrial structure optimization and build a resource-saving and environment-friendly society. In the policy, the measures like “research and development”, “development and extending” and “limitation, elimination and prohibition” are taken to standardize the energy saving technology policy based on domestic actual condition, proven level and cost of energy saving technology and the potential of energy saving.

In the policy, the energy saving technology and policy are described from the energy saving in industry, building, communication, urban and domestic facilities and agriculture & countryside and
utilization of regenerative energy, in which the industrial energy saving is directly referred to the iron and steel industry.

The mentioned policies are prepared based on the social economic development situation at the time. Some revision may be required for the mentioned policies due to the social, technical and economic development so as to establish more strict policy and then further promote the energy saving and emission reduction.

The policy-based sector CDM emission reductions are the GHG emission reductions arising from renewal of the above issued policies and from the newly issued policies. To analyze the above policies, almost all the policies above are made based on the following contents.

(a) Encouragement/restriction/elimination of equipment, product and technology;
(b) Adjustment of technological and industrial structures;
(c) Concrete regulations on some index;
(d) Strengthening of energy management.

According to the above classification, all polices are issued based on the technology, intensity index and management. Therefore, it is hard to distinguish whether the emission reduction is generated based on policy, technology or intensity. Policies, more often than not, control or guide the sector’s development in a macro aspect. Thus, the policy-based GHG emission reductions cannot be evaluated quantitatively. It is not suitable to evaluate emission reductions quantitatively in the case of promoting emission reduction by strengthening energy management. For example, the limitation of energy consumption for each process step is stipulated in “Limitation of specific energy consumption of product in a process step for crude steel production (submitted for approval)”, as shown in table 13.

Table 13 Data based on new factor for converting power into EC value (0.1229kgce/kWh)

<table>
<thead>
<tr>
<th>Process step</th>
<th>Limitation kgce/t</th>
<th>Allowable value kgce/t</th>
<th>Advanced value kgce/t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sinter plant</td>
<td>≤56</td>
<td>≤51</td>
<td>≤47</td>
</tr>
<tr>
<td>BF</td>
<td>≤446</td>
<td>≤417</td>
<td>≤390</td>
</tr>
<tr>
<td>Converter</td>
<td>≤0</td>
<td>≤-8</td>
<td>≤-20</td>
</tr>
<tr>
<td>EAF</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conventional EAF</td>
<td>≤88</td>
<td>≤92</td>
<td>≤90</td>
</tr>
<tr>
<td>Special EAF</td>
<td>≤171</td>
<td>≤159</td>
<td>≤154</td>
</tr>
</tbody>
</table>

In "General guideline on energy saving technology (2006)"", the energy saving technology for iron and steel production is described. For example, in the sintering process, low-carbon thick bedding, mixed material preheating, hot blast ignition and small-ball sintering technologies are applied and low-Si sintering technology is research and developed. New iron making technology is promoted, including large-sized BF, beneficiated burden, high blast temperature, high coal rate and low-Si melting operation. The smelting reduction and direct reduction technologies are imported. The energy saving technology for EAF is developed, including water-cooled panel and submerged arc melting with foam slag operation, high-voltage and low-current melting operation, scrap preheating, UHP DC EAF and double-shell EAF. The regenerative burning technology is applied. The continuous casting technology is extended with high-efficient casting, continuous thin slab casting and rolling and near-net-shape casting.

In the section of "industrial technological policy" of "Policy on iron and steel industry development", the following requirements are described: the utilizing land area for sintering machine built shall be ≥180m²; the carbonizing chamber height of coke oven shall be ≥6m; the effective volume of BF shall be ≥1000m³; the nominal capacity of converter shall be ≥120t; and the nominal capacity of EAF shall be ≥70t.

In the policy, both intensity target and detail technology are referred.

The emission reduction can be calculated quantitatively based on some items of the policy which referred to the detail technology like regenerative burning technology, or detail intensity targets like the advanced value of energy consumption for sinter plant: ≤47kgce/t. However, it is difficult to
confirm that the emission reduction is based on the policy due to the crossing between intensity-based sector CDM and technology-based sector CDM.

As the mentioned above, all the data for evaluation on additionality of policy and emission reduction is based on the intensity or based on the technology. Even if the data is available, there is crossing between the policy-based sector CDM and intensity-based sector CDM or technology-based sector CDM, which is crossed with the existing CDM project (which is meant a repeated calculation). For example, in a year of emission reduction crediting period, an advanced waste heat utilization technology is adopted in an enterprise which has been subject to application for emission reduction from the technology-based sector CDM. However, there is crossing between the policy-based emission reduction and technology-based emission reduction even if there is evidence to prove that the enterprise considers the policy-based sector CDM and the emission reduction can be calculated quantitatively. For the current CDM projects, regardless of selecting renewable crediting period or fixed crediting period, the enterprise should not apply for the policy-based emission reduction if the sector CDM system is established and the project is still in the crediting period, otherwise, the calculation of emission reduction can be repeated, except for the evidence to indicate the further increase of emission reduction in the enterprise is resulted from the policy and regardless of the existing emission reduction. However, it is difficult to confirm the evidence.

Therefore, the policy-based sector CDM is not possible in the actual operation.

4.2.5 Technology-based sectoral CDM

By the sector’s technological innovation and diffusion in iron and steel industry, the emission of greenhouse gasses (e.g. CO₂) is lower than the emission level when there is no technological innovation and diffusion, which is deemed that the corresponding emission reduction is generated and may be transferred to the countries in appendix I with demand in the market. Therefore, it is of great advantage to attempt and promotion of technological innovation in the iron and steel sector.

In recent years, there are great difficulties in making relatively great technological innovation. At the International Iron and Steel Institute Annual Conference, Philippe Varin, the CEO of Corus Group and a member of Executive Council Committee of International Iron and Steel Institute, warns us that it will take at least 10 years to introduce new iron making technology with few pollutant emissions to substitute for traditional blast furnace production process. The new method of steel making may be extended in an industrialized way by 2050. As viewed from short-term development, the emission of CO₂ can be reduced by 5%-10% by further improving the smelting efficiency of blast furnace and making rational use of resources according to local circumstances; As viewed from medium-term development, further increasing the proportion of steel scrap in converter and enlarging the proportion of electric furnace steel is an effective way to reduce CO₂ emission; As viewed from long-term development, the innovative or breakthrough technology must be developed to reduce CO₂ emission, e.g. extending hydrogen application, cyclic utilization of blast furnace top gas by decarburization, CO₂ collection and storage technologies, etc. and they all can be studied deeply. The iron oxides reduction by electrolytic method is a relatively unprecedented assumption and currently it is still in laboratory research stage; there is also great research space by means of plant fuel reduction and presently several blast furnaces in Brazil are making iron by charcoal produced by eucalyptus, and in the long run, the energy consumption can be reduced effectively by plant fuel reduction.

Technical classification: presently speaking, the technologies applied in iron and steel industry can be classified as follows:

a. Secondary energy recovery by advanced technology

The energy resource conversion function in iron and steel industry embodies in approx. 34% of energy value of coal used in production process, converted into by-product gas (coke oven gas, converter gas and blast furnace gas), excess pressure, excess heat and excess energy generated in production process. According to the analysis, the amount of secondary energy generated from iron and steel enterprises accounts for approx. 15% of total energy consumption by iron and steel enterprises. Nippon Steel Corporation has reutilized 92% of gross secondary energy recoverable. Chinese Baosteel Group has also reutilized 77% of gross secondary energy recoverable, but the reutilization of secondary energy in the majority of iron and steel enterprises is below 50% and some medium and small-sized enterprises just start in the recovery and reutilization of secondary energy. Therefore, the energy conservation potential of Chinese iron and steel enterprises is relatively great.
A. The dry quenching of coke (CDQ) is an item of recovering secondary energy of the greatest proportion. The sensible heat contained in red coke generated from coke oven is equivalent to 35%-40% of total heat consumption for coking. 80% of sensible heat contained in red coke can be recovered by CDQ and the coke per ton can produce 0.45t 3.9MPa steam (may reach 0.6t if advanced); BaoSteel Group can reduce coking process energy consumption by 68kgce/t by CDQ.

B. The excess heat of sintering waste gas and sensible heat of sinter are recovered. The combustion air and combustion gas are preheated by excess heat of hot blast stove fume and at the same time, a heater is increased on preheated air pipeline and a part of blast furnace gas will be to combusted to increase the temperature of preheated air and thus to increase hot-blast temperature and reduce fuel consumption, etc. The air is used to cool hot sinter; the high-temperature air makes the boiler generate high pressure and medium pressure steam, then generate electricity; the low-temperature air may be used for hot-blast sintering, which can reduce sintering process energy consumption by 10kgce/t.

C. Gas-turbine & steam-turbine combined cycle power plant (CCPP): the technical working principle of gas-steam turbines is that the gas after de-dusted is mixed with air and then combusts in gas turbine combustion chamber, and the high-temperature high-pressure gas is generated to impel turbine unit to apply work and generate electricity; the high-temperature gas enters waste-heat boiler to generate steam and the steam turbine applies work and generates electricity. The technical equipment can increase power output by 70%-90% than conventional boiler steam electric power generation and reduce water consumption by 1/3 than coal-fired power plants, and moreover, its floor space required is small and it is pollution-free.

b. Improvement of smelting efficiency, resource utilization ratio, equipment and technological level

A. By the development, research and application of new process and new technology, improving existing smelting efficiency and resource utilization ratio in iron and steel industry and reducing the solid and gas fuel consumption can effectively reduce CO₂ emission.

- Implement the beneficiated burden material policy and optimize ore proportioning scheme

Applying high-TFe iron ore fines can reduce the energy consumption per ton iron more greatly than applying low-TFe iron ore fines. By optimizing ore proportioning and high-Fe low-silicon sintering, high-quality sinter with TFe content equal to or more than 58% and SiO₂ content less than 4.5% can be provided for blast furnace, thereby the conditions for blast furnace to realize low slag ratio and high coal injection and greatly reduce the ratio of putting coke into furnace will be created. And in this way, it not only can reduce fuel consumption and cost but also can reduce the CO₂ emission. The production experience shows that iron ore TFe rises 1%, the blast furnace smelting coke ratio can be reduced by 2% and the output can be increased by 3%.

- Strengthen the pelletization and improve the sinter bed permeability

The sinter bed permeability is related to successful completion of sintering process and strengthening the pelletization is one of primary measures improving the sinter bed permeability. For strengthening the pelletization, the blending mode is very important besides optimizing ore proportioning and controlling mixture water content well. In the past, the blending facility of sintering material is only limited to the drum in sintering plants, and now, the sintering workers at home and abroad have developed new equipment, e.g. blending pelletter. Some tests show that the sinter solid fuel consumption after pelletized by bending is reduced by 5.9% than that after pelletized by drum.

- Deep-bed sintering

In sintering process, the heat quantity of burning bed can increase by about 4% under the action of automatic heat storage and thereby the consumption of solid fuel is reduced. In addition, because of low carbon operation, the oxidizing atmosphere in material bed is relatively strong and the temperature of material bed will not be over high, which can increase the oxidizing reaction of ferrous iron oxides and reduce decomposition heat loss of ferric iron oxides, and moreover, be favorable to produce low melting point binder phase calcium ferrite and further reduce fuel consumption. Currently, the deep bed sintering has been applied widely, and generally it reaches about 500mm and the maximum reaches 600 – 750 mm; it is predicated that the material bed will grow much thicker. A ferric low-silicon sintering test shows by deep bed sintering that the solid fuel consumption of 750mm material bed is reduced by 1.28 kg/t that of 600mm material bed. The experience from Liuzhou Iron and Steel Co., Ltd. shows that the material bed rises to 600 mm from 500mm and the electric
consumption is reduced to 40.54 kWh/t from 46.38 kWh/t; the coke consumption per ton sinter is reduced by 6.74 kg/t.

- Blast furnace pulverized coal injection technology (PLC)

The blast furnace pulverized coal injection technology is a key process of iron-making system structure optimization and it is the development trend of blast furnace iron-making technology at home and abroad and is also an effective measure to optimize energy structure, reduce energy consumption and production cost and is friendly to environment. Compared with coking process energy consumption- 142.21 kg ton-coke, the energy consumption for pulverized coal injection process is 20-35 kg ton-coal and substituting coal for coke not only can reduce energy consumption and abate the contradiction of prime coking coal lacking in China but also can reduce environmental pollution in coking process.

- Coal moisture control (CMC)

Reducing the water content in coal by excess heat to 5% and substituting coal for coke not only can reduce energy consumption and abate the contradiction of prime coking coal lacking in China but also can reduce environmental pollution in coking process.

B. Improvement of technological equipment level

In recent years, great progress made in technological equipment for China iron and steel industry has optimized the variety, structure and performance of home-made steels and the large scale, high speed and sophistication of metallurgy equipment create conditions for high efficiency production and further reduction of energy consumption. Table 14 is for analysis of CO₂ emission in various processes of China iron and steel industry and we can see that the more advanced the equipment is, the lower the CO₂ emission is; the CO₂ emission of above 3000 m³ blast furnace is lower than that of below 100 m³ blast furnace. In addition, the State-of-the-Art Clean Technologies (SOACT) for Steelmaking Handbook issued by APP also list a series of advanced technological equipment. By introducing advanced and large-scale equipment, the energy consumption for various processes in China's iron and steel sector will be reduced step by step, and thereby to reduce CO₂ emission further.

Table 14 Analysis of Section-wise CO₂ Emission in China's Iron and Steel Sector in 2003

<table>
<thead>
<tr>
<th>Equipment level</th>
<th>CO₂ emission intensity (tCO₂/t products)</th>
<th>Gross amount</th>
<th>Annual theoretical production capacity (10⁶ t)</th>
<th>Proportion</th>
<th>Annual actual production capacity (10⁶ t)</th>
<th>Annual CO₂ emission (10⁶ t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blast furnace</td>
<td>1.25</td>
<td>321</td>
<td>165.47</td>
<td>100.00</td>
<td>202.62</td>
<td>252.85</td>
</tr>
<tr>
<td>Gross amount</td>
<td>1.09</td>
<td>5</td>
<td>14.23</td>
<td>8.6</td>
<td>17.43</td>
<td>18.91</td>
</tr>
<tr>
<td>&gt;3000 m³</td>
<td>1.17</td>
<td>19</td>
<td>32.53</td>
<td>19.66</td>
<td>39.83</td>
<td>46.56</td>
</tr>
<tr>
<td>2000-2990 m³</td>
<td>1.21</td>
<td>31</td>
<td>27.88</td>
<td>16.85</td>
<td>34.14</td>
<td>41.41</td>
</tr>
<tr>
<td>1000-1999 m³</td>
<td>1.31</td>
<td>184</td>
<td>79.79</td>
<td>48.22</td>
<td>97.71</td>
<td>128.00</td>
</tr>
<tr>
<td>300-999 m³</td>
<td>1.33</td>
<td>70</td>
<td>10.06</td>
<td>6.08</td>
<td>12.32</td>
<td>16.33</td>
</tr>
<tr>
<td>101-299 m³</td>
<td>1.37</td>
<td>12</td>
<td>0.98</td>
<td>0.59</td>
<td>1.2</td>
<td>1.64</td>
</tr>
<tr>
<td>&lt;100 m³</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gross amount</td>
<td>0.07</td>
<td>245</td>
<td>163.68</td>
<td>100.00</td>
<td>187.20</td>
<td>12.72</td>
</tr>
<tr>
<td>&gt;300 t</td>
<td>-0.01</td>
<td>3</td>
<td>6.78</td>
<td>4.14</td>
<td>7.75</td>
<td>-0.05</td>
</tr>
<tr>
<td>100-299 t</td>
<td>-0.03</td>
<td>39</td>
<td>47.27</td>
<td>28.88</td>
<td>54.06</td>
<td>1.60</td>
</tr>
<tr>
<td>50-99 t</td>
<td>0.08</td>
<td>60</td>
<td>46.27</td>
<td>28.27</td>
<td>52.92</td>
<td>4.07</td>
</tr>
<tr>
<td>11-49 t</td>
<td>0.10</td>
<td>141</td>
<td>62.86</td>
<td>38.40</td>
<td>71.89</td>
<td>7.02</td>
</tr>
<tr>
<td>&lt;10 t</td>
<td>0.14</td>
<td>2</td>
<td>0.5</td>
<td>0.31</td>
<td>0.57</td>
<td>0.08</td>
</tr>
<tr>
<td>Gross amount</td>
<td>0.64</td>
<td>182</td>
<td>34.52</td>
<td>100</td>
<td>31.37</td>
<td>19.57</td>
</tr>
<tr>
<td>&gt;100 t</td>
<td>0.48</td>
<td>13</td>
<td>10.24</td>
<td>29.67</td>
<td>9.31</td>
<td>4.47</td>
</tr>
<tr>
<td>50-99 t</td>
<td>0.67</td>
<td>30</td>
<td>12.39</td>
<td>35.90</td>
<td>11.26</td>
<td>7.52</td>
</tr>
<tr>
<td>11-49 t</td>
<td>0.73</td>
<td>91</td>
<td>10.70</td>
<td>31.01</td>
<td>9.73</td>
<td>7.12</td>
</tr>
<tr>
<td>&lt;10 t</td>
<td>0.80</td>
<td>48</td>
<td>1.18</td>
<td>3.43</td>
<td>1.08</td>
<td>0.86</td>
</tr>
</tbody>
</table>

C. Improvement of technological level

The energy consumption of the iron making process by blast furnace accounts for 70% of total energy consumption of iron and steel enterprises, so the energy conservation should focus on the iron making process. 83% of energy source for blast furnace iron making is from coke and pulverized coal
and 17% is brought by hot blast. Therefore, the energy conservation for blast furnace iron making should center on reducing the fuel ratio of iron making and increasing hot-blast temperature. There are many single technologies to reduce blast furnace fuel ratio, e.g. improve sintering and coke quality; improve the technological level of blast furnace operation (high top pressure, high CO\textsubscript{2} utilization ratio, low ferro-silicon smelting, etc.); carry out modern management of enterprise (ensure stable operation of blast furnace at high level), etc.

And moreover, the application of current key technologies in iron and steel industry may also reduce energy consumption and thus reduce CO\textsubscript{2} emission. For example, the liquid iron is produced by smelting reduction method instead of blast furnace method. The method using the non-coking coal as major energy source, the lump ores, pellets or iron ore fines, etc. as raw materials; reducing iron oxides to metallic iron by use of carbon in high temperature molten state by smelting process is characterized by simple technology, high resource and energy utilization efficiency and little environmental pollution. The technology has developed into the third generation. The first-generation technology is based on shaft furnace, such as COREX method, FINEX method, etc. The second-generation technology is deep slag method, such as Japan DIOS, American AISI, Russia ROMELT, Netherlands CCF, etc. The third-generation technology is metal bath smelting method, such as Australia HISME\textsc{lt} method, etc. According to present research, the most of smelting reduction technologies are still in development and experimental stage and only both CORE\textsc{x} and HISME\textsc{lt} technologies have been applied in practice. The indexes of CO\textsubscript{2} emission from smelting reduction iron-making industry that has been put into production successfully and traditional blast furnace industry are shown as table 15.

### Table 15 CO\textsubscript{2} Emission Comparison of Smelting Reduction Technology vs Other Technology

<table>
<thead>
<tr>
<th>Production process</th>
<th>CO\textsubscript{2} emission /kgt\textsuperscript{-1}</th>
<th>Electric power/kWht\textsuperscript{-1}</th>
<th>CO\textsubscript{2} gross emission /kgt\textsuperscript{-1}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blast furnace + converter (150kgPCI)</td>
<td>2111</td>
<td>187</td>
<td>2198</td>
</tr>
<tr>
<td>Blast furnace + converter (250kgPCI)</td>
<td>2084</td>
<td>184</td>
<td>2170</td>
</tr>
<tr>
<td>COREX + electric furnace</td>
<td>1639</td>
<td>632</td>
<td>1934</td>
</tr>
<tr>
<td>HISME\textsc{lt} + electric furnace</td>
<td>About 1600</td>
<td>370</td>
<td>About 1970</td>
</tr>
<tr>
<td>Electric furnace (160kg liquid iron)</td>
<td>396</td>
<td>478</td>
<td>619</td>
</tr>
<tr>
<td>Electric power (100% steel scrap)</td>
<td>68</td>
<td>458</td>
<td>282</td>
</tr>
</tbody>
</table>

It can be seen from table 15 that the CO\textsubscript{2} emission by single CORE\textsc{x} and HISME\textsc{lt} technology is 20% less than that by blast furnace technology. If the CO\textsubscript{2} emission generated by consumed electric power is taken into consideration, gross CO\textsubscript{2} emission is also fewer than blast furnace.

c. **Recover the wastes produced outside iron and steel enterprises**

In the production process, if the iron and steel sector utilizes the by-products from any other industry as the substitute of raw material and fuel, it will be of great advantage to reduce both resource demand and wastes in the whole society.

Iron and steel enterprises may recover and apply waste plastics and scrap tires, etc. to coke oven and blast furnace processes, which not only reduces the consumption of carbon-bearing reducers but also disposes social wastes. Currently, the technology has been applied widely in Japan's iron and steel enterprises and according to the Volunteer Program formulated and issued by iron and steel enterprises under the organization of Japan Iron and Steel Federation (JISF) in December 1996, it is predicated that total one million tons of waste plastics will be reused to reduce energy consumption by 1.5%. In addition, the iron scraps produced by any other industry can be also reused as raw material, and moreover, the paper sludge produced in paper-making industry and aluminium slag produced in aluminum industry can be used as steel-making material. It is conceivable that the iron and steel industry will digest many quantities of carbon-base wastes from any other industry, but because of technological constraint and other factors in China, the technology is still in tentative
exploration stage, if the technology can be applied widely in the future, it not only can dispose social wastes but also can reduce process energy consumption and further reduce CO₂ emission.

d. Setting of baseline and confirmation of additionality

Whether the technology-based sectoral CDM project can guarantee the additinality of emission reduction depends on the establishment of baseline and the implementation of the technology that must bring additional greenhouse gas emission reduction benefit. It will be described in two aspects as follows:

When the baseline of technological level is discussed in a specific process of iron and steel sector, the input materials and products should be taken into consideration and only the enterprises with similar processes and similar input and output products can compare their technological level. For the technology-based sectoral CDM, its difficulty is to establish the baseline, on one hand, some iron and steel enterprises are unwilling to disclose the private data or the data that has important significances in strategy they deem, so it is difficult for setting of benchmarks; on the other hand, benchmarks may vary with time. Therefore, for the setting of baseline, we must be careful and give special consideration to ordinary emission level of the technology in iron and steel industry, and moreover, pay attention to assessment and timely update of technological list to eliminate the technology without additinality. The possible variance in baseline shall be pay attention.

In addition, the development level of iron and steel technology in different territories (like different regions) and different enterprises (existing production capacity and level of enterprises are different) is different, and therefore, adopting either uniform or independent baseline between different territories and different technologies should be determined according to specific circumstances. The technology-based baseline is very useful as the benchmarks to describe “here and now” background, but based on today’s technology and practice, it is hardly guidable for the technological achievements that may be made in the future. Therefore, we expect to generate the normalized method of establishing and monitoring baseline in iron and steel industry.

Unlike CDM, Chinese government and Iron and Steel Association should more than ever participate in development and negotiation of baseline. And at the same time, it is also hard to imagine that China agrees to participate in sectoral CDM in the case of not yet knowing the level of own and any other host country’s baseline. Whether it is appropriate or not to assess the assumption of a country’s potential technological breakthrough ratio, required growth rate and fuel availability and price, etc. is a very detailed and concrete question and even some difficulties may be met in the process of negotiation among multi-national governments.

In summary, the first type of technology is “to apply advanced technology to recover the secondary energy”, which is the most convenient to execution of sectoral CDM at present. The experience on current CDM waste heat recovery project in iron and steel sector can be used for reference on setting of baseline and review, approval and update procedure. The secondary energy (e.g. electric and heat energies) recovery value can be used for calculating emission reduction. For analysis of additinality, the extending and update of the technology shall be evaluated by international special organization to prevent it from being a baseline. As the technology can be widely executed within iron and steel sector, the transaction cost is reduced remarkably.

The second type of technology is “to improve the melting efficiency, resource utilization and equipment & process level”, which is to reduce the current energy consumption through improving the melting efficiency, resource utilization and equipment & process level and then reduce the CO₂ emission level. The technology shall be subject to evaluated by domestic and overseas experts of iron and steel industry due to its higher special technology and to set the baseline based on the current technology and the technical trend. For analysis of additinality, the extending, update and level improvement of the technology shall be evaluated by the international special institution to prevent it being the baseline. The setting of baseline and analysis of additinality are more difficult than other two types of technologies. At present, Chinese Iron and Steel Association and the iron and steel producers have not issued the condition of CO₂ emission and the emission reduction can be obtained only through calculating the difference of CO₂ emissions before and after the technological upgrading. Therefore, it is very difficult to verify and supervise. The development of sectoral CDM based on the technology is depended on the availability of CO₂ emission data from iron and steel sector.

The third type of technology is “to handle external wastes of iron and steel producer”. On the one hand, the CO₂ emission of other sector is reduced through utilizing the carbon-bearing wastes from
other sector; on the other hand, the energy consumption is reduced and then CO₂ emission is reduced through replacing raw material and fuel of iron and steel sector. For setting of baseline and analysis of additionality, the extending and update of the technology shall be evaluated by the international special institution to prevent it being the baseline. The verification and supervision of emission reduction are more difficult than the first type of technology, which is required to calculate the CO₂ emission reduction with replacing raw material and fuel with the recovered external wastes. The development of sectoral CDM based on the technology is depended on the availability of CO₂ emission data from iron and steel sector.

Except for the first type of technology, the verification and supervision of technology-based sectoral CDM are referred to each iron and steel producer and then the transaction cost at any phase is higher.

At present, the voluminous description concerning the indexes generated by technology has been given, but it is mostly in connection with technical and economic indexes and few indexes completely in relation to energy consumption and GHG emission reduction are available. But this hindrance can be overcome, so the setting of baseline is feasible in the technology. However, how to demonstrate the additionality of project requires the industry integral data about coverage and commercialization degree of the technology, etc. but the part of data is hardly published in the industry. The advanced technology applied for iron and steel industry can be obtained from some published official manuals, such as “The State–of-the-Art Clean Technologies (SOACT) for Steelmaking Handbook” issued by APP, “The supporting technology for sustainable development of iron and steel industry” issued by Chinese Iron and Steel Association, etc. regarding the extending rate of the technology, there is no open report, which is to be counted by Chinese Iron and Steel Association and evaluated by the relevant organization of International Iron and Steel Institute.

The technology-based baseline is very useful as the benchmarks to describe “here and now” background, but based on today’s technology and practice, it is hard to accurately judge the frequency of technology substitution in the future, because the update of baseline may cause uncertainties for crediting of emission reduction. At last, because of project implementation and other factors, the actual emission reduction may also fluctuate and there may be a great difference from the anticipated. The factors of causing emission reduction uncertainties include the fluctuation of project-self greenhouse gas emission, stability of emission reduction equipment operation, unconformity of monitoring equipment and means, etc.

As the mentioned above, the appropriate organization shall be established for management of technology-based sectoral CDM project: an international management organization, domestic authority responsible for the project and separate entity of the third party (the current CDM system structure can be applied). Taking the iron and steel sector of China as an example, it understands the level and range of the technological application and can give actual and fair evaluation and suggestion and is responsible for giving a suggestion on the technical activity to realize sectoral CDM in China or a region and setting the relevant baseline. And also the organization is responsible for upgrading of technical list in conformity with the condition. International Iron and Steel Institute (IISI), an international management organization, is responsible for the evaluation and approval of the proposals. The separate entity of the third party (similar to EB) is responsible for evaluation the calculation of emission reduction and avoiding the error of the calculation.

The territorial scope can be divided into the action within national scope and technological action within international scope. According to the difference in administration scope, the technology within national scope can be distinguished from provincial level. The sectoral CDM of iron and steel sector shall cover the new facility. The current facility is applicable for technical modification condition. Otherwise, the additionality can’t be proved.

The technology-based sectoral CDM system has a certain similarity with existing CDM (in particular with PoA) and some positive factors, such as methodology, operation means, monitoring mechanism, etc. in existing CDM system may be used for reference; on the other hand, International Iron and Steel Institute and Organization (e.g. APP) and Chinese Iron and Steel Association, etc. currently have played a very important role in data collection, technology share and influence on iron and steel industry, which is also helpful to implementation of sectoral CDM in iron and steel sector. Besides, we must also adopt relevant measures to ensure all sub-projects in sectoral CDM are neither registered in single CDM project nor included in any other sectoral CDM already registered, of which check may be in the charge of check institution.
The boundary of sectoral CDM project may be the whole city or region and the whole country or region, and at the same time, the boundary should pay attention to the technologies and sub-projects contained in the project in order to avoid free rider risk. For the technology-based sectoral CDM project of the same type, great attention should be paid to compulsory measures of national and local policies and technology update problems caused by industry and market competition, in order to ensure the additionality of project.

The key is to assess the technological potential. At present, it is very difficult to assess accurately the technological potential of developing countries and usually the optimistic estimate on technological potential of developing countries by developed countries may not be accepted by developing countries, so now, it is hard to judge which technologies may make appearance in the future. Governments, international organizations and iron and steel enterprises should make close cooperation and make great efforts to extend current advanced technologies, and moreover, should make more efforts to develop the technologies beneficial to reduce CO\textsubscript{2} emission in iron and steel industry at the next stage. The information system and capacity construction of developing countries should be enhanced. The governments should make great efforts, together with IISI, to adopt some new methods to analyze and measure the emission data of iron and steel enterprises. The development risk of the project is relatively great at primary stage, so it is suggested that countries should launch some demonstration projects.

In a word, the sectoral CDM variants based on absolute gross amount, intensity, policy and technology should not be isolated completely. That the policy index can act as a guide will lead to the technology renovation in iron and steel industry; the technical index is the foundation for ultimately generating emission reduction; the intensity index may be used as a good quantification means to measure and calculate the CO\textsubscript{2} emission from iron and steel enterprises; the gross emission reduction is final objective of sectoral CDM activities in iron and steel sector, and that is to say, only the reduction of gross amount index can exactly realize the CO\textsubscript{2} emission reduction in iron and steel sector.

China’s iron and steel sector example shows that all of the four approaches face serious challenges, which may vary in their aspects, in their application. However, it seems that the technology approach is most similar to the current approach and may have the smoothest linkage with the current system. Underlying corresponding processes for the technology approach could also be very transparent and reliable.
5. Overarching issues for CDM reform

5.1. Additionality

Benito Müller

The reasoning most frequently put forward as to why additionality is needed in the CDM is what can be called the argument from environmental integrity. It has recently hit the headlines in terms referring to ‘fraudulent credits’ or emission reductions which are ‘not genuine’. Roughly speaking, the argument is that, being an offset mechanism, the CDM requires additionality in order to preserve the regime’s environmental integrity, in the sense that any ton emitted in developed countries against a CER must not increase the level of emissions permitted under the regime. But what exactly does that mean? What is the ‘integrity baseline’ against which such integrity infringing increases are to be assessed?

The first thing to be clarified in this context is: what is the relevant ‘regime’? And to be more precise, what is its geographical scope? In the context of the CDM, the geographic scope of the ‘regime’ is that of the Kyoto Protocol; the relevant integrity baseline is given by quantified emission caps for developed countries; and by ‘Business as Usual’ (BaU) baselines – often defined in terms of ‘what would otherwise have happened’ – for developing country emissions. In other words, the integrity baseline is made up of two fundamentally different components, due to the fact that the regime, as is, contains both Parties with emission targets (Annex B Parties), and parties which participate in the regime purely on a project basis (non-Annex I Parties). The definitional heterogeneity of environmental integrity in the current Kyoto Regime creates sui generis problems which we shall turn to in due course (Section 3). For explanatory purposes, let us begin by discussing this ‘argument from environmental integrity’ by focussing on the environmental integrity of a pure cap-and-trade regime.

5.1.1. Environmental integrity of offsetting under a pure cap-and-trade regime

In the case of a pure Cap-and-Trade (C&T) regime, the regime integrity baseline – the level of permitted emissions under the regime – is the sum-total of all the permitted emissions (the caps) under the regime, that is to say, the sum of its Assigned Amounts. Note that for present purposes, we are using ‘baseline’ simply to refer to a (time) series of emission figures – measured, say, in tCO₂e – used to gauge the effects of certain activities. As such, baselines can be used for a variety of different purposes. One of which, as mentioned, is to define the environmental integrity of an (offsetting) regime. Another is to identify the ‘starting-line’ for offsetting activities themselves. Each of these functions will have specific characteristics that will determine the way in which the relevant baselines

10 ‘[W]e are exporting emissions that are difficult to address and importing, through carbon trading, the easiest and cheapest cuts. [...] while the emissions we export are certain and verifiable, the cuts we buy through carbon credits are often fraudulent. [...] 96% of the carbon credits from hydroelectric dam construction were issued after construction had begun: the dams would have been built without the carbon market, so no additional cuts have been achieved.’ [George Monbiot, ‘Traded Away – A cunning new loophole has wrecked the government’s Climate Change Bill’, 25 July 2008].

11 ‘One flaw in the CDM in particular is that credits are being claimed for investments that would have happened anyway, without the added stimulus of earning carbon credits. These projects should not qualify for the CDM because they do not create additional emissions reductions. In fact, they actually make matters worse by allowing companies in the rich world to exceed their limits without genuinely offsetting it elsewhere. [...] Perhaps surprisingly, there is a widespread view among investors and politicians alike that this is perfectly acceptable. Almost any project that cuts emissions is entitled to carbon credits, they argue - even if those investments would have happened anyway. In Monaco, green technologists were keen to show how adept they were at earning CERs, but many also claimed their schemes would be profitable anyway, without the windfall of carbon credits.’ [Fred Pearce, ‘Carbon trading: dirty, sexy money’, New Scientist, 19 April 2008. http://environment.newscientist.com/channel/earth/mg19826521.600-carbon-trading-struggles-to-cut-our-emissions.html]

‘The system is intended to give western firms a low cost way of achieving emission targets while at the same time getting businesses in developing nations involved in tackling climate change. But it only works if the carbon credits generated by projects in developing nations really do represent genuine emission cuts.’[Mark Gregory, ‘The great carbon bazaar’, BBC News Channel, 4 June 2008, http://news.bbc.co.uk/1/hi/ business/7436263.stm]
are specified. The one (and only) thing these functions have in common is that they involve a comparison of measured and baseline emission levels.

Under a C&T regime, offsets (called 'credits') are generally defined in terms of mitigating emissions relative to certain targets or, to be more precise, reductions below certain target-based offset baselines ('target baselines', for short). The credits thus generated can be used to offset emissions against (usually) a target baseline other than the one they are generated from. Target baselines – used both to generate credits and to ‘consume’ them – can be based on national targets, or sub-national ones, for instance pertaining to targets assigned to entities subject to a domestic C&T scheme.

Given that the integrity and offset baselines are all target-based, it is possible to interpret (i) the generation of a credit as diminishing the level of permitted emissions by the credit amount, and (ii) the use of the credits as an increase by the same amount, thus leading back to the original level of permitted emissions (= integrity baseline). Offsetting in a pure C&T regime is thus safeguarded against integrity infringements, at least if both the integrity and offsetting baselines are target-based. This is why offsetting in C&T regimes is generally regarded as harmless. However, it is important to point out that this is only the case for pure C&T regimes. In mixed regimes such as the one given by the Kyoto Protocol, credit generation in Annex B countries can actually compromise the environmental integrity of the regime (see the points on ‘carbon leakage’ below).

5.1.2. Environmental integrity of offsetting under a pure CDM regime

'Environmental integrity', as used here, is inextricably linked to the use of offsets, which in turn are linked to some kind of mitigation targets. It is therefore not really meaningful to speak of the former in the absence of emission targets, as one would have to in the context of a ‘pure CDM regime’. But it does make sense to use the term if we look at it simply with reference to offset generation, i.e. with reference to whether the reductions in question are ‘genuine’ or not. The integrity baseline then becomes the defining level for such genuine reductions.

In the case of a C&T regime, the benchmark for the environmental integrity of the regime – its 'integrity baseline' – was self-evident: the regime-wide ('global') cap. Unfortunately, this is not as clear in the case of a regime based on CDM-type activities: What would be the level of 'permitted emissions' under such a regime? What would be the baseline that determines genuine emission reductions? This is at the heart of how the CDM relates to environmental integrity. The answer that seems to correspond most closely to the ideas underlying the current CDM criteria is: the levels that would have been emitted in the absence of the mechanism. In other words, the integrity baseline is defined in terms of a hypothetical situation, usually referred to as Business as Usual (BaU). The offset activities ('projects') themselves have offset baselines that are also defined in terms of what would have been the case in the absence of the mechanism, which in this context is referred to in terms of projects being additional or not.

To understand the issue of additionality, it is important to keep in mind that this 'mechanism specific' interpretation is by no means the only possible interpretation of 'business as usual'. Take the case of the CDM: the reason why CDM additionality is an issue is because there can be what one would have to refer to as 'BaU emission reductions', that is to say, genuine emission reductions even in the absence of the CDM. They may be carried out because they are 'no regret measures' (i.e. at no or negative cost), because they were mandated (by law/regulation), or indeed because someone had a social and environmental conscience. The point is that they are emission reductions from a 'business-as-usual' level, but obviously not from the BaU level defined in terms of the absence of the CDM. Conceptually, one thus needs to differentiate this BaU conception from, for example, the emissions (baseline) in the absence of these BaU activities, say, BaU(→) ('BaU-minus'). The ‘additionality issue’ is

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12 Having said this, offsets need not be target related even in a (pure) C&T regime. They can also be project-based, as witnessed in the current regime in the ERUs generated through the Joint Implementation (JI) mechanism.

13 A 'target-based' baseline is a baseline derived from an emission (mitigation) target. As everything has to be translated into emission figures in order to carry out offsetting, one can, without loss of generality, simply think of targets as emission caps (which, in that case, they themselves constitute the relevant offset baselines).

14 The entity generating the credit may actually choose to bank the credit as insurance for their own compliance.

15 This rather cautious formulation simply reflects the fact that the issue of a supervening integrity baseline is not usually discussed in CDM additionality debates.
that these BaU emission reductions are included in the BaU baseline, and hence not additional, not because they are not really reductions, but because they do not comply with the condition that they would not have happened in the absence of the CDM.

Given the role of ‘what would have been obtained in the absence of the mechanism’ in the definitions of both the regime integrity baseline and the relevant project offsetting baselines, it is surprising that offset generation is again directly linked to integrity: a project, given these definitions, is non-additional if and only if it is part of the overall BaU situation of the regime.16 This, in turn, implies that to avoid regime integrity infringements, offsets should only be allocated to additional projects. But unfortunately, this does not really provide an answer to the first title question: Why Additionality?

The problem is that the conception of ’environmental integrity’ used in this context includes the relevant additivity constraints as part of its definition. In other words, the correctness of the argument from environmental integrity, in this context, has no real explanatory content. It cannot provide an answer to the first title question because it constitutes what logicians call an ‘analytic truth,’ i.e. it is true by virtue of the definitions of the terms involved. To say that someone is unmarried because he is a bachelor it true, but trivial, as it is part of the definition of ‘bachelor’ to be unmarried. The same holds for the claim that granting offsets to non-additional projects would infringe the environmental integrity of the regime as currently conceived: it is true, but only because we chose to define environmental integrity in that manner. The only way to justify additivity with reference to environmental integrity in the context of such a CDM-type regime is to give a proper justification of why ‘environmental integrity’ should be defined in the chosen manner. Is this possible?

With respect to the CDM (in its current form), such a justification can at least partially be given based on the fact that under the Kyoto Protocol, developing countries are meant to be exempt from emission limitations. This suffices to conclude that ‘Business as Usual’ emissions must be regarded as permitted and hence as legitimate objects for offsetting activities. But it does not suffice to conclude that emissions that were or would have been reduced under BaU conditions should not be permitted (and hence not be creditable); i.e., that the integrity baseline should be BaU and not (some form of) BaU17, to use the terminology introduced in the previous section.

Why? Because if the emissions that were reduced under BaU conditions are regarded as not permitted, then the BaU baseline in effect becomes a target baseline (defining what are and what are not permitted emissions). Had they not undertaken the BaU reductions, then they would have been in non-compliance with the ‘BaU target’, something which clearly does not square with the idea that they should not be subject to emission limitations. To put it differently, by not crediting actual BaU emission reductions – for reasons of not being additional – the current CDM practice can be regarded as de facto introducing the BaU baseline as a target baseline. Any emissions that were reduced under BaU conditions were in ‘non-compliance’ with that BaU target, which is why they are not to be certified. Clearly this sort of argumentation does not sit easily with the idea that developing countries are not meant to have emission limitations. Indeed, it could be turned on its head as an argument as to why non-additional reductions should be credited. Moreover, there are other arguments both for and against crediting non-additional emission reductions.

There is, for example, a widespread and often strongly-held belief that BaU emission reductions should not be credited if they are carried out at no or negative cost. This belief is rooted in a particular paradigm17 concerning the nature of the mitigation issue, namely that it is about sharing a common burden. According to this paradigm, it is perfectly acceptable that one may not be required to take on a share of this burden. What is unacceptable is ‘to profiteer’ from the problem, say by getting additional money for something which would have been profitable on its own.18 As it happens, this is closely related to arguments concerning the generation of offsets under a cap and trade regime as discussed in Section 3.2, namely a regime with a free initial allocation of emission permits (‘grandfathering’). Anyone reducing emissions below the target level will have a surplus of allocated permits. The question then is whether they should be allowed to sell these permits if the relevant

16 If a project would have happened in the absence of the mechanism, then it would be part of the scenario of all things that would have happened in the absence of the mechanism.
17 In The Structure of Scientific Revolutions (U. Chicago Press 1962), Thomas Kuhn defines a scientific paradigm as: what is to be observed and scrutinized; the kind of questions that are supposed to be asked and probed for answers in relation to this subject how these questions are to be structured, how the results of scientific investigations should be interpreted.
18 As it happens, under that paradigm, any sale of CERs at a profit should be banned, not just the ‘windfall profits’ from no regret measures.
reductions were at no or even negative cost. According to the burden-sharing paradigm, this should not be permitted. Indeed, according to that paradigm selling should only happen to cover the costs incurred.

This sort of conclusion is clearly contrary to the main purpose of having a trading regime in the first place, namely to foster economic efficiency. Indeed, it is a typical conflict between moral and efficiency aims. However, it is important to keep in mind that the moral argument in question critically depends on a specific paradigm regarding the mitigation issue, i.e. a specific view of the nature of the mitigation problem in general. The fact is, there are other paradigms, other fundamental ways of interpreting the nature of this problem, which do not support the ‘no pain no gain’ view. To exemplify this, assume the ‘mitigation problem’ is identified as the problem of assigning country targets, or rather allocating assigned amounts. In that context, the issue appears as the question of whether surplus permits (‘hot air’) should be tradable. According to the burden sharing paradigm, they clearly should not be. However, the allocation of assigned amounts – particularly in the context of a cap and trade regime – can also be seen in a different paradigm, namely as the allocation of (property rights to) a natural resource. In that paradigm, it can be perfectly justifiable to receive surplus permits and to sell them on at a profit. What is seen to be inadmissible, by contrast, are attempts to prevent this. Moreover, this conclusion can be intuitively persuasive, particularly when the surplus belongs to poor countries, or individuals, such as would be the case if one were to allocate emission rights globally to individuals on an equal per capita basis. How could it be morally wrong for subsistence farmers in Africa to sell their surplus permits at a profit?

Returning to the CDM, it can hence be argued – at least in the case of developing countries which would have surplus AAUs under the resource allocation paradigm – that all emissions have to be permitted, and therefore that all (actual) emission reductions have to be treated as creditable, whether or not they would have taken place in the absence of the CDM. The resource allocation paradigm thus provides another argument against (investment) additionality, at least for countries that would be allocated surplus AAUs. In short, while the burden-sharing paradigm provides an argument for investment additionality – albeit at the price of economic efficiency – the resource allocation paradigm provides moral reasons against (investment) additionality, in addition to the earlier mentioned BaU target baseline arguments.

5.1.3. Conclusion: Need for a pragmatic compromise

To be quite clear, none of these arguments is self-evidently persuasive – after all, if one of them were, there would be no additionality issue. The main conclusion to be drawn from the above analysis is that the issue is as inherently ambiguous as the mitigation problem in general: there are reasons for introducing additionality (in certain cases), and others for rejecting it (in certain circumstances). The only way forward is to try to come to a mutually acceptable compromise. Before that, it is useful to see how the results obtained thus far relate to the actual Kyoto Protocol regime.

The Kyoto Protocol offsetting regime is a mixture between the two types discussed so far: offset generation in Annex B is part of a cap and trade regime, while in non-Annex I countries, it is governed by the CDM – the prototype of the regimes discussed in the preceding section. While many of the characteristics of the two sub-regimes are as in their ‘pure’ application, there are problems that arise not only because of the mix, but also because of certain de facto differential treatments between them.

As concerns the use of offsets generated in Annex B, the integrity of the current Kyoto regime remains ultimately safeguarded by the commitment of the relevant governments to comply with their targets. But the same cannot be said of Annex B offset generation itself. Why? It is well known that mitigation activities in Annex B have the potential to cause ‘carbon leakage’, i.e. the ‘migration’ of emitting activities from Annex B to non-Annex I. Clearly, any amount ‘leaked’ into non-Annex I due to an Annex B mitigation activity/project will, ceteris paribus, be above the non-Annex I BaU baseline (‘what would have happened in the absence of the regime’). It would thus infringe environmental integrity, if it is not compensated by a commensurate cut in the relevant Annex B baseline. In other words, the current regime fails to safeguard its own environmental integrity by not discounting Annex

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19 Note that offset generation is not restricted to project-based regimes. For example, under a grandfathering cap and trade regime, potential offsets are generated if emissions are reduced below the cap, and thus permits freed for selling on as offsets.
B mitigation levels by the amount of carbon leakage they cause.\textsuperscript{20} It is to be noted is that this has nothing to do with the lack of investment additionality testing for these activities. It is an issue that would have to be addressed even if Annex B offset activities were subject to investment additivity constraints. At the same time, it is seems clear that addressing this sort of integrity infringement in practical terms would be very difficult, if not impossible. The point of raising this issue of carbon leakage here is simply to try and dispel the common myth that integrity infringement is only a problem for the CDM, and not for Annex B offset activities, often portrayed as completely innocuous. The previous section demonstrated that there is no fundamental difference between offset generation in Annex B and in non-Annex I as regards the potential for infringing environmental integrity. The generation of credits in Annex B can lead to integrity infringements due to carbon leakage, while crediting for BaU emission reductions would lead to infringements under a BaU interpretation of non-Annex I integrity.

Given this symmetry, it is difficult to see why offset generation in Annex B should be given a moral waiver as concerns the ‘profiteering’ argument used in defence of the application of investment additionality tests in the case of non-Annex I offset generation. In other words, if one argues for the adoption of BaU as integrity baseline – thus rejecting any BaU emission reductions as offsets – on the grounds that ‘pure profit’ (i.e. profit without costs) is immoral in this context, why should offset generation in Annex B not be subject to the same moral scrutiny? Why should it be moral to generate credits in Annex B at negative costs, and immoral to do so in non-Annex I?

It must be emphasised, that this question is not purely theoretical. The one-sided application of investment additionality criteria imposes genuine economic differences between offset generation in Annex B and in non-Annex I. It opens up the possibility that one and the same project/activity\textsuperscript{21} would yield negative cost offsets (credits) in Annex B, while it would be refused offsets (CERs), for not being additional, when carried out in non-Annex I.\textsuperscript{22}

One might try to argue that this differentiated application of investment additionality tests, and the resulting competitive advantage of Annex B offset generation is justified by virtue of the safeguards and overall mitigation effort of Annex B governments; that Annex B offset generation should be permitted ‘non-additional’ credits in recompense for the fact that Annex B countries have taken on mitigation commitments/burdens (at least those whose emission caps are binding). Be that as it may, the fact remains that, at the project level, the playing field in offset generation is not level. This is unlikely to be seen as anything but unfair, particularly when combined with prevailing differentiated responsibilities and respective capabilities.

One way of levelling that playing field would be to extend the investment additionality test to all offset generating activities, wherever they may occur.\textsuperscript{23} However, given the issues that have arisen with this in the context of the current CDM, it would probably be better to level the playing-field (wherever possible) the other way round, by dispensing with the investment analysis wherever it is possible.

Apart from the lack of a level playing field under the current mitigation regime, the real problem with additionality in the CDM is that there are valid reasons why it should be kept, and equally valid ones why it should be rejected. And as suggested, the only way forward is to try and find a mutually

\textsuperscript{20} See also: Geres, Roland; Michaelowa, Axel (2002): A qualitative method to consider leakage effects from CDM and JI projects, in: Energy Policy, 30, p. 461-3.

\textsuperscript{21} Note that, for the present purpose, any mitigating activity which results in offsets – whether they are in the form of CERs, or AAUs (generated through mitigating below the target-baseline) – are referred to a ‘projects’. It is important to keep in mind that it is possible to generate credits even in the context of an emission target, by reducing one’s emissions below that target, thus freeing assigned amounts. Further, it is possible to do so with ‘no-regrets’ measures, i.e. at a zero or negative cost.

\textsuperscript{22} It might look as if the argument here only applies to ‘grandfathering’ contexts. However, even in the ‘profiteering argument’ it could also be applied in the context of a regime with permit auctioning, where ‘credit generation’ would have to be the acquisition of permits over and above one’s actual needs. The profiteering would be in the selling of these credits with a profit (i.e. above cost).

\textsuperscript{23} There is no conceptual reason why a non-additional (Annex B) reduction below a project target baseline could not also be disallowed as generating surplus AAUs. Indeed, conceptually, the regime could easily be adapted by introducing ‘target discounting’ for Annex B activities. The results of any non-additional actions would be subtracted from the target before establishing compliance. It stands to reason that the environmental stringency of the regime would be increased, if the playing field were levelled, by applying the investment additionality rules throughout the regime (and not just in developing countries).
acceptable compromise between the proponents of the two contradictory paradigms. But how exactly could this be achieved?

One step in the direction of such a compromise concerns the need for investment analyses in determining whether a project is additional – in the above mentioned ‘narrowed’ sense of the word – or not. Is it possible to dispense with ‘investment analyses’ without abandoning the idea of Baseline integrity and thus of additionality? As it turns out, there are cases where this can be done through a judicious choice of how the notion of ‘BaU’ – of ‘what would have been the case in the absence of the mechanism’ – is interpreted (or, if we wish, operationalised).

The practice in the current CDM is to operationalize BaU in terms of hypothetical scenarios. The CDM combined tool to identify the baseline scenario and demonstrate additionality, for example, employs a scenario analysis to establish both the offset baseline and the additionality of a project. The methodology for establishing the baseline essentially involves putting up a list of scenarios – in this case descriptions of projects that ‘provide outputs or services with comparable quality, properties and application areas as the proposed CD project activity (including the project and all alternatives)’ which are practically possible with respect to available technologies, potential barriers, and legal constraints, and then designate the ‘most economically or financially attractive alternative scenario’ as ‘baseline scenario’. Whether or not reductions from that baseline are creditable depends on a number of additional additionality tests, among them an investment analysis. However, the scenario interpretation of BaU is not the only way in which that notion can be operationalised. Indeed, there are interpretations which do not require the sort of auxiliary baselines relied on in scenario interpretations.

For instance, there is what might be called the (historic) trend interpretation referring to ‘what one could reasonably expect to happen/to have happened on the evidence of past experience’. In more operational terms, it refers to historic trend projections of the relevant parameters, as used in the field of econometrics. Accordingly, the ‘trend interpretation’ of what emissions should be considered ‘permissible’ – i.e. below the ‘environmental integrity (baseline)’ under a (pure) CDM-type regime would be given by parameter projections based on historical data.

As it happens, something akin to this interpretation of ‘permissible emissions’ is already present in the current tool kit of the CDM, namely as baseline determinant in a renewable power methodology. To

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24 UNFCCC CDM EB, ‘Combined tool to identify the baseline scenario and demonstrate additionality’ (Version 02.2) EB 28 Report, Annex 14, 15 December 2006.
explain this, consider a ‘micro regime’ based on a single power grid. According to this methodology, the offsetting baseline for renewable projects feeding into that micro-regime, is, in essence, defined by the average emissions intensity of the grid over the past five years. In other words, the number of CERs which a renewable project would be assigned is determined by its impact on this grid parameter and by the past performance of that parameter (whether or not a project actually does get CERs even if it reduces the grid intensity below the historic average depends on further additionality tests, such as an investment analysis).

By comparison, the integrity baseline of this micro regime under a historic trend interpretation could be defined in terms not of a historic average, but a historic trend projection of the grid intensity, which would also serve as the relevant project offset baseline. The main difference would be that the trend projection would define the permissible emissions, and any reduction below that integrity baseline would by definition be additional (regardless of hypothetical financial decisions).

To be clear, while there would be cases of projects that would be judged additional – and hence allocated CERs – under this methodology, and not under the existing one (e.g. because they fail the investment test), that does not mean that overall, the trend methodology would always (or even generally) allocate more CERs than the traditional scenario-based one. After all, as suggested in Figure 1, the grid intensity trend projection could be decreasing below the historic average used in the current methodology, in which case projects which are additional under the current methodology would be allocated fewer CERs under the trend-based methodology. Thus, in the example depicted in Figure 1, if the project were to be judged to be additional under the current methodology, it would generate more than twice as many CERs under that interpretation than under the trend projection one.

It is important not to misinterpret the fact that projects would generate different amounts of CERs under these two methodologies, and indeed under the two corresponding interpretations of BaU, i.e. the trend-based and the scenario-based one. Even though there may be cases such as ‘greenfield’ projects, where a scenario-based approach may be unavoidable because trend-projections are obviously not possible due to a lack of historic data, this does not mean that the scenario approach is somehow ‘the correct one,’ and the trend-projection one ‘merely an approximation’. The situation is rather more complex. If anything, both approaches are approximations. What is more, they are approximations of something unknowable (namely of what would have happened otherwise), which makes it unlikely that one could even judge their accuracy. Of course, if we knew for certain ‘what would otherwise have happened’, then the situation would be different. But then we would not need BaU scenarios or BaU trend projections in the first place. Yet we do not know, which is why we need to have recourse to tools such as scenarios and/or projections. To think that either tool is somehow intrinsically epistemically superior is simply wrong.

This ‘epistemic parity’ between the two interpretations of ‘BaU’, of ‘environmental integrity’, of ‘permissible emissions’, and of ‘being additional’, is both extremely important and subtle. Thus, it may be useful to look at the two approaches in a different context, namely that of forecasting the future, of establishing ‘what will happen’. The main difference between this task and the one of establishing ‘what would have happened otherwise’ is that the future is not unknowable, and that forecasts can be assessed with regards to their accuracy, once the future has happened, as it were. It is well known that both forecasts based on historic trends or on scenario analyses are usually proved wrong, and that neither is always better than the other. The choice of approach depends very much on the context, and ultimately has to be decided on pragmatic grounds. The same is true in the context of establishing what would have happened otherwise.

This is not to say that the interpretations do not have considerable asymmetries regarding the practicability of their application in particular contexts. For one, as mentioned already, there are situations where the scenario based interpretation – with its investment analyses – would seem to be unavoidable, if only because historic trend projections are not possible due to a lack of historic data (such as in the case of green-field projects). However, given the experience with the scenario based approach – particularly with respect to the issues arising from its investment analyses – it stands to reason that whenever the trend projection approach is feasible,25 it is probably preferable on purely pragmatic grounds, not least because it would not involve second guessing people’s motivations.

25 Note that the trend-projection methodology may also less suitable if the trends in question are highly unstable, or non-existent, even in the presence of reliable data.
Indeed, it is likely that this superior transparency would even outweigh receiving less CERs in cases which would be additional under both interpretations.

5.2. Use of CDM to further the aims of the Bali Action Plan

Benito Müller, Prodipto Ghosh

The Bali Action Plan – adopted as Decision 1/CMP.3 during the 2007 UN Climate Change Conference in Bali/Indonesia – contains a decision to launch a process to reach an agreement by December 2009 on, among other things, enhanced national/international mitigation actions, considering, inter alia “Nationally appropriate mitigation actions by developing country Parties in the context of sustainable development, supported and enabled by technology, financing and capacity-building, in a measurable, reportable and verifiable manner” (Para. 1.b.ii, 1/CMP.3).

Although some people still worry about potential ambiguities with regard to what exactly is meant to be measurable, reportable, and verifiable (MRV) according to this paragraph, the G77 and China statements during the final plenary at Bali clarified that the triple adjective is meant to apply both to the mitigation actions by developing countries, and the developed country support through finance, technology transfer, and capacity building of these mitigation actions. In some crucial respects, this paragraph therefore can and must be seen as an evolution of Article 4.7 of the Convention, in the sense that it makes developing country climate change actions conditional on, among other things, developed country payments (for agreed full incremental costs).

What is not quite so clear is how this MRV support and enablement of the MRV mitigation actions is meant to happen? There are a number of ways in which this North-South relation could be operationalised. For example, it could be a relation at the level of individual activities (projects): MRV projects would be directly supported by MRV finance, technology and capacity building. Or the support could be at an aggregate level, say in terms of some form of budget support, particularly for capacity building (as this may be more efficient than capacity building on a mitigation project by project basis).

No doubt, considerable effort will be put into elaborating this relation in the months running up to the Copenhagen UN climate conference in December 2009. This paper is simply meant to consider the potential of the CDM – in whichever form (project-based, programmatic, sectoral) – to be used as one among possibly several instruments to implement the relationship envisaged in the BAP in respect of the provision of finance.

The idea of using the CDM as a tool for future mitigation action in developing countries (in compliance with Article 4.7) has been mooted long before the advent of the Bali Action Plan. Ambassador Chandrashekar Dasgupta (former chief climate change negotiator for India), for one, expressed some time ago the view that “it is essential to raise the Clean Development Mechanism from a project-based level to a sector- or programme-based level. This holds the key to success for a second commitment period under the Kyoto Protocol.” (Dasgupta 2007).

In order to establish the sort of relation envisaged in paragraph 1.b.ii of the Bali Action Plan, the CDM would have to deliver nationally appropriate MRV mitigation actions in the context of sustainable development by developing countries, supported and enabled by MRV technology transfer, financing and capacity building. Can it do this?

Notwithstanding some of the reservations that have been raised concerning its current implementation, the idea behind the CDM has been precisely that of delivering nationally appropriate MRV mitigation actions in the context of sustainable development. Moreover, the CDM has one key advantage as concerns the implementation of the BAP, namely its general acceptance by developing countries. One has to realise that the North-South relationship stipulated in 1.b.ii has the potential for serious sovereignty concerns, depending on the nature of the envisaged ‘enabling and supporting’ relationship. As witnessed in the UNFCCC workshop on what has become known as the ‘Russian Proposal,’ many developing countries are very concerned, not to say suspicious about seemingly

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To be absolutely clear: the issue here is not to define a new version of the CDM, but it is whether the CDM, in whatever shape or form it will emerge from the present negotiations, could be used as a tool to implement the Bali Action Plan. Moreover, the suggestion is not that the CDM should be the only way of implementing para. 1.b.ii, but (if at all) merely one of many ways.
innocuous proposals regarding the mitigation of developing country emissions being used to force them into taking on binding commitments. This is why it is crucial for 1.b.ii implementing tools to be accepted by developing countries.

As concerns the developed country side of the MRV relation, the CDM has the added advantage of a well-defined (project-related) MRV financing model\(^{27}\), based on the carbon market, where the size of the financing depends not (only) on the incremental mitigation costs for the actions in question, but on the amount of emissions mitigated, and on the prevailing price of carbon. The fact that this model goes beyond incurred incremental cost coverage by allowing (potential) carbon market profits is key to the attractiveness of the CDM to the private sector. At the same time there are also certain aspects of the CDM which are problematic for its use as an instrument to implement the BAP. On the one hand, the CDM has thus far not been particularly effective in providing the other two components of the developed country MRV activities, namely technology transfer and capacity building. The CDM also faces a problem with respect to the MRV mitigation actions (by developing countries), due to the fact that ordinarily, CDM mitigation actions generate offsets used to cover emissions elsewhere. This is problematic because it can be argued that it goes against the spirit, if not the letter, of the reference to “mitigation actions by developing countries”: while there is no question about CDM activities being in developing countries, it can be argued that the reference is meant to refer to activities which, apart from being carried out in developing countries, also contribute to limiting/reducing from baseline overall global emissions. This is not guaranteed if the generated CERs are used as offsets by developed country Parties.

5.2.1. The Core Model

Is it possible to overcome these problems without endangering the key features in favour of a use of the CDM in this context? As concerns the failure to deliver on technology transfer and capacity building, it can be argued that this should not really be held against the CDM qua instrument for implementing the BAP, provided that it is not regarded as the only way of doing so. Indeed, it would arguably not be reasonable to expect a project-based instrument to deliver all three of the developed country MRV constituents (finance, technology transfer and capacity building), particularly not with each and every project.

However, the issue of generally failing to reduce/limit global emission is a problem for the CDM as BAP instrument. But it can be overcome. One could, for example, simply not issue any CERs in the first place. Yet while overcoming the offset problem, this would also exclude a carbon market financing model. And while one could move to an incremental cost based model by directly reimbursing the incremental costs of the mitigation actions, this could be an additional instrument, not exclusive of the use of CDM as a BAP instrument.

However, there is a way to overcome the offset problem without undermining the desirable features of the CDM, namely by ‘retiring’ (taking out of circulation) issued CERs once they are in a relevant (developed country) account. In other words, under this model, if a tonne of carbon dioxide emissions is

(i) reduced through a registered CDM project,
(ii) is certified (by a Designated Operational Entity), and
(iii) if the CER issued is retired from a developed country account,
then it would be deemed an MRV action pursuant to the BAP\(^{28}\).

One of the advantages of this use of the CDM is that, by retiring the generated CERs, the scheme manages to counter at least two of the reasons that are often put forward in defence of the additionality requirement under the CDM, namely (a) to safeguard environmental integrity and (b) to safeguard the price of carbon from a collapse due to a surplus of supply of CERs. This means that one may wish to consider waiving the additionality condition for CDM projects which are used solely for purpose of generating ‘Retirement CERs’ (R-CERs). This could considerably reduce transaction costs, and thus may create incentives for developed country actors to engage in the bilateral generation of such R-CERs, as opposed to their generation in unilateral projects, particularly if the scheme has a mandatory element to it (see below).

\(^{27}\) Note that this is a significant advantage, because it pre-empts the otherwise inevitable debate of what level MRV financing should be, to be counted as supporting and enabling according to 1.b.ii

\(^{28}\) Note again that this is only meant to be one of many possible ways in which such MRV actions could be carried out.
There are, as indicated already, a number of aspects of this ‘core model’ that could be varied in using the CDM to implement the Bali decision. For one, there is the issue of whether the retirement of R-CERs would be voluntary or under some form of obligation.

A scheme based on voluntary retirements of R-CERs would obviously be politically less problematic than a mandatory one, but it is not clear how the private sector could be incentivised to participate in such a scheme, and it is doubtful whether left to the country legislatures, public funding would be forthcoming to retire sufficiently many CERs to have a real impact on global emissions.

A mandatory scheme, based on some form of Retirement CER Obligations (‘R-CEROs’) taken on by developed countries – while politically more difficult – could overcome this problem, for it would be possible to pass on the obligation to sub-national entities. For example, anyone subject to a domestic cap and trade regime could be assigned R-CEROs in proportion to their permitted emissions, say as a percentage of allocated emission caps, or as a percentage of emission permits acquired at auctions. However, imposing such obligations creates its own problems.

Demand-side obligations are only fair if they can be fulfilled, which means, in particular if there is sufficient supply (of R-CERs). Moreover, fair obligations must not be excessive, which in this context would be an excessive deviation from the expected incremental mitigation costs. These are two reasons why the introduction of R-CEROs may have to be coupled with some sort of safety valve, making it possible to fulfil ones obligations even if the supply of R-CERs is insufficient to meet the R-CERO demand directly. One way of doing so would be to allow for an exchange of R-CEROs for cancelling Assigned Amount Units (AAUs) on a 1:1 basis, i.e. an exchange for additional national (developed country) mitigation commitments. This would, in effect, introduce an endogenous price cap on R-CERs determined by the ‘regular’ carbon price of the regime. Unlike an exogenous price-cap, this approach would not compromise the environmental integrity of the regime.

There are other aspects of the basic idea of retiring CERs to implement the BAP apart from the retirement type (voluntary versus mandatory) that could be modified. One might, for one, wish to encourage the retirement of CERs from certain types of activities, say on the grounds of their desirability with respect to sustainable development, technology transfer, and/or capacity building. This, in turn, could be achieved by way of special incentives, such as subsidies or a restriction of the above-mentioned waiver of the additionality condition.

Alternatively, conditions with regards to technology transfer and capacity building which CDM activities would have to satisfy in order to be counted as being supported and enabled by MRV financing, technology and capacity could be specified, either generally, or left to the discretion of host countries.

5.2.2. Conclusions

Its general acceptance as tool for mitigating emissions in developing countries and its financing model make the CDM an ideal candidate for implementing the MRV (supported and enabled) mitigation actions by developing countries referred to in Paragraph 1.b.ii of the Bali Action Plan, provided that the generated CERs are retired from developed country accounts and not used as offsets for developed country compliance. In order to generate significant emission reductions in developing countries, developed countries may have to take on R-CER Obligations (R-CEROs) as part of their commitments. While this is not meant to replace ‘ordinary’ CDM offset activities, and while the CDM is not meant to be the only tool for implementing the Bali Action Plan developing country mitigation activities, CDM BAP activities have the potential of playing a major role in both respects.
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