

# The Global Financial Mechanism Project

Proposals for the Design and Operation of a UNFCCC Fund to Support At-Scale Mitigation in Developing Countries and Leverage Additional Public and Private Funding



David Reed  
Pablo Gutman

Discussion Paper  
June 2010

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## Introduction

### About the Global Financial Mechanism (GFM) and the Technical Working Group (TWG) Projects

Since its inception in late 2008, coordinated and supported by staff from the WWF US Policy Program, the Global Financial Mechanism and Technical Working Group projects have evolved into a multi-national, North-South “think tank” that analyzes climate change policy options and proposes realistic compromises that may be attractive to a large spectrum of climate change stakeholders.

At an early stage, pursuant to the request of several European governments, the GFM project focused on the gamut of financial arrangements that seemed capable of mobilizing the considerable public and private funds needed to attain the below 2 degrees centigrade goal for climate change stabilization. Its work program included:

- (a) A bottom-up analysis of mitigation opportunities and costs in different sectors of developing countries (e.g. cement in China and Mexico, iron and steel in China and Mexico, coal-based power generation in India, renewable energy opportunities in Tunisia);
- (b) A translation of the country and sector-level transformation needs into specific institutional requirements that could eventually be integrated into an international financing scheme;
- (c) Reviews by leading experts from North and South on their countries’ prior experiences in sector reforms designed to reduce emissions and increase energy efficiency;
- (d) Meetings of experts and negotiators, from North and South, to discuss these experiences and potential lessons; and
- (e) Presentations of the project findings and proposals to key climate change stakeholders and forums.

During 2008-2009, the GFM project mobilized the work of over three dozen experts around the world, produced or commissioned a dozen technical reports, delivered two synthesis reports, conveyed two international expert meetings, as well as participated in and addressed over a dozen climate change forums. Annex 2 presents a list of the GFM reports and the website to download copies of them.

In early 2009, the GFM project shifted its focus to address the issue of institutional arrangements to coordinate different sources of international funding for climate change. The goal was to identify institutional design options that could help reconcile the increasingly polarized perspectives between developed and developing countries and to improve the coordination between international funding sources and demands for funding. To address this issue, we convened the Technical Working Group, bringing together experts from North and South.

The Technical Working Group initially discussed three possible institutional designs: (a) a strongly decentralized one; (b) a strongly centralized one; and (c) an intermediate one organized around a UNFCCC Climate Registry. Further work focused on the latter and during 2009 and the first half of 2010, the TWG produced three main reports on the operation of a Climate Registry under the UNFCCC, as well as commissioning half a dozen supporting studies and policy briefs. During the same period, the TWG proposals were widely distributed among UNFCCC Parties, were presented at climate change conferences and discussed with officials from several governments. Annex 3 presents a list of the TWG reports and the website to download copies of them.

## About this Report

As stated in the title, this report discusses the design and operation of a UNFCCC fund to support at-scale mitigation in developing countries, while at the same time leveraging additional public and private funding. There is a double rationale for this proposal:

- First, the belief that the UNFCCC should play an important role in channeling financing for climate change investments in developing countries; hence the proposal for a new and substantial UNFCCC managed fund.
- Second, our understanding that even when such a UNFCCC managed fund is in place, a large portion of international financing will still come from other sources -- bilateral, multilateral and private -- and that there too the UNFCCC should be able to play a leading and coordinating function.

While the discussion in this document refers to the design and operation of an at-scale fund for mitigation activities in developing countries (or a mitigation window of a multi-purpose climate fund), many of the proposals discussed herein could be applied to related activities, such as REDD+ or technology transfer financing (and some examples are presented through the document). However, the applicability of this discussion to adaptation funding may be limited because we centered our attention on how to operate a UNFCCC fund that leverages additional public and private resources, mixing grants, loans, and the recipients' own capital; an approach that seems appropriate for mitigation investment that will have an economic payback. But this approach may not be relevant for adaptation investment, since the general agreement is that all, or a majority, of the international funding for adaptation should be in the form of grants. The content of the report is as follows:

- In lieu of a summary, the “Main Messages” section highlights the key points of the report.
- The first section encompasses the discussion of the design and operation of a UNFCCC mitigation fund. It includes the following chapters:
  - Chapter 1: “**The Global Cost of Addressing Climate Change in Developing Countries**” briefly presents available estimates of financing needs (UNFCCC Sec, EC, McKinsey, World Bank, NGOs) and discusses where the funds may come from. The conclusion is that, in all probability, funding for climate change will come from a variety of sources, inside and outside the UNFCCC framework.
  - Chapter 2: “**The Design and Operation of a New UNFCCC Mitigation Fund**” discusses the operation of a COP-managed fund whose purpose would be to provide financial resources to shift high greenhouse gas (GHG) emitting economic sectors of developing country economies to lower-carbon trajectories. The chapter discusses a three-phased approach and the role of a COP Mitigation Fund in each of these phases. Although the discussion has a mitigation focus, it can easily be extended to financing for REDD+ and technology transfer.
  - Chapter 3: “**How Large Should a New UNFCCC Mitigation Fund Be?**” One issue is how much additional money will be needed for mitigation in developing countries; we discuss this in Chapter 1. Once it is acknowledged that not all the mitigation money will flow through UNFCCC funds, a second issue arises: what could be an appropriate size for a UNFCCC mitigation fund? That is the subject of this chapter.

- Chapter 4: “**Leveraging Additional Financing: The Climate Registry**” discusses how the UNFCCC could attain a leading role in global financing, through coordinating leveraging and leading other sources of financing. In this regard it summarizes the Climate Registry proposal, which is a key development of the Technical Working Group Project.
- Chapter 5: “**The Private Sector Role**” discusses a variety of functions that the private sector needs to play in the transition to a low carbon economy, and how public policies and a UNFCCC Mitigation Fund can help mobilize private investments.
- The second section presents summaries of case studies, reviews and modeling exercises that were commissioned by the GFM project (a list of all these case studies, reviews and modeling exercises and the web site to download full copies of them can be found in Annex 2). Section II includes the following chapters:
  - Chapter 6: “**The Supporting Studies**” discusses the purpose of the GFM supporting studies and presents brief summaries of six review studies and one modeling exercise.

All the remaining chapters present summaries of the country case studies, namely:

- Chapter 7: **China: Opportunities to Reduce Emissions from the Cement Industry**
- Chapter 8: **China: Opportunities to Reduce Emissions from the Iron and Steel Industry**
- Chapter 9: **Tunisia: Opportunities to Scale Up Renewable Electricity Production**
- Chapter 10: **India: The Limits of Coal-Based Electricity Generation**
- Chapter 11: **Mexico’s Cement and Iron and Steel Sectors: A Case of Multinational Firms in Developing Countries**

#### **The Discussion on Institutional Options and the Climate Registry is Now in a Separate Series of Documents**

Previous versions of this report -- up to the May 2009 edition -- included a chapter devoted to institutional options. Apart from a summary discussion of the Climate Registry Option in Chapter 4, this document does not delve into institutional options in detail because after June 2009 that discussion was pursued in a parallel track that produced its own publications (see Annex 3). The interested reader may want to peruse the publication *The Climate Registry Option*, November 2009, that can be downloaded from [www.climateregistryoption.org](http://www.climateregistryoption.org)

## Main Messages

This report's main messages can be summarized as follows:

- Most available studies agree that to have any chance of containing climate change below the 2 centigrade threshold, additional funding requirements for developing countries' mitigation (including REDD+), adaptation, technology cooperation, and capacity building are likely to be in the order of one hundred to three hundred billion dollars a year around 2020. Studies also agree that funding mechanisms available as of mid-2010 would be able to deliver only a fraction of the needed amount (see more on this in Chapter 1).
- Regarding the potential sources of these additional funding requirements, it is important to recognize that they will have to come from many sources: International and national, public and private, traditional and innovative, for profit and not for profit. Scaling up and coordinating such a variety of fund streams would be a major challenge for climate change financing (see more on this in Chapters 1, 4 and 5).
- Regarding who would manage and allocate international public financing, it is worth considering the experience with official development assistance (ODA). After more than 60 years and a bevy of international agreements, multilateral agencies and funds manage less than 30% of annual ODA. The remainder, that is, more than 70% of international public funding, is actually handled by donor countries' bilateral programs. The reason is obvious: donor countries are reluctant to relinquish control over their funds. Public international financing for climate change will probably follow a similar pattern, with some portion of it channeled through existing multilateral or regional agencies; some portion channeled through existing or to be created UNFCCC funds; and the lion's share handled by donor countries' bilateral agencies (see more on this in Chapters 2 and 4).
- The multiplicity of sources and allocation windows underlines the importance of securing a strong role for the UNFCCC both as a funding window on its own, and as a coordination platform. Climate change is a truly worldwide challenge, and the UNFCCC is the only international mechanism that has the mandate to address it at a global scale and in an inclusive, equitable and transparent manner. Besides, a strong level of coordination is warranted on strictly economic grounds. Without it, there would be no way to steer international climate investment towards its most efficient use; e.g. direct mitigation investment to the least cost opportunities (see more on this in Chapters 2, 3 and 4).
- To address the issue of scaling up the UNFCCC's role as a funding window, we discuss the design and operation of a new UNFCCC mitigation fund that could be either a standalone fund, or the mitigation window of a multi-purpose fund. The goal of this new mitigation fund under the UNFCCC/COP would be to help shift key economic sectors of developing countries from carbon-intensive to low-carbon paths, by providing grants to pay for incremental costs, technology transfer, and technical support, and leveraging other sources of public and private funding.
- The new fund would operate through a three-phased approach -- Preparation, Initiation and Implementation<sup>1</sup> -- that would give it the flexibility to address the different needs of client countries,

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<sup>1</sup> The phases discussed here are titled differently than those envisioned for REDD+ (Readiness, Implementation, and Investment), but there is a great deal of overlap between these phased approaches.

while changing the mix of funding from one phase to the other and from one country to another. Initially the UNFCCC mitigation fund would provide grant financing to support the preparation of Sector Transformation Plans (and/or NAMAs and LCAPs). The proportion of grant financing from the UNFCCC Mitigation Fund would diminish in the subsequent Initiation and Implementation phases, as a range of other public and private financial sources are tapped (see more on this in Chapter 2).

- We suggest that such a new at-scale UNFCCC Mitigation Fund would require a start-up commitment from industrialized countries in the order of \$6 billion dollars a year for the first 5 years of operation, growing to \$20 billion dollars a year in the following 5-year period. This UNFCCC operated mitigation fund is intended to be neither the only mitigation fund, nor the mother of all mitigation funds. It is intended only to be the main mitigation fund under the aegis of the UNFCCC, providing grant resources large enough to have a substantial impact on its own and to leverage other financing from inside and outside the UNFCCC framework (see more on this in Chapter 3).
- Coordinating and leveraging: the UNFCCC Climate Registry Option. Many proposals discussed at the UNFCCC - COP include a call to set up a registry that would track commitments and climate change activities of one sort or another. Compared with them, this report endorses the idea of an enlarged UNFCCC Climate Registry that would be an active clearinghouse mechanism, aligning developing country needs with expertise and financial resources provided by various sources including public and private funding, and would also have a role regarding regulation, verification and certification of outcomes (see more on the Climate Registry Option in Chapter 4 and in the reports of the Technical Working Group project, listed in Annex 3).
- The discussion on how to mobilize private financing has thus far focused too much on luring the financier and too little on what would make investing in mitigation profitable; too much on reducing risks to the buyer and too little on reducing risks to the producer. This report argues that to foster private investment in climate change more attention should be paid to:
  - Moving to a Low Carbon Economy is not only about financing the additional costs; it is also about greening the business as usual costs. And the latter is where most of the private money is.
  - Creating the demand for mitigation. If there is no demand there will be no business prospects and no chances of luring private investors.
  - The many roles that businesses can and should play -- buyer, seller, technology developer, market developer, trader, and financier. If we narrow it all to the latter we are missing many opportunities.
  - Investment in technology R & D is critical to reducing the costs of transitioning to a low carbon economy and is one of the areas where the private sector would play a critical role
  - Going beyond risk reduction for lenders to focus on risks reduction for mitigation producers. See more on this in Chapter 4.
- Country case studies illustrate that there are different paths and different needs to accelerate the transition to a low carbon economy. Grants may be needed sometimes, but in other cases loans would do. At times capacity building and information dissemination may be the real bottleneck; small countries may need regional partnerships to reap the benefits of economies of scale; should multinational companies operating in developing countries be held accountable to developed or developing country emission standards? Looking at mitigation from a bottom-up perspective underlines the opportunities and complexity of scaling up mitigation in developing countries (see more on this in Section II Chapters 7 through 11).

## **Section I**

### **The Design and Operation of a UNFCCC Fund to Support At-Scale Mitigation in Developing Countries**



## Chapter 1

### The Global Costs of Addressing Climate Change in Developing Countries

#### 1.1. The Funding Challenge

Considerable efforts have been devoted to estimating the costs of addressing climate change in developing countries, and figures vary considerably, depending on the approach used and the assumptions made. Regardless of the variation, all available studies agree that to have any chance of containing climate change below the 2°C threshold, funding requirements for developing countries' mitigation (including REDD+), adaptation, technology cooperation, and capacity building are likely to be in the order of one hundred to three hundred billion dollars a year around 2020. They also agree that funding mechanisms existing as of mid 2010 would only deliver a small fraction of the needed amount. The following table summarizes some of the most widely acknowledged cost estimates (a more detailed rendering, listing the major assumptions and sources behind each cost figure is provided in Annex 1).

**Table 1. A Summary of Financing Needs for Climate Change Investment in Developing Countries**  
(In billions of 2005 US dollars)

| Estimates by                                     | When?                           | For Mitigation | For Adaptation | For Technology Cooperation |
|--------------------------------------------------|---------------------------------|----------------|----------------|----------------------------|
| <b>UNFCCC Secretariat 2008 update</b>            | Annually around 2030            | 64.7           | 27.75 to 58.75 | 17.5 to 22.5               |
| <b>European Commission 2009 estimates</b>        | Annually around 2020            | 117.5          | 28.75 to 67.5  | --                         |
| <b>Catalyst/McKinsey 2009 estimates</b>          | Annual average for 2010 to 2020 | 68.75 to 100   | 8.75 to 53.75  | 12.5                       |
| <b>World Bank, 2010 World Development Report</b> | Annually around 2030            | 140 to 175     | 30 to 70       | Included in mitigation     |
| <b>NGOs consortium 2009 estimates</b>            | Annual average for 2013 to 2017 | 97             | 63             | Included in mitigation     |

Source: See details in Annex 1

#### 1.2. Where Should the Funding Come From?

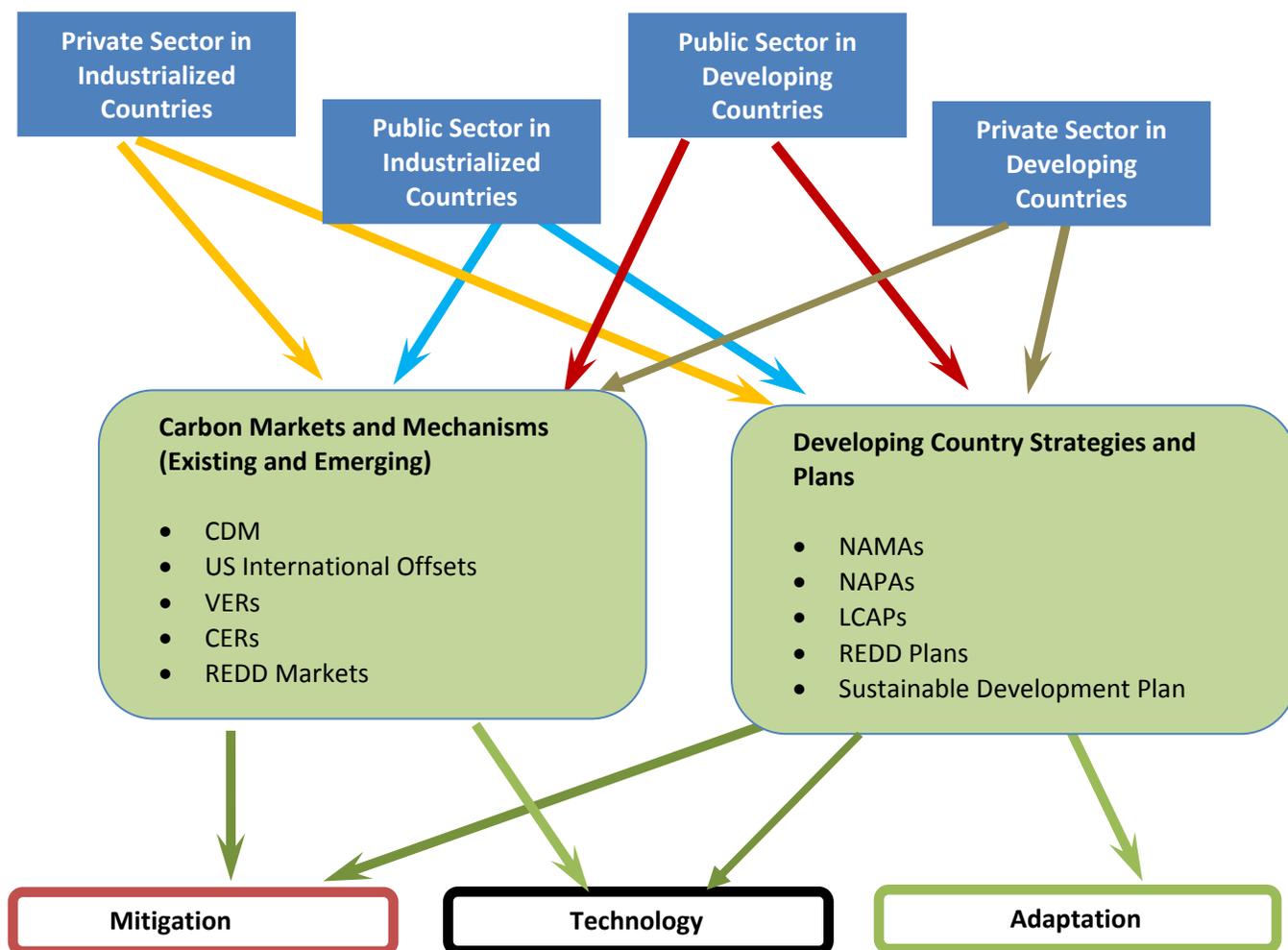
It is important to recognize that multiple sources of funding will have to be tapped in order to mobilize funding at the scale necessary to address climate change in developing countries, including:

- International levies and revenues from the international auctioning of emission rights;
- Bunker levies (on international air and maritime transport);
- Other international levies on GHG emissions based on the polluter pays principle;
- Other innovative sources of international financing for the global commons;
- National budgets of industrialized countries and revenues from the national auctioning of emission rights;
- National budgets of developing countries;
- Compliance carbon offset markets (national, regional or international);
- Voluntary international carbon offset markets;
- Private sector investors; and

- Private foundations.

Products delivered by these sources could include grants, commercial or concessional loans, guarantees, equity, mezzanine finance, and insurance products, among others. This multiplicity of flows is depicted in a somewhat simplified version in Figure 1.

**Figure 1. Sources and Flows of Financing to Address Climate Change in Developing Countries**



A significant limitation of the climate change discussion thus far is that the appropriate contribution of each of these sources has not been clarified or agreed upon. Some quarters argue that most funding will eventually come from carbon markets and private investors, while others argue that all or almost all costs for climate change in developing countries should be paid for by public funds from industrialized countries.

Some consensus is emerging – for instance, that most international funding for adaptation should be in the form of grants (e.g. Bredenkamp and Pattillo, 2010), but discussion continues regarding many other subjects – for instance concerning how much financing for mitigation should be in the form of grants and how much in the

form of soft loans, or if international financing should concentrate in less developed countries or reach all developing countries, etc.

While this discussion is still ongoing, it has become increasingly clear that international funds and industrial countries' public funds will be of critical importance to pay for:

- Adaptation costs, particularly in the most vulnerable and less developed countries;
- Some stages of technology cooperation;
- The start-up phase of mitigation efforts in most developing countries including the preparatory and capacity building stage of NAMAs; and
- All phases of mitigation implementation efforts in the cases of least developed countries, including those relevant for REDD.

On the other hand, domestic public funds may be an important source of mitigation funding in middle-income countries, especially those with high GHG-emitting sectors. However, carbon markets and other forms of private funding will become increasingly important and eclipse public funding as financial mechanisms mature and expand and as developing countries are able to market successful mitigation programs. In conclusion, while it is necessary to develop all sources of funding, it is urgent to scale up the availability of international and industrial countries' public funding for climate change investment in developing countries, particularly in early stages.

## Chapter 2

### The Design and Operation of a New UNFCCC Mitigation Fund

There are valid technical objections against pooling all the distinct funding sources needed to address climate change in developing countries into a single, centrally-managed fund. Such a super fund may result in increased risk, increased costs from over-centralization, and decreased efficiency. Moreover, even if there were no technical objections, it is difficult to envisage that UNFCCC Parties would agree on a single fund scheme.

On the other hand, the Bali Road Map and the discussions of the AWG-LCA in the run up to and at COP15 clearly indicated that the proliferation of many uncoordinated funds will not deliver the needed level of finances. This experience has shown that it is imperative to immediately establish a sizeable pool of public financing disbursed under the authority or guidance of the COP to initiate and scale up mitigation and adaptation activities in developing countries and to act effectively as a leverage and coordinator of other sources of funding.

It is true that different multilateral and bilateral institutions could channel additional international public funding for adaptation, mitigation, and technology cooperation activities. However, a consensus is emerging that reforming the UNFCCC financial mechanism and substantially increasing the funds it commands will be essential in building confidence among developing countries and encouraging them to launch more ambitious adaptation and mitigation programs in subsequent commitment periods.

These new and enlarged public funds managed by the COP could also be critical to help incentivize participation from other funding sources, notably from the private sector, as well as to allow the COP to fund priority climate change investments that are not attractive to other sources of funding.

At present there are only two COP-mandated funding institutions, the Global Environment Facility (GEF) and the Adaptation Fund Board (AFB). While the GEF is a well-established institution, there is a need to reform its structure and procedures to respond to the demands voiced by the COP. The AFB is a new institution and is currently in the process of acquiring operational capacity. It, too, will need to evolve as a flexible, demand-driven, COP-mandated funding source for adaptation.

There is no shortage of proposals for new funding mechanisms, many of which were tabled in the run up to COP15. Moreover, the Copenhagen Accord in its article 10 proposes the creation of a new Copenhagen Green Climate Fund to be established “... as an operating entity of the financial mechanism of the Convention to support projects, programme, policies and other activities in developing countries related to mitigation including REDD-plus, adaptation, capacity-building, technology development and transfer.”<sup>2</sup>

Additionally, there is the High Level Advisory Group on Climate Change Financing launched at COP15 that has to report to the UN on innovative options to mobilize funding by mid-2010; the Mexican proposal of a Climate Fund; and several other UNFCCC Parties and partners’ proposals that will surely be revisited in the run-up to COP16.

Three important issues have monopolized the financing for climate change discussions thus far. These are:

- The source of the money;

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<sup>2</sup> Copenhagen Accord. (2009). Article 10. Accessible at: [http://www.denmark.dk/NR/rdonlyres/C41B62AB-4688-4ACE-BB7B-F6D2C8AAEC20/0/copenhagen\\_accord.pdf](http://www.denmark.dk/NR/rdonlyres/C41B62AB-4688-4ACE-BB7B-F6D2C8AAEC20/0/copenhagen_accord.pdf)

- Representation of funders and recipients in the governing body; and
- Distribution of funds among recipient countries.

In what follows we discuss a complementary but somehow less researched issue, namely how a new UNFCCC mitigation fund could operate to promote at-scale mitigation in developing countries, both through its own resources and through leveraging and coordinating funding from other sources inside and outside the UNFCCC framework, including the private sector.

### **2.1. A New UNFCCC Mitigation Fund**

The goal of this new mitigation fund under the UNFCCC/COP would be to help shift key economic sectors of developing countries from carbon-intensive to low-carbon platforms by providing grants to pay for incremental costs, technology transfer, and technical support. As previously stated, this new mitigation fund could be either a standalone fund or the mitigation window of a multi-purpose fund. The focus of our discussion is how it could operate to (a) respond to the different stages of development of economic sectors in developing countries; (b) ensure compliance with international and national standards of monitoring, reporting and verification; and (c) how it could partner with and attract other sources of funding, including multilateral, bilateral and private.

We found that these goals can best be accomplished by a three-phased operational approach in that a phased approach allows financing to adjust to the specific needs, preparedness and technological levels of each country, while changing the mix of funding from one phase to the other and from one country to another. This approach would have the UNFCCC Mitigation Fund providing grant financing to support preparation of Sector Transformation Plans (and/or NAMAs and LCAPs) that must comply with internationally agreed upon standards and graduation requirements. Following completion of Preparatory Phase requirements, the proportion of grants from the mitigation fund may diminish in the subsequent Initiation and Implementation Phases, as a range of other public and private financial sources are tapped through a UNFCCC managed Climate Registry that acts as a clearinghouse for demands and offers of financing. Furthermore, the three-phased approach of the UNFCCC mitigation fund also provides opportunities for engaging a wide range of technical and institutional actors in a harmonized and coordinated manner.

In the following sections, we examine these three phases of a UNFCCC Mitigation Fund in detail, beginning with the Preparation Phase, then moving through the Initiation Phase and concluding with the Implementation Phase. As we begin this exploration of the three-phased approach, we underscore the point that preparation and subsequent implementation of Sector Transformation Plans, NAMAs, or LCAPs must be viewed as a process fully harmonized with and integrated into the developing country development strategy. Moreover, implementation of Sector Transformation Plans invariably requires institutional and policy changes that, likewise, must be harmonized with the broader development priorities and paths of each developing country.

Although this discussion focuses on a new mitigation fund, we believe that a similar design could be used to put in place scaled up funds for technology cooperation and REDD+ under the aegis of the UNFCCC/COP.

### **2.2. The Preparation Phase**

Achieving emission reductions at-scale may require sophisticated plans to guide a country's efforts over many years. Some developing countries have already prepared or are preparing Low Carbon Action Plans (LCAPs), Nationally Appropriate Mitigation Actions (NAMAs), or different types of Sector Transformation Plans (STPs) to reduce energy intensity and carbon emissions in whole sectors, across sectors, or nation-wide. For example, beginning in 1990, the Chinese government designed and has subsequently implemented important elements of

a modernization plan for the cement sector that currently produces upwards of 50% of the world’s cement. Although the economic efficiency gains were the principal drivers of changes made in China’s cement sector, modernization also resulted in substantial GHG emissions reductions per ton of cement produced. More recently, several developing countries have prepared Nationally Appropriate Mitigation Actions (NAMAs) and similar mitigation blueprints. Many other countries have not yet prepared such plans but may have covered considerable ground in their periodical National Communications, their National Adaptation Programs of Action (NAPAs), or their economic development plans.

In the operation of the new UNFCCC mitigation fund, the Preparation Phase would support development and refinement of sector or country-wide reform programs. The starting point of any transformation program is collection and distillation of required data and information about the current performance of a given sector and the setting of national emission reduction goals through sector reform. This may require completion of a life cycle analysis of goods produced and consumed in the sector. Improvement of data management and information acquisition capacity must deliver information systems capable of monitoring, reporting and verifying to the standards set by the COPs.

**Table 2. Preparation Phase**

| <b>Outputs</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>Eligible Activities</b>                                                                                                                               | <b>Funding Modalities</b>                                                                                           | <b>Graduation Requirements</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>Transformation Assessment</b><br/>This assessment will identify barriers and constraints to sector reform, including life cycle analysis, and institutional mapping.</p> <p><b>Transformation Plan</b><br/>The transformation plan (part of a NAMA or LCAP) will include a timetable with goals and cost estimates for each step. It will provide a plan for mobilizing financial resources, building institutional capacity and implementing policy/incentive reforms. GHG reduction targets will be identified and made monitorable, reportable and verifiable (MRV).</p> | <p><b>Analysis</b></p> <p><b>Planning Activities</b></p> <p><b>Preparation of Transformation Plans</b></p> <p><b>Institutional Capacity Building</b></p> | <p><b>Funding for 100% of preparation activities will be provided by grants from the UNFCCC Mitigation Fund</b></p> | <p><b>Sector Transformation Plan, NAMA or LCAP</b></p> <p>The COP or a COP mandated body would establish the standards and methods for ensuring compliance with the certification requirements for the Preparation Phase, including certification of STPs, NAMAs, and LCAPs, to signal readiness to move to the Initiation Phase.</p> <p>With certification, plans must be registered in a UNFCCC managed Climate Registry, allowing further access to funding from the UNFCCC Mitigation Fund and triggering potential financial support from other funding sources.</p> |

### Box 1: Experience with the Preparation Phase of Mitigation Initiatives in Developing Countries <sup>1</sup>

UNFCCC Parties recognized relatively early that in order to undertake large-scale mitigation or adaptation programs, extensive and expensive preparatory work would be needed. Those activities would include planning, strengthening institutions, establishing baselines, building monitoring facilities, and creating an adequate regulatory environment, among other activities. Moreover, Parties recognized that many developing countries would require international support to move through these preparatory tasks.

In the recent past, the World Bank's "Readiness Mechanism" of the Forest Carbon Partnership Facility (FCPF) has taken the lead in providing international support to developing countries for climate-related preparatory activities. The Readiness Mechanism's purpose is to build the capacity of developing countries to access a future system of incentives that would reward emission reductions achieved by curbing deforestation (REDD).

The FCPF's Readiness Mechanism makes up to \$3.6M available per country to establish REDD+ reference scenarios, build accounts of historical emissions, and analyze future developments that could influence deforestation trends and develop an emission reduction strategy. The process also allows countries to develop informed REDD+ negotiation positions based on an assessment of country REDD+ opportunities and constraints.

Developing countries have responded positively to the FCPF's Readiness Mechanism funding incentive. By late 2008, over 40 countries had applied and 25 had qualified for initial financial support. With that positive response, the World Bank decided to expand the Readiness Mechanism's original \$100 million budget by 50%. Moreover, shortly thereafter the UN REDD initiative, funded principally by the Government of Norway, put in place an equivalent to the Readiness Mechanism, called "Quick Start".

The UNFCCC Mitigation Fund's Preparation Phase draws on lessons learned from the REDD+ readiness process. It does not stop, however, at funding capacity and institutional strengthening for developing countries, but aims at ending with a full Sector Transformation Plan that would allow a country to match investment needs with domestic and international financing sources. Thus, when the country decides to commit to the reduction program, it can move to the next phases of initiation and implementation.

One of the most important features of the UNFCCC Mitigation Fund's Preparation Phase is that developing countries would not be required to commit to any investment or emission reduction until the very last stage of the preparatory process. At that time, the developing country government could make emission reduction commitments with full knowledge of what activities would be required, how much activities would cost, and the available financing options. Until that final stage of the Preparation Phase, developing country engagement would come without any strings attached. It would only require the willingness to participate in a Preparation Phase.

<sup>1</sup> This box is based on a GFM supporting report, C. Streck, 2008 "Sectoral Mitigation Plans as Strategic Planning Tools."

Accompanying the preparation of a sequenced series of reform activities, the plan must identify the financial, technological, and technical inputs required through successive years. Each stage of the Sector Transformation Plans, NAMAs, or LCAPs will identify the specific financial needs, the design of specific investment programs, and the anticipated sources of finance. Also, recent experience in sector reform has illustrated that overcoming institutional constraints invariably goes hand-in-hand with the need to implement new policies and, more often than not, new institutional arrangements.

Given that one of the key factors slowing implementation of sector reforms in some countries is the weakness of existing institutions, the Preparation Phase calls for an assessment of institutional capacity and institutional development needs. At the heart of the institutional development process is the identification of an overarching national agency, be it housed in a ministry or an interagency coordinating body, which will coordinate the increasingly complex activities required to change the technological, financial, and institutional foundations of

the specific sector. Likewise, Sector Transformation Plans, NAMAs, and LCAPs would have to detail the capacity building and human capital development needs to match the institutional and economic adjustment programs.

While financial requirements for preparing Sector Transformation Plans, NAMAs, and LCAPs will vary from country to country, the UNFCCC Mitigation Fund could be ready to provide 100% of those funding needs on a grant basis.

Finally, we should underscore the point that there is no predetermined duration for the Preparation Phase. For countries that have engaged in considerable preparatory work and are ready to submit their Sector Transformation Plans, NAMAs, or LCAPs, the Preparation Phase could be completed in a matter of months. For countries just embarking on the development of transformation plans, this phase could last several years.

### 2.3. The Initiation Phase

Recent experiences in middle-income countries illustrate the complexity of changing the technological foundations of a whole economy or a leading economic sector. These complexities underscore the need for an intermediary phase before embarking on the full-scale transformation of an important economic sector.

Reflecting these challenges, the main purpose of what we have called the Initiation Phase of the UNFCCC Mitigation Fund is to ensure that the institutions, human capacity, data systems, policy environment, and innovative technology applications are in place for an accelerated, scaled up sector reform process that will follow. An important part of this second phase is demonstrating the commercial and technological feasibility of innovative projects such that they are ready for broader application in a given sector. Implementing demonstration projects to test the deployment of innovative technologies is one of the central activities to be carried out during the Initiation Phase. Technologies proven in other countries need to be adapted to new economic and cultural contexts before a commercial strategy can be promoted and scaled up. To that end, a staged roll-out of those technologies, infrastructure, or production systems is a principal output of this second phase.

Equally important is ensuring that an enabling, supportive policy environment is in place to reinforce and consolidate the changes being proposed. Not only must new financial and social incentives supporting a low-carbon economy be established through economic and social policy, but old policies and incentives associated with the previous economic regime must often be dismantled in the face of opposition from groups and associations that have benefited from the older system.

Financing sources can begin to diversify during the Initiation Phase. Many core activities, such as institutional strengthening, certification of data systems, and human capital development, may require public funding, and many sources of public finance, both international and national, could be tapped to work to offer grant or concessional financing alongside the UNFCCC Mitigation fund grants. Other activities, including demonstration projects and testing of new technologies could attract a full range of commercial and private funding. For example, private investors can hold equity shares in production or transport systems being tested in a developing country. Loans from public institutions such as regional development banks and the International Finance Corporation can provide start-up capital for public or private demonstration projects. Guarantees and insurance can be extended through public-private partnerships.

**Table 3. Initiation Phase**

| <b>Outputs</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>Eligible Activities</b>                                                                                                                                                                                                                   | <b>Funding Modalities</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>Graduation Requirements</b>                                                                                                                                                                                                       |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>Capacity Development</b></p> <p><b>System Testing</b></p> <p><b>Demonstration Projects</b><br/>These projects could include (a) testing and deployment of innovative technologies that deliver GHG emission reductions; or (b) contribute to the deployment and testing of MRV; or (c) further develop policy, institutions, and know-how.</p> <p><b>Creating an Enabling Environment</b><br/>Priority would be given to policy and institutional reforms.</p> | <p><b>Institutional Development</b></p> <p><b>Human Capital Development</b></p> <p><b>Certification Processes</b></p> <p><b>Acquisition of IP</b></p> <p><b>Demonstration Projects</b></p> <p><b>Building of Enabling Infrastructure</b></p> | <p><b>Funding will include a package combining Mitigation Fund grants and other financing options</b></p> <p><b>Mitigation Fund Grants</b><br/>The Mitigation Fund grant could, on average, not exceed 25% of the total costs of the Initiation Phase.</p> <p><b>Other International and National Public Funds</b><br/>These could provide additional grants or other types of soft funding.</p> <p><b>Loans from public institutions</b><br/>These will include loans from RDBs, the IFC, MIGA, bilateral agencies, banks and others.</p> <p><b>Public-Private Partnerships</b></p> <p><b>Private Sector Finance</b><br/>These instruments can include equity shares, insurance guarantees, and carbon banking, among others.</p> | <p><b>International Certification of Standards Compliance</b><br/>The COP or a COP mandated body would establish the standards and methods for ensuring compliance with the certification requirements for the Initiation Phase.</p> |

We propose that, on average, the UNFCCC Mitigation Fund could provide 25% of the Initiation Phase costs as a grant, with the remainder coming from other public and private sources, both international and national. Our use of the term “average” allows for a larger or smaller participation of the UNFCCC Mitigation Fund in Initiation Phase activities in keeping with the requirements and economic conditions of the country and specific sectors.

Graduation from the Initiation Phase would be dependent on meeting agreed upon standards for performance established by the Climate Oversight Commission. At the heart of those standards are the development, testing, and certification of those data collection and management systems that can provide monitorable, reportable and verifiable reductions in GHG emissions.

#### 2.4. The Implementation Phase

The two initial phases of the UNFCCC Mitigation Fund are designed to facilitate a comprehensive approach to the restructuring of the designated sector to reduce emissions and increase energy efficiency. Upon graduation from the Preparatory and Initiation Phases, the national climate body will have brought together the institutional, political, technical, financial, and human resources required to implement the national Sector Transformation Plan and move aggressively to meet agreed upon mitigation goals for the entire sector.

#### **Box 2: The UNFCCC Mitigation Fund is More Than a Sectoral Approach<sup>3</sup>**

Since 2005 there has been a growing policy discussion inside and outside the UNFCCC COP regarding the use of sectoral approaches to climate change mitigation. In essence, a sectoral approach is a strategy to achieve emission reductions across an economic sector, as opposed to a countrywide or a project-by-project mitigation strategy such as the Clean Development Mechanism. Beyond this basic commonality, sectoral proposals differ widely in defining their goals, scope, and operational criteria. Support or opposition to those proposals has varied considerably. A brief typology of sectoral approaches is presented below:

- Sectoral approaches in developed countries as part of those countries' strategies to comply with their emission reduction commitments. There are many examples in virtually all developed countries. Since these strategies are integral parts of national policies they have not generated international controversy.
- International, business-driven, voluntary sectoral approaches to GHG emission reductions that include businesses in both developed and developing countries. One example would be the Cement Sustainable Initiative of the World Business Council on Sustainable Development. No controversies have arisen from these programs.
- Proposals to mitigate bunker fuel emissions. As these emissions are associated with international shipping and air transport, they were excluded from Kyoto Protocol negotiations because of their international character. There is now an international consensus that bunker emissions should be addressed as part of a global climate agreement, although there is no consensus regarding the best way to do so.
- Proposals for internationally binding sectoral approaches aimed at attaining emission reductions in heavily traded economic sectors such as steel, chemicals, and aluminum. These binding sectoral approaches would encompass both developed and developing countries as suggested by Japan's sectoral proposal. That proposal has been met with strong opposition from developing countries because it seeks binding targets on developing countries and because of fears that it would introduce a "level playing field" in international competitiveness into UNFCCC discussions. The UNFCCC Mitigation Fund does not endorse this approach.
- Proposals for voluntary national sectoral approaches in developing countries, also called "sector non-lose targets". This approach supports voluntary mitigation plans to be decided and driven by the developing country. The plans could elicit financial support from developed countries, but would entail no penalties if the country failed to achieve those targets. Since Bali 2007, this approach has gained support among many COP parties, one example being the REDD+ proposals that were tabled during 2008.

The UNFCCC Mitigation Fund's goal is to facilitate the scaling up of developing countries' voluntary mitigation initiatives. From a UNFCCC Mitigation Fund perspective, country mitigation initiatives can take many forms, including sectoral approaches, cross-sectoral policies, demand management strategies, sustainable policies and measures. They can be a standalone sectoral proposal or can be part of a NAMA or LCAP. All of them would qualify for financial support from the new UNFCCC Mitigation fund, provided that they meet agreed upon technical standards.

<sup>1</sup> This box is based on a GFM supporting report, S. Magnoni, 2008 "Sectoral approaches to GHG mitigation and the post 2012 climate framework"

In contrast to the preceding phases that are built around meeting specific graduation (or certification) requirements, the Implementation Phase would introduce a diverse set of activities, instruments and partnerships to accomplish the full set of emission reduction commitments for the designated economic sector. The most significant change resides in the expanding scale of operations undertaken. Whereas a limited number of demonstration projects were carried out in the Initiation Phase, multiple investments will be launched in the Implementation Phase, to modernize plants, build and upgrade infrastructure, and to refurbish industrial and residential building stocks.

The magnitude of the activities that can be undertaken and the scale of financing required in this phase are illustrated by the restructuring of the Chinese cement industry. Of the 13,000 cement plants in China, about one-third now use modern equipment. Although the Chinese government launched a sector modernization program in 1990, thousands of factories still need to undergo technological conversion, hundreds of the converted plants need additional modernization, and many outdated plants need to be shut down. In addition, training thousands of professional staff and managers must be carried out.

Changes of this magnitude require partnerships and financial resources of unprecedented scale. As the past two decades of reforming the Chinese cement sector have demonstrated, market dynamics can serve as the driving force of change. On a very basic level, the needs of individual plants to increase efficiency and improve product quality drive the impetus to modernize. National public and private capital, imported technology, and technical/management assistance can support the modernization process and have been enormously successful in helping to modernize one-third of China's cement plants and over half of the country's cement production. However, deepening the modernization drive and extending it to the rest of the industry is proving more difficult due to a mix of economic, political and social issues. Modernizing the rest of China's cement sector and further reducing emissions throughout the industry may require upwards of \$45B of additional investment and financial support over a 10- to 20-year period.

In keeping with the incremental criteria of the UNFCCC, only a portion of these costs may qualify for funding from the UNFCCC Mitigation Fund. We proposed that in the Implementation Phase, the UNFCCC Mitigation Fund grant contribution would be on average 15% of the total. Furthermore we expect that in the Implementation Phase the percentage of total funding requirements coming from the UNFCCC Mitigation Fund would be lower than in the Implementation Phase – say 15% of the total costs, on average-- while the share of other international and national public funds and the contributions from market-based and private financial instruments would continue to rise. It is precisely in this context that many innovative investments and financing mechanisms can be brought into play including: other international public funds; national public funds; international and national development banks; UNFCCC regulated carbon markets; international and national equity investors; and international and national not-for-profit programs.

Clearly, not all countries will embark on sector transformation programs as extensive as the one currently underway in China's cement sector. Nonetheless, regardless of size, the challenges posed to any middle- or low-income country will be comparable and will require sophisticated coordination mechanisms and equally sophisticated financing and technical support arrangements. Coming, as it will probably come, from a variety of sources, those financial arrangements would need a strong coordinating mechanism, an issue that the Technical Working Group has addressed with its Climate Registry proposal (see next chapter for a brief on the UNFCCC Climate Registry and Annex 3 for a list of the relevant publications).

Moving whole economic sectors towards low GHG emission trajectories would deliver major benefits to the country's populace and to the planet as a whole. Still, as any large transformation process it may entail short term social and environmental impacts that must be fully acknowledged and addressed as early as possible with

the best social and environmental safeguards and standards available. One of the key responsibilities of the country’s ministry or agency overseeing implementation activities would be to anticipate the dislocations caused by the reforms and to undertake all the counterbalancing measures required to eliminate or minimize social and environmental costs; and do so in a participative and transparent way.

**Table 4: Implementation Phase**

| <b>Outputs</b>                                                                                                                                                                                                                                                                                                                                      | <b>Eligible Activities</b>                                                                                                                                                                                                                                                                                                                                                  | <b>Funding Modalities</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>Graduation Requirements</b>                                           |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|
| <b>Sector Modernization/ Technology Change</b><br><br><b>MRV-able Sector Emissions Reduction</b><br><br><b>Increased Sector Energy Efficiency</b><br><br><b>Enhanced Enforcement</b><br><br><b>Mitigation of Negative Sector Impacts (Macro/Equity)</b><br><br><b>Conducive Policy Environment</b><br><br><b>Dissemination of Lessons to Public</b> | <b>Activities could include, among others:</b><br><br><b>Manufacturing Changes</b><br><br><b>Renewable Energy</b><br><br><b>Infrastructure Changes</b><br><br><b>Transport Sector Changes</b><br><br><b>Buildings’ Changes</b><br><br><b>REDD+</b><br><br><b>IP Acquisition</b><br><br><b>Applied R&amp;D</b><br><br><b>End-User Efficiency</b><br><br><b>Policy Reform</b> | <b>Funding will include a package combining:</b><br><br><b>Mitigation Fund Grants:</b> Mitigation Fund grants would cover on average 15% of total costs during this phase.<br><br><b>Other International and National Public Funds:</b> These could provide additional grants or other types of soft funding.<br><br><b>Loans from public institutions:</b> These could include loans from RDBs, the IFC, MIGA, bilateral agencies and others.<br><br><b>Regulated and Voluntary Carbon Markets</b><br><br><b>Public-Private Partnerships</b><br><br><b>Private Sector Instruments:</b> These instruments could include equity shares, insurance guarantees, carbon banking, and others. | <b>Progress Reports to the Operating Body and National Climate Body.</b> |

**2.5. Support for Sector-Wide Changes in Agriculture and Forestry**

According to the IPCC fourth assessment report (AR4)(2007) agriculture and forests ecosystems are both potential sinks for GHG but due to unsustainable management, they contribute approximately 13% (agriculture) and 18% (forestry) of the world’s annual GHG emissions in recent years. While the forest sector mainly releases carbon through deforestation and forest degradation including forest fires, agriculture releases a variety of GHG

such as carbon dioxide, methane and nitrous oxide. Furthermore, some of the emissions occur as a direct result of interaction between the two sectors, notably through deforestation and conversion of forests to agricultural lands.

Agriculture and forestry (and mixed landscapes) are two important wedges in the GHG reduction scenario but only recently have received attention commensurate with their emissions. Issues relating to Reduced Emissions from Deforestation and Forest Degradation (REDD+) are the most prominent in the current public debate and are a key element of the UNFCCC negotiations over the Protocol that will replace the current Kyoto Protocol when it expires at the end of 2012. One reason for the recognized importance of the REDD+ issue in the UNFCCC negotiations is that agriculture and forestry are not addressed adequately under the current Kyoto Protocol. Continuing to exclude the emission reduction potential from Agriculture, Forestry and Other Land Uses (AFOLU) in a post-2012 framework will increase the risk that the overall emissions reduction objective of the UNFCCC will not be achieved. Moreover, developing countries, and specifically those with economies rooted mainly in agriculture and/or forestry, have stated that their support for a post-2012 agreement will be conditional on the inclusion of mitigation options from agriculture, forestry and other land uses under terms that are comparable with those applicable to developed countries accounting practices for these sectors.

The proposed UNFCCC Mitigation Fund, designed to provide a vehicle to shift economic sectors from a high-GHG emissions path to a significantly reduced/low GHG emissions path, could also serve as a vehicle or a model to address emissions reductions from agriculture and forestry sectors. Below we outline how the three-phased approach of a UNFCCC Mitigation Fund could work for these sectors.

*Preparation Phase.* The first requisite of developing a sector-wide approach is to conduct a full assessment to understand the drivers of high GHG emissions rates and to assess the potential for carbon sequestration and retention in agricultural and forested lands. This assessment would allow countries to identify the emissions reduction potential of these functionally linked sectors and to review existing data, means, and barriers to realizing the necessary scale of emission reductions to avoid catastrophic climate change. This analysis would examine national circumstances and drivers such as overarching land use policies, the status of enforcement of existing laws and regulations related to land use, the contribution of current land tenure systems and resource ownership rights, current incentive systems, and the technology pool available for strengthening technical and institutional capacities for sustainable natural resources management. This assessment would also identify the scope and scale of international drivers, beginning with the current lack of prices for global ecological services that are provided by developing country forests. Moreover, this assessment should identify trade-related issues such as the impact of protectionist barriers that affect the ability of developing countries to engage in a fair and equitable manner in the global market for forest and agricultural products. Based on the assessment, sector transformation plans for agriculture, forestry and land use (AFOLU) will be developed that will align policies and measures to stimulate environmentally and socially responsible investments and establish clear deadlines, disbursement milestones and parameters for monitoring, reporting and verifying climate impacts. In keeping with the overall design of the UNFCCC Mitigation Fund, it should finance all preparation activities undertaken by developing countries.

*Initiation Phase.* The objective of the second operational phase of the UNFCCC Mitigation Fund as regards AFOLU would be to ensure that the enabling environment is in place for an accelerated, scaled up reform process related to the sectors. The barrier removal process related to policy and regulatory frameworks, incentive systems, institutional and human capacity, and access to knowledge and technology associated with sustainable agriculture and forestry will dominate this phase and will be further consolidated during the Implementation Phase. Demonstration projects such as testing the impact of methodologies for improved forest management to reduce emissions from deforestation and forest degradation can be supported under this phase

as well. The initiation process corresponds to a stepwise acquisition of implementation capacities that coincides with a sequencing of nationally appropriate mitigation actions to increase the rigor and credibility of measurement and reporting of emissions reductions attributed to these policies and measures. Whereas public resources will finance the preparation activities, a much wider array of financing instruments will be needed to finance eligible activities. During this stage of work, public financing can and should be used to support the creation of an enabling environment while demonstration projects that allow countries to test new financial instruments such as concessional loans, risk guarantees, or carbon trading and reflow arrangements should be encouraged.

*Implementation Phase.* The main objective of the Implementation Phase is to reduce GHG emissions from agriculture and forestry (AFOLU) activities by applying a diverse set of activities, instruments and partnerships at a much broader scale. Care must be taken to ensure that these sector changes do not jeopardize contributions to national economic development objectives from these sectors. The limited number of demonstration projects carried out in the Initiation Phase will need to be scaled up and expanded to areas that have similar ecological and socio-economic conditions. Modernization of legal and regulatory systems will allow for improving management systems of silvo-pastoral and forested lands with greater ownership by communities and reduced risk for private landowners and will encourage upgrading infrastructure and increasing access to a diverse pool of proven technologies and knowledge for REDD. Capacity building must continue and reach actual land-users. Sector policy reform processes must be consolidated and adapted as needed through authentically participatory processes. The Implementation Phase will require drawing on the full range of financial instruments that can be mobilized from both the public and private sectors, ultimately with private financing as the main source of capital driving the development of the sector.

## 2.6. Funding for Mitigation and Technology Cooperation

In the UNFCCC framework, financing is usually discussed under three and at times under four headings: adaptation, mitigation, technology cooperation, and capacity building. Usually the technology cooperation track also encompasses issues of research and development, demonstration, acquisition, transfer, and deployment.

While there are clear differences between adaptation, mitigation and technology cooperation, there are also many overlapping and gray areas. Take the case of technologies for mitigation. On one end of the spectrum there are distinctive technological, research and development issues. Then, along the spectrum are issues of technology demonstration, acquisition, transfer, and deployment. Part of these activities may be situated more clearly in the realm of financing for mitigation. By way of specific example, our case study on wind and concentrated solar power in Tunisia discusses how international financing could help small developing countries become dynamic participants in these technological demonstration and deployment activities.

Regarding the broader issue of financing for technology cooperation, both for adaptation and mitigation, many options have been tabled thus far. For example, at Poznan 2008 WWF and partners tabled a proposal to create, in the framework of the UNFCCC, a set of *Technology Action Programs (TAPs)*. The proposal was built on the experience of the global technology cooperative effort launched by the Montreal Protocol some 20 years ago, which was highly successful in helping to phase out ozone-depleting substances worldwide. More recently the Copenhagen agreement called for the establishment of “a Technology Mechanism to accelerate technology development and transfer in support of action on adaptation and mitigation that will be guided by a country-driven approach and be based on national circumstances and priorities.”

In any case, financing for technology cooperation could adopt many of the design and operation features here proposed for a new UNFCCC mitigation fund. Options include either creating a standalone technology fund or

adding technology funding to the mitigation fund to create a mitigation + technology fund. A major difference would be that, while funding for mitigation and adaptation would be in most cases a country by country process, driven by countries' need assessments; funding for technology may take a multinational, regional or sectoral approach too; driven not only by country assessments but also by a global or sector assessment of the potential for technology innovation in particular sectors worldwide (e.g. transport, renewable energy, CCS, etc).

## Chapter 3

### How Large Should a New UNFCCC Mitigation Fund Be?

The discussion on funding needs to address mitigation in developing countries should deal with several complementary issues, including:

1. Estimate the global costs of mitigation. We discuss this in Chapter 1 based on the estimates of the UNFCCC Secretariat, the Stern Report, the EU, Project Catalyst, the World Bank, and NGOs.
2. How much money could be raised through a variety of traditional and innovative financing mechanisms? There have been many proposals, and this question has lately been posed to the High Level Advisory Group on Climate Change Financing.
3. A less pursued but related question is: what would be the appropriate size for a mitigation fund operated by the UNFCCC mechanism?

In the run up to COP15, some UNFCCC Parties and partners seemed to equate question 3 with question 1: that is, they seemed to believe that UNFCCC managed funds should have all the money needed for climate change investment in developing countries. In the previous chapters we have discussed why that seems implausible. So the question remains: what would be the appropriate size for a mitigation fund operated by the UNFCCC mechanism? The “appropriate” clause here refers to a UNFCCC mitigation fund that is capable of:

- Independently financing the initiation of at-scale mitigation changes in a substantial number of countries (say 20 to 40 countries) and a substantial number of sectors (say a portfolio of 300-450 at-scale programs);
- Leading and leveraging other public and private sources of financing; and
- Providing no-cost or low-cost financing to address issues of equity, allocation balance, and needs of less developed or more vulnerable countries.

We have used six country sector case studies (see Section II), as well as experiences from development financing and REDD+ preparedness financing, to come up with a back-of-the-envelope answer to the above question that estimates the size required for a UNFCCC Mitigation Fund that is able to lead the financing of a portfolio of 300 to 450 at-scale mitigation programs over a 20-year span and through the three-phased approach sketched in the previous chapter - preparation, initiation, and implementation, as follows.

- **Preparation Phase:** Based on our series of case studies we have estimated that the Preparation Phase could cost an average of \$2M a year, and could last from one to five years, depending on the scale and complexity, data availability, and technical and human resources, among other factors. We have budgeted for 300 to 450 such preparation phases through 20 years of operation of the Mitigation Fund, with a majority front-loaded in the first 10 years of the fund operation. Even if Phase I costs are paid in full with grants from the UNFCCC Mitigation Fund, the funding requirements will be modest. The bottom line here is that the international community could jump-start an important transformation process with relatively modest resources.
- **Initiation and Implementation Phases** will be more costly. In our case studies of large sectors in large countries (e.g. China, India), costs can be in the order of hundreds of millions, or even billions of dollars per year and per sector. Based on our case studies, we have estimated that average costs of Initiation Phases can go from \$12M to \$120M a year (for 3- to 5-year programs) and the average costs of Implementation Phases can go from \$150M to \$3B a year (for 4- to 6-year programs). However, it must be kept in mind that

during these phases an increasing portion of the funding for mitigation can come from a variety of sources, including (a) other international funds; (b) national funds; (c) carbon markets; and (d) private investors.

For our exercise, we have assumed that (a) all the UNFCCC Mitigation Fund financing will be in the form of non-reimbursable grants; and (b) that the UNFCCC Mitigation Fund financing would be capped at 100% of the Phase I preparation costs; 25% of Phase II initiation costs; and 15% of Phase III implementation costs. These are average figures that would allow the UNFCCC Mitigation Fund to pay for a large percentage - or even one hundred percent - of the incremental costs of mitigation in less developed countries, while contributing a smaller percentage to a basket of funding sources for mitigation investment in middle-income countries.

Using the above figures we estimate that moving a portfolio of 300 to 450 at-scale mitigation plans would require the Mitigation Fund to disburse funds that would average \$6B annually during the first 5 years where most, but not all, sector transformation plans are in the Preparatory Phase, and up to \$30B annually in later years when those plans will be under full implementation (see Box 3).

### Box 3: How Large Should a New UNFCCC Mitigation Fund Be?

The below back-of-the envelope answer is based on several steps:

- (a) Estimating costs from real case studies and ongoing mitigation activities;
- (b) Estimating costs for three phases of mitigation initiatives: a Preparatory Phase, an Initiation Phase, and an Implementation Phase;
- (c) Acknowledging that the UNFCCC cannot and should not be the sole source of mitigation funding, and hence proposing a sliding funding percentage as follows: up to 100% of preparation costs; 25% of initiation costs on average; and 15% of implementation costs on average. These are averages and can be compatible with funding a larger portion of less developed countries' costs and a smaller portion of middle income countries' costs;
- (d) Estimating funding requirements to support some 100 to 150 sector transformation plans over a 20-year period; and
- (e) Including fees for fund operation and management (based on international standards).

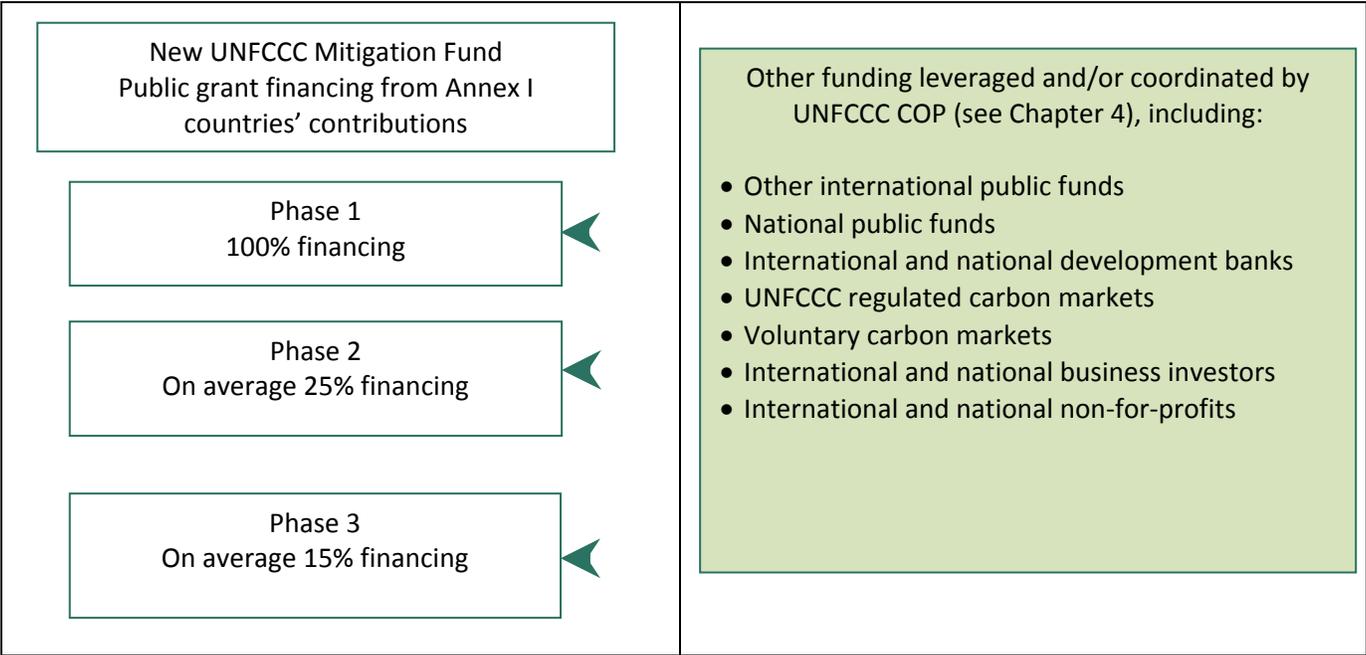
Based on the above assumptions, to establish a new at-scale UNFCCC mitigation fund would require a start-up commitment from industrialized countries on the order of \$6B a year for the first 5 years of operation, growing to \$20B a year in the following 5-year period. The details are shown in the table below.

| Years       | New UNFCCC At-Scale Mitigation Fund (per year 2005 US billion dollars) | To Leverage from Other Sources (per year 2005 US billion dollars) | Total Mitigation Funding, All Sources (per year 2005 US billion dollars) |
|-------------|------------------------------------------------------------------------|-------------------------------------------------------------------|--------------------------------------------------------------------------|
| 2010 – 2014 | 6                                                                      | 6                                                                 | 12                                                                       |
| 2015 – 2019 | 20                                                                     | 60                                                                | 80                                                                       |
| 2020 – 2024 | 25                                                                     | 120                                                               | 145                                                                      |
| 2025 – 2029 | 30                                                                     | 170                                                               | 200                                                                      |

Several important clarifications should be made regarding the above figures:

- The UNFCCC Mitigation Fund depicted above is intended to be neither the only mitigation fund, nor the mother of all mitigation funds. It is intended to be the mitigation fund under the aegis of the UNFCCC, providing grant resources large enough to have a substantial impact on its own and to leverage other sources of financing for mitigation from inside and outside the UNFCCC framework, as depicted in Figure 6 below.
- By the same token, this UNFCCC Mitigation Fund should not be viewed as the only source of money that industrialized countries should contribute to support mitigation activities in developing countries. Industrialized countries should contribute significantly more. But they may do so through other bilateral or multilateral financing windows.
- Moreover, estimates for funding requirements of the UNFCCC Mitigation Fund may vary either with the tightening of the world mitigation goals, the costs associated with sector changes or the percentage of the costs that the UNFCCC Mitigation Fund is expected to fund in each phase of operation.
- Lastly, it should be emphasized that these are figures for mitigation investment. Additional funding would be required for adaptation and technology cooperation, and it is generally accepted that adaptation in developing countries will require a larger component of public finance.

**Figure 2. The New Mitigation Fund Would Leverage Other Funding Sources**



## Chapter 4

### Leveraging Additional Financing: The Climate Registry

#### 4.1. How Would The UNFCCC Leverage Other Public Funds?

Consider the experience with official development assistance (ODA): after more than 60 years and a host of international agreements, multilateral agencies and funds manage less than 30% of annual ODA. The remainder, that is, more than 70% of international public funding, is actually handled by donor countries' bilateral programs.<sup>4</sup> The reason is obvious; donor countries don't like to relinquish control over their funds. Public international financing for climate change will probably follow a similar pattern, with some portion of it channeled through existing multilateral or regional agencies; some portion channeled through existing or to be created UNFCCC funds; and the lion's share handled by donor countries' bilateral agencies. This scenario begs several questions:

- Should the UNFCCC strive to manage an important slice of international climate change financing?
- Should the UNFCCC try to play a leveraging, leading or coordinator role regarding international financing for climate change?
- And if yes, how could it attain that role?

In the previous chapters we have addressed the two first questions and agreed with many UNFCCC Parties that there are good reasons to support a strong role for the UNFCCC regarding international financing for climate change. Climate change is a truly worldwide challenge, and the UNFCCC is the only international forum that has the mandate to address it at a global scale and in an inclusive and transparent manner. Besides, a strong level of coordination is warranted for strictly economic reasons too; without it, there would be no way to steer international mitigation investment towards its most efficient use (e.g. direct it to the least cost mitigation opportunities).

Regarding the third question, the following is a short list of what we believe are the minimum mandates and resources that the Parties should channel to the UNFCCC in order to give it the capacity to play a leading, leveraging and coordinating role in international public and private funding for climate change:

1. Create UNFCCC managed funds large enough to make a difference on their own;
2. Give the UNFCCC the right to track parties' major funding and investment activities and certify compliance with their international commitments;
3. Endow the UNFCCC with a body that actively matches funders and recipients of funds.

The rationale for these resources and mandates is straightforward. If you have money you attract money. If you manage one important seal of approval, more parties will hear your advice to avoid missing your certification. Plus, the mandate to act as a clearinghouse gives you a venue and the timing to influence the parties and broker agreements among them.

In Chapter 3 we have discussed how large a new UNFCCC mitigation fund should be. The remaining issues in the above list, and particularly the last one, have been discussed in detail by the Technical Working Group project

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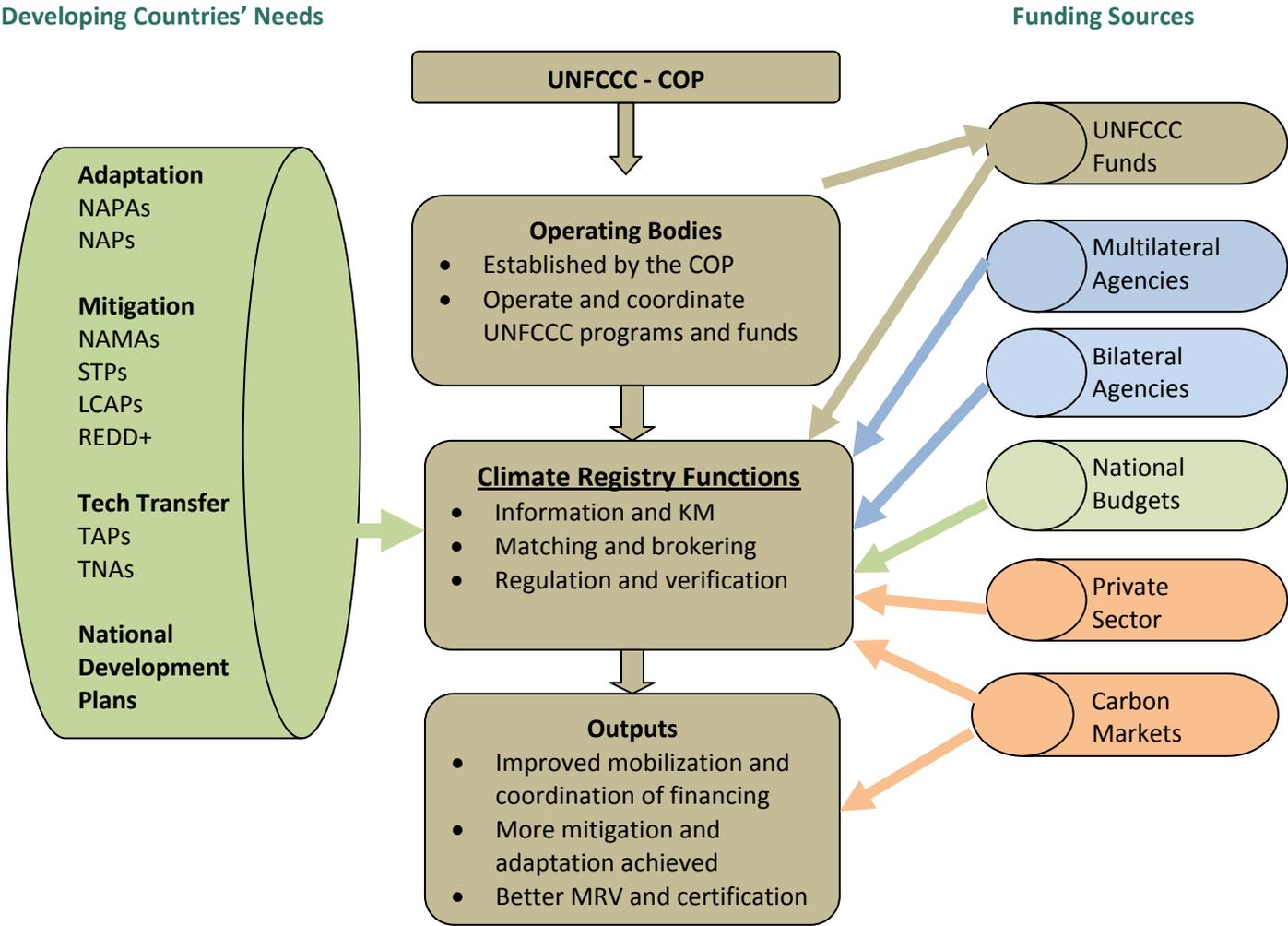
<sup>4</sup> See ODA statistics at <http://www.oecd.org/dac>

(TWG), and the next section gives a summary of the TWG “UNFCCC Climate Registry Option” of which more details can be found in the documents listed in Annex 3.

**4.2. The UNFCCC Climate Registry Option**

Many proposals discussed at the UNFCCC COP include a call to set up a registry that would track commitments and climate change activities of one sort or another<sup>5</sup>. Compared with them, the TWG project has proposed a larger role for what it has labeled a “UNFCCC Climate Registry Option (CR)”. In the TWG approach (see publications in Annex 3) the CR would grow from a post-facto tracking system to become an active clearinghouse aligning developing country needs with expertise and financial resources provided by various sources including public and private funding, and would also have a role regarding regulation verification and certification of outcomes. The operation of such a full-fledged UNFCCC Climate Registry Option is depicted in Figure 3 and would include the following functions:

**Figure 3. The UNFCCC Climate Registry Option**



<sup>5</sup> See for example the Climate Registry proposals in the May 2010 version of the UNFCCC AWG-LCA draft negotiation text, particularly in Chapter I, article 13 and in Chapter V (FCCC/AWGLCA/2010/6)

- The information and knowledge management function would provide a central posting medium through which all statements of national need and financing opportunities are rendered public.
- The matching function would reflect the proactive character of the Registry as it seeks to facilitate matching needs with financial opportunities.
- The regulatory, verification and certification function would provide all participants, whether recipient or contributing, with consistent and comparable standards and methodologies to apply in their climate investment (e.g. standards and methodologies developed by the SBSTA, or other technical bodies after they have been approved or accepted by the COP). Consistent and comparable standards would simplify the MRV of achievements, thus helping UNFCCC Parties track performances against commitments. It would also allow the UNFCCC COP to certify emission reductions, a function that may become a key “seal of approval” to enable global offset markets.

### 4.3. The Climate Registry and Private Financing

As expressed in Figure 3 the Climate Registry could play a coordination role not only for public financing but for private financing too. However, there are clear differences between coordinating public and private financing.

Regarding public funds, UNFCCC Parties number less than 200 and both for economic and political reasons governments may want to commit to a Climate Registry and hence instruct their funding agencies to engage with it. Furthermore, as of mid 2010, many developed countries have made substantial financial pledges, either as part of the UNFCCC process or on their own (e.g. see the pledges collected thus far by the Copenhagen Accord). Discussions linger regarding many issues: Do current pledges add up to the task? Where will the money come from? Would it be additional? Still, if the public moneys are not there yet, at least it is clear that they are forthcoming; that they will come through different windows; and that a coordination mechanism is in need.

Private financing lags way behind. To begin with, private financing may potentially come from tens of thousands of investors acting independently of each other. Only a few would specialize in climate change financing or would be large enough to warrant a permanent relation with the Climate Registry. The rest would enter and exit climate change financing according to their business plans.

On the one hand, for many private investors the Climate Registry could be no more than a source of information, without any business commitment to coordinate its activities through it. On the other hand, if the Registry establishes itself as a major hub for information and deals brokering, private financing groups interested in investing in climate change in developing countries may naturally approach the Registry, even in the absence of formal agreements and long term relations.

That is, if there is such a thing as “private financing for climate change in developing countries”. While many government and UNFCCC statements insist that the bulk of the money will have to come from the private sector, there is little clarity regarding where this private money would come from, to what type of climate change investments it would flow, and what would be needed to trigger the process. We turn to these issues in the next chapter.

## Chapter 5

### The Private Sector Role

The frequently made statement that “the largest part of financing for climate change in developing countries should come from private sources” raises many questions, some of which we intend to discuss in this chapter, including:

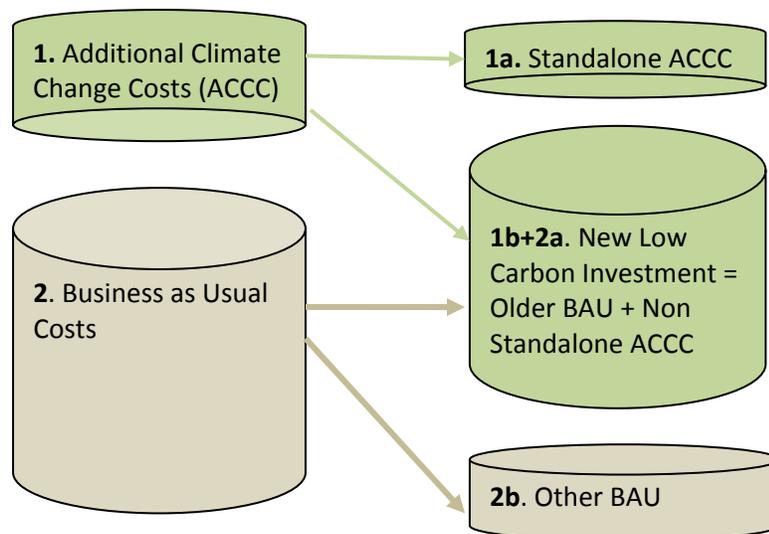
- What part of the investment?
- The private sector acting on what role? (As buyer, seller, or lender?)
- What mechanisms may trigger private sector participation?
- What are the potential and limitations of some of the most referred to mechanisms?

#### 5.1. Additional Costs and Total Costs of a Low Carbon Economy

Recall the estimates quoted in Chapter 1 regarding the 100 billion to 300 Billion a year circa 2020 needed to address climate change in developing countries. These are additional costs, climate change related costs, above and beyond the business as usual scenario (BAU). Large as these numbers are, they still would be a small percentage of developing countries’ total BAU investments that were above 5 trillion dollars a year by 2008.<sup>6</sup>

While the climate change financing discussion has correctly focused on additional costs, moving to a low carbon economy will actually entail moving most of the BAU investments as well. Figure 4 below illustrates why.

**Figure 4. Additional Costs and Total Costs of a Low Carbon Economy**



Take the case of mitigation costs. Some of them will be strictly standalone, for example, a reforestation project, or an end-of-the-pipe mitigation technology (case 1a in Figure 4). Likewise, some BAU costs may go on without changes (case 2b in Figure 4). But most of the costs of moving to a low carbon economy will be joint costs

<sup>6</sup> Gross capital formation in Low and Middle Income countries from the World Bank “World Development Report 2010 Development and Climate Change” Table 4 p.385

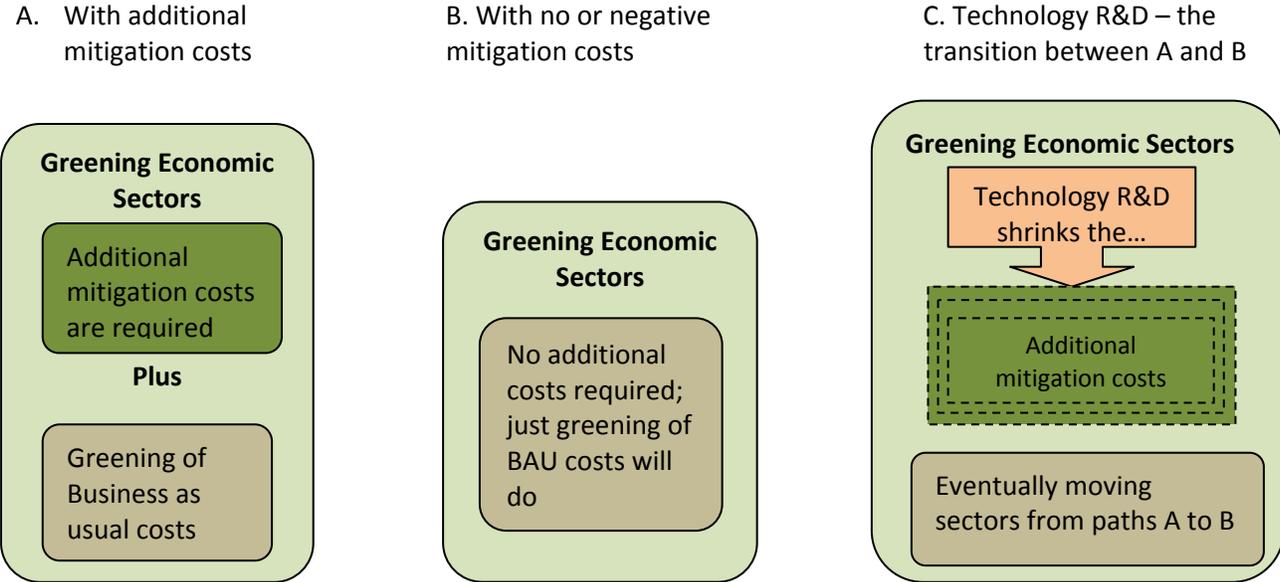
meaning that both the BAU costs and the additional costs need to merge and move to a low carbon alternative (case 1b+2a in Figure 4). The power sector is a good example. Replacing a coal-based power plant with a wind farm may cost say, 100% more<sup>7</sup>. But for the utility company, moving to a low carbon path is not about moving that 100%, but is about moving 200% because it needs to invest in the new wind farm what it was going to invest in the coal plant, plus the additional costs.

Looking at it this way underlines that statements to the effect that private financing will pay for most of the costs of moving developing countries to a low carbon economy have to clarify if they are referring to either (a) the total costs, which will happen by default since the BAU costs are the largest part of it; or (b) the additional climate change costs. Moreover, this point highlights that greening the economy is not only about financing additional costs. It is also, and at least equally important, about fostering the move of the much larger BAU investments from current high emission patterns, towards new low carbon production and consumption patterns.

**5.2. Three Models for Private Sector Investment in a Low Carbon Economy**

Figure 5 depicts three different paths towards a low carbon economy, each one associated with different requirements and opportunities for private financing.

**Figure 5. Three Paths to a Low Carbon Economy**



**5.2.1. Creating the Demand to Pay for the Additional Mitigation Costs**

Many economic sectors fall into model A: they would need extra investments to pay for the additional costs of greening the industry. See for instance in Section II the cases of the power sector in India and Tunisia, or the cement and the iron and steel sectors in China and Mexico. This raises a financial question: who would lend the money to these companies to pay for the extra costs? But, more importantly, it raises the final demand

<sup>7</sup> Approximately 3 to 4 cents per kWh for coal-based power and 7 cents per kWh for wind-based power.

question: who would pay the increased price of electricity that would be needed for the power company to recuperate the investment and pay back the loans?

A lot of the ongoing discussion about private financing for climate change does not go beyond the first question and boils it all down to how to mobilize private capital markets. Of course lenders, financial investors and brokers play an important role. Without mortgage financing, the real estate market would be very small. But without people and businesses that actually want to buy houses, there would be no mortgage financing whatsoever. The same goes for mitigation costs, if there is no final demand for it, there will be no business prospects, no chances that lenders or private investors can make a profit from it, and private capital will not flow to it.

Fortunately there are several ways to create or to bolster the international demand for mitigation in developing countries, including:

- International demand for emission reductions from national programs put up by developed countries or bilateral agreements (e.g. Norway's International Climate and Forest Initiative, the Brazil Amazonian Fund, or the Supplemental Emission Reduction provisions in the US Congress climate change bills);
- International demand for emission reductions through multilateral funds capitalized by contributions from national budgets or other innovative sources of revenue (e.g. the FCPF, FIP, GEF, etc.);
- International private demand for carbon offsets triggered by cap and trade legislation in developed countries;
- International, voluntary private demand for "stand-alone" carbon, that is, the carbon offsets bought and sold at the Chicago Climate Exchange and the plethora of offers to offset households' carbon footprint through conservation programs; and
- International, voluntary private demand for "embedded" carbon, for example, through voluntary demand for cleaner and more efficient products and environmentally sustainable food and fiber.

Furthermore, beyond opportunities from the international demand for emission reductions, many developing countries are creating a national demand through their own emission reduction programs. See for example in Section II China's investments in modernizing its cement and iron and steel sectors. Looking ahead, by mid 2010 developing countries have posted their mitigation goals in the Copenhagen Accord; these add up to between 3 and 5 Gt of CO<sub>2</sub>e for 2020. Full implementation of these strategies would create national demands for mitigation in all or most of the above categories, further triggering the interest of national and international private investors.

From the list above one can easily grasp that public policies are critical to create the first three types of demand, and may also play an important role in facilitating the growth of the other two. The point here being that there is a lot of policy work and market development that high income and middle income countries, as well as the UNFCCC/COP process, could do to create the demand for mitigation that would trigger private investment.

### 5.2.2 Low Hanging Fruit: Private Investment in Low Carbon with No Additional Costs

Coming back to Figure 5, and regarding energy efficiency opportunities, many industries and firms actually face a “B path” opportunity. Namely, they could move to a low carbon path at no or negative additional costs. For instance, McKinsey’s well known cost curves suggest that developing countries could achieve as much as 4 Gt of CO<sub>2</sub>e emission reductions in the 2020 horizon at no or negative additional costs. This could be done simply by redirecting part of their mostly private BAU investment towards energy efficiency investment in the building, transport and industry sectors<sup>8</sup>. These are large numbers, 4 GT of CO<sub>2</sub>e emission reductions by 2020 is from one fourth to half of what would be needed from developing countries to put the world in a below 2 C° trajectory<sup>9</sup>. And since the final products of this move to a low carbon economy would be cheaper than the business as usual ones, there is no need to create new demand. The market is already there.

As could be expected, part of this movement to greater energy efficiency at no extra cost, is taking place on its own, but surprisingly many firms and consumers do not take advantage of the opportunity and numerous studies have found that information, knowledge and market failures may need to be overcome in order to accelerate the transition.<sup>10</sup> Fortunately there are enough experiences regarding what would be needed to foster this win-win movement, including new policies, regulations and incentives, capacity building to help firms and investors identify efficiency gain opportunities, and loans for capital investment if initial costs are larger than in the BAU option.

### 5.2.3. The Critical Role of Technology R&D

The third path in Figure 5 underlines the critical role of technology research and development to reduce the cost of low carbon alternatives so that they can eventually overtake the market of traditional high carbon alternatives. We note that the demand for electricity is already there, waiting for wind or solar power to become cheaper than coal or oil based energy generation.

There is a long tradition of private venture capital investing in technology R&D and also a good record of public initiatives to support or cooperate with the private sector R&D. UNFCCC Parties and partners can replicate some of these experiences in order to attract private funds to R&D in mitigation and adaptation technologies (for instance through technology competitions and rewards; warranted purchase of successful technology improvements; R&D grants; and other means.)

## 5.3. Many Possible Roles for the Private Sector

As the previous discussion has shown, there are many roles that the private sector can play in the transition to a low carbon economy, including acting as a:

1. Regulated buyer: the private sector pays for emission reductions to comply with national regulations, for instance, a buyer of offsets in a cap and trade system;
2. Voluntary buyer: the private sector pays for emission reductions because of corporate responsibility and concerned consumers;

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<sup>8</sup> McKinsey (2009) GHG Abatement Cost Curves

<sup>9</sup> Of course, this depends on how much abatement is achieved by developed countries.

<sup>10</sup> The case studies of China’s cement and iron and steel industry (summarized in Chapters 7 and 8 below) exemplifies the learning and policy barriers that may prevent firms from moving to more energy efficient technologies, even when they are more profitable.

3. Supplier: the private sector invests in the production of emission reductions either for itself as a regulated firm that needs to reduce emissions, or to sell to others, be they governments, other businesses, or households;
4. Technology developer: the private sector invests in the research, production and sale of green technology that, if successful, would either open new opportunities (research on CCS) or would reduce the costs or improve results of existing technologies (research on solar power);
5. Market developer: the private sector invests in creating or expanding the market for new products or brands, in many cases associated with the deployment of new technologies;
6. Trader: the private sector buys and sells for a profit in any mitigation related market through wholesale, retail, futures, stock exchanges, or others; and
7. Provider of financing services: the private sector acts either as lender or investor that finances any of the above activities for a profit; or provides other financial products such as insurance, future trading, venture capital.

Many discussions on the role of the private sector quickly narrow to its role as provider of financing services as indicated in point 7 above, but the list is much larger, and each role may be triggered by different incentives.

#### 5.4. The Potential and Limits of Some Mechanisms to Mobilize Private Investment

The above discussion allows us to revisit some of the most commonly proposed mechanisms to mobilize private investment in climate change.

##### 5.4.1. Offset Markets

Offset markets are usually the first thing to be mentioned when talking about private investment in mitigation in developing countries. But, by definition, buying offsets increases neither global mitigation nor global investment in mitigation. It just reduces costs by moving mitigation around. A mitigation activity that should have happened in an Annex 1 country now takes place in a Non-Annex 1 country.

That said, there are good reasons to try to reduce the costs of mitigation, and that is what offset markets would do. Furthermore, there is much to be praised in bringing investment in low carbon technologies to developing countries, and that is what the CDM and other offset schemes do. But there is neither additional investment nor additional mitigation involved, just moving around the same investment for the same level of mitigation. Actually, the global investment in mitigation would decrease, because you would only buy international offsets if it is cheaper than investing in doing the mitigation in your own business or in your own country.

Shifting the site of mitigation in reality is already creating confusion and double counting. On the one hand, developed countries want to count the offsets they buy internationally as part of their mitigation efforts, because they pay for it. On the other hand, developing countries want to count the offsets they sell as part of their mitigation effort because they produced the reductions.

There is more than semantics involved here. On the one hand, private buyers' interest in carbon markets is predicated in their need to offset their own emissions. So, no offsets no private demand. On the other hand, developing countries may be wary of selling today's cheap offsets and being left with more costly mitigation options for the future, just when they are called to pay for their own mitigation commitments<sup>11</sup>.

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<sup>11</sup> This point is made by the recent NRC report on America's Climate choices, see NRC (2010) p.6

There are some solutions to the zero sum character, and the double counting of the offset markets. One solution would be to deeply discount international offsets – e.g. to offset 1 ton of CO<sub>2</sub>e in your own country you would need to buy, for example, 4 tons of CO<sub>2</sub>e in the international offset markets. In that way international offsets would actually add to global mitigation. However, many potential offset buyers and sellers are against discounting, albeit for opposite reasons. Buyers are afraid that it would raise their costs, and sellers are afraid that it would reduce their revenues. Another option could be selling international offsets with a buy-back clause, so that the developing countries may reclaim its mitigation efforts should it become necessary

#### 5.4.2. Risk Reduction

Risk reduction has been identified as an area that needs to be tackled in order to trigger private financing, with most of the discussion focusing on how to reduce the risks that international lenders or international buyers may face, including:

- a) Traditional international lenders' risk, like sovereign risk and exchange risks, and
- b) Offset buyers' risks, regarding, quantity, quality, longevity and MRV of the offsets.

Both issues are important, but we should note that focusing on how to reduce the risks that potential international lenders or international buyers face only goes half the way. The other half is to figure out how to reduce the risks faced by the potential producers of mitigation offsets<sup>12</sup>. A developing country producer of mitigation offsets may be cautious about taking risks and will have many concerns, including concerns about whether or not a market will exist for mitigation offsets and what the prices will be. These are the supply side risks that public policies may be able to reduce in order to foster private investment in mitigation.

There are good ongoing examples to learn from. For example, programs that guarantee profitable feed-in tariffs for producers of renewable power have put Spain, Germany and Denmark at the forefront of the wind power industry, and recently Deutsche Bank has proposed a similar approach to spur renewable power in developing countries with an international fund paying for the price difference.<sup>13</sup>

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<sup>12</sup> Furthermore, traditional international lenders' risk, like sovereign risk and exchange risks, are already managed by well established institutions like MIGA and Export-Import banks.

<sup>13</sup> Deutsche Bank Climate Change Advisors. (2010) "GET FiT (Global Energy Transfer Feed-in Tariffs) Program." <http://www.globalfeedintariffs.com/>

#### Box 4: How to Foster Private Investment?

The discussion on how to mobilize private financing has thus far focused too much on luring the financier and too little on what would make investing in mitigation profitable; too much on reducing risks to the buyer and too little on reducing risks to the producer. This chapter argues that more attention should be paid to the following issues:

- Moving to a Low Carbon Economy is not only about financing the additional costs. It is also about greening the business as usual costs, and the latter is where most of the private money is.
- Attracting private capital to mitigation is essentially about creating a demand for mitigation. If there is no demand there will be no business prospects and no chances of luring private investors.
- Businesses can and should play many roles -- buyer, seller, technology developer, market developer, trader, and financier. If we narrow it all down to the latter we are missing many opportunities.
- Technology R & D is critical to reducing the costs of transitioning to a low carbon economy and is one of the areas where the private sector would play a critical role.
- Beyond lenders and buyers, risks reduction should look more to reducing risk to mitigation producers.

## **Section II**

### **The GFM Sector Case Studies, Reviews and Modeling Exercises**



## Chapter 6 The Supporting Studies

To help develop the Global Financial Mechanism proposals, the project commissioned eleven supporting studies, including seven country case studies, six thematic reviews, and one modeling exercise. Findings of these studies have informed the drafting of the GFM proposals. In this section we provide a synopsis of all these studies and short summaries of each of the country case studies. A list of all the supporting studies and instructions on how to download them from the web can be found in Annex 2.

### 6.1. The Country Case Studies

The goal of the country case studies was to facilitate a more informed discussion on what is needed to shift high carbon sectors of developing countries to low carbon trajectories and how a funding mechanism in the framework of the UNFCCC could help achieve these changes. The list of country case studies appears in Table 5 below and a 2-4 page summary of each one follows in Chapters 2 through 6.

**Table 5. The Country Case Studies**

| Country | Sector / technology                 |
|---------|-------------------------------------|
| China   | • Cement                            |
| China   | • Iron and steel                    |
| India   | • Coal-based power generation       |
| Mexico  | • Cement                            |
| Mexico  | • Iron and steel                    |
| Tunisia | • Concentrated solar thermal energy |
| Tunisia | • Wind power                        |

### 6.2. The Thematic Studies and Modeling Exercise

The goal of the technical reviews was to take stock of recent developments regarding financing for climate change mitigation, both in practice and in the discussions in the run up to COP15. The modeling exercise was commissioned to help understand how different technology and market options affect the growth of GHG emissions in China's steel and cement sectors. The list of these technical studies and a brief description of each one appears in Table 6 below.

**Table 6. The Thematic Studies and Modeling Exercise**

| Thematic Studies                                                                                                                                                                                                                                                                                                                                                                             |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>Review of the CDM and Other Existing and Proposed Financial Mechanisms to Transfer Funds from North to South for Mitigation and Adaptation Actions</b><br/>By S. Magnoni</p> <p>This paper reviews the financial instruments, within and outside the UNFCCC framework, operating as of mid-2009, underlines strengths and weaknesses and suggests potential improvements toward an</p> |

enhanced financing system that could be more inclusive of beneficiary countries' views; more efficient in channeling significant amounts of money and technologies from North to South; and more inclined to programmatic or wholesale approaches rather than a one-at-time approach.

The study reviews the operation of (a) current funds and financial mechanisms in the framework of the UNFCCC, including the CDM, the Adaptation Fund, the Special Climate Change Fund, the Least Developing Countries Fund, and others; (b) it summarizes other environment related international funds, including the Montreal Protocol Fund and the Global Energy Efficiency Fund; and (c) it reviews major funds and financial mechanisms proposals tabled by UNFCCC Parties in the run up to COP15.

### **Financing REDD: A Review of Selected Policy Proposals**

By C. Streck

This report discusses the financial mechanisms proposed for REDD in the run-up to COP15. Many of these proposals call for the development of one or more international funds to help finance different aspects of REDD. These funds are described, their rationale, and issues associated with each of the various roles these funds would play, is discussed. While the majority of the reviewed proposals rely on carbon markets as the main source of funding, initiation phase funds and forest-based compensation schemes are suggested as well. The report concludes that an international REDD fund could help support or fully finance part of forest-related emission reductions. Given the stability and predictable nature of such a fund, it may facilitate developing countries' engagement in REDD. According to the authors, this international REDD fund should be complemented by private sector carbon finance, driven by businesses' demand for carbon offsets.

### **Financing Climate Change: Institutional Aspects of a Post 2012 Framework**

By C. Streck

This paper assesses COP15 options for an institutional financial architecture supporting a new global climate deal. It elaborates on some of the prominent proposals for a scaled up and reformed financial mechanism to help developed countries fulfill their obligations under the Convention and channel substantial resources to support climate change investment in developing countries, as submitted by UNFCCC Parties, experts, and nongovernmental organizations in the months leading up to COP15. After providing a brief overview of context the paper discusses the main functions a financial mechanism needs to perform, and how it needs to do them. The analysis focuses mostly on the institutional arrangements and overall architecture of a post-2012 financial mechanism.

### **Coming to Agreement on Technology in the Countdown to Copenhagen**

By B. Staley

This study explores the complementarities between financing for mitigation and financing for mitigation-related technology cooperation. An important component of the post-2012 climate negotiations will be the provision of financial and technical support to deploy advanced clean technologies in developing countries, an issue that has become a major focus of international discussion, even when most parties agree that a multilateral climate agreement will not be the primary driver of clean technology development. In this regard developing country interest is on securing financial flows to help technology deployment, while developed countries are more interested in policy reform to ensure enabling environments, primarily at the national level but also at the level of existing multilateral institutions for technology.

Emerging areas of consensus point to the strategic role that NAMAs could play as blueprints to promote the deployment of greenhouse-gas-reducing technologies in developing countries, facilitating and supporting the implementation of national and international policies and measures that enhance opportunities for public and private investment in clean technologies.

### **Sectoral Transformation Plans as Strategic Planning Tools**

By C. Streck

To help design the “Preparation Phase” of the GFM mitigation fund, this study reviewed similar experiences with other financial mechanisms, particularly the work of the Readiness Mechanism of the World Bank’s Forest Carbon Partnership Facility.

The REDD readiness process with the World Bank shows that diverse preparatory activities are needed before a country can effectively engage in sectoral GHG reduction activities. The international community effectively acknowledges this in its “readiness” process for Annex B Parties under the Kyoto Protocol considered essential for meaningful participation in climate and, in particular, carbon finance mechanisms. There is a strong argument for kick-starting sectoral emission reduction programs with a coordinated review of the emission reduction potential and challenges to realize such potential. Any mechanism that looks to governments to decide on emission reductions, to adopt relevant policies, to implement and enforce, and finally to account for emission reductions requires governments to be able to make educated decisions on priorities, alongside being able to implement them. A preparatory or initiation phase is thus needed that combines a factual part that informs governments, local stakeholders, and the international community with a strategic part that allows governments to prioritize sustainable development policies that lead to a reduction in emissions. This phase also defines an essential step in matching international funds with local emission reduction priorities.

### **Modeling Exercise**

#### **Using the T-21 Computing Model to Assess Alternative Scenarios of GHG Emissions in China’s Cement and Steel Sectors**

By W. Qu

The Threshold-21 Model (T-21) model was designed to assess countrywide impacts of different development strategies, with a particular focus on incorporating economic, social, and environmental interactions into a single, coherent framework. This study expands the existing T-21 China model, adding detailed information on the cement and iron and steel sectors, including use of different technologies and their costs, inputs, employment, and emissions associated with each technology choice. This enlarged T-21 model allows users to test a wide range of what-if policy options regarding changes in the production technology and in the final demand for cement and iron and steel in China.

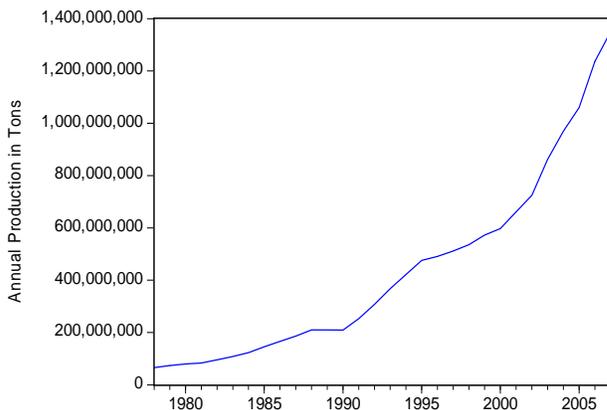
## Chapter 7

# China: Opportunities to Reduce Emissions from the Cement Industry<sup>14</sup>

### 7.1. The Facts

Cement production in China has been growing at 10% a year over the past two decades: today making China the world's largest producer--1.35 billion tons in 2007--representing 50% of the world's production. In comparison, the second largest producer, India, has an installed capacity of less than 200 million tons a year and the third, the United States, less than 100 million tons a year.

Figure 6. China's Cement Production



Source: Michael Rock (2008)

Worldwide cement production accounts for roughly 8% of global CO<sub>2</sub> emissions (in 2005). In China, the sector accounts for somewhere between 15% and 20% of the country's CO<sub>2</sub> emissions, and was responsible for 1 billion tons in 2006 alone. This is due in part to the sheer size of China's cement industry, but also to the fact that China's emissions of CO<sub>2</sub> per ton of cement are high. While China emits 870 K of CO<sub>2</sub> per ton of cement, the world average is 830 K of CO<sub>2</sub> per ton and some are well below that average. For example Brazil emits 520 K of CO<sub>2</sub> per ton).

The reasons for China's high emissions per ton of cement are obvious; almost all of China's cement industry is fueled by coal, and a good part of it is technologically obsolete and energy

inefficient. Paradoxically, while China's cement industry boasts some of the most technologically advanced plants in the world, approximately 50% of cement is still produced by highly inefficient and highly polluting, small-scale vertical shaft kilns (see Figure 8). Furthermore, the growth in demand and production has significantly outpaced the efficiency gains, and as a result, from 1990 to 2006 emissions increased fourfold.

### 7.2. The Opportunities

If China were to shift production to modern, dry rotary kilns and adopt an aggressive alternative raw materials and fuel program (burning waste products rather than fossil fuels), the emissions of CO<sub>2</sub> could fall by 45%. Assuming that cement production levels off at about 1 billion tons per year (see different scenarios in Figure 7) that shift would result in 450 million tons of CO<sub>2</sub> annual emission reductions. A short review of the forces at play can shed light on how this shift to lower CO<sub>2</sub> emissions could happen, and how a mitigation fund in the framework of the UNFCCC could help it happen.

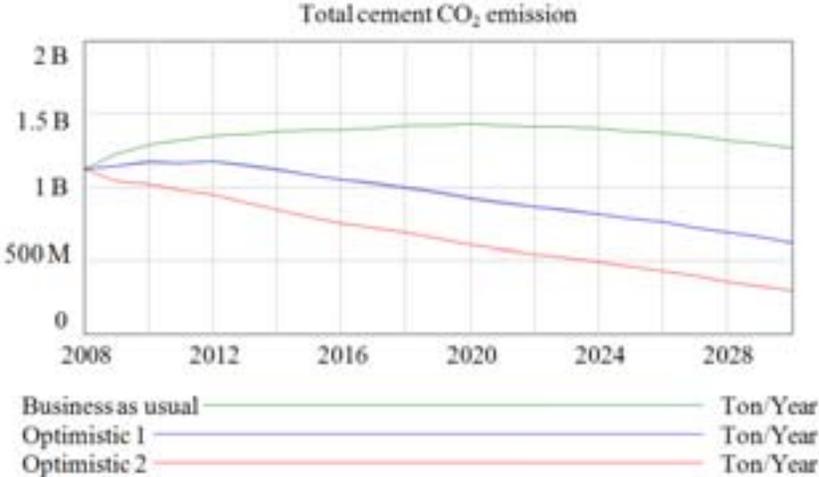
**Favorable policies are in place:** As recognition of the economic and social costs of highly polluting industries grows in China, support for low-carbon development is building steadily. The Chinese cement industry accounted for 35% of total dust emissions in 2004, making it a key contributor to local pollution that costs around 3% of the produced GDP and is responsible for 200,000 premature deaths each year. Furthermore,

<sup>14</sup> This is a summary of a longer case study commissioned for this project: Michael Rock (2008) "Using External Finance to Foster a Technology-Transfer-Based CO<sub>2</sub> Reduction Strategy in the Cement and Iron and Steel Industries in China"

according to Zhu Guangyao, head of the Chinese state environmental protection agency, “Environmental damage is costing the government roughly 10 percent of the country’s gross domestic product.”<sup>15</sup>

Since 1990 the Chinese government has had a program to close old vertical shaft kiln plants and replace them, where appropriate, with modern units. The aim of this policy is to rationalize the size distribution of firms by closing small firms, encouraging the consolidation of a smaller number of very large firms, and pushing the remaining firms to the technological frontier. This industrial development strategy offers real and substantial opportunities for putting China’s cement sector on a substantially lower CO<sub>2</sub> emissions trajectory.

**Figure 7. China’s Cement Sector: Three Abatement Scenarios**



Source: Weishuang Qu (2009)

**The market is pushing in the same direction:** The restructuring of China’s cement industry is also driven -- some would argue mostly driven -- by market forces. On the demand side large buyers request high quality cement that only modern plants can provide and, on the supply side, many firms have found that larger, modern kilns are more efficient and more profitable.

**Technologies are at hand:** Cutting China’s cement CO<sub>2</sub> emissions in half can be achieved with technologies and practices that are available today, including: (1) retrofitting existing kilns, (2) replacing all or part of old vertical kilns with larger, more efficient kilns, (3) upgrading performance of existing rotary kilns, (4) decreasing electricity use in raw materials preparation and in the grinding of clinker<sup>16</sup>, (5) shifting to blended cement, and (6) using alternative (waste) fuels in kilns. China’s more advanced cement plants already use several of these technologies, and while most modern equipment is still imported, China already manufactures large rotary kilns. New large cement plants in China have energy efficiencies similar to Japan’s plants. Table 7 below lists several of these technological improvements with their energy/CO<sub>2</sub> savings per ton of cement.

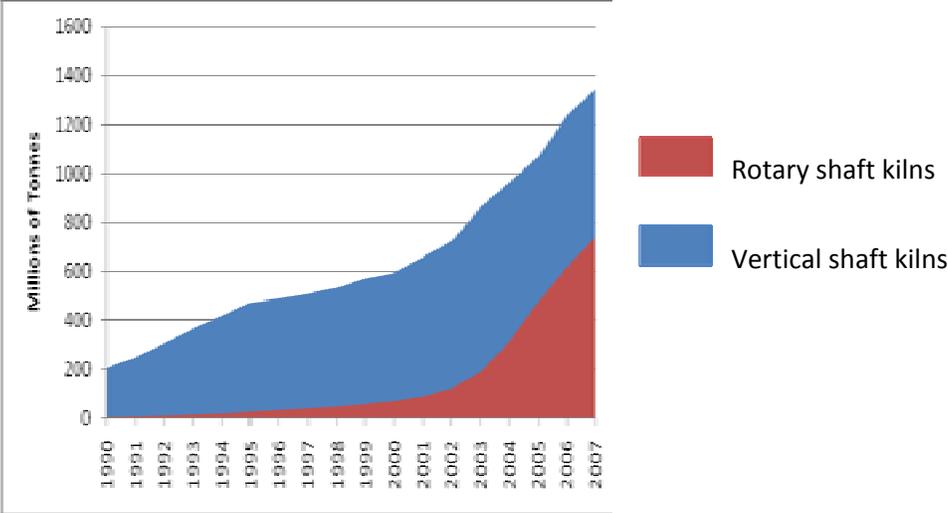
**But modernization costs would be high:** Table 8 presents a summary of the investment costs that would be necessary to reduce China’s cement industry emissions by approximately 45%. Total costs are large, in the order of \$43B, three quarters of which are the costs of switching most of the production to new rotary kilns with pre-

<sup>15</sup> Muller, Nicolas & Harnisch, Jochen. (2008) p. 56

<sup>16</sup> Additives and substitutes to clinker (e.g. fly ashes) would deliver “composite cement” that would be less energy intensive; also, the government is planning to equip 70% of large plants (over 1,200 tpd) with waste heat recovery (WHR); WHR has been estimated to be able to save around 75 Mt CO<sub>2</sub>/year by 2030. (Muller and Harnisch, 2008)

heaters and pre-calciners. Marginal investment costs vary significantly. The first 50 million tons of CO<sub>2</sub> reductions could come very inexpensively, but costs climb steeply thereafter, first to \$20 per ton, and then to \$30 per ton (see Figure 9).

**Figure 8. China’s Cement Production: Share of Shaft and Rotary Kilns**



Source: Michael Rock (2008)

**Table 7. China: Possible Technological Improvements in the Cement Sector**

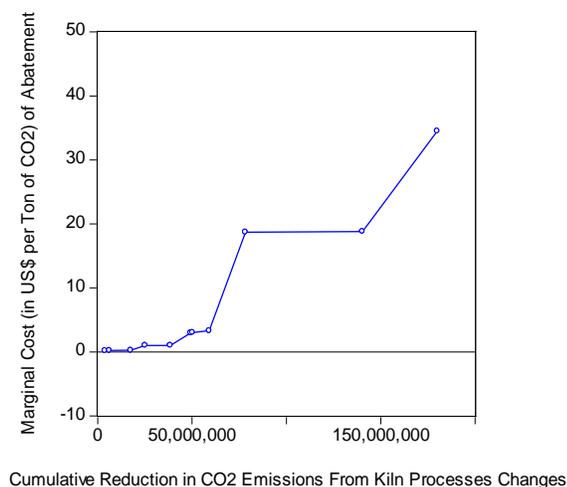
| Intervention                                                                       | Fuel Savings (GJ/Ton) | Electricity Savings (kWh/Ton) | CO <sub>2</sub> Savings (KgC/Ton) |
|------------------------------------------------------------------------------------|-----------------------|-------------------------------|-----------------------------------|
| Replacing vertical shaft kiln with rotary kilns with pre-heaters and pre-calciners | 2.4                   |                               | 62                                |
| Retrofitting rotary kilns                                                          |                       |                               |                                   |
| Kiln shell heat loss                                                               | .4-.6                 |                               | 10.3-15.5                         |
| Energy management/process control                                                  | .1-.2                 | 1.5-3.2                       | 2.9-5.9                           |
| Upgrade rotary kilns by adding                                                     |                       |                               |                                   |
| Pre-calciner to kiln with pre-heater                                               | .16-.7                |                               | 4.1-18.1                          |
| Pre-heater and pre-calciner                                                        | 1.4                   |                               | 36                                |
| Multi-stage pre-heater                                                             | .9                    |                               | 23                                |
| Reciprocating grate cooler                                                         | .27                   |                               | 6.3                               |
| Improved kiln combustion system                                                    | .1-.5                 |                               | 2.6-12.9                          |
| Optimize heat recovery/upgrade clinker cooler                                      | .05-.16               |                               | .8-3.7                            |
| Heat recovery for power                                                            |                       | 20-35                         | 4.6-8.1                           |
| Low pressure drop cyclone                                                          |                       | .7-4.4                        | .16-10                            |
| Energy savings in raw material processing                                          |                       |                               |                                   |
| Efficient transport system                                                         |                       | 3.4                           | .78                               |
| Raw meal blending                                                                  |                       | 1.7-4.3                       | .4-1.0                            |
| Process control vertical mill                                                      |                       | 1.4-1.7                       | .3-.4                             |

|                                                                                                                                                                                                          |  |           |         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-----------|---------|
| High efficiency roller mill                                                                                                                                                                              |  | 10.2-11.9 | 2.3-2.7 |
| High efficiency classifiers                                                                                                                                                                              |  | 4.8-6.3   | 1.1-1.4 |
| Slurry blending and homogenizing                                                                                                                                                                         |  | .5-.9     | .1-.2   |
| Wash mills with closed circuit classifier                                                                                                                                                                |  | 8.5-11.9  | 2.0-2.7 |
| Roller mills for fuel preparation                                                                                                                                                                        |  | .7-1.1    | .2-.3   |
| <i>Source: Worrell et al. (2008) World best practice energy intensity values for selected industrial sectors. Lawrence Berkeley National Laboratory. University of California. Paper No. LBNL-62806.</i> |  |           |         |

**Table 8. China: Direct Cost of Reducing Cement Sector Emissions by 45%**

| Cost of reducing China's cement sector CO <sub>2</sub> energy related emissions by 40% to 50% for an industry with 1.5 billion tons a year of cement capacity (US costs) | Cost per Ton | Million Tons | Total Cost in Millions of US \$ |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|--------------|---------------------------------|
| Replacing 600,000 t a year of vertical kilns with                                                                                                                        |              |              |                                 |
| New rotary kilns with pre-heaters and pre-calciners                                                                                                                      | \$41         | 600          | \$24,600                        |
| Expanding capacity by 150 million tons with                                                                                                                              |              |              |                                 |
| New rotary kilns with pre-heaters and pre-calciners                                                                                                                      | \$41         | 150          | \$ 6,150                        |
| Improving 25% of 2007 rotary capacity                                                                                                                                    |              |              |                                 |
| Kiln shell heat loss                                                                                                                                                     | \$.25        | 170          | \$42.5                          |
| Improved energy management/process control                                                                                                                               | \$1.00       | 170          | \$170                           |
| Adjustable speed drive for kiln fan                                                                                                                                      | \$.23        | 170          | \$39.1                          |
| Add pre-calciner to kilns with pre-heaters                                                                                                                               | \$18.70      | 170          | \$3,179                         |
| Add pre-heater and pre-calciner                                                                                                                                          | \$34.50      | 170          | \$5,865                         |
| Convert to reciprocating grate cooler                                                                                                                                    | \$2.95       | 170          | \$501.5                         |
| Kiln combustion improvement system                                                                                                                                       | \$1          | 170          | \$170                           |
| Indirect firing                                                                                                                                                          | \$7.40       | 170          | \$1258                          |
| Optimize heat recovery/upgrade clinker cooler                                                                                                                            | \$.20        | 170          | \$34                            |
| High temperature heat recovery for power                                                                                                                                 | \$3.3        | 170          | \$561                           |
| Low pressure drop cyclone                                                                                                                                                | \$3          | 170          | \$510                           |
| Shift to blended cement (for 1/3 of production)                                                                                                                          | \$.70        | 500          | \$350                           |
| Adopt aggressive alternative fuels program to substitute 20% of fuel consumption                                                                                         | \$3.70       | 300          | \$1,387                         |
| Total cost                                                                                                                                                               |              |              | \$44,817                        |
| <i>Sources and assumptions in M. Rock (2008)</i>                                                                                                                         |              |              |                                 |

**Figure 9. China's Cement Sector: Marginal Cost of Abating CO2 Emissions**



Source: Michael Rock

Most of these costs could be repaid by the efficiency gains accompanying the modernization process. For example, retrofitting existing vertical and rotary shaft kilns could pay back in as little as three years. Still, few cement plants in China are investing in retrofitting. On one hand, the small local companies with antiquated vertical kilns are usually cash-strapped, and would not even be able to invest in technological innovations if they wanted to. On the other hand, some medium size firms with rotary kilns do invest in retrofitting, but most do not, due to lack of technological foresight, a phenomena well studied in the literature on technology diffusion. The bottom line is that strong incentives may still be required (e.g. favorable loans, regulations, training and capacity building, etc.) to push a significant part of China's cement sector towards a low CO<sub>2</sub> emission path.

**There may also be important social and institutional indirect costs:** Since the late nineties, China's drive to restructure the cement sector has progressed much more slowly than anticipated. That delay is attributable to the fact that many of the smaller firms and kilns are owned by local governments that use them to prop up production and employment within their jurisdictions. These governments are averse to closing them down and seeing production and employment shift to larger plants located elsewhere. It has been estimated that when the Chinese industry reaches the level of productivity of the European Union, only 200,000 jobs would be left in the cement sector. This would lead to a loss of 1.2 million jobs over the next two decades.<sup>17</sup> China's strong decentralization process shields local governments from central government pressures. In addition, given the potential social disruption associated with the closing of many of these small-scale production units, the central government is reluctant to move too quickly for fear of increasing social unrest. The bottom line is that accelerating the cement sector restructuring may require investing in alternative economic activities, labor training and safety nets in the thousands of localities affected by the closing of old cement plants.<sup>18</sup>

### 7.3. What Role for a UNFCCC Mitigation Fund?

The above summary illustrates some of the main opportunities and challenges that China would face in trying to move a large industrial sector towards a low GHG emission trajectory. It also gives a framework to discuss what could be the role for a UNFCCC mitigation fund.

<sup>17</sup> Muller, Nicolas & Harnisch, Jochen. (2008) p. 56

<sup>18</sup> In its China chapter, a recent world-wide review of the cement sector commissioned by WWF International, discusses the same emission reduction opportunities of our study and put forward two more that we have omitted in this summary: opportunities for carbon capture and sequestration in the cement sector, and demand management (to reduce the demand for cement). On the other hand that study does not address the indirect economic and social costs that our study highlights as one of the barriers to the modernization of China's cement sector (see, ECOFYS, 2008 "How to turn around the trend of cement related emissions in the developing world? A background report prepared for the WWF-Lafarge Conservation Partnership, Nuremberg, Germany").

- Replacing old plants with state of the art rotary kilns may require as much as \$30B in investment. The largest part of these investments is justified on strict business terms and is in line with China's own restructuring program. Yet, there are additional mitigation costs too (above and beyond what is justifiable by firm-level business considerations) and China may want to pay for them on its own or resort to an international financing mechanism; similar to what China firms have been doing through the CDM, but in this case instead of a firm by firm approach, through a sectoral funding approach.
- On the technology side, to replace old cement plants China has the option of either importing most of the new equipment and know-how or, alternatively, expanding the already existing but incipient country capacity to design and build high-end cement equipment. In both cases, this may be fully funded by China or through some mix of in country and international financing. Improving GHG emission performance of existing modern plants also entails significant investments estimated at approximately \$13B.
- Actually, before investing in modernization and innovation, managers need to be convinced that such an investment makes sense, and that in itself is a challenge, as reflected by the large disparity in companies' willingness to improve productivity and efficiency. Thus, beyond the issue of paying for modernization costs, international funding in the framework of the UNFCCC could support a strategic public - private collaboration focused on accelerating technological learning among firms and providing financial incentives to overcome information externalities (costs of sector-wide information and know how dissemination) and coordination failures (where a number of firms need to adopt a new technology in a coordinated way in order to make it economically attractive).
- In that line, a strong capacity building effort may be needed to promote investment on emission abatement among medium size firms; both to gain managers' interest, and to train the staff that would design and operate the improvements. There are firms in China that have already mastered this knowledge, but they may be reluctant to share the actual source of their competitive advantage for free, or they may request a fair compensation to do so. Hence, an important role for the STF could be to support the Chinese government's capacity building efforts with the goals of (a) accelerating the spread of knowledge regarding emission reduction options among firms; (b) helping China address the required legal or regulatory frameworks and public staff training needs; and (c) where necessary, facilitate international level exchanges regarding technology information, capacity building, and the brokerage of cooperation activities.<sup>19</sup>
- Indirect costs, to provide alternative economic activities, labor training and safety nets to the thousands of localities associated with the closure of old cement plants, may be the exclusive responsibility of the Chinese government, and they should be factored into a sector-wide GHG emissions reduction strategy. Additionally, it may be possible for China to pursue these investments as part of a "Sustainable Development Policies and Measures" framework that could qualify for financial support in the framework of a UNFCCC managed mitigation fund.

The overall conclusion is that moving China's cement sector to a lower CO<sub>2</sub> emission trajectory is possible, and would result in large GHG emission reductions. However, it is a multi-year endeavor that would require a multi-tiered strategy addressing not only technical and financial issues but also issues of

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<sup>19</sup> The importance of capacity building, even in the relatively advanced context of China's cement industry, was brought to our attention by the work of WWF-China staff.

regional employment, regional income, capacity building, and more. Helping China (and other countries in a similar situation) refine such strategies –the preparatory phase– could be the initial contribution of a UNFCCC funding mechanism to be followed by a networking effort to mobilize a variety of international and national funding sources to support the and implementation of the emission reduction strategy.

Due to its large financial sector and its technology prowess, China could undertake the greening of its cement sector on its own; but it may also want to turn to the UNFCCC and other sources of international support in order to, inter alia:

- Pay the incremental costs of closing existing vertical kilns early; this could be one of the world's cheapest carbon mitigation strategies available;
- Pay, co-pay or give technical support for policy development and policy reform at national and sector levels, to help tame cement demand growth;
- Pay, co-pay or give technical support for capacity building and demonstration of new cement mix and fuel mix;
- Soft loans to accelerate improvements in medium size cement companies; and
- Facilitate China's access and partnership with international clean cement technological developments.

## Chapter 8

# China: Opportunities to Reduce Emissions from the Iron and Steel Industry<sup>20</sup>

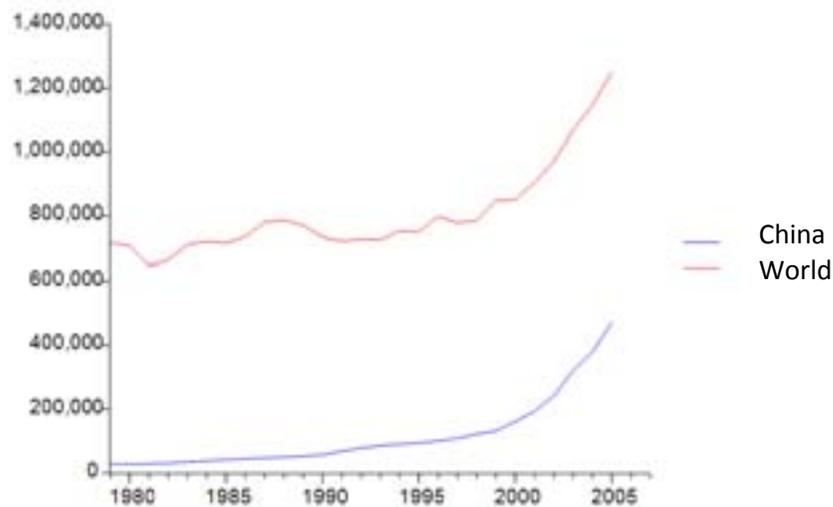
### 8.1. Iron and Steel Production in China: A Contrasting Story

Following the Sino-Soviet split of the 1950s and the isolation of China from the global economy, policy-makers in China set out to disperse iron and steel (I&S) making away from the coasts and large urban areas. The government also set out to promote local self-sufficiency in steel production. Not surprisingly, this policy promoted the proliferation of low efficiency, highly polluting, small-scale plants throughout China.

After 1978, with the liberalization of the Chinese economy, public policies reversed and focused on rationalization and structural adjustment of the industry. Main elements of the new policy included closing older open hearth furnaces, shifting production toward larger and more efficient plant sizes, and reducing the number of firms by promoting the emergence of several very large I&S conglomerates that could compete in the world economy.

This change of policies, coupled with China's two digit economic growth, resulted in the explosive growth of the I&S industry. Crude steel production grew 8.1% per year between 1980 and 1995 and 17.8% per year between 1996 and 2006. As a result, China has become the largest producer of crude steel, with 36% of the world production in 2007.

**Figure 10. China and World Crude Steel Production (thousands of tons)**



Source: Michael Rock (2008)

<sup>20</sup> This is a summary of a longer case study commissioned for this project: Michael Rock (2008) "Using External Finance to Foster a Technology Transfer-Based CO<sub>2</sub> Reduction Strategy in the Cement and Iron and Steel Industries in China." All the figures quoted in this summary are from Wang et al (2007) "Scenario Analysis of CO<sub>2</sub> emissions reduction potential in China's iron and steel industry" *Energy Policy* 2320-2335.

As a result of the different forces at play, the I&S sector in China still presents today a contrasting picture. On the one hand, China has a small number of medium and large-scale, state of the art, energy efficient steel mills. On the other hand, a large number of small, inefficient plants linger (see Table 9 below).

**Table 9. China Steel Production: A Mix of Large-Modern and Small-Outdated Plants**

| Process                                                                                                                                                         | Percentage of Production Capacity (circa 2004) |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|
| Iron, pig iron blast furnaces <ul style="list-style-type: none"> <li>• large furnaces (more than 1000 m<sup>3</sup>)</li> <li>• small furnaces</li> </ul>       | 17%<br>55%                                     |
| Steel, basic oxygen furnace (BOF) <ul style="list-style-type: none"> <li>• Large furnaces (more than 300 tons)</li> <li>• Small (less than 100 tons)</li> </ul> | 4%<br>67%                                      |
| Steel, electric arc furnaces (EAF) <ul style="list-style-type: none"> <li>• Large furnaces (more than 100 tons)</li> <li>• Small furnaces</li> </ul>            | 30%<br>70%                                     |

Source: Wang et al, 2007

## 8.2. GHG Emissions in the Iron and Steel Industry

Worldwide the I&S industry is a major source of GHG emissions. In 2002 the sector accounted for 4% of the world CO<sub>2</sub> emissions and 3.2% of the world GHG emissions. In China, the I&S industry accounted for approximately 10% of the country's CO<sub>2</sub> emissions and 7% of its GHG emissions in recent years.

China's I&S industry has made enormous progress in increasing efficiency and reducing CO<sub>2</sub> emissions per ton of steel and its large modern mills already operate close to international best practice. For example, in 2004 average energy consumption in large China's mills was 705 kg of standard coal equivalent per ton of steel, just 7.5% higher than the energy consumption per ton of steel in Japan's mills.

On the other hand, the average energy efficiency in China's small mills is 1,045 kg of standard coal equivalent per ton of steel. This is nearly 50% higher than the average of medium and large mills in China and nearly 60% larger than those mills in Japan. Furthermore, due to China's ample supply of iron ore and its limited supply of scrap steel, China is one of the few countries in the world that has been building new integrated primary steel plants that require production of pig iron to make steel. As a consequence, a large share of crude steel (83%) is produced in basic oxygen furnaces, rather than in more energy efficient and less polluting electric arc furnaces.

Because of all the above, large technical opportunities are available to reduce energy and the CO<sub>2</sub> intensity of China's I&S industry, particularly through two complementary strategies:

- Closing the large number of small, inefficient and energy intensive mills and replacing them with larger and more energy efficient mills. For example, a shift from small to large blast furnaces

could save 0.28 tons of CO<sub>2</sub> per ton of steel, while a shift from small to large electric arc furnaces could save 0.16 tons of CO<sub>2</sub> per ton of steel (Wang et al. 2007).

- Even larger savings in CO<sub>2</sub> could be achieved if China were able to shift production away from integrated steel mills that produce pig iron, and increase the share of electric arc furnaces that rely on scrap as the basic raw material for making steel. Such a shift could save 0.61 tons of CO<sub>2</sub> per ton of steel.<sup>21</sup>

### 8.3. Three Scenarios of GHG Emissions in the Iron and Steel Industry

Due to the strong relation between the country's economic growth and the growth in the demand for steel, no one expects that I&S total emissions will fall in absolute terms in the near future, but there is ample room to reduce the emission intensity (GHG per ton of steel produced), and eventually arrive to a peak and subsequent reduction in total emissions. In a recent paper Wang et al. (2007) describe how this could happen. They base their analysis on:

- A projection of China's demand for steel that peaks in 2020 at some 660 million tons a year and thereafter contracts slowly.
- Three different scenarios to the year 2030: (a) a status quo scenario; (b) a scenario with intermediate mitigation goals that reflects policy changes that the Chinese government introduced between 2000 and 2005 and further sustainable development policies, and (c) a more ambitious CO<sub>2</sub> mitigation program.
- From one scenario to the next the simulation increases the percentage of China's S&I industry that adopts available international best practice technology (IBPT). On average the percentage of the industry that is working at IBPT by 2030 is 30% in Scenario 1, 40% in Scenario 2, and 50% in Scenario 3.
- Carbon capture and sequestration (CCS) and other infant technologies have not been considered because there is no data available to include them in the model (e.g. cost per ton of steel produced and per ton CO<sub>2</sub> sequestered).

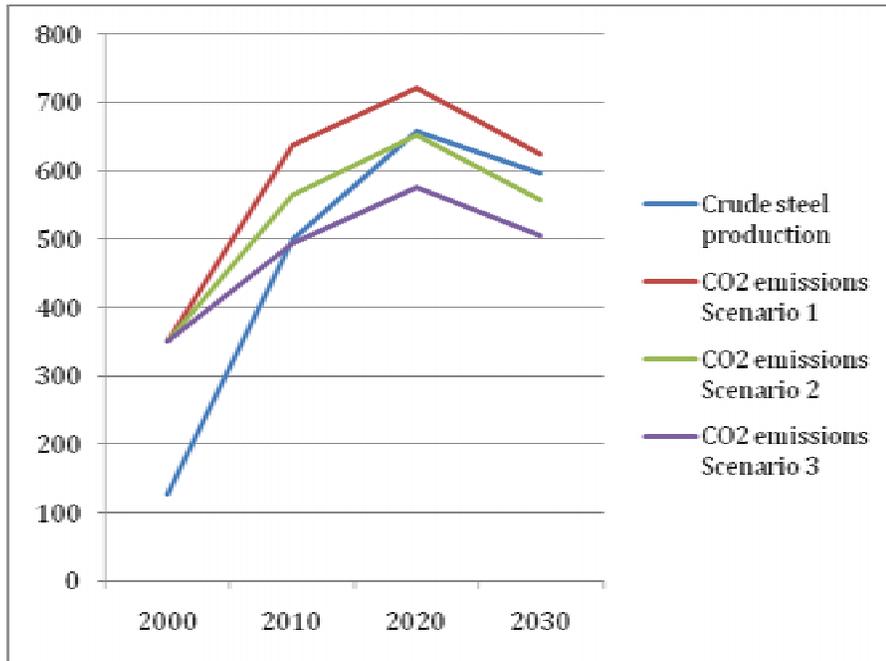
Figure 11 gives an overview of production and emission trajectories in the three scenarios and Table 10 highlights in more detail the CO<sub>2</sub> savings associated with different technology upgrades for Scenario 3, "ambitious mitigation."

Almost 70% of the emission savings would come from (a) reducing the iron to steel ratio; (b) shifting to larger and more efficient blast furnaces; and (c) using improved smelt reduction technology. If all of the twelve proposed measures were adopted, CO<sub>2</sub> emissions from the I&S sector could be 140 million tons less per year than in Scenario 1. Even so, due to the pace of growth of steel production, total emissions in all three scenarios would keep growing up to 2020 and fall thereafter.

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<sup>21</sup> But this shift assumes that China could significantly increase the use of scrap iron and steel. Available evidence suggests that scrap iron and scrap steel are in short supply in China and in the world. This may well constrain China's ability to save CO<sub>2</sub> by shifting to electric arc furnaces.

Figure 11. China's Steel Production and Emissions Under Three Mitigation Scenarios (millions of tons)



Source: Based on Wang et al, 2007

Table 10. China's Steel Industry: Potential Emission Reductions  
(Difference between Scenario 1 and Scenario 3)

| CO <sub>2</sub> Savings Intervention | Annual Reductions by 2010 (Millions of CO <sub>2</sub> ) | Annual Reductions By 2015 (Millions of CO <sub>2</sub> ) | Annual Reductions by 2020 (Millions of CO <sub>2</sub> ) |
|--------------------------------------|----------------------------------------------------------|----------------------------------------------------------|----------------------------------------------------------|
| Energy management center             | 6.75                                                     | 5.99                                                     | 3.64                                                     |
| Powder coal injection                | 4.67                                                     | .71                                                      | --                                                       |
| Advanced continuous casting          | 4.14                                                     | .85                                                      | --                                                       |
| Advanced blast furnace               | 34.51                                                    | 31.24                                                    | 24.63                                                    |
| Reduce ratio of iron to steel        | 33.13                                                    | 40.46                                                    | 43.55                                                    |
| Dry coke quenching                   | 8.28                                                     | 8.52                                                     | 3.52                                                     |
| Advanced coke oven                   | 12.42                                                    | 11.36                                                    | 9.07                                                     |
| Advanced sintering machine           | 11.73                                                    | 11.40                                                    | 10.78                                                    |
| Advanced direct steel rolling        | 1.92                                                     | 4.17                                                     | 4.43                                                     |
| Advanced converter                   | 10.72                                                    | 7.71                                                     | 7.59                                                     |
| Advanced EAF                         | 1.75                                                     | 4.45                                                     | 5.68                                                     |
| Smelt reduction technology           | 8.01                                                     | 15.02                                                    | 25.63                                                    |
| <b>Total CO<sub>2</sub> Saved</b>    | <b>138.03</b>                                            | <b>141.98</b>                                            | <b>138.52</b>                                            |

Source: Wang et al. (2007)

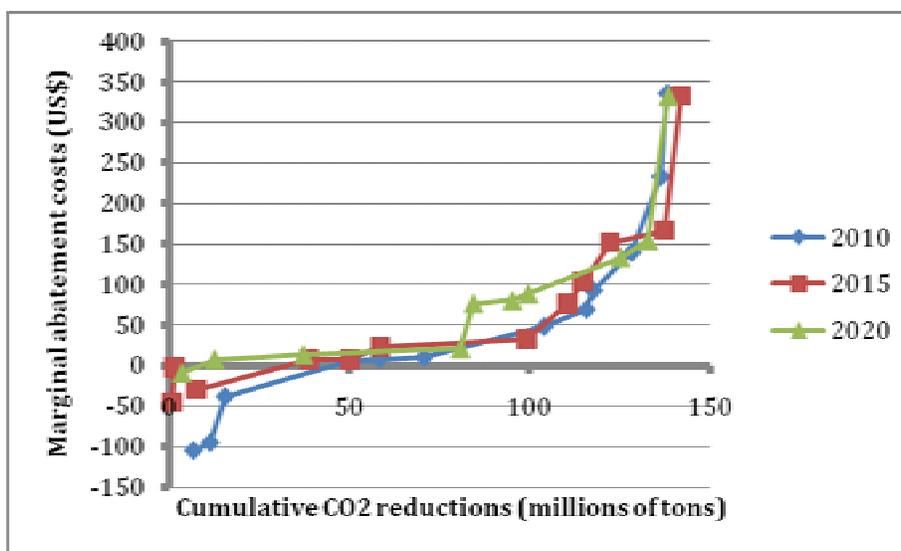
#### 8.4. The Costs of Mitigation

Overall moving from the current trend to Scenario 2 has total incremental costs of \$9.34B through 2030. Scenario 2 can be associated with the deployment of sustainable policies and measures, not directly

focused on climate change but still having substantial mitigation benefits. In the 20 years from 2010 to 2030 it could save approximately 1 billion tons of CO<sub>2</sub>.

Scenario 3, if fully implemented could save three times as much, 3 billion tons of CO<sub>2</sub> emissions in the 30 years from 2010 -2030. But the price tag would be \$80.95 billion dollars of incremental costs. With such a stiff price tag Scenario 3 may look unrealistic, so it is important to underline that moving down the emission ladder has different costs. Initial steps and the initial years may actually have negative costs, that is, net savings. For example, in 2010 half of the emission savings of Scenario 3 can be achieved at negative costs, and even in 2020 as much as 60% of the emission reductions of Scenario 3 can be achieved at an average cost of \$16/ton CO<sub>2</sub>. But costs can escalate fast, and emissions savings from advanced converters, smelt reduction technology and advanced EAF can come with a price tag between \$ 140 and \$333 per ton of CO<sub>2</sub> saved (see Figure 12).

**Figure 12. China Steel Production: Marginal Costs of Reducing Emissions**



Source: Wang et al 2007

### 8.5. What Role for a UNFCCC Mitigation Fund?

To a large extent, the discussion of how a UNFCCC mitigation fund could support China's cement sector transition to a lower carbon trajectory holds true for the I&S industry. It includes, among other activities, support for:

- Capacity building and training to promote investment on emission abatement among medium size firms; both to gain managers' interest, and to train the staff that would design and operate the improvements;
- Policy and institutional reform to support the industry move towards low carbon paths;
- Development of strategic public-private collaborations focused on accelerating technological learning among firms and providing financial incentives to overcome information externalities;
- Support for mitigation-related incremental costs of replacing of old plants; and
- Support for the selection and acquisition of mitigation technologies.

The previous discussion also suggests three areas that may be of particular interest for China's iron and steel industry.

- **Technology:** The rapid growth of marginal costs of mitigation with currently available technologies almost ensure that, after a 40% reduction in CO<sub>2</sub> intensity (emissions per ton of iron), further progress will stall in the absence of new technology breakthroughs that can significantly reduce the cost of further mitigation. A UNFCCC mitigation fund could help China partner with industry and research centers around the world to foster these technological developments and ensure their fast deployment.
- **International sector coordination:** Steel is a world commodity and the industry is highly globalized, hence a UNFCCC mitigation fund could help China partner with other manufacturers and providers around the world to accelerate low carbon changes. For example, modest increases in the world's supply of scrap could have a dramatic impact in China ability to reduce emissions.
- **Demand management and sustainable policies and measures:** Even factoring in significant reductions in emission intensity, China's CO<sub>2</sub> emissions from its iron and steel industry will keep growing through 2020 if demand grows as fast as predicted. Here a UNFCCC mitigation fund could help China devise demand management strategies and sustainable policies and measures that tame China's demand for steel without affecting consumer satisfaction or economic development.

## Chapter 9

### Tunisia: Opportunities to Scale Up Renewable Electricity Production <sup>22</sup>

#### 9.1. Why Tunisia?

Tunisia is a small middle-income country in Northern Africa. Considering countries' total GHG emissions, Tunisia is number 100, and considering per capita GHG emissions it is number 125. So, why focus on a small middle-income country with a modest GHG footprint? Why go beyond the 20 largest emitters? The answer is that Tunisia is an example of a large number of developing countries that are small players on their own, but as a group they are a significant source of GHG emissions and an important component of any global climate deal (see Table 11).

Because they are small, these countries might require mitigation strategies and technology cooperation measures that are tailored to their markets and to their characteristics. These might include specific multi-country and regional initiatives on top of the local programs required in large countries.

**Table 11. Tunisia in a World Perspective (2005)**

|                                           | Tunisia | North African Countries* | Medium and Small GHG Emitters Developing Countries** |
|-------------------------------------------|---------|--------------------------|------------------------------------------------------|
| <b>Population</b> (millions, 2005)        | 10.03   | 152.88                   | 2,130                                                |
| <b>GDP total</b> (\$ billions, 2000 US\$) | 64.63   | 339.46                   | 8,435                                                |
| <b>GHG emissions</b> (year 2000)          |         |                          |                                                      |
| <b>Total</b> (Mt CO <sub>2</sub> )        | 36.7    | 355.44                   | 10,812                                               |
| <b>% of world total</b>                   | 0.09    | 1.21                     | 25.46                                                |
| <b>Per capita</b> (tons CO <sub>2</sub> ) | 3.8     | 2.3                      | 5.0                                                  |
| <b>World per capita average</b>           | 7       | 7                        | 7                                                    |

\* Morocco, Algeria, Tunisia, Libya, and Egypt

\*\* World, minus Annex 1 countries, minus any developing countries that emits 1% or more of the world's 2000 total GHG emissions, namely Brazil, China, India, Indonesia, Malaysia, Mexico, Myanmar, Nigeria, South Africa and South Korea.

Source: WRI, CAIT website database.

#### 9.2. Tunisia's Energy Sector

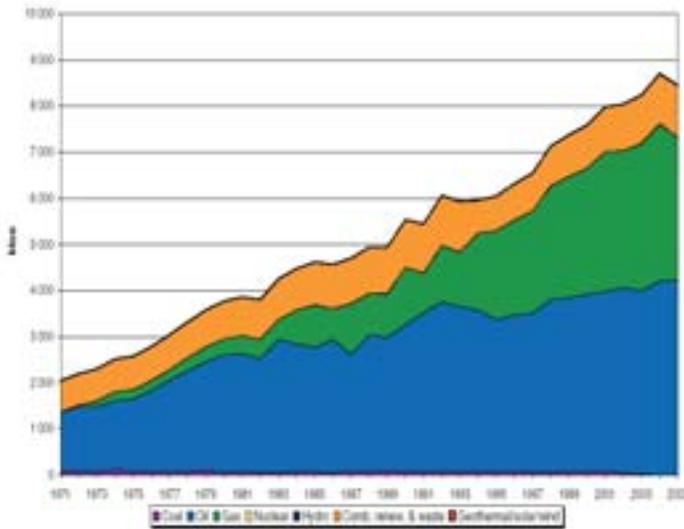
Tunisia's primary energy production is dominated by oil, gas and charcoal. There is a very small component of renewable energy --including hydro but not counting charcoal which could be renewable but currently is not managed to be so, and no nuclear power. The energy sector is controlled by two public companies, ETAP is in charge of oil and gas, and STEG is in charge of electricity production. Beyond ETAP and STEG, some large industries (e.g. cement) produce their own electricity, and firewood collection, charcoal production and mini-hydro are all small-scale independent activities.

Until recently, Tunisia was a minor net exporter of oil and a self-supplier of natural gas, but by the beginning of the century, dwindling oil resources turned the country into a net importer of both. The

<sup>8</sup> This is a summary of a longer case study commissioned for this project: Christine Woerlen (Arepo Consult, Berlin) 2009; "Opportunities For Renewable Energy In Tunisia: A Country Study"

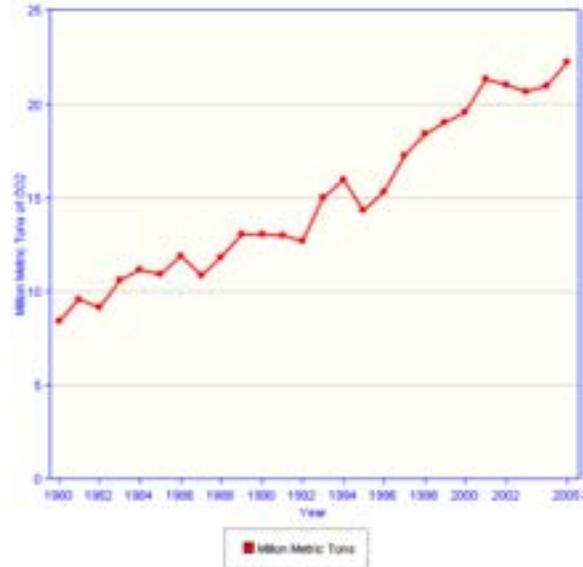
world oil price became a major factor for Tunisia as here like in many other countries world market price swings are not handed on to the consumer but absorbed in the government’s budget. End user energy services and products from oil and gas (including car fuel and electricity) are highly subsidized in Tunisia. To stave off the hiking costs of oil imports, the Tunisian government launched aggressive programs to substitute oil with natural gas. These programs also encouraged energy savings, energy efficiency and initial investments in renewable energy. As a result of all these measures energy intensity has gone down in the last 10 years, and GHG emission intensity has gone down even faster, due to the switch to natural gas. But the economic growth and the consequent growth in energy demand have overcome these efficiency gains, and, overall, emissions have kept growing (see Figures 13 and 14). Compared to a business as usual scenario, the energy measures have led to cumulative energy savings of 2 Mt CO<sub>2</sub>eq (about 80 PJ) over the last 20 years. Of these savings 10% came from increased use of renewable energy sources, but most of it was the result of public awareness campaigns (to educate against energy losses), car checkups, and labeling of household appliances (to spotlight their different energy efficiency).

**Figure 13. Tunisia: Primary Energy Consumption**



Source: IEA website database

**Figure 14. Tunisia: CO<sub>2</sub> Emissions**



Source: IEA website database

In recent years, under the impact of oil prices of over 100 USD per bbl, the government of Tunisia paid increased attention to the energy sector, and the 11<sup>th</sup> Five-Year Plan (2007 – 2011) put forward a suite of energy efficiency activities expected to reduce energy intensity by 2% per year; for example by allowing industries to self-generate electricity, introducing minimum energy efficiency standards for buildings, supporting solar water heating on large buildings, introducing two million energy savings lamps, energy audits and the cogeneration of heat and electricity.

As energy efficiency has become a central mandate of a national agency’s agenda (ANME), important opportunities linger to reduce the country’s oil bill and at the same time further cut GHG emissions. They range from further improvements in the efficiency of electricity generation to gas flaring and waste-to-energy projects as well as continued demand side activities and the deployment of renewable energy.

### 9.3. Tunisia's Experience with Renewable Energy

Since 2005 Tunisia has put in place a lively but modest renewable energy program, investing some \$20M+ a year in activities such as the energy certification of electrical equipment, installation of solar thermal collectors, photovoltaic systems and wind energy<sup>23</sup>.

Regarding renewable energy sources, the Tunisia government has emphasized the diffusion of distributed technologies, including solar water heaters, rural electrification with solar photovoltaic, household scale biogas digesters, improved wood burning technologies and wind power for water pumping. The promotion of solar water heaters has been quite successful with 57.000 m<sup>2</sup> of solar collectors installed by 2006 and a target of 740.000 m<sup>2</sup> by 2011.

Thus far Tunisia has looked at renewable power mostly as an option to supply small, isolated rural consumers, not as an alternative for the country's main power supply, in spite of the fact that electricity is the largest consumer of primary energy and the largest source of CO<sub>2</sub> emissions. As of 2007 there were only 20 MW of wind power installed and, since STEG (the national utility) is not very open to wind power, the government and UNDP/GEF have supported some large energy-intensive industries to invest in captive wind energy generation, and feed the surplus into the electricity grid. Three wind projects were under development and review for CDM accreditation during 2008, two in the cement sector and the other directly commissioned by STEG. Government plans foresee some 200 MW of wind power installed by 2011. As of late 2008, the country had no experience with concentrated solar power (CSP).

### 9.4. Can Renewable Energy Become the Centerpiece of Tunisia's Power Sector?

Like many other countries Tunisia has large wind resources that could be tapped for wind power, and it shares with neighboring North African countries unique solar radiation conditions for concentrated solar power generation. With the right incentives both wind power and CSP may become important sources of power for the country, and even for export. Still, both technologies differ a lot regarding their short and medium term prospects and challenges.

- Wind is already one of the most competitive sources of renewable power generation and the last two decades have seen two digits growth of the industry, mostly in Europe (Denmark, Germany and Spain in particular), North America, India and China. Demand for turbines currently outstrips supply and most manufacturers face large order backlogs. Wind power also has limitations; due to the intermittency of wind and the lack of economic technologies for power storage, a rule of thumb states that 15% to 20% of the energy supply is the maximum that wind power can contribute to a country standard electricity grid (yet in Denmark wind power currently contributes close to 25%). But even with a 15% limit Tunisia could increase its wind power 30 to 50 times from the current 20MW to 600- 800 MW.
- Concentrated solar power (CSP) is still in an early stage of commercial application, and experts differ on how long it will take for CSP to become economically competitive; some say as little as 5 years and others say as much as 25 years (see Figure 15). In a nutshell, CSP consists of optical devices (e.g. mirrors, lenses) that focus sunlight on small receptor devices (e.g. on tubes) so that a heater fluid is heated to high temperatures (between 130 and 1000 °C, depending on the optical

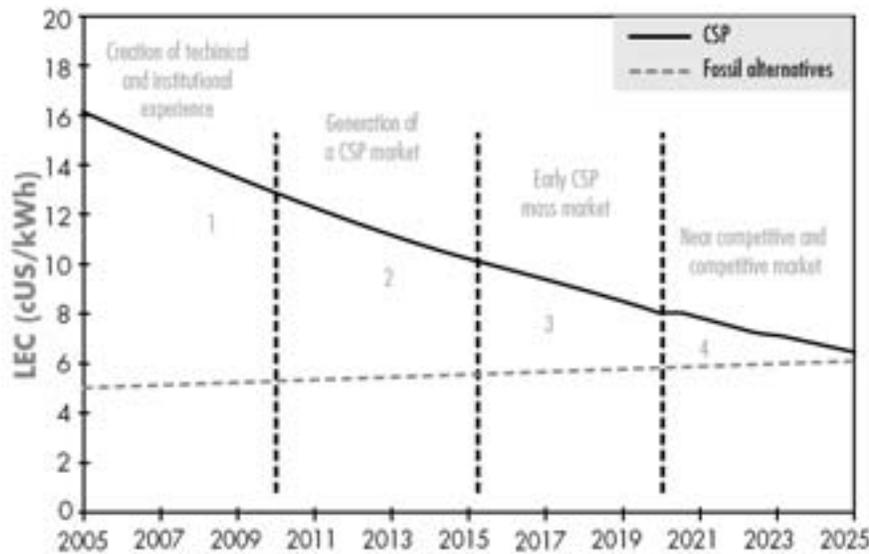
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<sup>23</sup> A significant share of the money for this program came from foreign aid sources.

technology and overall efficiency of the system) and then can be used to produce electricity in steam turbines.

If CSP develops, Tunisia may be able to take advantage of the exceptional solar radiation conditions of the country to become a major producer and exporter of electricity. For example, a 2005 study of CSP potential in Mediterranean countries, estimated Tunisia CSP potential for 2050 at 9,250 TWh a year. That would be more than the country’s total electricity needs and could offer export opportunities to Europe if sufficient transmission capacity is built.

**Figure 15. CSP Technology Development Estimates**



Source: World Bank- GEF (2006) “Assessment of the World Bank/GEF Strategy for the Market Development of Concentrating Solar Thermal Power”, World Bank, Washington DC

In Table 12 we present the government’s CO<sub>2</sub> emissions abatement scenario for 2010 – 2020 (from the Initial National Communication to the UNFCCC), plus our own scenario of accelerated deployment of wind power and CSP. This latter scenario assumes that, after 2010, Tunisia moves decidedly to increase wind power to some 20% of the country’s electricity supply, and begins to develop the technical capacity to manage CSP, although large investments on CSP and integration of larger amounts of wind power are delayed to 2020 and after, when the CSP technology is expected to be competitive and grid technology can accommodate more intermittent power.

**Table 12. Tunisia's Energy Sector**  
(Currently and to 2020, according to several scenarios)

| CO <sub>2</sub> emissions (in thousand tons)                                                    | 2005   | 2010   | 2020   | 2030  |
|-------------------------------------------------------------------------------------------------|--------|--------|--------|-------|
| <b>Reference Scenario</b>                                                                       | 19,290 | 31,636 | 48,993 |       |
| <b>Government attenuation scenario</b>                                                          |        | 24,245 | 36,151 |       |
| <b>A scenario of accelerated deployment of renewable power</b>                                  |        |        |        |       |
| • Wind power                                                                                    |        |        |        |       |
| Additional GW installed                                                                         | 20     | 60     | 600    | 1,600 |
| CO <sub>2</sub> emissions reductions per year *                                                 | 33     | 600    | 1,040  | 2,770 |
| • CSP                                                                                           |        |        |        |       |
| Additional GW installed                                                                         | --     |        | 200    | 3,000 |
| CO <sub>2</sub> emissions reductions per year **                                                | --     |        | 460    | 6,924 |
| * Assuming 3000 full load hours in 2010 and after; and CO <sub>2</sub> emissions of 577 kg/MWh. |        |        |        |       |
| * Assuming 4000 full load hours and CO <sub>2</sub> emissions of 577 kgCO <sub>2</sub> /MWh     |        |        |        |       |

Source: Christine Woerlen (2009)

Although the targets of the renewable power scenario as well as the CO<sub>2</sub> savings would look modest to a large country (e.g. the wind power capacity proposed for Tunisia for 2030 is 5% of the current wind capacity in Germany), they are quite ambitious for Tunisia, and they would be globally significant if repeated in 20 or 40 developing countries that face similar opportunities and constraints.

### 9.5. What Role for a UNFCCC Sector Mitigation Fund?

Small or medium sized developing countries that are scaling up renewable power are faced with several challenges, including:

- Information and awareness barriers that keep potential buyers (e.g. power companies and large electricity users) away from renewable options;
- Policy framework barriers, including a lack of technical standards, grid codes, lack of regulation to allow independent renewable power providers to feed-in the electricity grid, etc.;
- Lack of access to the actual technologies;
- Lack of local operation and maintenance capacity;
- Limited financing availability, particularly for demonstrative or initial plants; and
- Shortcomings of physical infrastructure (e.g. power grids).

Some of these issues need to be tackled nationally, but others may require or may benefit from an international approach. For instance:

- To scale up wind power, Tunisia would require (a) nationally, an increase in power producers and large power consumers' interest in wind power; developing the country's technical capacity and infrastructure necessary to operate and maintain a large wind power sector; and (b) internationally, wind power manufacturers would have to be attracted to a market – Tunisia– which, on its own, may be too small.
- To make CSP a large power generation alternative, Tunisia would require (a) nationally, to build capacity, pilots and infrastructure; and (b) internationally, that the maturation and deployment of the CSP technologies proceed at a pace that meets Tunisia's CSP expectations.

A UNFCCC mitigation fund could play a key role in support of such paths. To begin with, our proposed three-phased approach– preparatory, initiation and implementation –fits well with the challenges listed above.

- During the first phase, analyses of the natural resources potential and prefeasibility studies of the technology transfer programs could be fully sponsored by a global financing mechanism that at the same time could help raise interest among private sector funders. The total cost of these preparatory activities could be on the order of two or three million dollars including funding the buildup of necessary planning and analytical capacities.
- Phase 2 could include a significant grant component to continue the buildup of relevant local capacities for maintenance and operation, together with the deployment of public-private partnerships to support the technology transfer.
- Phase 3 with a smaller share of multilateral grant funding could focus on the scale up of the renewable capacity and its link to the grid with a strong participation of private funding.

In the case of Tunisia, the success of captive wind power production has already demonstrated the feasibility of a Phase 3 type of approach, that is public-private partnerships leading the process with the support of international funding (in this case it was CDM and GEF funding). Due to the fragmentation of the existing funding schemes, this process was difficult and unreliable for the local stakeholders. In contrast, the UNFCCC mitigation fund here proposed could offer clear funding structures and a long-term coordinated transition from more to less international grant aid towards a complete mainstreaming of clean technologies.

Of particular interest could be the regional or international scale that a UNFCCC Mitigation Fund could bring to bear in support of mitigation efforts in small and medium sized developing countries. Whereas large developing countries --e.g. China, India, Brazil, Mexico-- have the size to make mitigation initiatives totally or mostly a single country endeavor, that is not the case for Tunisia and similar developing countries. On the other hand, a number of important steps require a minimum market size in order to be built up in a self-sustaining manner.

- Take the case of developing industrial capacities for manufacturing, assembling and maintenance of wind power equipment. The Tunisian market on its own is too small to justify a wind power manufacturing plant in the country. But the right demand size could be achieved if a group of countries move in a coordinated way to add up to a regional market. A mitigation fund in the framework of the UNFCCC could support this type of regional initiatives and create the financial incentives and align the technical support to facilitate the emergence of regional mitigation strategies.
- Or take the case of research and development to bring a CSP technology to maturation. Establishing a new energy technology on the market may take as much as 20 years and cost billions of dollars.

This is not a task for Tunisia, or for that matter for any small or medium size developing country. On the other hand, an international research, development and commercialization program could include Tunisia as an ideal partner where pilots and demonstrative plants could be built and tested, giving Tunisia an active role in an international R&D efforts, and helping build the country's CSP operation and maintenance capacity that will be a necessary piece of a future commercial deployment of CSP in the country. Here, too, a UNFCCC mitigation fund would be well positioned to offer the financial incentives and broker the required international cooperation agreements, and ultimately work towards technology cooperation as written into the Convention.

## Chapter 10

### India: The Limits of Coal-Based Electricity Generation<sup>24</sup>

#### 10.1. The Focus of this Case Study

In 2005 India emitted roughly 1.12 metric tons of CO<sub>2</sub> per capita.<sup>25</sup> Compared with world averages that are seven times higher and some OECD country figures that are ten times higher, India is in fact a very low per capita emitter. Nevertheless, due to India's sheer size, its total GHG emissions are already large and their future trajectory is of global concern. India's energy sector accounts for the largest share in total national greenhouse gas (GHG) emissions, and these are growing fast, particularly in the electric sector that relies heavily in coal. Hence the focus of this study, reducing emissions from electricity production, can be achieved by many different strategies including:

1. Increasing distribution and end use efficiency (doing the same with less energy);
2. Demand management (doing things in a way that requires less energy to attain the same level of utility);
3. Changing the mix of primary energy sources (from high pollutant and non renewable sources to less pollutant and renewable sources);
4. Capturing emissions at the end of the pipe (carbon capture and sequestration technologies); and
5. Improving energy production technology in traditional power generation (getting more electricity per unit of primary energy source).

The authors of this case study focused on the latter, namely on technological progresses in the coal-based thermal power sector. Their overall conclusion is that such technological changes, even when carried to their full potential, are only part of the solution to the problem of growing emissions from India's coal-based power sector.

#### 10.2. Alternative Technologies in the Coal-Based Thermal Power Sector

Approximately 53% of India's total installed power generation capacity is presently coal-based, and in most scenarios coal is anticipated to remain a major energy source (see Figure 16). This put India's power sector on par with US and China that also rely heavily on coal for power generation.

Currently the three major technological options relevant to India for reduction in GHG emissions in the coal-based thermal power generation offer a range of emission intensities and overall efficiencies improvements (e.g. tons of CO<sub>2</sub> produced per MWh) but each technology carries a significant price tag compared with a medium to large sized subcritical steam cycle pulverized coal power generation that can be considered the current "business as usual" alternative (see Table 13).<sup>26</sup>

Supercritical (SC) and ultra-super-critical (USC) steam parameters deliver known and proven improved efficiencies, but are more costly and require technological upgrades to existing plants. India is currently testing Integrated Gasification Combined Cycle (IGCC) based on high-ash Indian coal, that is even more

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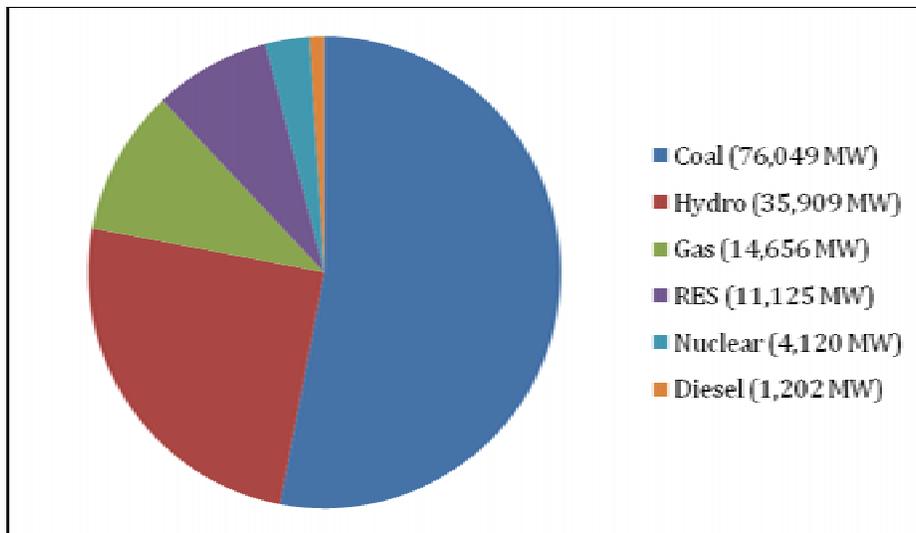
<sup>24</sup> This is a summary of a longer case study commissioned for this project: The Energy and Resources Institute (2009) "Strategies to Reduce GHG Emissions from India's Coal-Based Power Generation" Delhi

<sup>25</sup> WRI 2005 data

<sup>26</sup> This study didn't considered carbon capture and sequestration (CCS) technologies because neither cost estimates nor technical parameters were available for CCS

efficient and less pollutant than SC and USC, but IGCC is still in the demonstration and deployment stage.

**Figure 16. India: Power Sector Fuel Mix (in 2008)**



Source: TERI (2009)

It is anticipated that good operational experience of thermal plants with supercritical steam parameters will be achieved by 2012; by this time indigenous capacity for design and manufacture of these plants should also be in place. There is also a possibility that before 2012 one or two USC plants will start functioning, and semi-commercial demonstration of IGCC technology will take place. Thus the period beyond 2012 is expected to see large-scale introduction of supercritical and USC plants.

**Table 13. India: Emission Factors for Coal-Based Power Plants**

| Technology                                                                                    | Ratio of net generation efficiency (compared to 500 MW unit) | Emission factor (t CO <sub>2</sub> /MWh) |
|-----------------------------------------------------------------------------------------------|--------------------------------------------------------------|------------------------------------------|
| 500 MW subcritical<br><i>(the current standard)</i>                                           | 1.0                                                          | 0.9576                                   |
| 660 MW supercritical (SC)*<br><i>(improved technology)</i>                                    | 1.0863                                                       | 0.8815                                   |
| 800 MW ultrasupercritical (USC)<br><i>(further improved technology)</i>                       | 1.1088                                                       | 0.8636                                   |
| Integrated Gasification Combined Cycle (IGCC)<br><i>(best technology currently available)</i> | 1.1709                                                       | 0.8178                                   |

\*Taking North Karanpura as base case for future; data from TERI case study, adapted for this summary  
Source: TERI (2009)

Regarding IGCC, its penetration in India will depend on several factors including the successful operation of the semi-commercial demonstration plant. Besides improving efficiency, this demonstration has to

show the reliability and availability of the plant with a plant load factor (PLF) of 85% and above. If demonstration of these parameters is delayed, the penetration of the technology will also be delayed. Additionally, IGCC requires high quality coal, as used in US and Europe, and India may need to rely on imported coal or find ways to upgrade local coal.<sup>27</sup>

It should be noted that from a short-term developing country perspective – absent political will and international financial support – there may be insufficient incentives and resources to invest in the more expensive new cleaner-coal technologies over inherently cheaper and dirtier traditional technologies ones. Thus far, India’s progress in setting up supercritical power plants has been in part based on promotional financial incentives from India’s government, and in part on expected benefits from applying to the Clean Development Mechanism (CDM). If the CDM doesn’t extend beyond 2012, or if alternative international financial mechanism does not arise, the rate at which the sector is transitioning to cleaner technologies is likely to slow down. Hence the availability of financial support from international climate change mitigation funds will be critical.

### 10.3. Emission Reductions Opportunities

Taking into account the projected growth of the power sector, and the share of the coal-based thermal power in India, three scenarios were developed by the consultant, with different degrees of technology penetration specific to the coal-based power sector to better understand the impact of cleaner coal technologies on the CO2 emissions of the thermal (coal) power sector. These scenarios consider the various mixes of subcritical technology, supercritical technology, USC technology, and IGCC technology.

The BAU scenario (hereafter referred to as ASCU, “all subcritical units only”) has been calculated with just one improvement: that the efficiency of future plants will be at least equal to present 250/500 MW plants. The technology upgrade scenario TU-1 is based on the prediction that efforts being made presently to introduce supercritical, USC, and IGCC technology for future power plants during the 11<sup>th</sup>, 12<sup>th</sup>, 13<sup>th</sup>, 14<sup>th</sup> and 15<sup>th</sup> Five-Year Plan periods will be successful.

**Table 14. India: Coal-Based Power Sector Emission Scenarios (in billion tons)**

| Scenarios                                            | 2006–07 | 2007–12 | 2012–17 | 2017–22 | 2022–27 | 2027–32 |
|------------------------------------------------------|---------|---------|---------|---------|---------|---------|
| Total emissions in the last year of each Plan period |         |         |         |         |         |         |
| ASCU                                                 | 0.49    | 0.82    | 1.31    | 1.76    | 2.40    | 3.31    |
| TU-1                                                 | 0.49    | 0.78    | 1.19    | 1.56    | 2.08    | 2.83    |
| TU-2                                                 | 0.49    | 0.78    | 1.18    | 1.55    | 2.06    | 2.80    |
| Absolute emissions cumulated for each Plan period    |         |         |         |         |         |         |
| ASCU                                                 | 0.49    | 3.37    | 5.25    | 7.33    | 9.82    | 13.46   |
| TU-1                                                 | 0.49    | 3.36    | 5.15    | 7.09    | 9.40    | 12.75   |
| TU-2                                                 | 0.49    | 3.34    | 5.14    | 7.05    | 9.33    | 12.63   |
| Cumulative emissions until end of each Plan period   |         |         |         |         |         |         |
| ASCU                                                 | 0.49    | 3.3727  | 8.6252  | 15.9503 | 25.7733 | 39.2323 |
| TU-1                                                 | 0.49    | 3.3618  | 8.5151  | 15.6025 | 25.0071 | 37.7563 |
| TU-2                                                 | 0.49    | 3.3443  | 8.4832  | 15.5351 | 24.8647 | 37.4964 |

<sup>27</sup> The import of coal for power generation is already growing. It was 10.7 million tons in 2007–08 and it is expected to be 40 million tons in 2012.

Emission reduction possible through different scenarios in the last year of each Plan period

|      |      |      |      |      |      |      |
|------|------|------|------|------|------|------|
| TU-1 | 0.00 | 0.04 | 0.12 | 0.20 | 0.31 | 0.48 |
| TU-2 | 0.00 | 0.04 | 0.13 | 0.21 | 0.33 | 0.51 |

Cumulative emission reduction until end of Plan period

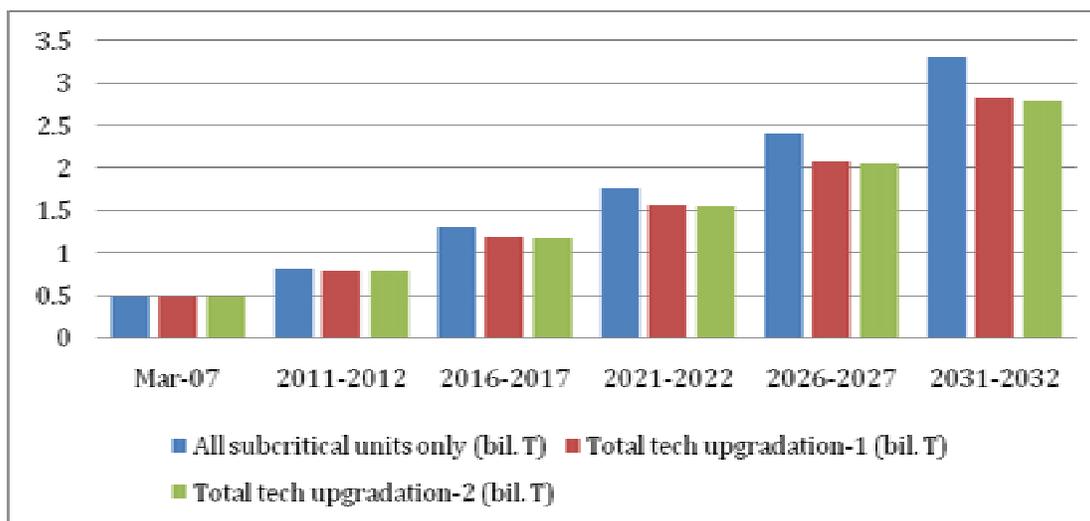
|      |      |      |      |      |      |      |
|------|------|------|------|------|------|------|
| TU-1 | 0.00 | 0.12 | 0.56 | 1.41 | 2.75 | 4.83 |
| TU-2 | 0.00 | 0.12 | 0.58 | 1.50 | 2.97 | 5.17 |

Source: TERI (2009)

In TU-2, an even more optimistic scenario for the introduction of these technologies has been considered to envision its quantitative impact on GHG emission reductions (see Table 14). This scenario corresponds to only 0.6% capacity addition through subcritical technology during 2027–32; the balance, 99.4%, is through supercritical, USC, and IGCC technologies.

The above table shows emissions calculations for each planning period under different scenarios<sup>28</sup> Figures 17 and 18 give a graphic representation of total emissions and emission reductions.

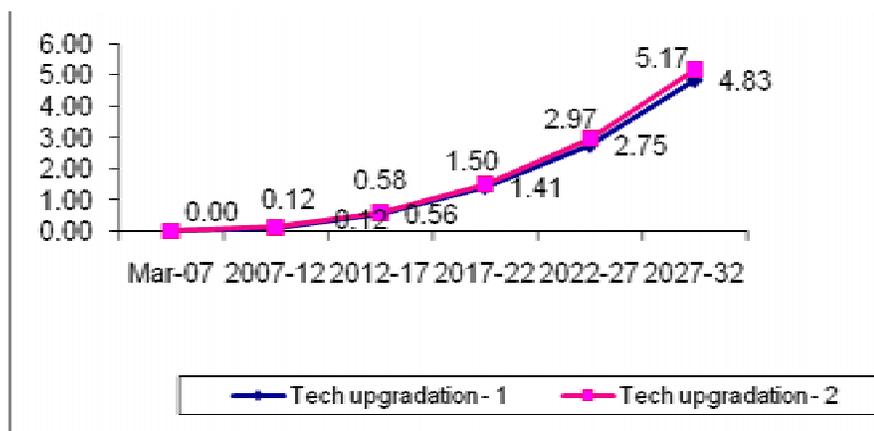
**Figure 17. India: Coal-Based Power Emissions of CO<sub>2</sub> in Different Scenarios (in billion tons)**



Source: TERI (2009)

<sup>28</sup> Almost all power sector investments in India are made by the government; hence the consultants adopted the national five-year plan period for their projections.

**Figure 18. India: Coal Based Power Sector Cumulative Emission Reduction Scenarios**



Source: TERI (2009)

As shown in the table and figures above, the scenarios TU-1 and TU-2 represent significant emission reduction potential. However, in every scenario emissions continue to rise through 2032, moreover,

- With the country GDP growing at 8% per annum and coal maintaining its current share in the power sector, the coal-based power generation capacity is estimated to grow from 67,596 MW in 2007 to 416,505 MW in 2032.
- With the BAU technology scenario, the annual emissions would rise from 0.49 billion tons in 2006–07 to 3.31 billion tons in 2031–32.
- With the technology upgrading of the TU-1 scenario that basically follows existing public plans, annual emissions would rise to 2.83 billion tons (year 2031–32). This shows a reduction of 0.48 billion tons per annum in 2031–32, as compared to the ASCU scenario.
- With the technology upgrading of the TU-2 scenario, annual emissions would rise to 2.80 billion tons (year 2031–32). This shows a reduction of 0.51 billion tons per annum by 2032.

#### 10.4. What Role for a UNFCCC Sector Mitigation Fund?

The additional costs of TU1 and TU2 are significant, in the range of billions of dollars a year (see Table 15 below); and the cost per ton of CO<sub>2</sub> reductions are in the low-middle range of world abatement cost estimates – approximately 15. US\$/t CO<sub>2</sub> for TU-1 and 17 US\$/t CO<sub>2</sub> for TU-2.

**Table 15. India: Coal-Based Power Sector Cumulative Incremental Investment in Different Scenarios (USD billion)**

|               | Up to 2011/12 | Up to 2016/17 | Up to 2021/22 | Up to 2026/27 | Up to 2031/32 |
|---------------|---------------|---------------|---------------|---------------|---------------|
| <b>TU – 1</b> | 0.73          | 13.30         | 25.94         | 44.39         | 73.69         |
| <b>TU – 2</b> | 2.07          | 16.01         | 30.94         | 53.86         | 86.26         |

Source: TERI (2009)

As mentioned above, these improvements are unlikely to happen without national commitment and international support, including both public and private sector investment. Existing international funding

windows – the CDM and GEF – do not have the scale and resources to meet the challenge posed by India’s power sector. A new mitigation fund under the UNFCCC may have the resources and the leverage to attract other public and private funders.

Equally important, a new mitigation fund under the UNFCCC could support India’s efforts to go beyond the factory by factory approach of the CDM, or the project by project approach of the GEF and many bilateral and multilateral donors. Instead, it could focus on developing and supporting full sector transformations or a national low carbon strategy. This is particularly relevant in this case because the above exercise shows the limitation of a sectoral approach. Simply stated, technological improvements in coal-based power generation can only go so far; reducing emissions further would require either a move to renewable energy, or, even more broadly, a move to low carbon development paths.

## Chapter 11

### Mexico's Cement and Iron and Steel Industries: A Case of Multinational Firms in Developing Countries<sup>29</sup>

#### 11.1. Multinational Firms: Where Developed and Developing Countries Meet

Mexico's cement and iron and steel (I&S) sectors present a picture that may be found in many other developing countries: the production is in the hands of a small number of large multinationals. In the case of Mexico, seven firms in the cement sector and eight firms in the I&S sector supply almost 90% of those markets. Some of these companies are Mexican multinationals (e.g. Cemex in the cement sector and AHMSA in the I&S sector) and others are foreign (e.g. Lafarge in the cement sector and ArcelorMittal in the I&S sector) but, irrespective of where their headquarters are located, these firms operate on a global scale, have sophisticated management, are knowledgeable of latest technologies, and have easy access to national and international capital markets.

As a result, when looking for opportunities to reduce GHG emissions, one should not expect to find low-hanging fruits here. These companies aren't lacking training or capacity building; if they are not doing something it is not for lack of knowledge or financial resources. It is for lack of economic incentive. Hence in most cases the motivation for change would need to come from new public policies (e.g. mandatory mitigation or efficiency improvement requirements) or country-wide low carbon development strategies that change the price signals (e.g. increase country-wide supply of renewable energy).

#### 11.2. Current GHG Emissions

One would expect that large multinational firms already work close to international best practices regarding GHG emissions. This is the case for Mexico's cement sector that is responsible for GHG emissions of 0.73 tons of CO<sub>2</sub> per ton of cement, comparing favorably to the world average of 0.87 tons of CO<sub>2</sub> per ton of cement. Similarly, Mexico's I&S sector average emissions of 1.87 tons of CO<sub>2</sub> per ton of crude steel is comparable to world standards, although the average masks significant differences between plants in Mexico (see Table 16).

**Table 16. Mexico: CO<sub>2</sub> Emissions in the Iron and Steel Sector (2007)**

| Company                                           | Millions of tons of CO <sub>2</sub> | Millions of tons of steel produced | Ton of CO <sub>2</sub> /ton of steel |
|---------------------------------------------------|-------------------------------------|------------------------------------|--------------------------------------|
| Altos Hornos de México (AHMSA)                    | 8.4                                 | 3.54                               | 2.37                                 |
| ArcelorMittal ASSA, Las Truchas y Lázaro Cárdenas | 7.9                                 | 4.78                               | 1.65                                 |
| Ternium de México                                 | 4.1                                 | 2.60                               | 1.58                                 |
| TOTAL                                             | 20.4                                | 10.92                              | 1.87                                 |

Source: Energía, Tecnología y Educación, S.C. (2009)

<sup>29</sup> This is a summary of a longer case study commissioned for this project: Energía, Tecnología y Educación, S.C. (2009) "Strategies to Reduce Mexico's Cement and Iron and Steel Industry GHG Emissions"

Although CO<sub>2</sub> emission figures for Mexico's cement and I&S sectors are better than world averages, they still lag far behind other developing countries. For example, Brazil emits only 0.52 tons of CO<sub>2</sub> per ton of cement and 1.32 tons of CO<sub>2</sub> per ton of crude steel. It is worth noting here that the low emissions of the Brazilian cement and I&S sectors are to a large extent not the result of technology advances in these sectors, but are the outcome of a country-wide decision that Brazil made to rely significantly on low carbon sources of energy (mostly hydropower and renewable fuels).

### 11.3. Mitigation Opportunities and Emission Forecasts in the Iron and Steel Sector

The business as usual (BAU) scenario outlined in the case study anticipates a continued rate of 1.8 tonCO<sub>2</sub>/ton of steel through 2030.<sup>30</sup> In contrast, under an alternative scenario, a rate of 1.5 tonCO<sub>2</sub>/ton of steel could be achieved through the following measures:<sup>31</sup>

- An increase of up to 97% of direct reduced iron (DRI) production (it was 61% in 2006),
- An increase in electric arc furnace (EAF) production from 74.5% in 2006 to 96% of national steel production, and
- Increased use of natural gas both as fuel and as a reducing agent (by 20%).

Still, growing demand and production would overcome the efficiency gains. As a result, overall emissions are expected to grow from 32 M tons of CO<sub>2</sub> per year (circa 2002) to:

- In the BAU scenario: 60 M tons a year by 2020 and 95 M tons a year by 2030.
- In the alternative scenario: 48 M tons a year by 2020 and 76 M tons a year by 2030.

### 11.4. Mitigation Opportunities and Emission Forecasts in the Cement Sector

The BAU scenario outlined in the case study for the cement sector is 0.73 tons of CO<sub>2</sub> emitted per ton of cement produced, given anticipated growth through 2030.<sup>32</sup> The alternative scenario suggests that emissions from Mexico's cement sector could be 40% lower than the BAU scenario, at 0.437 tons of CO<sub>2</sub> per ton of produced cement. The alternative scenario considers the following advancements in Mexico's cement sector:

- Employing a multistage dry process,
- Reducing electricity intensity,
- Producing more blended cements, and
- Growth in the use of alternative fuels as biogas.

Because the demand for and production of cement is forecasted to grow at moderate rates, the alternative scenario would be enough to stabilize emissions close to the current levels of 28 M tons of CO<sub>2</sub> per year (circa 2007). More precisely,

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<sup>30</sup> The case study sets the business as usual (BAU) scenario based on the 2007 emissions of the three main steel-producing companies, which are responsible for over 60% of Mexico's steel production.

<sup>31</sup> The case study bases the alternative scenario on assumptions made by the World Steel Association and the American Iron and Steel Institute.

<sup>32</sup> This is based on an analysis by the National Institute of Ecology (INE), which looked at 20 operational plants.

- In the BAU scenario: 41 M tons a year by 2020 and 56 M tons a year by 2030.
- In the alternative scenario: 25 M tons a year by 2020 and 33 M tons a year by 2030.

### 11.5. What Role for a UNFCCC Mitigation Fund?

The review of the Mexican case suggests that promoting low emissions in developing countries' sectors dominated by large international firms may not require offering them capital and technology. They already have good access to both.

Nevertheless, like other firms, these firms are concerned with national and international competitiveness and may not act in the absence of clear national regulations and energy supply programs that compel them into action, and/or in the absence of international agreements that protect the competitiveness of firms that invest in emission reductions. In both cases a UNFCCC mitigation fund could be a valuable leverage of action:

- At the country level the UNFCCC mitigation fund could support the development of the nation's low carbon development strategies and enforcement of new mitigation regulations. As summarized above, there is potential for further emission reductions in Mexico's cement and I&S sectors and all that multinational firms may need to reduce emissions is a clearer regulatory framework.
- At the country level, investments to increase the national supply of renewable sources of energy can significantly impact the emissions from the cement and I&S sectors as well as any other sector that is a large user of energy. A UNFCCC mitigation fund could help fund such movement on the supply side, potentially triggering complementary private investments on the demand side (e.g. the investments that the cement, I&S and other users would need to make in order to adapt to the use of new renewable fuels).
- At the international level a UNFCCC mitigation fund could act in support, not of a single country, but of a sector. For example, they could support the financing of technology research, development, and dissemination (RD&D) to increase available low emission options for large emitting sectors. The cement industry may be a good case for this since current world research on CO<sub>2</sub> emission reduction options for the cement sector is relatively small, especially considering that the cement sector is likely to account for more than 10% of total global GHG emissions in the period 2030-2050.<sup>33</sup> Technology Needs Assessments (TNAs) based on both national and international scopes could be the starting point to identify such needs and broker broader support for ongoing or new international technology RD&D initiatives.<sup>34</sup>

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<sup>33</sup> See WWF (2008) "A Blueprint for a Climate Friendly Cement Industry" (Pg. 8)

<sup>34</sup> There are ongoing experiences of business driven international RD&D programs, for example the World Business Council for Sustainable Development Cement Sustainability Initiative. This or similar endeavors could be a point of entrance for UNFCCC technology collaboration with the private sector.

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## Annex 1

### Estimates of Financing Needs for Climate Investment in Developing Countries

(In billions of 2005 US dollars)

| Who/When                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Mitigation Financing                                                                                             |                                                                                                                                                                                      |                                                                                                                           | Adaptation financing costs per year<br><br>(b)                                | Technology financing costs per year<br><br>(c) | Total financial costs per year<br><br>(a+b+c)                |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|------------------------------------------------|--------------------------------------------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | To abate how much CO <sub>2</sub> e?                                                                             | Financial costs per year<br><br>(a)                                                                                                                                                  | Up-front investment (Capex) per year                                                                                      |                                                                               |                                                |                                                              |
| <b>UNFCCC Secretariat 2008 update estimates</b><br><br>Annual average costs circa 2030, not before *                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | - 21.7 below a business as usual (BAU) of 35.6 GT for 2030<br><br>includes mitigation in forests and agriculture | <b>64.7 B USD year by 2030</b>                                                                                                                                                       | Capex costs included in financial costs                                                                                   | <b>27.75 to 58.25 B USD / year by 2030</b>                                    | <b>17.5 to 22.5 B USD /year by 2030 **</b>     | <b>109.7 to 145.4 B US dollars per year in the year 2030</b> |
| <p>*Estimates are for the year <b>2030</b>. The UNFCCC Secretariat studies don't provide estimates of annual costs from now to 2030.</p> <p>** The UNFCCC Secretariat studies only provide world figures for technology R&amp;D of 35 to 45 B USD / year. We have arbitrarily assigned 50% of these costs to developing countries.</p> <p>Source: Investment and Financial Flows to Address Climate Change: An Update, 26 November 2008 (FCCC/TP/2008/7), Table 5 and 16.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                  |                                                                                                                                                                                      |                                                                                                                           |                                                                               |                                                |                                                              |
| <b>European Commission 2009 estimates</b><br><br>Annual average costs circa 2020, not before *                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | - 7GT below a BAU of 33.7 GT for 2020 **<br><br>includes mitigation in forests and agriculture                   | <b>117.5 B USD / year total in 2020</b><br><br>including<br>88.75 B USD / year for energy and industry<br>+<br>22.5 B USD / year for REDD+<br>+<br>6.25 B USD / year for Agriculture | <b>112.5 B USD per year in 2020</b> , The cost of repaying this Capex is already factored into the annual financial costs | The EC quotes UNFCCC Secretariat estimates of 28.75 -67.5 B USD/ year in 2030 | No estimates                                   | <b>1146.25 to 185 B USD per year</b><br><br>Only a+b         |
| <p>* Estimates are for the year <b>2020</b>. The EC provides estimates of annual costs from 2013 to 2020 for energy mitigation but not for other costs. 2005 Euros have been converted into 2005 US dollars at the rate of 1 € of 2005 = \$ 1.25 of 2005.</p> <p>** The EC presents separate figures and costs for 3 areas of abatement (a) -5.2 GT below a BAU of 26.7 GT of energy related emissions; (b) -1.3 GT below a BAU of 3.5 GT of gross deforestation; and (c) -0.5 GT below a BAU of 4.8 GT of non CO<sub>2</sub> agricultural emissions in 2020.</p> <p>Sources: (a) EU/JRC/IPTS,2009 Economic Assessment of Post – 2012 Global Climate Policies (p. 7,38, 50, 63 and 64); (b) EC 2009 Commission staff working document accompanying the communication "Towards a Comprehensive Climate Change Agreement in Copenhagen" (p. 9, 10, 62, 71, 80,81, 86 and 87); and (c) Council of the EU, 2009 Council Conclusions on the further development of the EU position on a comprehensive post 2012 climate agreement (P. 7)</p> |                                                                                                                  |                                                                                                                                                                                      |                                                                                                                           |                                                                               |                                                |                                                              |

| Who/When?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Mitigation financing                                                                                    |                                                                                                         |                                                                                                                          | Adaptation costs per year<br><br>(b)                                                           | Technology costs per year<br><br>(c)   | Total financial costs per year<br>(a+b+c)    |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|----------------------------------------|----------------------------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | To abate how much CO <sub>2</sub> e?                                                                    | Financial costs per year<br>(a)                                                                         | Up-front investment (Capex) per year                                                                                     |                                                                                                |                                        |                                              |
| <b>Catalyst/McKinsey 2009 Estimates</b><br><br>Annual average costs from 2010 to 2020 *                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | - 12 Gigatonne (GT) below a BAU of 40 GT for 2020<br><br>Includes mitigation in forests and agriculture | <b>68.75 to 100 B USD per year average</b><br><br>(going from approx. 40 B in 2013 up to 135 B in 2020) | <b>162.5 B USD per year</b><br><br>The cost of repaying this Capex is already factored into the annual financial figure  | <b>from 8.75 to -13.75 B USD per year average to 20- 53.75 B USD per year average **</b>       | <b>12.5 B USD per year average ***</b> | <b>83.75-160 B USD per year average</b>      |
| <p>* These are average annual costs for the period 2010 and 2020. Catalyst/McKinsey also has per year estimates that, as expected, are lower in 2010 and grow over time. 2005 Euros have been converted into 2005 US dollars at the rate of 1 € of 2005 = \$ 1.25 of 2005.</p> <p>** The lower range is for adaptation knowledge and technology in all developing countries, plus investment in resilient development for only more vulnerable countries. The higher range is for investment in climate resilience development in all developing countries.</p> <p>** Only R&amp;D all other technology cooperation is included in mitigation and adaptation investment.</p> <p>Source: Project Catalyst Symposium March 4 and 5, 2009 Washington DC document, Chapter 3 on Adaptation, and Chapter 6 on financing a global deal.</p> |                                                                                                         |                                                                                                         |                                                                                                                          |                                                                                                |                                        |                                              |
| <b>World Bank</b><br>Annual average costs circa 2030                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Stabilizing CO <sub>2</sub> e at 450 ppm                                                                | <b>140B to 175B per year</b>                                                                            | <b>265B to 565B per year</b><br><br>The cost of repaying this Capex is already factored into the annual financial figure | <b>9B to 41B yearly average 2010-2015</b><br><br><b>75 B to 100 B yearly average 2030-2050</b> |                                        | <b>215 to 275B yearly average circa 2030</b> |
| <p>The World Bank call mitigation cost and incremental investment needs what we have called financial costs and up-front investment (Capex)</p> <p>Source: World Development Report 2010 "Development and Climate Change" Chapter 6</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                         |                                                                                                         |                                                                                                                          |                                                                                                |                                        |                                              |

| Who/When?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Mitigation financing                                                                                                                        |                                                              |                                         | Adaptation costs per year<br><br>(b)                                                                 | Technology costs per year<br><br>(c) | Total financial costs per year<br>(a+b+c) |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|-----------------------------------------|------------------------------------------------------------------------------------------------------|--------------------------------------|-------------------------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | To abate how much CO <sub>2</sub> e?                                                                                                        | Financial costs per year<br><br>(a)                          | Up-front investment (Capex) per year    |                                                                                                      |                                      |                                           |
| <b>NGO Consortium</b><br>Greenpeace,<br>WWF<br>et al.<br><br>Annual average costs from 2013 to 2017*                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | -16.5 GT below a BAU of 40 GT for 2020<br><br>Including approx. 2.9GT of REDD+ to bring total emissions from deforestation to more than 1GT | <b>97 B US\$ per year</b><br><br>Including 42 BUS\$ for REDD | Capex costs included in financial costs | <b>63 B US\$ per year</b><br><br>(including 7B US\$ per year for a multilateral insurance mechanism) | Included in mitigation               | <b>160 B US\$ per year</b>                |
| <p>* These are average annual costs for the period 2013 to 2017.<br/> The NGO consortium has not done original cost estimates. It has collected figures from different sources, detailed in the report quoted below.<br/> It is not clear what base year is used. The authors mention that they have used figures in Euros and dollars and converted them at an exchange rate of 1 €= \$ 1.39.<br/> Source: A Copenhagen Climate Treaty Version 1.0. A Proposal for a Copenhagen Agreement by Members of the NGO community accessible at <a href="http://www.panda.org">www.panda.org</a></p> |                                                                                                                                             |                                                              |                                         |                                                                                                      |                                      |                                           |

## Annex 2

### Publications of the Global Financial Mechanism Project (GFM)

#### Main Publications

- a) **Global Financial Mechanism: The Institutional Architecture for Financing a Global Climate Deal (March 2009)**
- b) **Global Financial Mechanism Project: Proposals for the Design and Operation of a UNFCCC Fund to Support At-Scale Mitigation Developing Countries and Leverage Additional Public and Private Sources of Funding (June 2010)**

#### Supporting Studies

1. Michael Rock (Bryn Mawr College) "Using External Finance to Foster a Technology Transfer-Based CO<sub>2</sub> Reduction Strategy in the Cement and Iron and Steel Industries in China"
2. Christine Woerlen (Arepo Consult, Berlin) "Opportunities for Renewable Energy in Tunisia: A Country Study"
3. The Energy and Resources Institute (TERI, Delhi) "Strategies to Reduce GHG Emissions from India's Coal-Based Power Generation"
4. Britt Childs with Casey Freeman (WRI, Washington DC) "Tick Tech Tick Tech: Coming to Agreement on Technology in the Countdown to Copenhagen"
5. Energía, Tecnología y Educación, S.C. (ETE, Mexico DF) "Strategies to Reduce Mexico's Cement and Iron & Steel Industry GHG Emissions"
6. Charlotte Streck (Climate Focus, Brussels) "Sectoral Transformation Plans as Strategic Planning Tools"
7. Charlotte Streck (Climate Focus, Brussels) "Financing REDD: A Review of Selected Policy Proposals"
8. Charlotte Streck (Climate Focus, Brussels) "Financing Climate Change: Institutional Aspects of a Post-2012 Framework"
9. Silvia Magnoni "Review of the CDM and Other Existing and Proposed Financial Mechanisms to Transfer Funds from North to South for Mitigation and Adaptation Actions in Developing Countries"
10. Silvia Magnoni "Sectoral Approaches to GHG Mitigation and the Post-2012 Climate Framework"
11. Weishuang Qu (Millennium Institute, Washington DC) "Using the T21 Computing Model to Forecast Production and Emissions in China's Cement and Steel Sectors"

All publications can be downloaded from:

[http://www.panda.org/what\\_we\\_do/how\\_we\\_work/policy/development\\_poverty/macro\\_economics/our\\_solutions/gfm/](http://www.panda.org/what_we_do/how_we_work/policy/development_poverty/macro_economics/our_solutions/gfm/)

## Annex 3

### Publications of the Technical Working Group (TWG)

The “Technical Working Group on the Institutional Architecture for Climate Finance” (TWG) was convened by the WWF US Policy Program in early 2009 to focus on compromise alternatives to the institutional architecture for a post-2012 climate change agreement. The TWG is composed of experts from developing and developed countries and proceeds through face to face meetings, electronic and phone consultations, the production and commissioning of reports.

#### Main Publications

- a) **The Institutional Architecture for Financing a Global Climate Deal: An Options Paper (June 2009)** This document is the result of the TWG’s first round of discussions (February – June 2009) and discusses three possible institutional designs: (a) a strongly decentralized one; (b) a strongly centralized one; and (c) an intermediate one organized around a UNFCCC Climate Registry.
- b) **The Climate Registry Option (November 2009)** The TWG’s second round of discussions (July – December 2009) produced this paper that focused in greater detail on the actual functioning of a UNFCCC Climate Registry option.
- c) **A Registry Approach to REDD+ (April 2010)** This paper discusses the design of a REDD+ Registry that would align developing country needs with expertise and financial resources provided by various sources including public and private funding from contributing countries and private finance.

#### Supporting Studies

Seven input papers were produced or commissioned by the TWG to examine how a UNFCCC-COP operated Climate Registry could leverage and direct the demand and supply of funds for adaptation, mitigation and technology transfer.

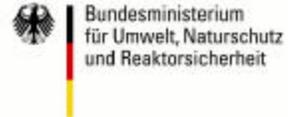
1. Jochen Harnisch “Leveraging Private Sector Climate Investment in a Post-2012 UNFCCC System” (September 2009)
2. Pablo Gutman “The UNFCCC Climate Registry Approach: In the Contexts of a Global REDD Deal and Sector-Specific Mitigation Actions” (September 2009)
3. David Reed “Mexico and the Clean Technology Fund/CIF - Exploring the Role of the Climate Registry” (September 2009)
4. Charlotte Streck “The UNFCCC Climate Registry and the Private Sector” (February 2010)
5. Charlotte Streck “The UNFCCC Climate Registry and COP-Mandated Funds” (February 2010)
6. Silvia Magnoni and Saleemul Huq “How a UNFCCC Climate Registry Approach Could Manage and Serve the Adaptation Needs of Developing Countries” (October 2009)
7. Pablo Gutman “The Life Cycle of a REDD+ National Program and Its Interactions with a Climate Change Registry” (December 2009)

All these publications can be downloaded from <http://www.climateregistryoption.org/>





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