The Effectiveness of the Clean Development Mechanism – A law and economics analysis

De effectiviteit van het 'Clean Development Mechanism' – Een rechtseconomische analyse

Alexander Vasa

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A LAW AND ECONOMICS ANALYSIS

ALEXANDER VASA

For my parents

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Proefschrift ter verkrijging van de graad van doctor aan de
Erasmus Universiteit Rotterdam op gezag van
de rector magnificus
Prof.dr. H.G. Schmidt
en volgens besluit van het College voor Promoties.

De openbare verdediging zal plaatsvinden op
Dinsdag 26 juni 2012 om 09.30 uur

door

Alexander Vasa

geboren te Boekarest, Roemenië

ERASMUS UNIVERSITEIT ROTTERDAM

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This thesis was drafted within the framework of the
European Doctorate in Law and Economics

A collaboration between

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FOREWORD

This thesis is the result of the past years' research, consulting and discussions with my supervisors, my colleagues and friends, as well as travelling around with my laptop and papers in my backpack. This thesis would certainly not have been written if it were not for this combination. The idea to write a PhD came during my European Master in Law and Economics, while I was enjoying my time in Bologna in 2007 with a great group of friends. Only a few months earlier I had become interested in climate change policy, a topic that cuts cross so many areas of our everyday life, and where I felt that I contribute to improve the understanding of how policy works in practice. After finishing my Master thesis on the European Union Emissions Trading Scheme, I realized that the other side of the emissions trading "coin" is a far greater challenge: the reduction of emissions in developing countries through policies such as the Clean Development Mechanism. Working together with Delia Villagrasa, Sanjeev Kumar, and Stephan Singer at the European Policy Office of WWF, where I completed my master thesis, helped me to decide to focus my research on the Clean Development Mechanism during the European Doctorate in Law and Economics.

I am grateful to Delia, Sanjeev and Stephan for their guidance and the various occasions we could discuss these issues. I am grateful to Professor Marco Lamandini and Professor Vincenzo Denicolò, who both wrote reference letters to support my admission to the PhD program. They are also the two scholars, great teachers and discussion partners, who inspired me most to continue with a doctorate after the master.

As I did not have any particular knowledge of the way the Clean Development Mechanism works when I started my PhD, I decided to collaborate with experts in the field. I am grateful to my supervisors, Professor Michael Faure and Professor Marco Lamandini to trust in me and to support my various guest research positions at the University of Zurich and the German Institute for Economic Research, as well as a traineeship at the European Commission in the Directorate General Enterprise and Industry. These exchanges were in particular helpful to shape my understanding about the workings of the Clean Development Mechanism, its actors, as well as an understanding of climate policy questions from a policy-maker perspective.

Professor Faure is a great supervisor, who patiently supported my approach to thesis writing. His guidance and supervision enabled me to finally put my ideas to paper.

Thank you for your continuous support, honest feedback and encouragement at all times.

Professor Lamandini has provided me with the freedom to pursue my ideas during the PhD as he has seen the benefit in learning from other economists and lawyers working on energy and climate policy. I am grateful for this invaluable support as it enabled me to write a thesis that is useful in practice and the application of law and economics concepts. The feedback that I received on early and later ideas of papers helped me shape the thesis into its current form. Thank you for your trust during the past years.

Regarding my research stays, I would like to thank Axel Michaelowa, who gave me the opportunity to closely work with and learn from him while working at the University of Zurich. His continuous and invaluable feedback to early and late paper and chapter drafts are indispensable for the development of this book. His overview and experience with international climate policy as well as his research about and involvement in shaping the rules of the Clean Development Mechanism based on evidence were a great source of inspiration.

My work at the European Commission on identifying carbon leakage sectors was an interesting experience that was the more rewarding as I worked under the guidance of and collaborated with two great, honest and open minds: Jesús Barreiro-Hurlé and Ingmar Jürgens. I am grateful that the friendship and collaboration extends to the present day.

My collaboration with the German Institute for Economic Research and my close work with Karsten Neuhoff were particularly conductive for my research. Working with Karsten allowed me to look at climate policy from different angles, learning at the same time to actually write and improve paper drafts, while receiving feedback from him and from experts in the community. Working with Karsten meant for me constantly challenging economic theory, and Karsten's rigor and enthusiasm in analysing climate and energy policy is encouraging. The feedback and the numerous table rounds to discuss and present my work, as well as numerous opportunities to collaborate with other researchers in the field made working with Karsten very conductive to this thesis and beyond.

Several colleagues and friends contributed at various stages of the thesis writing process with feedback, editing of draft versions, and fruitful discussions at conferences, lunches and tea breaks: Aleksandra Novikova, Alexandra Quandt, Angus Johnston, Anja Kollmuss, Anja Rosenberg, Anne Montgomery, Anne Schopp, Charlotte Streck, Christian Feuerhake, Claudia Desogus, Eric Brousseau, Ferdinand Vieider, Florens

Flues, Hauke Hermann, Hermann Amecke, Ingrid Weyher, Jan Abrell, Jonathan Klick, Josephine van Zeben, Karsten Neuhoff, Kateryna Stelmakh, Luigi Franzoni, Marianne Breijer, Meagan Jooste, Miriam Schroeder, Moritz von Unger, Pantelis Pipergias Analytis, Prabhat Upadhaya, Rodney Boyd, Roland Ismer, Ruby Barcklay, Sandra Greiner, Sarah Lester, Stefan Weishaar, Stefano Clò, Thilo Grau, Tom Heller, Valerijus Ostrovskis, and Zohal Hessami. These colleagues and friends took their time to read, revise and comment on my work. Some of them repeatedly and patiently looked at various versions of chapters. Without their support and encouragement this thesis would look quite different. Thank you for your ideas, most of them are in embedded in this thesis.

I would like to thank the participants of various conferences in Paris, Rotterdam, Maastricht, Bolzano, Budapest and Zurich where I could present my work. Comments received at these conferences were helpful in refining my working papers. Furthermore, I would like to extend my thanks to my “Inner PhD committee”, Louis Visscher, Alessandra Arcuri, and Edwin Woerdman, who carefully and thoroughly reviewed my thesis. Their constructive comments and encouraging suggestions were well received.

My friends were a great source of motivation, encouragement and energy during the past years. Some of them do not know how much they actually helped to make this thesis real, through their patience, by listening and sometimes by diverting my attention and mind away from the thesis: Adam, Bettina, Chardy, Cristina, Dana, Franziska, Ken, Markus, Markus, Michael, Olia, Pantelis, Sarah, Simon, Sofia, Toba, Valerijus, Vanessa, and Zohal. Thank you. Cecile and Rebecca hosted me during crucial thesis writing times in Paris and Beijing respectively. Having a home away from home is invaluable in general but especially in such times.

However, the person who supported me the most especially during the past three years by listening patiently and by bearing much of the weight of this thesis is Hannah. This thesis would not have been realized without her continuous support, and our conversation in Hamburg in 2006, which sparked my interest in climate change policy. I thank you for our friendship.

My parents and family has been a great support. They listened carefully and I took great benefits from sparring ideas with them. They always trusted my decisions and I am grateful for the moments we shared during the past years. Although I was often travelling, my heart and thoughts were and are always with you. Thank you for supporting me and letting me go into the world. I devote this thesis to you.

Beijing, 15 May 2012

ABBREVIATIONS

AAU	Assigned Amount Unit
BAU	Business-as-usual
CDM	Clean Development Mechanism
CDM-AP	Accreditation Panel
CDM-EB	Executive Board
CER	Certified Emission Reduction
CH4	Methane
CITL	Community International Transaction Log
CO2	Carbon Dioxide
CO2eq	Carbon Dioxide Equivalent
DNA	Designated National Authority
DOE	Designated Operational Entity
ERU	Emission Reduction Unit
EU	European Union
EU ETS	European Union Emissions Trading Scheme
EUA	European Union Allowance
GHG	Greenhouse Gas
HFC	Hydrochlorofluorocarbon
IET	International Emissions Trading
IPCC	Intergovernmental Panel on Climate Change
IRR	Internal Rate of
JI	Joint Implementation
LoA	Letter of Approval
MAC	Marginal Abatement Cost
MRV	Measurement, Reporting and
N2O	Nitrous Oxide
NAMA	Nationally Appropriate Mitigation Actions
NAP	National Allocation Plan
NPV	Net Present Value
OECD	Organization for Economic
PDD	Project Design Document
PFCs	Perfluorocarbons
RIT	Registration and Issuance Team
SD	Sustainable Development
SF6	Sulphur hexafluoride
UNFCCC	United Nations Framework Convention on Climate Change
VVM	Validation and Verification Manual

1. CLIMATE CHANGE AND THE NEED TO PAY COUNTRIES TO REDUCE EMISSIONS

Climate change is a threat to modern society (IPCC, 2007). According to the Intergovernmental Panel on Climate Change, the cumulative impact of greenhouse gas (GHG) emissions has an adverse impact on the climate including, among others, an increase in high impact weather events such as storms, floods and draughts (IPCC, 2007).[1] Most of these impacts are expected in developing countries.[2] Statistics from reinsurance companies confirm and attribute this trend to the changing climate (Mills, 2005). Over the past decades, scientific consensus has grown that climate change is the result of human-induced emissions of GHGs (Weart, 2010). Today greenhouse gas emissions occur as the result of almost all human activity such as combustion of fossil fuels for electricity generation, industrial production of steel, cement and chemicals, agricultural production, deforestation and transportation to name a few (IPCC, 2007 WG III). The IPCC recommends the reduction of global GHG emissions in the range of 80%-95% by the year 2050 relative to 1990 levels (Solomon et al., 2007). This requires a substantial effort by all countries to decarbonise their economy.

Market forces lead to an oversupply of emissions. This is because, in the absence of any regulatory intervention, the cost of damages caused by emissions is not factored into the prices set for the production of goods or their consumption. According to economic theory, because the abatement of a ton of CO2-equivalent has the same effect for the global climate regardless of where the abatement is achieved, emissions should be reduced where the marginal cost of abatement is lowest. According to Coase (1960), where transaction costs are zero or negligible, the allocation and subsequent trade of property rights leads to economic efficiency independent of the initial allocation of rights. Crocker (1966) and Dales (1968) have extended this rationale to show that an

[1] GHGs covered under the Kyoto Protocol are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF_6) (UNFCCC, 1997: Annex 2). All GHGs can be restated in terms of CO_2-equivalent (CO2eq.) by multiplying their quantity in tonnes with the 100 year global warming potential (GWP) of the respective greenhouse gas. In 2011, during the UNFCCC conference in Durban a seventh gas, Nitrogen trifluoride (NF3), has been added to the list of greenhouse gases covered.

[2] "Developing" is an umbrella term to denote countries that have a low GDP per capita relative to industrialised countries that are members of the Organisation for Economic Co-operation and Development (OECD). However, the economic status of many countries classified as "developing" when the Kyoto Protocol was signed 25 years ago, changed in the meantime. A new concept of newly industrialised countries is emerging for countries that have rapidly growing economies and are increasingly industrialised. Acknowledging these changes is important for current global climate policy. However, this book will use the term "developing" to denote the fact that when the Kyoto Protocol was signed, the difference between industrialised and developing countries was more pronounced.

emissions trading system (ETS) can reduce emissions cost-effectively. In such a system, emitters (e.g. private companies or countries) receive emission rights, a so-called emission budget, while the total volume of rights is limited. Each emitter assesses whether it is cheaper to reduce emissions inside the company (internally) or to buy emission rights on the market. Emitters sell unused emission rights to the market or bank them for later use. In the absence of transaction costs, market forces of supply and demand of emission rights lead to an equalization of marginal abatement costs between emitters and to a minimization of total abatement costs (R. Hahn, 2000; Montgomery, 1972; Tietenberg, 1985, 2006). However, difficulties arise where some emitters refuse to participate in the system or where no global emissions limit can be established, thus reducing the potential cost-effectiveness of the system.

1.1. Kyoto Protocol - Emission reduction targets for industrialised countries

To address the need to reduce GHGs at the global level, the Kyoto Protocol set legally binding emission reduction targets for 37 industrialised countries and the European Community (UNFCCC, 1997a). The countries, also called Annex I countries, agreed to reduce anthropogenic (human-made) emissions of six GHGs to 4.2% below 1990 levels during the Kyoto commitment period, from 2008 to 2012 (UNFCCC, 1997b: Art. 3).[3] At the same time, developing countries agreed to provide GHG inventory reports, but did not commit to any binding emission limitations.

In order to reduce the costs of compliance for industrialised countries, four flexible market mechanisms have been introduced to increase the efficiency of emission reduction opportunities by global trading:

- Target Reallocation (Bubble Mechanism) (Article 4),[4]
- Joint Implementation - JI (Article 6),
- Clean Development Mechanism – CDM (Article 12), and
- International Emissions Trading – IET (Article 17).[5]

International Emissions Trading (IET) allows governments of countries with Kyoto commitments to sell unused shares of their emissions budgets, so-called Assigned

[3] The United States did not ratify the Kyoto Protocol. According to Olivier, Janssens-Maenhout, Peters, & Wilson (2011) the average target that industrialised countries including the United States would have to meet during the Kyoto commitment period is 5.2 %.
[4] This mechanism, although often omitted in the list of flexible mechanisms, is used by the European Union to achieve the emission targets as a group rather than as individual countries.
[5]There is a wealth of abbreviations in the Kyoto carbon market. For convenience, the most frequently used terms can be found in the Annex to this chapter.

Amount Units (AAUs), to other countries that want to use more Assigned Amount Units than they have been assigned under the Kyoto Protocol. Joint Implementation (JI) permits the generation of emissions credits through emission reduction projects in an Annex-I (industrialised) country. These credits may be used by the credit-acquiring Annex I country to fulfil its Kyoto commitments; an equivalent amount has to be deducted from the emissions budget of the country hosting the projects to avoid double counting (Geres & Michaelowa, 2002; Metz, 1995). The Clean Development Mechanism (CDM) allows projects that reduce emissions in non-Annex I countries to generate emission credits, so-called certified emission reductions (CERs), which can be used by Annex I countries to fulfil their commitments.

Of all the Kyoto Parties, the European Union (EU) is the only one that applies the "bubble mechanism" of the Kyoto Protocol, which allows the EU to pursue emissions reduction targets as a group rather than as individual countries. The EU has agreed to reduce emissions by 8% from 1990 levels. Furthermore, in 2008 the EU agreed to cut its GHG emissions by 20% by the year 2020 relative to 1990 emissions (Council of the European Union, 2008). It has thus extended the EU targets specified in the Kyoto Protocol beyond the Kyoto commitment period 2008-2012.

A part of the emissions reductions may be achieved outside the EU through the CDM or JI (Council of the European Union, 2009; Council of the European Union & European Parliament, 2009). This is in accordance with the CDM supplementarity criteria, which mandates that only part of a country's Kyoto target may be achieved through CDM. In its efforts to reduce emissions, the EU distinguishes between the emissions trading sector and those sectors not covered by the emissions trading scheme (EU ETS). Approximately 12,000 installations across the EU are covered by the EU emissions trading scheme, as identified in Annex I of EU ETS Directive 2003/87/EC (CITL, 2010; Council of the European Union & European Parliament, 2009). These installations are combustion installations and engage in energy-intensive manufacturing activities. During the period 2008-2012, installations are allocated EU Allowances (EUAs) predominantly at no cost. Each EUA allows its holder to emit one ton of CO2 (as CERs confer the same right to their holder, CERs and EUAs can be regarded as equivalents).

1.2. Clean Development Mechanism - Rationale and procedures

Before the Kyoto Protocol was drafted, the IPCC concluded that "international transfers, in one form or another, are likely to serve as both the building blocks of globally optimal action and the cement of global cooperation" (IPCC 1995: 71, section 2.4.2). Of all the Kyoto mechanisms, the CDM is the only instrument aimed at incentivising abatement in developing countries. The CDM is based on the notion that emissions reductions can be achieved at lower costs in developing countries than in industrialised countries (Hoglund et al., 2009; Wetzelaer, Van Der Linden, Groenenberg, & de Coninck, 2007). However, in the absence of any binding emission targets for developing countries, an instrument is needed to encourage the implementation of such abatement opportunities. The rationale behind the CDM is that industrialised countries pay for emissions reduction projects in developing countries and can apply the generated certified emission reductions towards achieving their own Kyoto target (Hanisch, 1991; Liroff, 1980; UNFCCC, 1997a).

Developing countries were initially strongly opposed to such an instrument (Depledge, 2000). The concept was previously discussed under the heading of joint implementation, which would allow industrialised countries to reduce emissions in other countries. Depledge (2000: 298) emphasises that "the G-77 and China repeatedly expressed opposition to JI, specifically JI" between industrialised and developing countries.[6] The main argument of developing countries and the non-governmental organization community against the CDM was that it would allow industrialised countries to buy themselves out of the responsibility to reduce emissions domestically and thereby allow industrialised countries to continue to emit as before (Depledge, 2000).

Developing countries favoured an alternative, the so-called Clean Development Fund (CDF), following the Brazilian Proposal (Cole, 2010; Olsen, 2007). The Brazilian Proposal would have established emission reduction goals for industrialised countries based on historical emissions, and the CDF would collect penalties from industrialised countries that exceed their emission limitations. The proceeds from the penalties would be channelled to developing countries on the basis of developing countries' projected emissions between 1990 and 2010 (UNFCCC, 1997b). However, both the CDM and the CDF allow industrialised countries to exceed their emissions limit. According to Olsen (2007), this similarity was picked up by the United States negotiators and in the final hours of negotiation the CDF proposal was changed into the CDM in Article 12 of the Kyoto Protocol (UNFCCC, 1997a; Werksman, 1998).

Initially, the CDM also faced strong opposition by the EU (Depledge, 2000; Michaelowa, 2004). This initial opposition had begun to diminish when the United

[6] Group of 77 (G-77) is a group of developing countries within the United Nations with the aim to "to articulate and promote their collective economic interests and enhance their joint negotiating capacity on all major international economic issues within the United Nations system" From an initial membership of 77 countries, the G77 has 132 member countries by November 2011 (Group of 77, 2011).

States left the Kyoto Protocol and, following a stakeholder consultation in the EU on emissions trading, industrial emitters pushed for the CDM to be allowed for achieving compliance (Michaelowa, 2004: 2). Indeed, the impact of the CDM on lowering total abatement costs was highlighted in several model simulations at the global (Bollen, Gielen, & Timmer, 1999; Weyant & Hill, 1999) and at the EU level (Anger, Böhringer, & Moslener, 2007; Klepper & Peterson, 2005). These simulations found that the CDM can lower compliance costs for industrialised countries.

Beyond the interest of industrialised countries in cost-effectiveness*, developing countries had stressed throughout the negotiations to the Kyoto Protocol their need for financial and technological assistance to achieve sustainable development* (Depledge, 2000: p. 62, para 333).[7] Sustainable development (SD) is aimed at combining the goals of economic development, natural resource extraction, and improvements in socio-economic environment. While sustainable development is not defined in the Kyoto Protocol, its inclusion indicates the need to integrate climate and socio-economic objectives (Hopwood, Mellor, & O'Brien, 2005; Swart, Robinson, & Cohen, 2004). Although developing countries differ in their economic positions and their national priorities, most countries aim to improve their socio-economic status in order to address challenges such as poverty, health inequality and education issues.

The CDM is aimed at both cost-effective abatement for industrialised countries and supporting sustainable development for developing countries (UNFCCC, 1997a). Cost-effectiveness, as discussed above, suggests that the marginal costs of emissions abatement should be equalised across all emitters (Liroff, 1980; Tietenberg, 1985). This would ensure that the greatest amount of abatement is conducted with the least funds. Thus, by reducing emissions where costs are lowest, industrialised countries decrease their total cost of compliance with their emission targets. Sustainable development implies that the activities conducted to reduce emissions have socio-economic benefits beyond emission reductions in the country where the activities are conducted. If both of these goals are fulfilled, the CDM is able to raise welfare for the countries involved. Industrial countries benefit from reduced costs of abatement, while developing countries receive finances to pursue emission reductions and sustainable development.

The CDM is thus the result of two different agendas: the sustainable development agenda of developing countries and the cost minimisation agenda of some industrialised countries (McDougall, 1999). Participation in an international treaty is according to Guzman (2008) and Wiener (1999) a rational choice of countries. For

[7] The three goals of the CDM are marked with an asterix (*).

instance, Wiener (1999) argues that in the absence of dictatorial rules, countries cannot be forced to participate in a treaty. These countries will weigh the costs and benefits to join the treaty and will aim at maximising their benefits from joining. Thus cooperation in a treaty depends on potential side-payments that induce cooperation. The CDM can be interpreted as such a side-payment that intends to satisfy the demands of both developing and industrialised countries in order to induce cooperation.

Beyond the two objectives of cost-minimisation and sustainable development, the main goal of the CDM is to reduce emissions in developing countries in the same volume by which industrialised countries decrease their domestic efforts. Therefore, the reductions generated by the CDM should be "additional*" to any that would have happened in the absence of the CDM support. This is important for two reasons. First, investment in emissions reduction activities that would have occurred anyway wastes money that could have been used to reduce emissions or pursue other goals (i.e. improvements in health care or education). Second, since the emissions reductions generated in the CDM are applied towards achieving Kyoto targets, approving non-additional projects does increase global emissions. Thus, for environmental integrity to hold, the CDM should only finance projects that would not have been implemented in the absence of the CDM. An institutional framework has been set up to ensure that the CDM does not waste money on non-additional projects and lead to global emission increases.

1.2.1. Clean Development Mechanism – Procedures and actors

The CDM framework can be understood in the three stages of demand, supply and compliance:

1) Demand stage: The Kyoto Protocol sets an emissions target for industrialised countries. These countries *demand* low-cost mitigation opportunities, which they search for in their own country and in developing countries.
2) Supply stage: Industrialised countries finance CDM projects in developing countries, which *supply* emissions reductions to the industrialised countries.
3) Compliance stage: Industrialised countries use the emission reductions generated in the supply stage to *comply* with their individual emissions reduction targets. Any reduction of emissions achieved in the developing country does not have to be conducted domestically.

In the following, these stages are described in more detail.

1.2.1.1. Demand stage

The demand stage depends on the individual targets of industrialised countries and of the costs to reduce emissions domestically and in developing countries. First, each industrialised country has individual emissions reduction targets to be achieved during the commitment period relative to 1990 levels (the base year) (UNFCCC, 1997c).[8] For instance, country A has a Kyoto target of reducing emissions by 5% during the Kyoto commitment period relative to the base year 1990. If emissions in 1990 were 100 units (e.g. 100 tons of CO2- equivalent), country A would need to reduce to 95 units on average per year during the five years from 2008 to 2012.[9] The effort needed by country A depends on projected business-as-usual (BAU) emissions in country A, which would occur in the absence of any target. If BAU emissions are 120 units in each of the years from 2008 to 2012, the reduction effort is 25 units per year (BAU emissions – target; 120 – 95 units).

If country A wants to minimise the cost of reducing by these 25 units, it will consider the options of pursuing the reduction domestically or abroad. Country A can compare the different abatement options according to a marginal abatement cost curve, which indicates the price of emissions reductions that can be achieved at a cost per unit abated (usually denoted as cost/ton of CO2) (Nordhaus, 1991). Country A will choose to abate the cheapest units, independent of where the reductions have to be conducted. If country A finds that part of the reduction can be achieved at lower cost in a developing country (country B), then it contracts a project developer in country B to supply these emission reductions through a CDM project.

1.2.1.2. Supply stage

To supply the demanded emission reductions, referred to as CERs (see section 1.1), the project developer needs to conduct a project. Each CER generated from this project allows its holder to emit one ton of CO2- equivalent. An example of a project is as follows:

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[8] The Kyoto targets are reprinted in Appendix 2 to this chapter. Bulgaria (1988), Hungary (average of 1985-1987), Poland (1988), Romania (1989), Slovenia (1986), have different base years relative to 1990. Due to economic restructuring, emissions fell rapidly in these countries in the 1990s, so that targets are set to the higher emissions pre-1990, which makes it easier for these countries to achieve their targets. This is frequently referred to as “hot air” (Grubb, Laing, Counsell, & Willan, 2010).

[9] This example is only for illustrative purposes. The emissions of individual countries are greater, for instance emissions in the Germany were 1.2 billion tons CO2-eq in 1990 (UNFCCC, 1997c) .

Assuming that a CDM wind project is conducted in a country B, where most electricity (the BAU baseline) is produced by CO2-intensive means such as coal. If electricity produced by a CDM project such as a wind park replaces that produced with coal, then emissions are reduced by the difference between what would have been emitted with coal and what is actually emitted with the wind park.

However, since the wind park is more expensive, it requires additional funds in order to be financially viable. Country A, the industrialised country, finances the incremental cost of the wind park by buying the CERs generated by the wind project in country B, so as to make the project financially viable. Country A will engage in such a trade if the CERs are cheaper than conducting emission reductions in its own territory.

In order to generate CERs, CDM projects need to be registered (UNFCCC, 2001). The CDM executive board (CDM-EB) is in charge of CDM administration, meaning that it ultimately decides whether projects are registered or not. In order to be registered, CDM projects must be additional. CDM projects can be developed by companies from the host country (so-called unilateral CDM) or through investments by companies from industrialised countries (Michaelowa, 2007).[10] The registration of projects follows an institutionalised procedure frequently called the “project cycle”. This project cycle is conducted in seven steps and involves private and public actors, which are introduced in the following:[11]

1) Companies that implement projects are called project developers. Their responsibility is to document how the project contributes to sustainable development and to provide evidence that the project would not have happened without CDM support (additionality determination). The project developer calculates the expected emissions reductions (e.g. the difference between coal-fired power plant and wind park emissions). These emissions reductions determine the potential CERs to be generated by the proposed project. The additionality determination is frequently done through the barrier or the benchmark test. If the project developer can show that the proposed project faces barriers that can be removed through the CDM, or

[10] CDM projects include, for example, energy-efficiency improvements in industry and power generation, flaring or use of landfill methane gas for electricity generation, the installation of renewable technologies such as wind, hydroelectric and solar. Appendix 1 to this chapter provides an overview of the registered project types, their number and share of emission reductions.

[11] The representation of the project cycle here is simplified and based on the CDM procedures approved in the Marrakech Accords for large projects (UNFCCC, 2005a, 2005b). A detailed description of the CDM project cycle is provided in Chapter 2.

that the project is not financially viable without CDM support (compared to a benchmark rate of return), then the project is deemed additional.[12]

2) The project developer sends this documentation to the host country, in which the project is to be located, for approval. A designated national authority (DNA) in the host country determines whether the proposed project fulfils the national sustainable development criteria as set by the DNA. The DNA of the CER buyer (industrialised) country must also approve the project by confirming that it is conducted voluntarily and that country A is a Party to the Kyoto Protocol.
3) The project developer submits project documentation and the DNA approval to an auditing company, a so-called designated operational entity (DOE). The DOE is a private actor contracted by the project developer to assess the credibility of the project documentation. The DOE needs to have technical expertise for monitoring and quantifying greenhouse gas emissions from emitters (UNFCCC, 2001). In addition, the DOE needs to be licensed by the CDM-EB to conduct CDM auditing activities. If the DOE approves the documentation, in particular the determination of additionality, the project is submitted to the CDM-EB for registration.
4) The CDM-EB is made up of ten experts from the ministries of developing and industrialised countries that have ratified Kyoto (UNFCCC, 2005). Its task is to register CDM projects according to the recommendation of the DOE, based in particular on the additionality determination for the project and confirmation of sustainable development by the host country DNA.
5) If the project is registered, the project developer monitors the actual emissions from the implemented project and submits a monitoring report to an auditing company other than the one in step 3 above.
6) The auditing company verifies the monitoring report and, if it regards the assumptions and calculations of emissions by the project developer as credible, it certifies the amount of emissions reductions specified in the monitoring report.
7) Upon receipt of the certification from the auditing company, the CDM-EB issues CERs to the project developer.

The project developer can then transfer the CERs to the industrialised country or a company in that country, which can use projects' CERs in the compliance stage to fulfil part of its Kyoto targets.

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[12] Chapter 2 describes these tests in detail.

1.2.1.3. Compliance stage

The CERs purchased from a project in country B are transferred to country A. As each CER confers the right to emit one ton of CO_2- equivalent, Country A needs to reduce less domestically in proportion to the number of CERs it holds. For instance, if the project conducted in country B generates 10 units per year for five years during the Kyoto commitment period, then country A only needs to reduce 15 units per year (25 minus 10 units as discussed in section 1.2.1.1) domestically. The use of CERs for compliance needs to be established so that emitters in country A have legal certainty over which credits are allowed and which are not.

In summary, the three stages involve six main actors whose behaviour impacts the delivery of the criteria of additionality, sustainable development, and cost-effectiveness:

1. Country A compliance buyer (cost-effectiveness)
2. Project developer (additionality, sustainable development, cost-effectiveness)
3. DOE (additionality)
4. DNA of the host country (sustainable development)
5. DNA of the buyer host country (cost-effectiveness)
6. Executive Board (additionality)

In the following, a brief literature review shows how CDM has performed in practice, and which questions arise from this performance.

1.3. Literature

In the past two decades, the CDM moved from theory to practice and has spurred a vibrant community of academics, investors, industry, NGO and government representatives that participate in the CDM market (Michaelowa, 2004). In May 2011, the Executive Board of the Clean Development Mechanism registered the 3000th CDM project (UNEP Risoe, 2011). Since the first CDM project was registered in 2003, private investors and public institutions have transferred funds equal to €25 billion to CDM projects in developing countries over the period 2005-2010 (Linacre, Kossoy & Ambrosi, 2011). China is host to 45% of all registered projects, India to 21% and Brazil to 6%. CDM projects in these countries are expected to deliver emissions reductions in the order of over one billion tons of CO_2- equivalent by the end of 2012 (Risoe, 2010). The CERs thus gained can be used by industrialised countries to achieve their Kyoto targets.

1.3.1. Large number of registered CDM projects

The number of registered projects in the CDM is impressive given the recent establishment of the global market for emission allowances through the Kyoto Protocol's ratification in 2005. This suggests that the carbon market is working, and that initial concerns about burdensome institutional cost hindering growth in the CDM have not been confirmed. Scholars were not overly optimistic about the prospect of the CDM in generating real emissions reductions and project impact on sustainable development before the CDM started. For instance, McDougall (1999) concludes that: "the CDM will achieve little cost reduction and little development" and will thus lead to disappointment. He bases his analysis on the assumption that incentives for private investors to participate in the CDM are weak, as the CERs can only be used during the commitment period 2008-2012, yet investments in projects are already allowed as of the year 2000 (Depledge, 2000; McDougall, 1999; UNFCCC, 1997a Art. 12.10). The author argues that, given this uncertainty, investors from industrialised countries are unlikely to engage in CDM projects, and due to the lack of engagement sustainable development will also not be advanced as a goal. Furthermore, he points to the determination of additionality as imposing costs on industrialised country investors, who will resent such a system. Indeed, Rentz (1998) argues that verifying whether a project would not be financially viable without CDM support will prove difficult and will only impose additional costs on investors.

However, Michaelowa & Jotzo (2005) provide a review and estimation of transaction costs in the CDM, estimating it at a minimum of €150,000 per project. Of that, nearly half is estimated to be the cost of auditing and of registering the project. The profitability of a project is thus dependent on the volume of CERs and the price that a project can generate in order to cover its transaction costs. The authors estimate the CDM market to be in the range of 300 million tons of CO2-equivalent per year and CER prices to be around €2-3 per CER, after transaction costs. The authors conclude that permit prices and thus the supply market of the CDM depend on the stringency of targets in a potential second commitment period.

1.3.2. Main demand market for CDM derives from the European Union

The largest demand market for the CDM is in the European Union. While hopes for a second commitment period were not met, the European Union decided unilaterally to extend its Kyoto target to a 20% reduction goal to be achieved by the European Union by 2020 (Council of the EU, 2008). The establishment of the EU Emissions Trading Scheme and the Linking Directive, which allows the use of JI and CDM credits by EU

ETS participants, have already led to active investor participation in the CDM (Michaelowa, 2004). The European Union established a quantitative limit for the use of project credits from JI and the CDM, and has thus provided a legal framework for EU emitters to use CERs for compliance. In total, the EU allows about 2.3 billion project credits for compliance. About 1.7 billion project credits can be used in the EU ETS, while the remainder can be used in sectors not covered by the EU ETS in the period 2008-2020 (Vasa & Neuhoff, 2011). JI is expected to deliver about 300 million tons of CO2-equivalent up to 2012 (Risoe, 2011). Demand from other industrialized countries such as Japan, New Zealand, and Australia make up about 300 million tons in the current market, but this demand includes the sum of Assigned Amount Units, CDM and JI, while the demand in the EU is only regarding JI and CDM (Linacre et al., 2011). Before 2009, these countries were expected to contribute a larger share of demand for CERs, as it was expected that these countries would implement domestic emission trading schemes earlier (Capoor & Ambrosi, 2009). This expectation has not materialized in practice. As of November 2011, about 80 % of CERs find their way to Europe (Karsten Neuhoff, Schopp, Boyd, Stelmakh, & Vasa, 2012).

1.3.3. Challenges for additionality of CDM projects

Whether the CDM goals have been achieved at the project level has frequently been called into question. For instance, Michaelowa & Purohit (2007) and Schneider (2009) show that credits generated from certain CDM projects are not additional, meaning that the project would also have been implemented in the absence of the CDM. These authors base their findings on an in-depth review of CDM project project documentation. They argue that project developers have frequently made the claim that projects are not financially viable and face certain barriers that would make CDM support necessary. Michaelowa & Purohit (2007), for instance, show that project developers have omitted tax benefits from their calculation to make the project seem less economically viable, in order to fulifll the condition for additionality. Schneider (2007) has shown that companies have used company-internal profit benchmarks to suggest that a proposed project does not meet these, i.e. making the project additional. Furthermore, Haya (2007) finds that many of the large hydroelectric power plants in China are likely to be non-additional, and Wara & Victor (2008) show that all new hydroelectric installations in China have applied for CDM status.[13] Arguing that most of large hydro plants require long lead times and government involvement, Haya & Parekh (2011) question the additionality of these projects. A similar conclusion is

[13] In addition to hydro power plants, Wara & Victor (2008) also show that all new wind and natural gas capacity in China applies for CDM status.

drawn by Hahn & Richards (forthcoming), who however conclude that there is a lack of insufficient empirical research on the CDM.

1.3.4. Challenges for sustainability of CDM projects

Where sustainability is concerned, scholars have long argued the need for the concept of SD to be defined and to be incorporated in the cost of abatement. For instance Kolshus, Vevatne, Torvanger, & Aunan (2001) create criteria for SD that incorporate health, poverty alleviation and employment benefits. Without monetising these benefits, the abatement costs of reducing emissions is positively correlated with the level of SD. That means that low abatement costs of an activity suggest that this emissions reduction activity will confer low SD benefits and vice versa. Thus, monetising the SD benefits in the CER price is crucial to achieve higher SD benefits. In the same vein, following an extensive review of the literature on SD, Olsen (2007) argues that if the CDM is left to market forces, it will deliver no SD benefits. Indeed, the literature on achievement of SD argues that sustainability criteria have not played a role in the decision to pursue a CDM project (Schneider 2007). To remedy this situation, scholars recommended taxing low-SD projects (Muller 2007), and reforming the CDM by applying multiple indicators (Nussbaumer, 2009) as well as a verification standard for SD criteria (Olsen & Fenhann, 2008) aimed at checking whether benefits claimed in project documentation have been realised.

1.3.5. Challenges for cost-effectiveness of CDM projects

Cost-effectiveness provides the main rationale for industrialised countries to participate in the CDM.[14] It has two principle aspects: First, projects in developing countries should be conducted at the lowest possible costs. Second, the use of the CERs generated from the projects in the compliance market should be as cost-effective as possible. Concerning the first aspect, transaction costs played a large role in early discussions on the CDM, as illustrated above. However, as Woerdman (2001) has shown, the CDM (and JI) can have lower transaction costs than the alternative, international emissions trading[15] between industrialised countries, if there are only a small number of buyers and sellers in IET, and if standardised baselines can be used in the CDM (and JI).[16] This is the case in practice, as the CER market is much more liquid than the Assigned Amount Unit market (Linacre et al., 2011).

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[14] See for instance, Ogus (2006, pp. 290–292) for the relevance of cost-effectiveness in law and economic analysis.
[15] See section 1.1 above.
[16] Indeed, there has been a lack of trading in AAUs, the currency of IET in comparison to CERs from the CDM (Grubb et al., 2010) See also Footnote 8. An additional reason next to the number

In general terms, cost-effectiveness is determined by the difference between the price paid for domestic emissions reductions and the price paid for a CDM project in a developing country. However, as an effect of the market system, the price paid for emissions reductions in developing countries confers a rent that is equal to the difference between the market price and the actual abatement costs. In practice, Wara (2008) has shown that a particularly strong greenhouse gas, HCF-23, could have been reduced at a fraction of the costs had it been regulated through traditional command and control regulation rather than through the CDM market system. The main reason is that the destruction of one ton of HFC-23 is equivalent to reducing 11,700 tons of CO2-equivalent, and that the destruction process is relatively cheap at below one Euro per ton of CO2-equivalent (Green, 2008; Wara & Victor, 2008). Wara (2008) estimates that direct regulation would have cost €26 million, while 10 to 30-times that amount of funds was transferred to these projects under the CDM. The large rents conferred to these projects call the cost-effectiveness of the mechanism into question, especially because although these projects constitute a small number (less than 1 % or 22 projects) of the 3,000 projects registered by November 2011, they will produce one fifth of all CERs expected from the CDM by the end of 2012 (Risoe, 2011).

The second aspect of cost-effectiveness lies in the compliance market. This aspect has been somewhat side-lined in the literature. The main driver for industrialised countries to adopt the CDM was cost-effectiveness (e.g. Heller, 1996). Indeed, the focus was primarily on the macroeconomic cost gains from the CDM which were examined in model simulations (Bollen et al., 1999; Weyant & Hill, 1999) and which were aimed at showing the inefficiency of a limit on the use of CDM (supplementarity) (Klepper & Peterson, 2005). Surprisingly, there has been no study on the use of the CDM in the compliance market so far so aimed at demonstrating inefficiency using empirical data. The European Union offers a particularly interesting case for such a study, as it is the largest market that also has set quantitative limits on the use of CDM for compliance in the EU ETS (Council of the European Union & European Parliament, 2009; Linacre et al., 2011).[17] De Cendra de Larragán (2006) points to the allocation of rent established through the right to use offsets, as do Gorecki et al. (2010) for the non-ETS sector. This could potentially lead to large rents conferred to emitters. However, there is no

of small buyers was the reluctance of some industrialised countries to buy the "hot air" from Eastern European economies that profited from a large AAU budget due to the economic restructuring.

[17] Woerdman (2002) illustrates, using in-depth interviews with key EU policy-makers, that the EU accepted a quantitative supplementarity limit on the basis of equity for developing countries. Developing countries feared that industrialised countries would buy themselves out (see section 1.2). The EU policy makers wanted to signal to developing countries that they are serious in their efforts to combat climate change.

empirical study of this issue for the EU ETS. The analysis conducted in the present book is an empirical assessment of how CDM limits were implemented in the EU ETS, and what the effects of the current rules are.

To summarize, the brief literature review above illustrated some of the main challenges identified in the literature with regards to the goals of the CDM: additionality, cost-effectiveness, and sustainable development. There seems to be a trade-off between the delivery of these goals, especially cost-effectiveness and sustainable development. Low-cost abatement opportunities are often also accompanied by low sustainable development benefits. As SD benefits are not included in the CER price, SD seems not to be a decisive factor in the decision to pursue a project. Furthermore, there seems to be some indication of gaming by actors within the CDM system in order to gain financial support through the CDM, for instance by omitting positive cash-flows in the investment calculation. The inclusion of non-additional projects in the CDM increases global emissions and endangers environmental integrity. Regarding cost-effectiveness, the literature shows a large share of CERs (from HFC-23 projects) is bought at a much higher price than actual abatement costs, suggesting that the CDM has not achieved its cost-effectiveness objective. Furthermore, while the compliance market has been studied through macroeconomic model simulations, no empirical study exists of the use of CDM for compliance in practice.

1.4. Research question

In light of the literature reviewed above, this book assesses whether the CDM is an effective tool with which to achieve additional, cost-effective and sustainable mitigation in developing countries. Catching two birds with one stone is difficult, as Tinbergen (1952) argued when he wrote that at least one policy instrument is needed for each policy goal. In the case of the CDM, the main objective is to reduce emissions, but this should be conducted in a cost-effective manner and support sustainable development in developing countries. Does the CDM achieve these objectives? If the CDM is found to be ineffective in achieving its goals, what can be done to align the instrument with its objectives? From the description of the CDM procedures and the literature review, the question arises whether the institutional framework provides the right incentives to the various private and public actors to fulfil their responsibilities with regards to additionality, sustainable development, and cost-effectiveness.

1.5. Method

To answer these questions, the analysis in this book applies law and economics, i.e. economic theory using neoclassic environmental economics and public choice. It assumes that actors involved in implementing and using the CDM are conscientiously calculating the costs and benefits of their actions. It is thus important to first understand what the costs and benefits of these actions are, and in a second step, to analyse whether the institutional design can alter the cost benefit calculation in favour of the CDM objectives. According to Korobkin & Ulen (2000) there are four notions that can be distinguished in rational choice theory, which is a key element in neoclassical economics. In order of their falsifiability, they are: definitional, expected utility, self-interest, and wealth-maximisation. The authors argue that wealth-maximisation is the most testable of these, because it is possible to observe both the ends (e.g. financial wealth) as well as the means (e.g. decisions). In the context of this analysis, this definition of rational choice is applied in an attempt to understand the incentives of the various actors within the CDM system. According to rational choice theory, private actors are assumed to weigh their decisions carefully in terms of the costs and benefits of each decision, so as to maximise wealth. Similarly, it is assumed that governments act rationally so as to maximise wealth, for instance by maximising tax revenue available for climate and non-climate ends.

Six actors have been distinguished within the framework of the CDM, (see section 1.2.1.3). Three of these are private actors: the compliance CER buyer, the project developer, and the auditor. The other three are public actors: the government of the host country, the government of the buyer country, and the CDM executive board. In the following, the costs and benefits involved in the different decisions to be taken by these actors are described, in order to form hypotheses about their behaviour. These hypotheses guide to answer the question whether the CDM achieves its objectives in theory and practice and if not what can be done to improve the CDM's performance. The costs and benefits for actors in the supply stage are first addressed, followed by those in the compliance stage (the government of the buyer country and the compliance buyer).

1.5.1. Hypotheses

In the supply stage, the main actors are on the one hand private actors, the compliance buyer, the project developer and the DOE. On the other hand are the host country DNA and the EB.

The project developer supplies CERs to the compliance buyer. As the compliance buyer is interested in achieving target compliance at the lowest possible cost, it will search for a project developer that can deliver the emissions reductions at the least expense. The project developer in turn is faced with the decision of whether to conduct an emissions reduction project or not. It will only do so if the benefits outweigh the costs, in other words, the benefits of a project under the CDM have to be greater than the cost of conducting the same project without the CDM. This is a standard business practice, as projects that do not lead to profit are generally not conducted.[18] The project developer would normally choose the project that yields the largest profit.

In the presence of the CDM, project developers are faced with an additional choice. They can either a) pursue the project that would have been selected in the absence of the CDM, without applying for CDM status, b) conduct another project that is more profitable under the CDM, but which would not have been chosen without CDM support, or c) apply for the CDM status with the project that is already the most profitable without CDM support. Assuming that these three options have increasing profitability (Profitability Option A < Option B < Option C), the project developer will choose Option C, all else equal. However, Option C means that a project that would also have been conducted without the CDM will generate CERs for the compliance buyer, thus serving to increase global emissions if used for compliance purposes. However, assuming that project developers want to maximise their own wealth, making a project that was already profitable yet more profitable is rational.

However, independent of whether option B (additional project) or C (non-additional project) is selected, applying for CDM status implies transaction costs, which are primarily constituted in documentation and proving that the project is additional, and in payment of the DOE for verification of the documentation provided by the project developer. Assuming that there is no additional "penalty" besides the transaction costs lost should the project be rejected, the project developer will apply for CDM status if the benefits of CDM registration outweigh the transaction costs. The benefits, in turn, are dependent on the multiplication of the volume of CERs generated by the project, the CER price to be achieved, the probability that the DNA will confirm the project's sustainability, the probability that the auditor validates the project positively, and the probability that the executive board registers the project.

The project developer has incentives to influence all of these five variables, but will likely only try to influence the first four in the exclusion of an outright attempt to bribe the executive board. First, it wants to maximise the expected volume of CERs (Michaelowa, 2005). An attempt to do so in a fraudulent way, however, might be detected by the DOE or the CDM-EB and thus decrease the probability of final registration. However, the fraud does not trigger any other sanctions against the project

[18] That is to say, there are instances where businesses make losses; however, these businesses will exit the market unless these losses cannot be compensated by profit elsewhere.

developer. Fraud that has not properly been detected by the DOE however can trigger a sanction against the DOE. Second, the project developer increases its chances for DNA confirmation by claiming sustainable development benefits that fit the DNA's demands (Olsen & Fenhann, 2008). Third, it can contract with the compliance buyer for a high CER price, however, the compliance buyer will make the price dependent on the probability of registration and on the availability of other options to buy CERs in the market. If the compliance buyer can find cheaper CERs elsewhere, the project developer has to accept a lower CER price. Fourth, the project developer can offer the DOE a performance fee that is only payable if the project achieves registration, in order to increase the chances of a positive DOE opinion. These extra efforts must be outweighed by the increased probability of registration. This leads to the following hypothesis:

> *Hypothesis I: The project developer maximises the profit from project registration by optimising the volume of Certified Emission Reductions, their price, and the probabilities of approval by the designated operational entity, the Designated National Authority, and the Executive Board.*

The DOE is paid by the project developer and licensed for operation by the Executive Board. The Executive Board can withdraw this license at any time if the auditor is found not to be performing its auditing tasks. The DOE is dependent on commission fees from project developers to finance its auditing business. Assuming that the more auditing contracts it has with project developers the better it is for the DOE, the DOE will attempt to maximize the number of projects it audits. A project developer aiming at CDM registration will chose the DOE with the best track-record for auditing projects positively. If a particular DOE has declined a large number of projects, project developers will look for another, more lenient DOE. Thus, DOEs compete for business and have an incentive to exercise lenience in determining additionality and calculating CER volumes (Betzenbichler, 2004; Schneider, 2007; Schneider & Mohr, 2010). However, in doing so, the DOE runs the risk of losing its license by the EB. The probability of this happening is dependent on the extent to which malperformance on behalf of the DOE can be observed or, more precisely, the cost for the EB, and the financial capacity of the CDM-EB to detect DOE mal-performance. This leads to the following hypothesis:

> *Hypothesis II: The Designated Operational Entity will maximize project business while minimising the risk of losing its operating license.*

The host country DNA aims at maximising a combination of project inflow and sustainable development benefits. The number of projects conducted in the host country increases financial inflow to the country and can lead to increased economic activity if directed towards additional projects. Furthermore, SD benefits can potentially alleviate poverty, health and employment concerns. According to economic theory a host country DNA maximises the combination of large financial transfers and SD benefits. There is, however, competition for projects among different host countries, as well as within the host country. As long as SD benefits have no value in the compliance market and countries offer similar abatement opportunities, DNAs will lower their SD criteria so as to maximise project inflow. The value of SD benefits is a function of international requirements of a certain level of sustainability to be achieved by each project, and the unilateral sustainable development requirements by industrialised countries to use CERs (Haya & Parekh, 2011; Olsen & Fenhann, 2008). Thus, the DNA aims to satisfy the demand market, which is driven by the compliance buyers' demand for low-cost CERs. The DNAs of countries with a large volume of low-cost abatement opportunities have a monopoly/oligopoly position in the CER market and can impose higher requirements (e.g. higher SD standards, taxes or even prices) without sacrificing project inflow (Muller, 2007). The DNAs would do that if higher SD standards do not reduce the financial inflow from projects. This is the case if the additional cost due to higher SD standards still allows the country to sell CERs at lower costs than other CDM host countries, and still at a CER price below domestic abatement costs in industrialised countries. Furthermore, the DNA is subject to interest groups within the respective host country, which want to influence the definition of sustainable development so as to include their technology in the definition. This leads to the following hypothesis:

> *Hypothesis III: Designated National Authorities compete for project inflow and will thus engage in regulatory competition that leads to a "race to the bottom" of sustainability criteria, unless the DNA's country holds a monopoly/oligopoly position in the low-cost abatement market.*

The Executive Board is interested in maximizing the number of registered additional projects and safeguarding the environmental integrity of the CDM. At the same time, the members of the Executive Board are interested in maximizing their own wealth, which could be achieved by seeking promotions within the regulatory system or attaining other higher government positions (Flues, Michaelowa, & Michaelowa, 2009). CDM-EB members benefit from scrutinizing CDM projects in that they demonstrate their ability to fulfil their mandate. Thus, the cost of scrutinizing CDM projects is expressed in the effort and expertise needed to conduct the work. Additional costs arise for CDM-EB members where their mandate as board members interferes with the interests of host country DNAs to maximize project inflow. This leads to the following hypothesis:

> *Hypothesis IV: Executive Board members maximise the volume of additional projects to be registered subject to their expertise and in avoidance of any costs imposed by a conflict of interest with their country of origin.*

At the compliance stage, the compliance buyers of CERs are interested in minimizing their total *private* compliance costs (Weyant & Hill, 1999). Assuming an emissions trading scheme such as the EU ETS, compliance buyers aim at minimizing their total abatement costs by using the cheapest mitigation options first and selling or banking the more expensive options for later (e.g. Anger, Böhringer, & Moslener, 2007; Klepper & Peterson, 2005). If compliance buyers have been allocated any emissions rights for free, these rights can be exchanged for CERs if that trade yields a profit. The costs of doing so are determined by the transaction costs for procuring CERs in the supply market and the costs associated with trading in the ETS market. This leads to the following hypothesis:

> *Hypothesis V: Compliance buyers aim at minimizing the target compliance costs. This can be achieved through arbitrage of emission rights against Certified Emission Reductions.*

The buyer country wants to minimize the costs of achieving the emission reduction target at the (*country) society-level* (Böhringer, Löschel, Moslener, & Rutherford, 2009; EU Commission, 2008). At the same time, the government wants to keep the use of government budgets for emissions reductions to a minimum, where these expenditures are in competition with other expenditures for infrastructure, health care or education, just to name a few. If the budget available for these other purposes is eroded by government spending on the climate, it can carry a cost for the government in terms of declining constituent support, i.e. voters. However, if emissions reduction costs are directly internalised by companies, these companies can pass the costs of climate regulation on to consumers (or taxpayers). While this loose interpretation of indirect spending of consumer tax money is more difficult for consumers to detect, governments will want to minimize adverse impact as a result of distributional policies. This leads to the following hypothesis:

Hypothesis VI: Governments aim to minimize the costs imposed on society by emissions reduction targets by pursuing the lowest cost policy and maximizing the revenue available for climate and non-climate issues, so as to be able to compensate potentially adverse effects from the emissions policy.

As discussed above, the main research question of this book is whether the CDM achieves its objectives of cost-effectiveness, the promotion of sustainable development, and additionality? If the CDM is found to be ineffective in promoting its goals, what can be done to align the instrument with its objectives? The six hypotheses in this section guide the analysis in the following chapters. After a survey of the institutional procedures for conducting a CDM project in Chapter 2, the following questions will be addressed in the respective chapters:

1) Chapter 3: How has the CDM performed in practice? Can potential inefficiencies be addressed by an alternative approach?
2) Chapter 4: What incentives exist to set the appropriate benchmark for the CDM additionality test? A case study of renewables projects in India and China.
3) Chapter 5: Has the EU implemented the CDM efficiently?

Chapter 3 answers the research question whether the CDM has been effective in achieving its goals in practice. The chapter focuses on the question, whether the institutional framework at the supply stage generate cost-effective, sustainable and additional projects. Chapter 4 analyses renewable energy projects and their additionality. The chapter analyses data on a subset of the projects examined in Chapter 3. Chapter 5 analyses whether the European Union, the prime demand market, has established an institutional framework that maximises the benefits of the CDM. Chapter 5 thus fills a gap in the existing literature on the CDM which mainly focuses on how CDM projects and credits are generated, rather than how credits are used.

1.6. Scope

This dissertation applies economic theory and uses neoclassic environmental economics and public choice in order to draw general lessons for the institutional design of climate policy instruments. The CDM exemplifies the interaction between the administrative and institutional design of market instruments, the presence of information and transaction costs, and the divergence of public versus private interest. These challenges are also present in other contexts such as health care, the insurance sector, and the financial market in general. Effectively dealing with these issues and their interaction with other policies enables policy-makers and academics to make better public policy choices in the future.

The boundaries of the research are set by the international legal framework of Article 12 of the Kyoto Protocol and the Marrakech Accords, which determined procedures for the CDM. Furthermore, frequent use will be made of guidance by the CDM Executive Board, which has established and changed at times the rules for registering a project within the project cycle (UNFCCC, 1997a, 2001, 2005a, 2005b). Furthermore, this dissertation examines EU legislation governing the EU Emissions Trading Scheme with respect of CDM project credit use (Council of the European Union & European Parliament, 2009).

This study does not address cost-benefit analysis and the scientific debate on target-setting. The adequacy of Kyoto targets and the 2020 targets of the European Union is not disputed and these targets are taken as given. The study also does not address the literature on new market mechanisms and nationally appropriate mitigation actions (NAMAs). The discussion on nationally appropriate mitigation actions on the terminology, typology as well as a common understanding is currently evolving (Upadhyaya, 2012). Sectoral trading and crediting systems, brought forward to address emissions in developing countries and competitiveness and leakage concerns, also fall outside of the scope of this dissertation. All of these mechanisms are not operational at the time of writing of this dissertation and an empirical assessment is therefore not possible.[19] In addition, sectoral approaches, while theoretically able to address competitiveness concerns, are practically difficult to implement. Sectoral approaches comprise in essence three options (Baron, Buchner, & Ellis, 2009; Meckling & Chung, 2009):

a) Sectoral crediting: intensity targets operationalized through pre-set CO2/output benchmarks, where the sector receives credits when the benchmark is surpassed,

b) Sectoral trading: fixed targets with ex-ante allocation of allowances and subsequent trading, and

c) Technology approaches: a sectoral technology-based cooperation in research and development and technology transfer

[19] However, experience with the CDM can and has been used to inform discussions on the design of these instruments. For a good overview of the discussion of sectoral approaches and their strength and weaknesses see Chapter 6 in Karsten Neuhoff (2011).

According to Meckling & Chung (2009, pp. 19–23) the discussion around sectoral approaches is based on the competitiveness agenda of industrialised countries and the technology transfer agenda of developing countries. Industrialised countries and their industries prefer a fixed or intensity targets approach so as to create a level playing field for industry. Fixed targets were consistently rejected by developing countries at both the national and the sectoral level and thus it became apparent that sectoral trading is not a politically feasible option in the medium term. Intensity targets bear the challenge on how to distribute credits after a sector has achieved a particular benchmark. Good performance by companies in a sector can be offset by bad performance by other companies (Baron et al., 2009, p. 23). Thus, intensity targets run the risk of not providing direct incentives for good performance. Furthermore, data gathering and benchmark-setting is less controversial for sectors with homogeneous products such as cement and steel, than it is for instance for chemical products with a large variety of production processes. In addition, Baron et al. (2009, p. 15)caution that the potential credit supply from intensity targets would potentially surpass demand from industrialised countries in the presence of CDM credit supply. This would require a careful assessment of industrialised country targets, and of the interaction with CDM (Baron et al., 2009; Meckling & Chung, 2009). At the same time, sectoral technology cooperation and transfer approaches preferred by developing countries, do not address the industrialised countries' criteria of cost-minimisation and competitiveness. Summarising, the proposed sectoral approaches do not fulfil simultaneously the interests of both industrialised and developing countries, as the CDM does (Heller, 1996; Wiener, 1999). A further discussion and analysis of sectoral approaches is beyond the scope of this book.

The CDM is only one element in the mix of national and international policies. It is not in the scope of this work to illustrate the interaction of the CDM with other energy-relevant policies, such as fossil fuel subsidies still in existence in several countries (see e.g. Cust & Neuhoff, 2010). Examples will be provided, however, where the interaction with national policies leads to positive or negative effects with regards to the goals of the CDM. The latest developments in the design of the CDM and the EU ETS up to November 1, 2011 are taken into account.[20]

[20] Political, legal and economic developments that occurred after this date cannot be taken properly into account in this thesis. Thus, the relevant CDM decisions taken at the UNFCCC conference in Durban in December 2011 have not been addressed here.

1.7. Synopsis

Chapter 2 provides an overview of the institutional procedures of the CDM. It serves as a basis for the analysis in chapters three to five. At the same time, each chapter is to some extent self-standing, and includes a brief introduction to the CDM and its relevant concepts where necessary. Thus, readers familiar with the concept of the CDM can skip these parts in chapters three to five.

Chapter 3 approaches the CDM from the supply side.[21] Guided by Hypotheses I through IV, the analysis aims to show the effects of different actors' actions on the CDM market with the use of the marginal abatement cost concept. The hypotheses are mainly approached via a review of the literature addressing how the CDM achieved its three objectives of cost-effectiveness, sustainable development and additionality. Furthermore, publicly available data from the CDM Pipeline (Risoe, 2007, 2011) will be used to assess the rents conferred to CDM host countries and how the EB, DOEs and project developers took decisions with regards to projects up to November 2011. Previous analysis has been primarily based upon in-depth case studies of samples of registered projects. This analysis aims to apply a high-level categorization to sustainable development and abatement costs found in the CDM literature. Lastly, the chapter assesses whether an alternative funding approach would be better suited to align the incentives of actors in the CDM to achieve the three objectives.

Chapter 4 examines how the benchmark rates used in the determination of additionality have been selected over time in India and China. The chapter implicitly relates to Hypotheses I and III and aims to show that both the project developer and the host country want to maximize project inflow and will thus set the benchmark rate strategically so as to achieve this goal. The chapter analyses how benchmark rates have changed over time by focusing on the two main renewable technologies, wind and hydro, in the two principal CDM host countries India and China. These countries differ within the benchmark test mainly because one uses a fixed rate (China) and the other a flexible rate to be chosen by the project developer (India). This chapter intends to show that, faced with the flexibility to choose, Indian project developers will select benchmark rates that maximise their expected wealth (Hypothesis I) and, when fixing the benchmark rates, governments will aim to maximize project inflow (Hypothesis III). The analysis is conducted using publicly available benchmark rates and project information from Institute for Global Environmental Strategies (IGES, 2010).

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[21] The literature review in this chapter is a reworked version of a Climate Strategies report written with Karsten Neuhoff (Vasa & Neuhoff, 2011).

Chapter 5 analyses the CDM from the compliance dimensions on how the CDM has been used by emitters in industrialised countries emitters.[22]It thus completes the picture on the life-cycle of a CDM credit from generation to actual usage. Such an assessment has to the author's knowledge not been conducted previously and is an important link between previous macroeconomic model simulations aimed at showing the inefficiency of limits to the use of CDM in emissions trading markets and the actual implemention of such limits. This chapter is aimed at showing how the European Union has implemented the CER limits, using the example of the EU Emissions Trading Scheme. The right to use CERs in the EU ETS entails a value for emitters, the impacts that such a rent has will be assessed. Hypotheses V and VI guide the analysis and aim to show that by conferring the right to use CERs for free, the EU is creating windfall profits for emitters. Options to capture this rent and apply it towards increasing abatement are discussed. The chapter applies comparative statistics and uses publicly available empirical data from the EU ETS Community Independent Transaction Log on verified emissions, allocation of EUAs and surrendered CERs in the EU ETS for the year 2008 (CITL, 2010).

[22] This chapter is a slightly reworked version of an article recently published in Climate Policy (Vasa, 2011).

Appendix 1: Overview of CDM project types

Table A 1.1 Registered CDM project types November 2011

Type	Number of registered projects	Share of CERs expected 2012
Afforestation	5	0,03%
Biomass energy	391	5,36%
Cement	19	1,02%
CO2 usage	2	0,01%
Coal bed/mine methane	51	3,99%
EE households	26	0,13%
EE industry	64	0,47%
EE own generation	196	6,12%
EE service	5	0,02%
EE supply side	28	0,59%
Energy distribution	5	0,22%
Fossil fuel switch	67	5,98%
Fugitive	21	2,40%
Geothermal	12	0,61%
HFCs	22	22,50%
Hydro	1064	15,09%
Landfill gas	210	7,83%
Methane avoidance	411	3,37%
N2O	66	11,72%
PFCs and SF6	14	0,55%
Reforestation	27	0,61%
Solar	46	0,10%
Tidal	1	0,05%
Transport	10	0,18%
Wind	793	11,08%
Total	**3556**	**100,00%**

Source: Risoe (2011)

Appendix 2: Kyoto Protocol targets

Table A 1.2 Kyoto Protocol targets for commitment period 2008-2012

Country	GHG emissions (2008-2012) relative base year	Base year
Australia	8%	1990
Austria	-8%	1990
Belgium	-8%	1990
Bulgaria	-8%	1988
Canada	-6%	1990
Croatia	-5%	1990
Czech Republic	-8%	1990
Denmark	-8%	1990
Estonia	-8%	1990
European Community	-8%	1990
Finland	-8%	1990
France	-8%	1990
Germany	-8%	1990
Greece	-8%	1990
Hungary	-6%	average 1985-1987
Iceland	10%	1990
Ireland	-8%	1990
Italy	-8%	1990
Japan	-6%	1990
Latvia	-8%	1990
Liechtenstein	-8%	1990
Lithuania	-8%	1990
Luxembourg	-8%	1990
Monaco	-8%	1990
Netherlands	-8%	1990
New Zealand	0%	1990
Norway	1%	1990
Poland	-6%	1988
Portugal	-8%	1990
Romania	-8%	1989
Russian Federation	0%	1990
Slovakia	-8%	1990
Slovenia	-8%	1986
Spain	-8%	1990
Sweden	-8%	1990
Switzerland	-8%	1990
Ukraine	0%	1990
United Kingdom of Great Britain and Northern Ireland	-8%	1990
United States of America*	-7%	1990

*Not Party to the Kyoto Protocol - Source: (UNFCCC, 1997a)

2. PROCEDURES AND ACTORS WITHIN THE CDM AND THE EU EMISSIONS TRADING SCHEME

The Kyoto Protocol is based on the United Nations Framework Convention (UNFCCC), which was established in 1992 and ratified in 1994.[1] The Kyoto Protocol set legally binding emission reduction targets for 37 industrialised countries.[2] These countries agreed to reduce anthropogenic emissions of six greenhouse gases (GHGs) to 4.2% below 1990 levels during the Kyoto commitment period, 2008-2012 (UNFCCC, 1997, Article 3).[3] These targets have set a cap on the emissions of the countries involved.[4] To achieve their emission reduction targets, industrialised countries distribute the responsibility to reduce emissions among national emitters, usually private entities. Developing countries did not agree to any emission caps and thus their emissions are not limited.

Reducing emissions in developing countries is possible at lower costs than in industrialised countries (Hoglund et al., 2009; Wetzelaer et al., 2007). One example is that many industrialised countries already achieved a certain degree of energy-efficiency which translates in a lower carbon intensity of industrial and power production. Conversely, in developing countries, the available power generation and industrial infrastructure is more carbon intensive and much of the infrastructure still has to be built. It is thus assumed that installing energy-efficient low-carbon technology in developing countries is cheaper than retrofitting existing infrastructure in industrialised countries.[5] Therefore, both industrialised and developing countries can benefit from finding an instrument that encourages emission reductions where they can be conducted at lowest cost.

The Clean Development Mechanism allows emitters from industrialised countries to achieve part of their emission reduction target with emission reductions accomplished through distinct projects in developing countries.[6] To achieve their emission reduction target, industrialised

[1] Readers familiar with Chapter 1 can skip the introduction to section 2.1. Readers familiar with the CDM procedures, its actor and the EU ETS can skip this chapter and continue with Chapter 3.
[2] Each country that has ratified the Kyoto Protocol is a Party to the treaty. The European Union has also joined the Kyoto Protocol as a Party. Parties to the Protocol are differentiated between “Annex I”, i.e. industrialized countries and “Non-Annex I”, i.e. developing countries.
[3] With United States ratification of the Kyoto Protocol, the average target would be 5.2% below 1990 levels (see also Chapter 1 Footnote 3).
[4] To track their progress towards this goal, industrialised countries agreed to monitor, report and verify (MRV) their GHG emissions on an annual basis.
[5] High-carbon technologies are defined in terms of the volume of GHG emitted per unit of product output. This includes production of output such as steel and cement, and electricity. Low-carbon technologies are technologies that emit less GHG emission in the production process. In the power sector low-carbon technologies relate to renewable energy technologies such as wind, hydroelectric power plants, solar and geothermal.
[6] The CDM is one of four flexibility mechanisms of the Kyoto Protocol, and the only one that motivates emission reductions in developing countries. The other mechanisms are emissions trading between industrialised countries, the bubble mechanism used by the European Union to achieve its goal jointly, and joint implementation between industrialised countries. JI is a project-based mechanism similar to

countries usually distribute responsibilities to reduce emissions to emitters within their territory. By paying for emission reductions in developing countries using the CDM, an industrialised country can lessen the domestic reductions needed to achieve its own target. CDM projects in developing countries generate CERs.[7] Each CER allows an industrialised country emitter to lower its domestic reduction effort by one ton of CO_2. Besides generating cost-efficient emission credits, the CDM is to further sustainable development in the countries hosting projects.

In order to generate CERs, CDM projects need to be registered with the CDM EB (UNFCCC, 2001). [8] The CDM-EB is in charge of CDM administration, meaning they ultimately decide whether projects are registered or not. To do so, they should be sustainable, cost-effective and additional to any that would have happened anyway (UNFCCC, 1997). The registration of projects follows an institutionalised procedure frequently called the "project cycle".

CDM projects can be developed by companies from the host country (so-called unilateral CDM) or through investments by companies from industrialised countries; the latter is however rare (Michaelowa, 2007).[9] The emission reductions from a CDM project are calculated against the baseline emission scenario, i.e. the emissions scenario of what would have happened without the project's implementation. The difference between this baseline emissions scenario without the project and the emissions of the project are the emission reductions generated by the project, which are then issued as CERs. Emitters from industrialised countries or their

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the CDM, which generate emission reduction units. The main difference is that JI is conducted in industrialised countries, and that any emission reduction units generated are deducted from the emission cap. While JI is also challenged by setting a baseline (see following paragraph) emission reduction units cannot inflate global emission emissions beyond the cap from industrialised countries (Hoogzaad, 2009).

[7] Developing countries were initially strongly opposed to such an instrument (see also Section 1.2 in Chapter 1). They favoured a compliance fund, called the clean development fund (CDF) for industrialised countries (Cole, 2010; Olsen, 2007). The CDF, proposed by the Brazilian delegation in 1997, would collect penalties from industrialized countries which exceed their emission limitations and channel the proceeds to developing countries (UNFCCC, 1997; Cole, 2010). Industrialized countries opposed the penalty nature of the CDF, and in the last hours of the Kyoto negotiations, the concept of the CDF was changed to the CDM (UNFCCC, 1997a; Werksman, 1998). Chapter 3 of this book compares the two instruments using static analysis.

[8] The CDM-EB is made up of ten experts from ministries of Kyoto ratifying developing and industrialised countries. To ensure the independence of CDM-EB decisions, board members must act in their own personal capacity (UNFCCC, 2005: para 8c) and notify conflicts of interests when they arise (UNFCCC, 2005: Rule 10 (2)). A violation of this principle can lead to suspension of the respective board member (UNFCCC, 2005: para 10-11 and 4/CMP.1 Rule 7-8). CDM-EB fulfils both a rule-making and rule-enforcing role. Decisions by the CDM-EB are legal documents denoted by the respective meeting when the decision was taken (e.g. EB2 denotes the second meeting of the executive board). Decisions of the CDM-EB can be divided into three main classes (Netto & Barani Schmidt, 2009): 1) Regulatory decisions relating to the supervision of the CDM in implementing its modalities and procedures throughout the project activity cycle, 2) Rulings relating to compliance with the CDM modalities and procedures by the project participants, accredited entities and/or DOEs, such as, accrediting and provisionally designating operational entities, approving methodologies, registering CDM project activities, and issuing certified emissions reduction units, and 3) operational decisions relating to the functioning of the EB.

[9] CDM projects include for example energy-efficiency improvements in industry and power generation, flaring or use of landfill methane gas for electricity generation, the installation of renewable technologies such as wind, hydroelectric and solar.

governments buy the CERs that are generated by the project. The first CDM project was registered in 2003, with the first credits issued in 2005, the year the Kyoto Protocol was ratified (Risoe, 2011). By the end of November 2011, the CDM-EB had registered over 3,000 CDM projects.

The cap on emissions in industrialised countries creates the demand for CERs. Compliance with the Kyoto targets by industrialised country emitters is conducted in three stages:

1) Demand stage: Industrialised countries demand CERs to lower the cost of achieving their individual emission reduction responsibilities
2) Supply stage: CDM projects in developing countries supply CERs to industrialised countries
3) Compliance stage: Industrialised countries use CERs to achieve part of the Kyoto target

In principle, all industrialised countries want to reduce their total compliance costs, and thus there is theoretical demand for CERs from each of these countries. However, industrialised countries need to specify legal procedures that regulate how CERs can be used at the compliance stage, especially when individual emitters have distributed reduction responsibilities. Few countries specified the legal procedures for private entities to use CERs for compliance. An exception is the European Union, which has established an EU-wide emissions trading scheme (EU COM, 2003). In the EU ETS, emitters receive EU allowances that allow its holder to emit one ton of CO2- equivalent (see section 1.1). The European Union has also specified compliance rules for CERs, which confer to its holder the same right as an EUA, and has thereby created the biggest demand market for CERs (Council of the European Union & European Parliament, 2004; Linacre et al., 2011; Michaelowa, 2004; Karsten Neuhoff et al., 2012).

The aim of this chapter is to provide the necessary background to understand and analyse the demand-, supply- and compliance-stage in the following chapters. Firstly, this chapter defines the supply-side. It defines the necessary criteria each CDM project is required to fulfil and the private and public actors involved in the process, the so-called project cycle. The CDM criteria addressed in the project cycle are discussed, in particular: additionality, sustainable development and cost-effectiveness. Particular attention is devoted to the requirements to demonstrate additionality of projects and emission reductions. Secondly, this chapter introduces the compliance market and in particular the rules that govern compliance with CERs in the EU ETS.

2.1 Criteria for successful CDM projects

The CDM specifies three criteria that each project needs to fulfil to receive registration. The CDM should 1) promote cost-effective abatement for industrialised countries, 2) support sustainable development for developing countries (UNFCCC, 1997a), and 3) ensure environmental integrity, i.e. that the CDM does not increase global emissions, the CDM should lead to real, measurable and additional emission reductions. A condition for the use of the CDM by industrialised countries is that the CDM should only be used to achieve part of the targets of these countries. This limitation is called supplementarity criterion.[10]

2.1.1 Additionality safeguards the environmental integrity of the CDM

The CDM requires that only additional emission reductions are certified. Additionality is a key aspect to ensure the environmental integrity of the CDM. By using CERs generated from CDM projects in developing countries, emitters in industrialised countries can increase their emissions beyond their individual country emission caps. The emission reductions in developing countries are thus offset by an increase in emissions from industrialised countries.[11] Additionality therefore requires that only emission reductions are credited that would not have occurred anyway. Otherwise, if industrialised country emitters use non-additional CERs for compliance, the CDM contributes to an increase in global emissions (Greiner & Michaelowa, 2003; L. Schneider, 2007).

Environmental additionality is a measure of how many emissions are reduced by a certain project activity relative to the emission baseline scenario (Baumert, 1999).[12] The emission baseline scenario assumes the emissions that would occur in the absence of the project (UNFCCC, 2001: para 43). The baseline is thus a hypothetical, counter-factual scenario. The estimation of the baseline is described in a baseline methodology. To quantify emission reductions, once the project is implemented, the project's actual emissions need to be monitored through procedures specified in a monitoring methodology. The difference between baseline emissions and monitored emissions from the project is the volume of emission reductions of the project. This is the volume of CERs that should be awarded to the project. The baseline and monitoring methodologies, which are inextricably linked, have to be approved by the CDM-EB for a project to apply them.[13]

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[10] The interpretation of "partly" has an effect on the restriction on the use of the CDM for compliance in industrialised countries. The Protocol uses a different wording for Joint Implementation and International Emissions Trading on one side and the CDM on the other. This difference points towards a difference in intent. Instead of "partly", Article 6 (1d) and 17 of the Protocol state that the use of these mechanisms should be "supplemental" to domestic efforts. One possible interpretation of the difference in wording is that the CDM should be used to a lesser extent than JI and IET (Michaelowa, 2004). Zhang (2001) argues that such a differentiation would lead to replacing the use of one mechanism with the other, thereby rendering the differentiated limits of IET, JI and CDM use inefficient. For the remainder of this book we assume that the use of all flexibility mechanisms shall be "supplemental" to domestic action.

[11] The offset concept was first applied in the US Environmental Protection Agency Clean Air Act (Liroff, 1980). For a comprehensive overview of offset applications, see Hahn and Richards (forthcoming).

[12] Additionality is frequently assessed through the investment analysis test, i.e. whether the project would be implemented in the absence of the revenue from the CDM. Section 2.3 illustrates the different additionality tests to demonstrate project additionality.

[13] To illustrate the information challenges to estimate baseline emissions, one can imagine that all factors that impact emissions directly and indirectly have to be accounted for. These factors include for instance

This section introduced the concept of additionality. The next section introduces the concept of sustainable development.

2.1.2 Sustainable development addresses developing countries priorities

CDM projects should assist developing countries in achieving sustainable development (UNFCCC, 1997). The UNFCCC makes frequent reference to the concept (UNFCCC, 1992).[14] For example, Article 3 of the UNFCCC states that "[...] Parties have a right to, and should, promote sustainable development." However, the UNFCCC does not define sustainable development. At the global level, sustainable development can be defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland, 1987).[15] Chichilnisky (2009) argues that when extinction matters, sustainable development is the level of consumption that avoids extinction. These findings argue in favour of a standard definition that maximises sustainable development at the global level. However, these definitions are difficult to operationalize in practice due to differences in understanding among between different countries what that level of consumption should be and how it should be distributed.

The aim of the CDM is thus to maximise the sustainable development benefits as understood by the different countries involved. Within the CDM, the criteria for sustainable development are subject to CDM host country interpretation (UNFCCC, 2001: para 40a). To establish sustainable development criteria, the host country empowers an institution to act as the DNA.[16] Each CDM project conducted needs to fulfil the sustainable development criteria setup by the respective host country DNA. Thus, CDM projects conducted in different countries are subject to different sustainability criteria.

One argument in favour of country-specific criteria for sustainable development derives from differences in economic conditions in developing countries. In her review of the literature on sustainable development criteria in the CDM, Olsen (2007) distinguishes between three dimensions of sustainable development: social, environmental and economic. The importance of these individual dimensions is different in each country, and varies among others with regional economic conditions. For instance, Markandya & Wilkinson (2007) show that

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energy and non-energy taxes and subsidies that have an effect on emissions. The baseline scenario has to reasonably estimate the effect of these factors to approximate baseline emissions. Appendix 1 to this chapter provides a graphical overview of estimating baseline emissions.

[14] For instance in the Preamble, and Articles. 2, 3 and 4.

[15] Balancing the needs of future generations against present needs involves normative judgments. A standard cost-benefit analysis of discounted utility is ill-equipped to account for the risk of extinction that is inherent in climate change and the absence of sustainable development.

[16] The DNA can be located in an existing government department or ministry (the choice for most host countries), be established as an inter-ministerial committee (e.g. in Brazil) or as a new and independent office (e.g. Indonesia) (Curnow and Hodes, 2009 p. 21).

electricity access is a prerequisite for human wellbeing.[17] The authors argue that providing electricity with renewable energies does decrease the adverse local health effects from fossil-fuel, especially coal-fired, electricity generation.

At the same time, Markandya & Wilkinson (2007) argue that the largest health benefits from electricity generation increase with income up US$7,500 per capita and only slowly beyond that level.[18] As the incremental benefits of health vary with the per capita income level, and this level varies between countries, there is a rationale to differentiate sustainable development criteria between countries. This suggests that multiple interpretations of sustainable development are the result of different national development priorities and economic conditions.

The inclusion of sustainable development as a criterion for the design of a climate mitigation instrument can be understood in the context of international cooperation. Wiener (1999) argues that in the absence of dictatorial decision making, countries need to be made better off to induce them to join an international agreement. Sustainable development is a key term to gather support from different developing countries, despite their diverging priorities, and to induce cooperation when local benefits matter. However, sustainable development goes beyond the side-payment nature for cooperation.

In short, the definition and interpretation of sustainable development depends on the country context. It includes in general also non-climate related aspects. In the context of climate change mitigation, sustainable development can provide a long-term guide for a transformation to a low-carbon economy, which entails higher costs of abatement in the short-term, but lower costs in the long-term. The next section introduces the concept of cost-effective abatement.

2.1.3 Cost-effectiveness minimises global abatement costs

Cost-effectiveness means that an emission reduction goal is achieved by using the least resources necessary (Kolshus et al., 2001). The UNFCCC addresses the importance of cost-effectiveness by stating: "policies and measures to deal with climate change should be cost-effective so as to ensure global benefits at the lowest possible cost."(UNFCCC, 1992 Article 3 para. 3) [19] Abatement costs vary within and between countries. The differential abatement cost between countries can generate cost-effectiveness gains, when abatement is conducted by emitters which face the least cost (Montgomery, 1972). This approach aims an equalization of

[17] As electricity generation from fossil fuels, such as coal, produces additional pollutants such as SO_2, NO_x gases and particulate matters, electricity generation can also impact population health adversely through respiratory diseases.

[18] In detail see Deaton (2004) and Woods (2000).

[19] The second part of Article 3.3 states "To achieve this, such policies and measures should take into account different socio-economic contexts [...]." Thus, while cost-effectiveness is a driving force, socio-economic contexts also determine abatement actions (UNFCCC, 1992). This is an important reason to look beyond cost. This is reflected in the addition of sustainable development to the goals of the Convention.

marginal abatement costs across countries. The gains of this approach are economic surpluses, and the size, potential distribution, and use of these rents are important factors to judge the viability of an instrument. CDM projects should allow industrialised countries to achieve their emission reductions (abatement) cost-effectively irrespective of the location of emissions.[20]

The differential costs to reduce emissions can be illustrated with the comparison of marginal abatement cost (MAC) curves.[21] The MAC curve illustrates the cost of abating one additional unit of emissions, and increases with the quantity abated (see Figure 2.1 for representation of MAC curves in two countries).[22] The slope of the MAC curve determines the cost of abatement: a steeper MAC curve leads to higher cost for abating the same amount of emissions, all else equal.[23] Thus an industrialised country with a steep sloping MAC curve reduces total abatement costs of reaching a pre-defined emission reduction goal, if it can reduce emissions in a country with a flatter sloping MAC curve.[24] The CDM allows emitters in industrialised countries to identify and use cost-effective opportunities in developing countries with flatter MAC curves.

Figure 2.1 illustrates that two countries with different MAC curves have different total costs to achieve the same emission reduction. MAC_A denotes the marginal abatement cost curve of country A (schedule A). MAC_B denotes the marginal abatement cost curve of country B (schedule B). Imagine that emitters in country A and emitters in country B have to reduce emissions by R units each. If country A emitters have to reduce R emissions domestically, their total costs will be equal to the area T_A. The price at which supply meets demand (equal to R) of emission reductions is P_A. If country B emitters have to reduce R emissions domestically, total costs will be equal to the area T_B. At price P_B supply meets demand in schedule B. Schedule A and B show that T_A is greater than T_B. That is because emission reductions in country B cost less

[20] The wording of the Article 12 in the Kyoto allows for partial achievement of compliance through the CDM. (UNFCCC, 1997a: Art. 12). Emission reductions in developing countries shall be supplemental to domestic abatement in developed countries. Section 2.1.4 discusses briefly the implications of this rule, and chapter 5 analyses the implementation of this rule in the European Union.

[21] The MAC curves in this section are illustrated at the country level. The logic can equally be applied at the company and project level. Each unit abated (x-axis) could then be a particular CDM project.

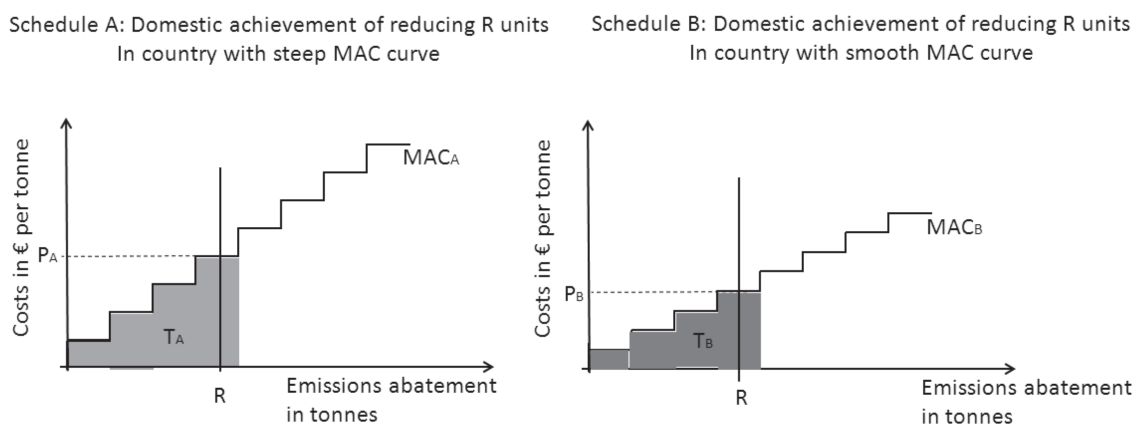
[22] There is viable criticism to the use of marginal abatement cost curves including the non-consideration of ancillary benefits such as health improvements from reduced air pollution (Gohlke et al., 2011; Smith &Haigler, 2008), the static representation of abatement costs for only a single year which does not address path dependency, and the inability of MAC curves to capture wider social implications of climate change mitigation (Ekins, Kesicki, & Smith, 2011). As stated above in the section about sustainable development, cost-effectiveness alone does not account for the wider social implications, including transformational and health benefits from choosing higher cost abatement options. Nevertheless, marginal abatement costs curves despite these shortcomings are a useful tool to illustrate implications on costs. In the further analysis, we will point out where challenges arise and where they cannot be addressed by a view on the marginal abatement cost curve alone.

[23] Thus, when a country can negotiate its own reduction target, instead of it being fully externally imposed, a steeper abatement MAC curve would impose higher costs and thus incentivise the country to negotiate a lower reduction target, all else equal.

[24] For cost-effectiveness opportunities to exist, the MAC curve in the developing country can be steeper relative to the industrialised country curve. The gains from trade would just be smaller. However, it is commonly assumed that MAC curves in developing countries exhibit a smoother slope (den Elzen and de Moor, 2002; Castro 2012).

per unit relative to country A, and because costs are increasing at a lower pace as the slope of MAC_B is flatter than that of MAC_B. Thus, the same target R imposes higher costs on country A relative to country B emitters.

Figure 2.1 Total abatement costs to reduce R units in different countries



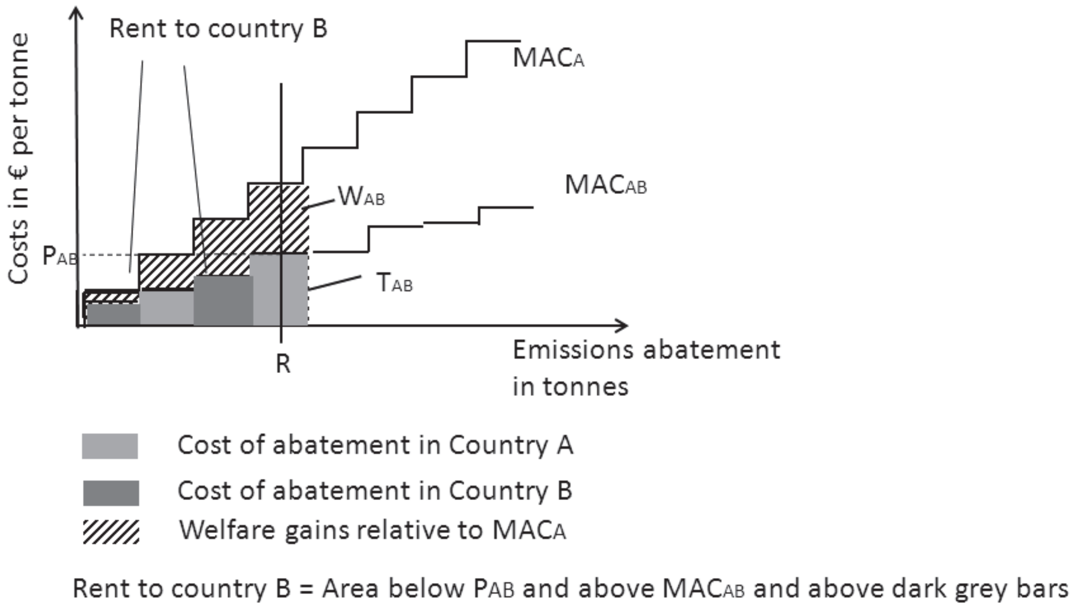
Combining the emission reduction opportunities in country A and B would lead to even lower total abatement costs than reducing R units in country B. Combining the two MAC curves, MAC_A and MAC_B yields a new MAC curve MAC_{AB}. If country A is an industrialised country with a reduction target of R units and country B is a developing country without a target, the lowest costs of achieving the reduction R is for country A emitters to i) achieve part of the reduction in country A domestically, and ii) achieve part of the reduction in country B by paying firms in country B to conduct emission reduction projects.

For illustrative purposes, Figure 2.2 shows that if R is equal to four units to be reduced, country A decrease its total abatement costs to T_{AB} by reducing two units in each country A and B.

Country A pays a price P_{AB} for each unit reduced. As two units are reduced in country B, the difference between the price P_{AB} and the cost of these abated units is a rent to country B. The rent for firms in country B that have implemented the CDM project is equal to the area above the dark grey bars and below P_{AB}. This rent is important as it means that actual emission reduction costs have been lower than the price paid for them.[25] Total costs for country A thus reduce from T_A in schedule A of Figure 2.1 by the hatched area W_{AB}. W_{AB} is welfare improvements for country A. If country A emitters are given the opportunity to abate in country B, this option leads to welfare improvements.

[25] This rent can be used to leverage investments in additional emission reductions (Hepburn, 2009). Section 3.4.3 of Chapter 3 quantifies the rent conferred by the CDM to host countries, and to China, India and Brazil in particular.

Figure 2.2 Combining MAC curves from different countries



The marginal abatement cost view has an important draw-back. It is static and does not incorporate the potential for technological change. For instance abatement from some renewables technologies with a large abatement potential is currently only available at a higher marginal abatement cost. These technologies would be implemented last according to the marginal abatement cost curve perspective. However, with targeted support for these technologies, the technology becomes cheaper due to the learning curve effect and thus shifts leftward along the MAC curve over time (Vogt-Schilb & Hallegatte, 2011). In the long-term, this can reduce the total cost of abating a given volume of emissions and is essential if deep emission reduction targets (e.g. 80% by 2050) are concerned. Natural candidates for these technologies are renewables due to their low-carbon intensity and underlying high abatement potential. Without targeted support the market will need much more time to make renewables cost-competitive with other technologies in the presence of imperfect competition and absence of electricity grid infrastructure suitable for renewables.

2.1.4 Supplementarity increases the slope of the combined MAC curve

Figure 2.2 has shown that part of the abatement necessary for country A to reduce R emission units would occur in country B, the developing country. However, the CDM allows industrialised countries to achieve only part of their emission reduction targets in developing countries.[26] This rule is called supplementarity principle, which aims at ensuring that

[26] This rule was the source of much controversy before and after the adoption of the Kyoto Protocol (Depledge, 2000). Some industrialised countries argued that this would increase compliance costs significantly. These claims were supported by marco-economic modeling of trading of CERs between countries (Weyant & Hill, 1999).

industrialised countries reduce emissions primarily domestically.[27] Quantitatively limiting the volume of emission reductions allowed to be achieved in B-type (developing) countries in Figure 2.2 leads to a contraction of the MAC_{AB} curve. The contracted MAC curve is steeper, but still less steep than both MAC_A and MAC_B. The total abatement costs increase with a contracted MAC curve under the supplementarity rule.

However, in practice, the Kyoto Protocol and subsequent guidance through the Marrakech Accords does not specify any quantitative limit of abatement in developing countries (UNFCCC, 1997, 2001). The European Union has defined supplementarity unilaterally to mean that at least 50% of the EU's emission reduction target should be achieved domestically (EU Com, 2004). The EU thus limits the inflow and use of credits from the CDM for EU target compliance. Chapter 5 analyses the implementation and effects of this rule in the European Union. For the purposes of this chapter it is sufficient to note that according to the CDM rules, the CDM should not be the primary emission reduction strategy of industrialised countries, but that only the European Union has defined the supplementarity limit quantitatively to address equity concerns by developing countries that the EU does "buy itself out" of its responsibility (Woerdman, 2004).

The sub-sections above have introduced and defined the concepts of additionality, sustainable development and cost-effectiveness and supplementarity. Additionality is important so as to only reward projects that actually reduce emissions beyond any that would have happened anyway to avoid an increase in global emissions. Sustainable development is important to address the different sustainable development priorities of developing countries and to maximise benefits beyond emission reductions. Cost-effectiveness is important to achieve the goal at lowest cost. The next section introduces the institutional framework that was established to ensure the above criteria are met.[28]

2.2 Process steps of supply-side of CDM

Each proposed CDM project needs to pass through the institutional framework of the CDM. The steps that this involves are commonly called project cycle. It involves legal responsibilities for public and private actors. The project cycle aims at identifying and registering the projects that fulfil the criteria of additionality, sustainable development and cost-effectiveness and reject those that do not.

[27] Developing countries felt that industrialised countries "buy themselves out" of their responsibility to reduce emissions domestically if they were allowed to reduce a large part or their whole target in developing countries. Furthermore some developing countries felt that industrialised countries would use all low-cost abatement options leaving developing countries only with high-cost abatement options (Akita, 2003; Narain and van 't Veld, 2008; Castro, 2012). Chapter 3 shows how the argumentation of developing countries that industrialised countries buy themselves out lead to the adoption of the CDM.

[28] Netto and Barani Schmidt (2009) provide a detailed account of the different roles of actors in the CDM project cycle.

The regulator of the project cycle is the CDM Executive Board. The role of the CDM-EB is to register projects that meet the criteria of additionality, and to reject projects that do not. The Registration and Issuance Team (RIT) supports the CDM-EB in this work (UNFCCC, 2007). The host country DNA is responsible to ensure that the project contributes to sustainable development. Project developers are responsible to demonstrate additionality to the EB, sustainable development to the host country DNA, and cost-effectiveness to potential CER buyers from industrialised countries. The CDM-EB supervises the project cycle and ensures that each project follows the modalities and procedures of the CDM (UNFCCC, 2001).

As mentioned above, CDM projects supply CERs for emitters in industrialised countries. Emitters will demand CERs if these are cheaper than reducing the same amount of GHG emissions domestically. To receive CERs, the emitter contracts a project developer to identify and conduct a suitable CDM project. Both the project developer and the buyer of the CERs become project participants in the project. The project developer can be from any country, but is generally from a developing country and thus well-informed about project opportunities in the respective country. The buyer is usually from an industrialised country and buys CERs for compliance.[29] The following paragraphs explain the procedures and the involved actors in chronological order of the seven steps a project needs to go through to become registered. The project cycle introduces the complete supply-stage. The CDM project cycle is conducted as follows (UNFCCC, 2011)[30]:

1) Project Design
2) National Approval
3) Validation
4) Registration
5) Monitoring
6) Verification
7) CER issuance

These are described in the following three sub-sections.

[29] Buyer can also act as intermediaries between project developers and ultimate compliance buyers. For the purpose of this book, buyers are compliance buyers.
[30] In the following, the procedures and modalities for large-scale projects are described. Small-scale projects have simplified rules to decrease transaction costs (UNFCCC, 2005b Annex II, para. 9, 2005c Annex, para 55). However, the actors involved and their responsibilities are the same independent of the project size (exemption is Step 6, where small scale projects can use the same auditing firm as in Step 3).

2.2.1 Project design and approval by host country

Step 1 (Project design): The project developer identifies a project[31] and documents the information about the proposed activity in the project design document (PDD). The main aim of this step is for an external observer to understand all details necessary to determine whether the project is additional, i.e. would not have happened without the CDM. The PDD also quantifies how many CERs and which sustainable development benefits are expected from the project. To estimate CERs, the PDD provides information on the baseline and monitoring methodology.[32] Project developers try to identify projects with the lowest abatement costs per ton of CO2-equivalent, as these can be sold in the market with a high profit (a higher rent between P_{AB} and MAC_{AB} in Figure 2.2).[33] Project developers can choose between the barrier test and the investment analysis to demonstrate additionality. These test will be introduced at the end of the project cycle.

Step 2 National Approval: The project developer submits the PDD to the host country and to the buyer country for approval. Each country that participates in a CDM project (either directly, or through a private actor (e.g. buyer or project developer)) needs to a DNA (see section on sustainable development).[34] The task of the DNA is to issue of Letter of Approval (LoA) that:

- The respective country is a Party to the Kyoto Protocol,
- The proposed CDM project is conducted voluntarily.

Furthermore, the DNA of the host country needs to confirm that the:

- The proposed CDM project contributes to sustainable development according to the host country national criteria.

Each project participant listed in the DD needs a LoA from its country DNA.

[31] The identification of a project is mostly done in a Project Idea Note (PIN), which just describes the location, size and project type of the project proposed. The project design document builds on the PIN and is a more detailed description that includes all the requirements to be validated (Step 3) and registered (Step 4). We assume for the remainder of this book that projects developers start by drafting a PDD. This does not alter any of the conclusions in the following chapters.

[32] In this example, it is assumed that the baseline and monitoring methodologies used already exist. If the project is the first of its kind, the project developer first needs to register the methodology with the executive board. The process is described in Netto & Barani Schmidt (2009: 223).

[33] In bilateral projects, the buyer of CERs and seller of CERs, usually the project developer, contract beforehand the volume and price of CERs. A project can also be conducted unilaterally. That means that the project developer sells CERs generated by the project in the open market and does not contract beforehand with a buyer from an industrialised country. Unilateral CDM has become a widely used method for conducting CDM projects (Michaelowa, 2007). See also Footnote 35.

[34] The project developer can ask for the host country confirmation at any time during the project cycle, but latest before the project is submitted for registration to the EB.

Usually, LoAs need to be issued before Step 4 (Registration) starts. However, in unilateral projects where the project developer does not specify any buyer of CERs, the LoA of the CER buyer need only to be issued before Step 7 (CER issuance).[35]

2.2.2 Validation by auditing firms and executive board assessment for registration

Step 3 Validation: The project developer submits the PDD to an auditing firm. This private auditing firm is called DOE. The DOE has to have technical expertise for monitoring and quantifying greenhouse gas emissions from emitters (UNFCCC, 2001). The DOE can be from any country but needs to be approved by the EB. The CDM Accreditation Panel (CDM-AP) recommends the accreditation or withdrawal of accreditation of DOEs to the CDM-EB (UNFCCC, 2007a). The DOE is contracted and paid by the project developer. The tasks of the DOE are to:

- audit the information in the PDD regarding the additionality determination and the choice of baseline and monitoring methodologies,
- assess whether the information provided in the PDD is complete, and
- make the PDD public for stakeholder comments.

If the documentation is complete and the DOE has assessed that the right baseline and monitoring methodology are used in the PDD, the DOE makes the PDD publicly available (online).[36] Parties, stakeholders and non-governmental organisations accredited by the UNFCCC can comment on the project within a 30-day period (para 40 b-c).[37] These comments have to be made publicly available.[38] After the 30-day commenting period, the DOE determines how the project should be validated.

On the basis of the information provided in the PDD and the stakeholder comments received, the DOE drafts a validation report. The aim of the validation report is for the DOE to identify the projects where either a) the additionality demonstration is credible, or b) the demonstration is not credible and the project should thus receive a negative validation report. If the additionality demonstration is credible, the DOE issues a positive validation report, which is forwarded to the CDM-EB for registration and made public simultaneously. If the additionality demonstration is not credible, the DOE issues a negative validation report, the project will not be further submitted for registration, and the decision has to be made public as well. The DOE

[35] See for instance, Jahn, Michaelowa, Raubenheimer, & Liptow (2004); Krey (2005); Michaelowa (2007).
[36] The official CDM registry website is http://cdm.unfccc.int.
[37] Parties are defined as countries, or supra-national organization (e.g. European Union), that ratified the Kyoto Protocol.
[38] Registered non-government organsiations, research institutes and private parties can comment on the DOE validation report. These comments can identify questions of additionality, the calculation of emission reductions, and the sustainable development benefits of the project (McCully, 2008 or 2010).These comments have to be addressed by the DOE.

submits a request for registration to the EB, by enclosing the validation report, the LoAs (Step 2), and the PDD. All documents are uploaded online for public access.[39]

Step 4 Registration: Based on the information submitted by the DOE the CDM-EB decides whether the project should be registered. Only projects which have received a positive validation report are analysed. During a four-week period following the submission of these documents by the DOE, the Registration and Issuance Team supports the CDM-EB in assessing the project.[40]

The task of the Registration and Issuance Team is to analyse, using the information provided by the DOE validation report and the underlying PDD, whether the project is truly additional and submit recommendations to the CDM-EB on the project.[41] The final decision is taken by the EB. The Registration and Issuance Team can recommend one of three decisions to the EB: 1) to reject the project, 2) to issue a request for review, or 3) to register the project. Unless at least three members of the CDM-EB follow the RIT's recommendation to issue a request for review or to reject the project, the project is registered automatically after the four-week period.[42]

2.2.3 Monitoring and verification of emissions and issuance of credits

Step 5 Monitoring: If the project is registered, the project developer monitors actual GHG emissions from the project, for the duration chosen by the project developer, according to the monitoring methodology listed in the PDD. The results of the monitoring are detailed in a monitoring report, to be able to calculate actual emission reductions from the project.[43] The actual emission reductions are calculated as the difference between monitored emissions and baseline emissions as specified in the baseline methodology. This amount of CERs should be awarded to the project.

Step 6 Verification: The project developer submits the monitoring report to a DOE. To avoid a conflict of interest, the project developer is required to contract a different DOE from the one

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[39] The DOE can also choose to terminate the validation pf a project.

[40] The rules regarding the CDM-EB procedures have changed frequently as it became apparent that the CDM-EB needs additional technical support and expertise to identify suitable CDM projects. Following a series of criticism of long delay, the Registration and Issuance Team was established in 2006 to support the CDM-EB in its task to identify additional and non-additional projects (UNFCCC, 2007; Michaelowa, 2009).

[41] The Registration and Issuance Team is former from the UN's roster of technical experts.

[42] Data on registration, rejections and withdrawals per project type is publicly available. The United Nations Environment Programme (UNEP) RISOE centre provides a public database in spreadsheet format (UNEP Risoe, 2011). The database, called CDM Pipeline, is updated monthly and contains every CDM project that has been proposed. It contains information about the project type, the location of the project in the host country, the DOE that validates the project, the estimated amount of emission reductions mentioned in the PDD, and important dates such as the submission of the PDD for public comments, and the date of registration of the project. The CDM Pipeline further documents all decisions that have been taken with regard to the project. Chapter 4 uses the CDM Pipeline to assess the effectiveness of benchmark test of the CDM.

[43] The usual length of the monitoring period is one year.

that has validated the project.[44] The task of the DOE is to make the monitoring report public on the CDM website and to compile a verification report. In this report, the DOE verifies that the emissions monitored by the project developer are authentic (UNFCCC, 2005, Annex, para 62).

This includes a confirmation whether the project developer has monitored the emissions from the project accurately, and whether emission reductions from the CDM project activity are calculated accurately. Where the DOE discovers that project developers have not monitored emissions in accordance with the registered PDD, the DOEs are required to make the most conservative assumptions theoretically possible about the parameters monitored by the project developer.[45] Based on the verification report, the DOE certifies in writing the volume of emission reductions achieved by the project, announces in writing the CDM-EB and the project developer of its decision, and uploads the decision publicly.

Step 7 CER issuance: This last step is the actual process of CER creation. Based on the verification report and the certification by the DOE, the CDM-EB issues CERs at the request of the DOE. The CDM-EB issues the amount of CERs specified in the verification report. These CERs are directly forwarded to the participants specified in the PDD. The CDM-EB keeps 2% of all issued CERs as the so-called adaptation fee to finance climate adaptation in developing countries, which are "particularly vulnerable to the adverse effects of climate change" (UNFCCC, 2001). The remainder of CERs can be used subsequently for compliance in industrialised countries (compliance-stage), provided these have specified rules to do so.

Summarising, this section introduced all main private and public actors that participate in the project cycle, and the responsibilities of actors to ensure the criteria of additionality, sustainable development and cost-effectiveness. The CDM-EB and DOEs are thus responsible for ensuring additionality of projects and emission reductions, while the project developer is responsible for cost-effectiveness and the host country DNA is responsible for sustainable development. In Step 1, the project developer chooses the project cost-effectively, documents expected sustainable development benefits and demonstrates that the project and the resulting emission reductions are additional. In Step 2, the DNA of the host country confirms that the project contributes to sustainable development. In Steps 3 and 4, the DOE and the CDM-EB are responsible to ensure the additionality of the project. In Steps 5 and 6, the CDM-EB and another DOE monitor and verify that the emission reductions claimed in the PDD actually materialised to ensure only additional emission reductions are issued in Step 7.

[44] To reduce transaction costs small-scale projects can use the same DOE which has validated the project.
[45] To verify the data from the monitoring report, the DOE can conduct on-site visits of the project, interviews with project participants (technical staff) and local stakeholders. Moreover, it can gather additional data, if necessary.

As discussed in Step 1, the project developer uses additionality test to demonstrate that the project and the resulting emission reductions are additional. These tests are explained in the following section.

2.3 Additionality tests

Project developers can chose between two additionality tests, the barrier test and investment analysis. [46] To conduct any of these tests the project developer carries out and documents the different steps of additionality determination:

- the identification of alternatives to the proposed project[47],
- barrier test, or
- investment analysis test, and
- for all projects as a credibility check, the common practice analysis.[48]

The *identification of alternatives* involves a comprehensive illustration of all realistic and credible alternative projects that provide outputs or services comparable with the proposed CDM project activity. These alternatives should include (UNFCCC, 2008):

I. The proposed project activity *not* undertaken as a CDM project;
II. Other realistic and credible alternative scenario(s) to the proposed CDM project activity scenario that deliver the same quality of outputs (e.g., cement) or services (e.g. electricity, heat); or
III. The alternative of continuing the current situation (i.e. no project activity).

These alternatives and the proposed CDM project have to be assessed with the barrier or the investment analysis tests.

The *barrier test* requires that the project developer shows that the proposed project faces barriers, which can be removed if the project receives CDM support. These barriers can be of financial and technological nature. For instance, if the proposed project has difficulties to acquire funding or only receives funding at unfavourable rates, the project developer can show how the CDM revenue helps overcome this financial barrier (UNFCCC, 2008a Annex 3, para. 114). For technology barriers, the project developer can show that the necessary infrastructure

[46] The procedures to demonstrate additionality are described in the 'Tool for the demonstration and assessment of additionality' (henceforth: additionality tool) and the 'Combined tool to identify the baseline scenario and demonstrate additionality (henceforth combined tool)' (UNFCCC, 2008). Their use is voluntary, but it has de facto become the standard for project developers (Michaelowa, 2009). The rules discussed in this book relate to the additionality tool. The combined tool requires that project developers conduct both the barrier test and the investment analysis. The combined tool refers to the case where project developers can implement all alternatives themselves. Michaelowa (2009) argues that this is rarely the case, because for instance a wind project developer does not have the financial strength to implement a coal-fired power plant as an alternative. The combined tool is rarely used in practice.
[47] This includes the alternative of doing anything, i.e. not implementing any action.
[48] EB 44, Annex 3, paragraph 119.

to operationalize the project or that skilled labour to operate and maintain the technology is not available in the relevant country/region. If the project developer can demonstrate that the proposed project overcomes the financial and technological barriers with CDM support, the project is deemed additional according to the barrier test.

As an alternative to the barrier test, the project developer can conduct the *investment analysis test*.[49] The investment analysis allows project developers to choose between two approaches, a) the investment comparison analysis, and b) the benchmark approach.

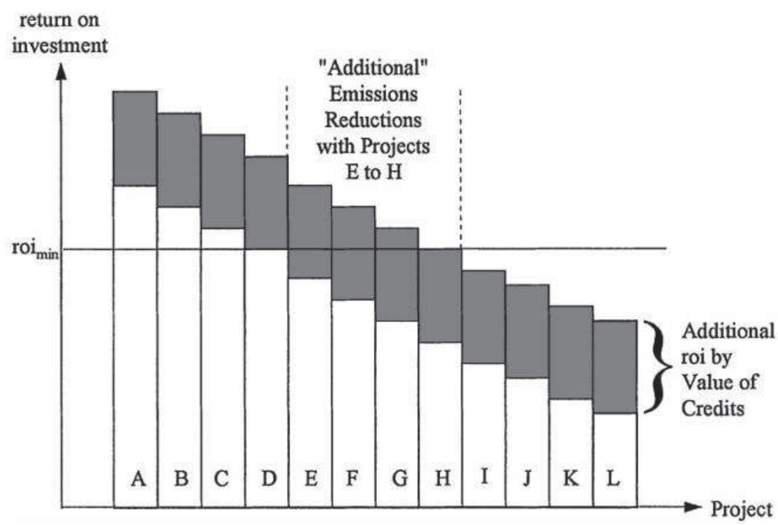
a) For the investment comparison analysis, the profitability of the proposed project and any identified alternatives are compared against each other. If one of the identified alternatives is more profitable than the proposed project, the project is deemed additional. The alternative could be a more profitable project including the alternative of not taking any action. For instance, if the project developers can show that another more emission intensive project (e.g. coal-fired power plant) would be more profitable than the proposed CDM project (e.g. renewable energy from wind turbines), the proposed project is additional.
   If one of the identified alternatives is "not taking any action", project developers can show that this alternative is more profitable because reducing emissions under the proposed project only carries costs but no revenues without the CDM.[50]
b) Project developers which use the benchmark approach demonstrate additionality by showing that the financial returns of the proposed CDM project activity are insufficient to justify the required investment. That means that the proposed project is not financially attractive when compared to a benchmark return on investment (ROI). This benchmark rate of return is usually a national or sectoral profitability rate usually achieved by similar projects.[51] The benchmark test does not require that the project reaches the benchmark rate with the extra CDM revenue, the project's profitability should only be below the benchmark rate without CDM support.

Figure 2.3 illustrates the functioning of the benchmark test. The figure shows several projects A to L and their profitability in terms of return on investment (ROI) without and with the extra revenue (in grey) from CERs. For a firm to conduct a project, the ROI of a project needs to be above a minimum threshold ROI_{min}. ROI_{min} is the benchmark rate. In Figure 2.3, the ROI of projects A to D is already equal or above ROI_{min}. These projects are financially viable without CDM support and will not be registered under the CDM. The CDM revenue provided to projects

[49] Renewable energy projects are allowed since 2008 to apply exclusively the investment analysis (UNFCCC, 2011).
[50] This variant within the investment analysis is called simple cost analysis and has been mainly applied to industrial gas projects. These will be introduced in the literature review in Chapter 3.
[51] Until the year 2008, project developers also used company internal profitability rates as benchmark rates (Schneider, 2007). The potential effect of this rule is further examined in Chapter 4.

E to H pushes these projects beyond the ROI_{min} threshold. These projects would not happen without the CDM because they do not reach the benchmark ROI. These projects are thus additional. Projects I to L are not financially viable even with CDM support. The incremental ROI from the CDM is still not enough to reach the ROI_{min}. While these projects would in theory not be implemented, in practice the benchmark test does not require that the project reaches the ROI_{min} benchmark threshold. Thus, the benchmark test would render all projects from D to L additional.[52]

Figure 2.3 Illustration of the benchmark approach to determine additionality



Source: Rentz(1998)

The *common practice analysis* is a credibility check after the project has passed the barrier test or the investment analysis. It aims at identifying whether the proposed project (e.g. technology or practice) is already commonly applied in the relevant sector and region of the respective host country. If similar activities to the CDM project are observed essential distinctions between the two must be reasonably explained (UNFCCC, 2011a: Annex 7). If similar activities are widely observed and commonly carried out, it calls into question the claim that the proposed project activity is financially unattractive or faces barriers.

Summarising, each project has to pass through an additionality test. This comprises three steps: the identification of alternatives, the application of the barrier or the investment analysis test to these alternatives, and the common-practice analysis. The barrier test requires that the project developer shows that barriers exist that can be overcome with the proposed activity registered as a CDM project. The investment analysis requires that the proposed CDM project is not the most profitable alternative. The common-practice analysis checks whether the proposed project

[52] There is thus an incentive for both project developers and host countries to choose a high benchmark rate so as to render more projects additional. Chapter 4 assesses the importance of benchmark parameters applied for registered Chinese and Indian CDM projects that have supported wind parks and hydroelectric power plants.

is already commonly applied. If the project passes all these tests, the project can be registered as described above in the seven project cycle steps.

2.4 Challenges of additionality determination and responsibilities of actors in the project cycle

In theory, there are at least three challenges for the CDM to achieve cost-effectiveness, additionality and sustainable development:

- Moral hazard to set high baselines, to misrepresent the financial profitability of project,
- A principal-agent conflict between the CDM-EB and DOEs, as DOEs want to maximise commissions paid by project developers for project validation,
- Regulatory competition between developing countries to set low sustainable development criteria so as to maximise project inflow.

The next chapter explores these challenges in detail.

This section has introduced the goals and project cycle of the CDM, its actors and the additionality test required from project developer. After issuance of credits by the executive board, the CERs can be used by companies in industrialised countries for compliance. The next section describes the compliance market and introduces the European Union as the biggest CER compliance market.

2.5 The compliance market in industrialised countries

In principle, all industrialised countries can use CERs to achieve part of their target. The use of CERs is dependent on the difference in marginal abatement cost curves, as shown in Figure 2.2, and on the presence of legal procedures that govern the use of CERs for compliance. Some countries have only specified rules to use CERs at the country level, but have not specified the rules for individual emitters. In the absence of these rules, there is no demand for CERs from emitters in industrialised countries. The European Union was the first Party which distributed legally binding emission reduction responsibilities to private actors in its territory through the EU emissions trading scheme (EU Commission, 2003). Subsequently, the European Union established legal rules for the use of project credits from CDM and JI (EU Commission, 2004).[53] In the following, the book focuses on the European Union, which is currently the biggest demand market for CERs, with about 80% of CERs in the CDM project pipeline being demanded by European buyers (Point Carbon, 2012; Neuhoff, Schopp, Boyd, Stelmakh and Vasa, 2012).

[53] JI was only allowed to generate credits from 2008 onwards. While the system is operational, the JI market is much smaller in terms of projects and projected emission reductions relative to the CDM. Hoogzaad (2009) provides an overview on how to scale-up joint implementation.

The EU has agreed to cut its GHG emissions by 20% by the year 2020 relative to 1990 emissions (Council of the EU, 2008). It thus has extended the EU targets specified in the Kyoto Protocol beyond the Kyoto commitment period 2008-2012. Part of the emissions reductions can be achieved outside the EU through the CDM or JI. In its efforts to reduce emissions, the EU distinguishes between the emissions trading sector and those sectors not covered by the emissions trading scheme.

The EU limits the use of CERs both quantitatively and qualitatively. The absolute amount of project credits (CDM and JI) allowed for compliance in the EU is slightly above 2.4 billion tons (Vasa and Neuhoff, 2010). Of these, the majority, about 1.67 billion tons are allowed in the EU ETS to be covered by project credits. The EU ETS does not accept projects from large hydroelectric power plants (above 20 megawatts), which do not comply with the World Commission on Dams (WCD) Guidance. Chapter 5 provides a detailed assessment on the rules, and their origin on how project credits can be used in the EU ETS, and analyses empirically how the EU has implemented the quantitative rule in practice.[54]

2.6 Concluding remarks

This chapter provided the background for understanding the different actors involved in the CDM project cycle on the supply side, and has introduced the European Union as the main demand market for CERs, due to the presence of procedures to use CERs. There is considerable delegation of responsibilities to private entities such as project developers and auditing firms. The information provided by these firms on the proposed CDM project is scrutinised by the executive board and national authorities in the CDM host and buyer country. This aims at safe-guarding the environmental integrity and sustainability of the CDM. The information in this chapter should serve as a basis for the analysis in the following chapters and will be referred to frequently throughout the next chapters.

The next chapters analyse how the CDM worked in practice. Chapter 3 provides an overall assessment of the challenges of the CDM to fulfil the criteria of cost-effectiveness, environmental integrity and sustainable development. Chapter 4 focuses on the workability of the benchmark approach. Chapter 5 analyses the efficiency of the rules to use the CDM within the European Union Emissions Trading Scheme.

Appendix 1: The concept of baseline emissions at the country level

A country’s baseline emissions are dependent on supply and demand factors of emission relevant production and policies that impact these variables. Baseline emissions are frequently

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[54] To the author‘s knowledge, no assessment of CERs from large hydroelectric power plants has been conducted. Such an analysis would shed light on the effectiveness of the qualitative limits of CERs in the EU ETS. This is beyond the scope of this book and is left for future research.

called business-as-usual emissions. The supply side for energy is influenced, for instance, by the mix of power generation through the conversion of conventional (oil, gas, coal) and renewable (wind, solar, biomass) fuels to electricity as well as the use of energy sources as feedstock in industrial processes (e.g. steel).[55] The demand side is influenced, for instance, by the population, energy efficiency of production processes and buildings, climatic conditions, and demand for road, air and marine transport just to name a few. Additional GHG emissions come from agricultural production, for example through the use of fertilizers, and land-use change and forestry (IPCC, 1996). Agriculture can both be demanding energy and supplying by providing biofuels for energetic use.

All of these supply and demand factors are influenced by the domestic policy in the respective country. For instance, the country can implement energy taxes to tax the energy content of fuels and thus ration the use of energy. Or it could regulate emissions directly by making mandatory the requirement to install emission filters in industrial production. Or the country might subsidize the costs of energy aimed at increasing electricity access for low-income households or supporting domestic industry, thus resulting in increased energy demand. The interaction between demand and supply factors on one side and the link to domestic government policies on the other (taxes, subsidies, direct regulation) is illustrated in Figure A 1.

Figure A 1 The effect of taxes or subsidies on energy and emissions

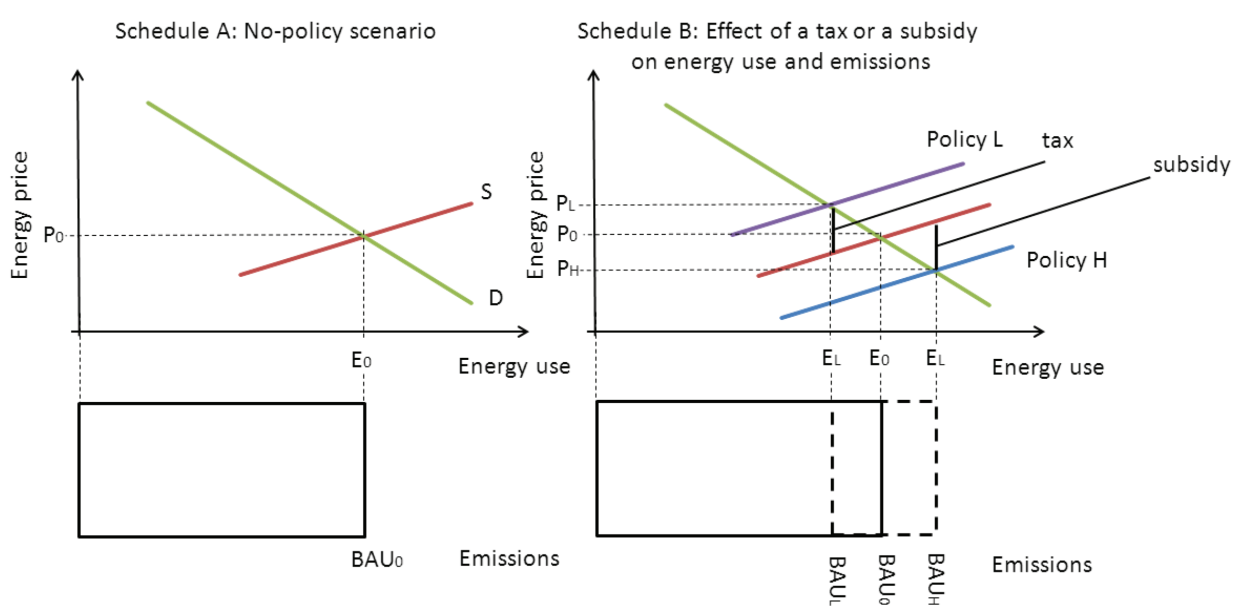


Figure A 1 illustrates in Schedule A the effect of the supply and demand curves on energy use. The figure assumes that one unit of energy used translates to one unit of emissions emitted. Furthermore, Schedule A assumes that the government has not implemented any energy policy at all. The supply (S) and demand (D) curve of energy meet at the price P_o and lead to the use of

[55] Nuclear fuels are somewhere between these two.

E_o energy units. The no-policy scenario generates baseline emissions equal to BAU_o. This is the level of emissions that prevails when no policy intervention occurs.

Schedule B introduces two types of mutually exclusive policies. We consider the introduction of policy L, an energy tax, or policy H, an energy subsidy to the scenario in Schedule A.[56] In general, the subsidy on energy shifts the supply curve down by the amount of the subsidy and increases energy use and underlying emissions. The tax on energy shifts the supply curve up by the amount of the tax and decreases energy use and underlying emissions. It is assumed that these policies are introduced individually and are not present at the same time. The tax reduces energy use to E_L and emissions to BAU_L. The subsidy increases energy use to E_H and emissions to BAU_H.[57]

These policies are taken for illustrative purposes. However, it is important to note that quantifying the effects of a tax or a subsidy in practice is a complex endeavor as the "no-policy" case, as well as the effects of a tax and subsidy, are not readily observable and quantifiable in reality. A quantification of these effects requires perfect information. However, in the presence of imperfect information, establishing baseline emissions is at best challenging and at worst impossible.

[56] These policies are taken for illustrative purposes; their effect in practice depends largely on factors including the price elasticity of demand and supply of the underlying goods.

[57] These policies are taken for illustrative purposes; their effect in practice depends largely on factors including the price elasticity of demand and supply of the underlying goods. In general, the subsidy (tax) on energy shifts the supply curve up (down) by the amount of the subsidy (tax) and increases (decreases) energy use and underlying emissions.

3. The Clean Development Mechanism: Theory, Practice and the alternative Clean Development Fund[1]

The Clean Development Mechanism of the Kyoto Protocol allows countries with an emission reduction target, so-called Annex I countries, to achieve part of their emission reductions in countries without emission reduction targets. Developing countries (Non-Annex I) were initially strongly opposed to such an instrument. They favoured a compliance fund, called the clean Development Fund (CDF) for Annex I countries, according to the Brazilian Proposal (Cole, 2010; Olsen, 2007). The Brazilian Proposal would establish emission reduction goals based on historical emissions and the CDF would collect penalties from Annex I (industrialised) countries which exceed their emission limitations. The proceeds from the penalties would be channelled to Non-Annex I countries according to Non-Annex I countries' projected emissions between 1990 and 2010 (UNFCCC, 1997b). Annex I countries opposed the penalty nature of the CDF and, in the last hours of the Kyoto negotiations, the concept of the CDF was changed into the CDM in Article 12 of the Kyoto Protocol (UNFCCC, 1997a; Werksman, 1998).

The CDM, as defined by the Kyoto Protocol, should lead to environmental integrity through real and measurable emission reductions, promote cost-effective abatement for Annex I countries, and support sustainable development for Non-Annex I countries (UNFCCC, 1997a). Achieving these three goals would further the achievement of the ultimate objective of the United Nations Framework Convention on Climate Change, to avert dangerous climate change (UNFCCC, 1992, Art. 2). Cost-effective abatement means that emissions reductions are obtained at the least cost. The criterion of sustainable development ensures that abatement incorporates co-benefits such as health improvements, employment and other factors. Environmental integrity aims to ensure that any project implemented under the CDM does not increase global emissions, i.e. projects supported through the CDM shall be additional to any that would have happened anyway.

Chapter 2 has introduced the procedures to conduct a CDM project and responsibilities of the main public and private actors to ensure the criteria of additionality, sustainable development and cost-effectiveness are met. The CDM regulator (the Executive Board - EB) and auditing firms (Designated Operation Entities – DOEs) are responsible for ensuring additionality of projects and emission reductions, while the project developer is responsible for cost-effectiveness and the host country DNA is responsible for sustainable development.

[1] The literature review in this chapter is a reworked version of a Climate Strategies report written with Karsten Neuhoff (Vasa & Neuhoff, 2011).

This chapter analyses whether the CDM incentivises these actors to achieve the three criteria of environmental integrity, cost-effectiveness and sustainable development. The aim of this chapter is thus to analyse whether the CDM is an effective tool to encourage emission reductions in developing countries and to achieve global emission reduction goals. An alternative instrument, the Clean Development Fund, is analysed with regards to its potential performance of cost-effectiveness, environmental integrity and sustainable development.

To answer the question (whether the CDM is an effective instrument or not), the analysis in this chapter is split in three parts. The first part analyses the incentives of actors in the CDM from a theoretical perspective. The second part assesses whether the theoretical predictions were met in practice. This is done through a review of the literature, and by conducting an analysis of projects with regards to sustainable development and cost-effectiveness. The third part assesses whether the CDF, if it had been implemented, would have fulfilled the three CDM criteria. For this purpose, the CDM and CDF are compared. The analysis also assumes that all actors, including at the country level, behave rationally (see also section 1.5 in Chapter 1).

While several authors have analysed the different individual criteria of the CDM in practice, as the literature review will show, the contribution of this chapter is an extension of the analysis to the projects that have been registered since the beginning of the Kyoto commitment period in 2008 and an analysis of the CDF. There is scarce literature on the CDF. The literature focused more on the establishment of historical responsibilities for industrialised countries, rather than the CDF itself (Elzen et al., 1999; La Rovere, de Macedo, & Baumert, 2002; Rosa, Ribeiro, Muylaert, & Pires de Campos, 2004). An exception is Cole (2010) who analyses the initial intent of the architects of the CDF idea with regards to sustainable development, arguing that the initial intentions of the CDF were met in practice by the CDM. In general, however, there is to the author's knowledge no such analysis on how the CDF would have been operationalized. This chapter aims to fill this gap.

The chapter proceeds as follows. After a brief review of the CDM and CDF rationale,[2] and governance structure, the next section provides an overview of the incentives the CDM provides in theory to achieve the three criteria. This section is followed by a review of the literature and two analyses of cost-effectiveness and sustainable development of projects in the CDM pipeline by November 2011. This section aims to identify whether any inefficiencies found in practice, are predicted by the theoretical overview in the previous section. The last section analyses whether the CDF is able to reduce the inefficiencies of the CDM and thereby

[2] Readers familiar with Chapter 1 and 2 of this book can skip reading section 3.1.1.

better achieve the goals of sustainable development, cost-effectiveness and environmental integrity.

3.1 The clean development mechanism and the clean development fund – Background and rationale

3.1.1 Clean Development Mechanism

Since GHG are universally mixed pollutants, the location of abatement does not matter for climate change impacts. Based on this notion, GHG emission abatement should be conducted where it is cheapest so as to reduce the overall cost of abatement or conversely maximize abatement opportunities with a given budget. To reduce total abatement costs, countries can reduce emissions in another country and count these reductions against their own emission limits target. This is called an offset system, as emission decreases in one country are offset by increases in another.[3]

As developing countries do not have emission reduction targets under the Kyoto Protocol, emission reduction opportunities could be used to reduce abatement costs and avoid or slow down a lock-in of carbon-intensive infrastructure in developing countries (Heller, 1996). Emission increases in countries with an emission reduction obligation are counted against emission reductions in countries without emission reduction obligations. If the increases are completely offset by reductions, global emissions do not increase. The currency used in this transaction is CERs. Each CER is equivalent to one tonne of CO_2- equivalent reduced and can be used to increase emissions elsewhere by the same amount.

3.1.2 Clean Development Fund

The CDF was part of a proposal put forward by Brazil in May 1997 (UNFCCC, 1997b). This submission had two parts. The first part suggested a mechanism to establish emission reduction targets for countries based on historical responsibility. Countries, which have emitted (historically) the most GHG emissions, should also bear the greatest reduction effort under this proposal. Cumulative emissions were counted as of 1850 in the proposal. Using available data at the time, Brazil's submission projected that developing countries' absolute emissions will take over those of industrialised countries approximately by 2037. In terms of historical cumulative emissions, developing countries would only over take industrialised countries emissions by 2162 (UNFCCC, 1997b). This justified, according to the proposal that only developed countries should be subject to an emission limitation, a so-called cap on emissions.

[3] See for pioneering work on offsets Liroff (1980) and for a review of the literature on offsets in general (R. W. Hahn & Richards, 2010).

The second part suggested a compliance regime for achieving the emission targets established in the first part of the proposal. This proposal outlined the CDF. The proposal works as follows: According to the formula proposed in the first part of the Brazilian submission, industrialised countries would receive individual emission reduction limits, an individual cap. Developing countries would not have a cap on emissions. If a country emits more than its emission reduction limit allows, then it has to pay a penalty fee (F) for each tonne of GHG emitted in excess of the emission limitation. These penalty fees would be collected by a so-called Clean Development Fund (UNFCCC, 1997b, p. 5). The proposed penalty fee per tonne of CO2- equivalent in Brazil's submission was US$ 10.

3.1.3 Similarities between the two instruments breaks initial opposition to CDM

The CDM explicitly allows achieving compliance with a reduction target through abatement in countries without a cap. The CDF in turn implicitly allows a country with a cap to emit more than the cap, if the country pays a penalty fee. Thus, both instruments allow a country with an emission limit to exceed this limit. Developing countries were at first strongly opposed to the idea that industrialised nations could exceed their cap and argued that rich countries could buy themselves out of the responsibility to reduce emissions domestically (Depledge, 2000).[4] The CDF however allows exactly that: according to Olsen (2007) this similarity was picked up by the US negotiators and the proposal of the CDF changed into the CDM.

3.1.4 Institutional framework of the CDM

Chapter 2 introduced the goals and procedures of the CDM. These are in short: CDM projects should be cost-effective, contribute to sustainable development, and should be additional to any that would have occurred anyway. The project host country is responsible for ensuring that proposed projects meet the sustainability criteria of the respective country they are located in. Buyers and sellers of CERs generated by CDM projects aim to reduce emissions at lowest cost, i.e. cost-effectively. However, as host countries and CER buyers in the CDM market both have an incentive to overstate emission reductions, an institutional procedure (described in Chapter 2) has been established to avoid the registration of projects that would have happened anyway, i.e. also without CDM support. Projects and emission reductions that would have happened also without the CDM support are called non-additional.

[4] This view is supported by Najam (2002), who argues that by using the low-cost abatement opportunities, low-hanging fruits in developing countries, future generations are only left with more costly options. See Castro (2010) for an empirical analysis refuting the claim that the low-hanging fruit issue hinders advanced developing economies to engage in mitigation.

3.1.5 Institutional framework of the Clean Development Fund

In contrast to the CDM, the CDF has no market for emission reductions. The price for exceeding the emission cap in industrialised countries is set by the level of a penalty fee (F). The proceeds from the penalty are transferred to developing countries, which then conduct abatement of emissions in their territory. Assuming the host country is interested in maximising emissions abatement, it would set up a national system similar to the one described in Chapter 2 for the CDM. The main difference is that the funds received by the developing country are dependent on the penalty fee and not the actual price to reduce emissions in the developing country.

3.2 Clean Development Mechanism – Theoretical predictions

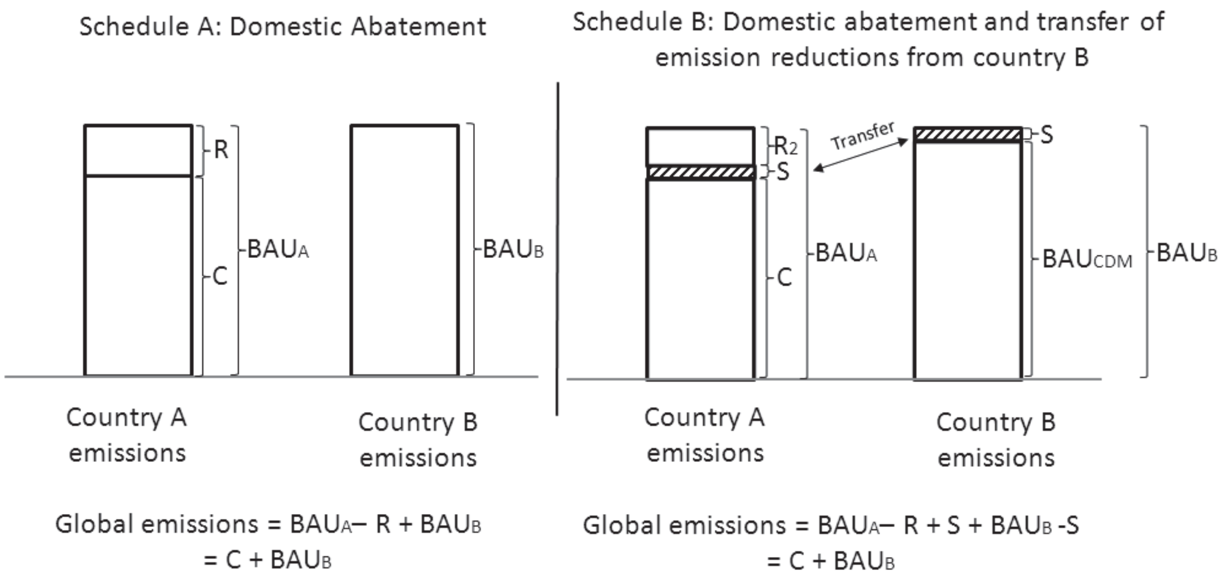
The following section analysed the incentives of actors to pursue projects and emission reducing activities that fulfil environmental integrity, cost-effective abatement, and sustainable development criteria. Each of these criteria is analysed separately. In general, it is assumed that projects are conducted through the government. In practice, however, private actors conduct emission reduction projects in the CDM. Regardless, the conclusions about incentives do not change.

3.2.1 Environmental integrity Clean Development Mechanism

The rationale of the CDM is illustrated graphically in Figure 3.1 Schedule A illustrates the emissions of country A (with an emission reduction limit cap) and country B, without a cap. Absent any emissions limit, country A emits business-as-usual (BAU) emissions equal to BAU_A.[5] The reduction necessary for country A to meet its target is equal to R (reduction) units. If country A achieves its emission limit domestically, it will emit C (the cap) units of emissions. Thus, it reduces emissions from its current business-as-usual (BAU_A) emissions by the necessary reduction R. Country B will continue to emit a volume equal to BAU_B emission units as it does not have any emission cap.

[5] For a simplified introduction to the concept of business as usual, see Appendix 1 of Chapter 2.

Figure 3.1 Global emissions are equal under domestic abatement only and domestic abatement with the transfer of country B emission reductions



The CDM is illustrated in Schedule B. The mechanism allows the counting of emission reductions achieved in Country B against the emission reduction target of Country A. If country A pays to reduce emissions in Country B, for instance emission reductions equal to a volume S, then country A finances S emission reductions (hatched area in schedule B) compared to the business-as-usual emissions, BAU_B. Thus, after abatement country B emits BAU_{CDM} units of emissions. The S units reduced in country B are "transferred" to country A. These emission reductions count fully against the target of reducing R emission units in country A. Thus, the reduction target of country A becomes R_2, equal to the initial target R minus the S units already abated in country B. Thus, country A's new emissions cap becomes C + S. As emissions are reduced in country B by S units and increased in the Country A by the same amount, global emissions do not increase.

With the transfer of S emission reductions, country A's emissions will be higher by S units. Country A can emit C+S emissions by reducing emissions abroad instead of domestically. Country A would, however, only use emission reductions from country B when it is cheaper to abate abroad (i.e. in country B) relative to domestic abatement.

To illustrate the moral hazard challenges of this approach two cases are analysed regarding the information a country possesses about its own business-as-usual emissions. In the first case, the country is able to calculate its business-as-usual emissions under any scenario and knows the impact of policies on emissions. In the second case, the country knows its BAU emissions under the no-policy case, but is unable to estimate the effect of policies or a specific project on emissions because of a lack of capacity.[6] This creates a challenge for environmental integrity. For instance, if projected BAU emissions are above the actual BAU emissions, the reductions S are calculated from the higher baseline. This creates S_F emission reductions, which would not have occurred in practice. They are simply the result of an "accounting" error, the absence of knowledge of the actual BAU emissions. These are non-additional emission reductions.

Case 1 Assumption: Complete Information - The country can perfectly calculate its BAU emissions and the impact of policies on BAU.

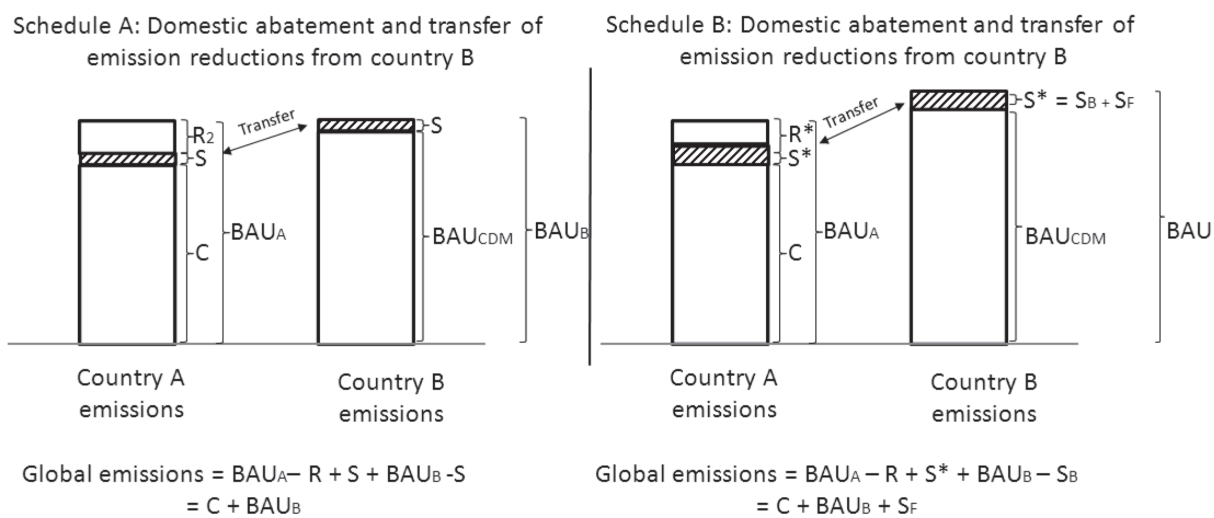
Case 2 Assumption: Incomplete Information - The country can calculate its BAU emissions for the no-policy case but cannot calculate the impact of policies on BAU.

Thus, the emission reductions counted against the (false) BAU scenario BAU* are equal to S* which is the sum of S_F and S_B (see Figure 3.2). In reality only S_B units have been reduced. If country A increases its emissions by S*, global emissions increase by S_F. This is how imperfect information of the BAU emissions in one country creates global emission increases, and is a fundamental challenge as the transfer of emission reductions to countries with a cap actually increases emissions rather than reduces emissions.

Figure 3.2 illustrates this: schedule A shows the real BAU emissions of country B as BAU_B and the overestimated BAU emissions in schedule B as BAU*. The higher emission reductions of S* are transferred to Country A. Only S_B, however, are truly additional emission reductions.

[6] Note that the absence of knowledge about BAU emissions is a problem of ex-ante projection capacity rather than the exactness of ex-post reporting and verifying emissions. Estimating the effect of a policy is inherently difficult. Currently various research projects are aimed at addressing this question. The EU monitoring decision requires each EU member state to project the impact of its policies on emissions (Council of the European Union, 2004). For an example of such a report and its projections in Germany see for instance the policy scenarios (Matthes et al., 2009) that feed in into the projection report.

Figure 3.2 The impact of overestimated BAU emissions in country B



We have defined emission reductions to be additional only if they occur in addition to emission reductions that would have happened anyway (the real BAU scenario). S_F are non-additional emissions reduction units. Global emissions thus increase by S_F emission units.

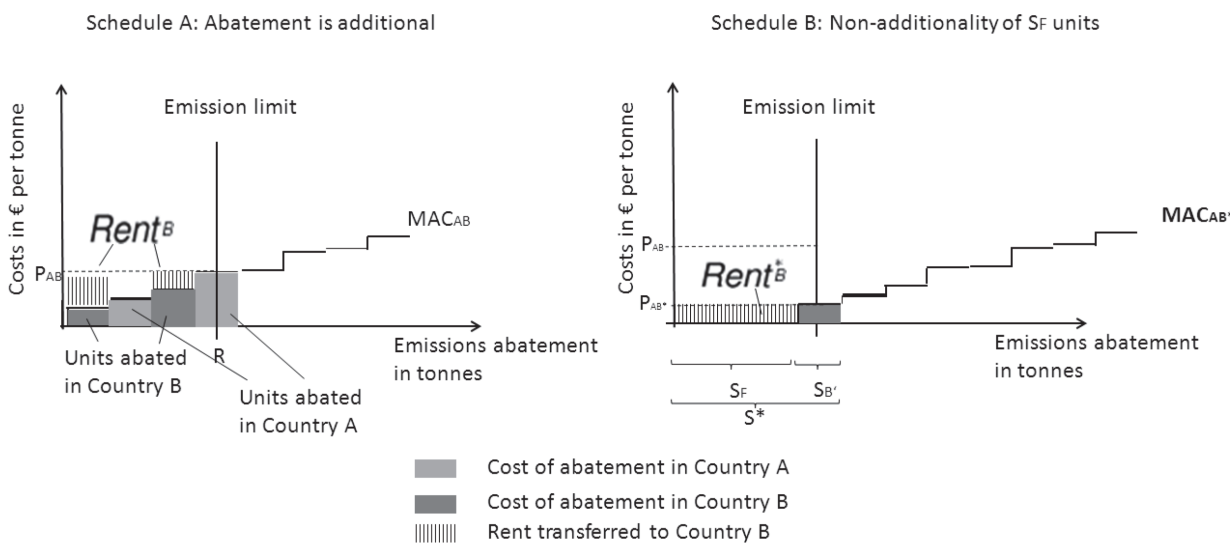
Non-additional emissions can thus be the result of imperfect knowledge. The country certifies the reduction of more emissions because it believes its country's emissions would have been higher than is the case in reality. However, even if the country has complete information about its BAU scenario, it has incentives to overstate the actual BAU scenario to a higher level BAU* (Figure 3.2 schedule B). Country B, the country without an emission limit, overstates BAU emissions in order to sell more emission reductions to Country A. Instead of S_B emission reductions, country B now sells S* emission reductions. The "production" cost of the difference, S_F, emission reduction, however, is zero; they are only reductions on paper.

Country A has incentives to buy non-additional emission reductions as these decrease compliance costs. Figure 3.3 illustrates how the S_F non-additional emission reductions shift the combined MAC_{AB} curve (Schedule A)[7] to the right and results in the new MAC_{AB*} curve. The non-additional emission reduction lowers the compliance cost of abating R emissions for country A. Country A's domestic abatement in Schedule B is zero. It achieves compliance with its reduction target R via S_F non-additional units and one unit, $S_{B'}$, abated in Country B. The S_F emission reductions cost nothing to produce and replace real emission reductions. Global emissions increase thus by S_F, the volume of non-additional credits.[8] Figure 3.3

[7] Compare with Figure 2.2 in Chapter 2.
[8] Global emissions are equal to BAU_B-$S_{B'}$ + BAU_A – D + S_F, where D is domestic abatement. This is higher than BAU_B+ BAU_A-R, if R ≤ D+ $S_{B'}$ -S_F. Domestic abatement D is zero and additional emission reductions in country B $S_{B'}$< R

emphasizes that with non-additional emissions (S_F) the amount of emission reductions conducted both domestically, in country A, and abroad, in country B, is reduced. The price paid by country A for abatement in country B drops to P_{AB*} relative to the price P_{AB} (Schedule A). This affects the rent that country B receives. The non-additional credits change the rents transferred to country B from $Rent_B$ (Schedule A) to $Rent_{B*}$ (Schedule B). Depending on the volume of S_F and the slope of the MAC_{AB} curve, the rent transferred to country B can actually decrease (Michaelowa, 2005). Thus, even with complete information country B has incentives to overstate its BAU emissions.[9]

Figure 3.3 The effect of non-additional emission reductions on abatement costs and location



Above, we have illustrated that even with complete information, country A and B have an incentive that country B's BAU emissions are overstated as non-additional emission reductions lower the compliance costs for country A and lead to economic surpluses for country B. Non-additional emission reductions, when counted for compliance in country A, raise global emissions. Note that the situation does not change if the target in the country A is increased beyond R. With a more stringent reduction target (R*>R) the incentive for country A to use non-additional emission reductions actually increases as overall costs decrease with more non-additional emission reductions from country B.

[9] A dynamic scenario can be constructed, where country A possesses a low-carbon technology that enables country B to reduce emissions more cost-efficiently by lowering marginal abatement costs. Country A would be interested in selling as much as possible of this technology to country B and thus would be interested that country A abates as many emissions as possible. The overstatement of country B's BAU emissions would reduce demand by country B for the technology. In this case, country A would have an incentive to avoid non-additionality. Another scenario is that industries in country A and B compete. A payment for non-additional emission reductions from industry in country A to industry in country B would be equivalent of a direct transfer of wealth without any effort for country B's industry. Competitiveness could be undermined, and industry in country A has thus, an interest in avoiding non-additional emission reductions. This is however beyond the scope of this chapter.

3.2.2 Cost-effectiveness

Country B receives rents from the CDM equal to the difference between actual marginal abatement costs and the market price paid for emission reductions: these rents were labelled $Rent_B$ in Figure 3.3. To increase the transfer of these rents, country B has an incentive to lower its marginal abatement cost curve so as to increase the difference in marginal abatement cost curve slopes between countries. Such a "lowering "of the abatement cost curve can occur in two ways. The first type could be generated by removing non-monetary barriers or increasing the financial profitability of abatement options, for instance through domestic policy. The second is by increasing emissions to claim reductions later.

However, the nature of the CDM, where abatement needs to be additional to what would have happened anyway relative to BAU emissions, precludes somewhat the incentives to improve the domestic framework in country B. Country B needs to balance the implementation of domestic policy to reduce abatement costs with the risk of losing part of the transfers because abatement units become ineligible if domestic policy addresses them already. Thus, there is an incentive for country B only to engage in a degree of domestic GHG regulation that does not preclude CDM transfers (Tirole, 2008, p. 34).[10]

To avoid such perverse incentives, an E+/E- rule has been defined for the CDM. The E+/E- rule stipulates that regulatory changes to the baseline at the national level should not be incorporated into baseline calculations if the regulation favours a less or a more emissions-intensive technology over the other (UNFCCC, 2005d, para. 5). Regulations that give comparative advantage to more emission-intensive (E+) and less emission-intensive (E-) activities should be disregarded in the baseline calculation as of the end of 2001 and 1997, respectively. Projects are evaluated against policies that have historically been in place. This can allow governments in 'country B'-type countries to improve supporting policies for less emission intensive projects while retaining financial inflows from the CDM. The result is, however, equally challenging, as project developers can qualify for CDM projects even if the projects are already commercially viable under the current policy framework.

The second kind, directly generating low-cost abatement opportunities is due to the subsidy nature of the CDM (Tirole, 2008, p. 33). In the presence of a subsidy such as the CDM, projects are conducted that would not have occurred without the subsidy. For instance, if a

[10] We have focused here on the incentives for country B to lower marginal abatement cost curves. However, country A has also incentives to lower its cost burden by reducing its own non-monetary barriers and for providing a stable investment environment for low-carbon technologies. However, the incentives for such steps are lower in the presence of "outside" options such as abatement abroad. Thus, while cost-effectiveness ensures the short-term optimization of resources spent on abatement, it does not necessarily optimize resource use in the long-term.

project produces simultaneously a product X with profit Y and emissions of 0, a lump-sum transfer for abatement could induce inefficient behaviour of the project owner so as to emit emissions only to receive the subsidy. The project owner would do that if the cost of changing the technology to an emitting alternative increases overall profit, including profit from receiving the subsidy. This effect is likely to appear with low cost products, where the monetary value of the subsidy can change the economics of the project's profit function. The generated abatement cost opportunities endanger the environmental integrity of the instrument.

This section has illustrated how the CDM achieves cost-effectiveness. Country B receives economic rents and receives transfers for abatement in their country. Abatement in country B would in general not have occurred due to financial or other barriers, and is thus additional. A moral hazard problem exists where countries can increase emission reduction estimations, to increase revenues associated with these reductions. Furthermore, the potential economic surpluses from such a strategy can incentivise country B to craft domestic regulation so as to produce "additional" abatement opportunities and thereby CDM eligibility. The subsidy effect can also generate market entry opportunities for polluting technologies profiting from the subsidy to halt pollution. The literature review in section 3.3 will examine whether these effects can be observed in practice. In the next section the effect of the CDM on sustainable development will be assessed.

3.2.3 Sustainable development

As discussed in the definition of sustainable development in chapter 2 (section 2.1.2), there are good reasons for the interpretation of sustainable development to depend on the development context of the respective developing country. Depending on the development status, each developing country has a different interpretation of sustainable development. To analyse the impact of the CDM on sustainable development we thus assume that a country chooses its own interpretation. This creates several challenges for the attainment of sustainable development benefits due to a conflict with cost-effectiveness goals.

Kolshus, Vevatne, Torvanger, & Aunan (2001) argue that some projects with SD benefits might not be the preferred option under cost-effective perspective. This is only the case if the benefits from sustainable development are not priced in to the marginal abatement costs. Aunan et al. (2004) show, using emission abatement options from coal power generation[11] in

[11] The ranking of the abatement options by costs only would be 1) cogeneration, 2) modifying the boiler design, 3) boiler replacement, 4) improved boiler management and 5) coal washing have been implemented (Aunan et al, 2004: Table 7).

the Shanxi province in China, that briquetting[12] would be the most expensive abatement option, and thus the last to be implemented according to the marginal abatement cost approach. However, when central estimates of health benefits are included to the cost of abatement, briquetting becomes substantially cheaper from a social welfare perspective and would be preferred to all other abatement options. The sustainable development benefits, in the form of health benefits, would outweigh the higher abatement costs. The positive health impact of briquetting is due to the elimination of coal dust which is responsible for respiratory diseases.

By choosing the sustainability criteria, the CDM host country can in theory change the order of abatement options that are implemented in its territory. The simplest way to imagine this is by assuming that abatement opportunities with low sustainable development benefits are just excluded from the abatement cost curve.[13] If a relatively cheap abatement opportunity induces negative health effects, country B will prefer not to undertake it, while country A, if focused on cost-effectiveness, will not oppose conducting this measure. By setting the standard such that this abatement opportunity is not eligible for the CDM, country B "erases" this option and the marginal abatement cost curve becomes steeper. Country A needs to comply with the rules set by country B and will conduct abatement using the remaining options, based on cost-effectiveness criteria.[14]

However, if a second (developing) country C without a cap enters the CDM supply market, country A can chose between abating in country B or C. For simplicity, we assume that country C is equal in all regards to country B, except that it has more lax sustainability criteria. Thus, with stricter sustainability criteria in country B relative to country C, country A prefers to conduct abatement in country C as, all else equal, it has to pay less for abatement. Country B would lose the economic transfers. This can lead to regulatory competition between country B and C and a "race to the bottom" in sustainability criteria between country B and C. Countries without a cap lower their sustainability criteria such that they create a large abatement market for country A and transfers for themselves (Kelly &

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[12] 'Briquetting' is a way to bind coal together. The effects are more efficient operation and the elimination of coal dust. The reduction in SO2 emissions depends on the addition of lime to the briquettes. This is also the costly component that if left out lowers the positive reduction of SO2 emissions (Aunan et al., 2004).

[13] The decision to "erase" abatement costs options can also be based on other grounds such as security grounds. For instance, the exclusion of nuclear abatement opportunities from the CDM might be based, in addition to sustainability criteria, on national security concerns. Detailed information about domestic nuclear power plants is sensitive and unlikely to be shared publicly with other nations, as would be required by the CDM procedures described in Chapter 2.

[14] In the following, especially in chapters 4 and 5, we will introduce a deviation to this assumption. In the EU Emissions trading demand market for CDM, the EU Linking Directive has set sustainability criteria for hydroelectric power plants that go beyond the criteria defined in the institutional framework of the CDM.

Helme, 2000). This can substantially reduce the ancillary benefits from climate mitigation benefits as cost-effectiveness becomes the only driving force behind abatement.

Regulatory competition is particularly concerning given the need to switch away from fossil fuels to significantly reduce GHG emissions. Renewables can provide these benefits and also have in general higher sustainability benefits than other project types (Olsen & Fenhann, 2008). Renewables deployment is strongly regionally dependent, which warrants regionally differentiated support policies (M. Schneider, Schmidt, & Hoffmann, 2010). Abatement options through renewables deployment and grid expansion are in general more expensive than incremental efficiency projects that maintain fossil fuel based power generation and industrial production. Despite the importance of these investments, countries B and C will prefer transfers for incremental efficiency improvements with lower sustainable development benefits if they are concerned that transfers go to other countries otherwise. Thus, even though sustainability criteria between countries differ, CDM host countries will lower these criteria to maximize the transfer to be received. Regulatory competition, however, is less a concern for developing countries that have a monopoly position in providing low-cost emission reductions. These countries can maintain a higher level of sustainability criteria because they do not need to be concerned of losing transfers. The literature review in the following sections aims to understand whether this has been the case.

3.3 Literature Review - Clean Development Mechanism

The following section reviews the literature on the performance of the CDM with regards to environmental integrity (additionality), cost-effectiveness and sustainable development. It aims at verifying whether the theoretical predictions analysed in section 3.2 hold.

3.3.1 Environmental Integrity

3.3.1.1 Non-additional projects achieved registration

Various studies agree that a large share of registered CDM projects is non-additional (Michaelowa & Purohit, 2007; Schneider, 2007, 2009a; Wara & Victor, 2008).[15] Based on a random sample of 93 of the 803 CDM projects registered by October-2007, Schneider (2007, 2009a) finds that a large share of projects (up to 40%) would have happened without support from the CDM. In many cases, project developers' additionality demonstrations through benchmark analysis, common practice analysis, and barrier analysis, have not been credible. For the barrier and investment analyses, for example, project developers chose

[15] The procedures to register a project and to demonstrate additionality are described in Chapter 2. Chapter 4 examines the use of the benchmark approach within the investment analysis test do demonstrate additionality.

subjective, company-specific barriers or used company-specific investment hurdle rates, rather than a sectoral or national market rate, as suggested by CDM-EB guidelines. When using the common practice analysis as a credibility check, project developers frequently chose the technology narrowly and the comparison group broadly (e.g. all national power producers) in order to demonstrate a low technology penetration rate for the technology in question and to gain CDM status.

Furthermore, the DOEs charged with validating projects' additionality have been ineffective in filtering non-additional projects. According to Schneider (2009), this results partly from a lack of guidance and partly from the misinterpretation of available guidance by both project developers and DOEs. With many projects, DOEs have not checked the credibility of the information provided by project developers in Project Design Documents, or they have simply restated the information given in the Project Design Document in the validation report. These findings are supported by various other scholars, who find a share of non-additional projects of between 20% (Michaelowa & Purohit, 2007) and two-thirds (Wara & Victor, 2008) in their analysis.

3.3.1.2 Moral Hazard - Strategic behaviour to achieve CDM registration

Other studies find evidence that the CDM is often the “icing on the cake”; making already economically feasible projects more profitable (Ellis & Kamel, 2007; Haya, 2007). These authors find that projects have to be economically feasible without the CDM in order to attract investment capital in the first place, for instance investment by banks. In addition, Purohit & Michaelowa (2007, p. 11) find that most wind energy projects in India pass the investment additionality test only if they omit tax benefits, which at least one project has done.

According to Michaelowa (2005), project participants react directly on Executive Board decisions. The scholar cites an example where after a biomass project with doubtful additionality had been registered in India, submissions of this project type increased by 56% suddenly thereafter. Michaelowa (2005) further cautioned that if the barrier test captures decision-making processes in companies developing CDM projects it might be better suited than the investment analysis test. However, he cites that past experience with the CDM validation process has shown that misrepresenting (i.e. gaming) “of barriers [was] relatively simple and not always detected by the validators” (Michaelowa, 2005, p. 17). This is confirmed by the analysis conducted by Schneider (2007), who recommends that clear guidance is given to validators especially with regards to the barrier test and the investment analysis. McCully (2010) goes even further and suggests banning the barrier test altogether.

Furthermore, Schneider (2007) recommends that projects that have started already and only apply for CDM status more than a year after project start, should not be registered. These so-called ‘prior consideration projects’, the author argues, claim that they have counted on CER revenue when they started the project. This claim however is hardly credible, because if the project needs to prove that it cannot start operation without the CDM, its actual project start is evidence against the need for CDM. These projects are arguably non-additional. Requiring the project to substantiate and document the claim and proving that knowledge existed about the CDM support and that it was considered is one way, the CDM-EB and DOEs have dealt with the issue. As Michaelowa (2005) states, however, project documentation has frequently been backdated to conform to the prior consideration claim.

The theoretical concern of a subsidy-effect voiced by Tirole (2008) in section 3.2.2 has materialized in practice. While credits from HFC-23 projects are clearly additional in the absence of regulation, Schneider (2011) has shown that producers of HCFC-22, the refrigerant gas that produces as waste gas HFC-23, have increased the production of HCFC-22 to profit from the sale of HFC-23 CERs. The sale of HFC-23 credits is more profitable than the actual sale of the main product HCFC-22.[16] The large price difference in market price and actual abatement costs conferred a large rent to sellers of CERs from these projects (see section 3.3.3.1 for an estimate of the rent).

3.3.1.3 Renewable energy projects and interaction with domestic policy

Renewable energy projects are the most numerous in the CDM (UNEP Risoe, 2011). They made up 17% of issued CERs by the November 2011 and are expected to command a share of 35% of all CERs up to 2012, according to project documentation.[17] However, renewable energy projects have had a more difficult start than industrial gas projects (Ellis & Kamel, 2007; Ellis, Winkler, Corfee-Morlot, & Gagnon-Lebrun, 2007; Pearson, 2007). When evaluating CDM projects, banks discount expected CDM revenues because of the uncertainties around registration and issuance, future carbon prices, and potential import constraints. This reduces the contribution that CDM revenue can make to capital-intensive investment. Hence, CER cash flow is frequently only seen as an add-on to domestic support schemes.

[16] With regards to HFC projects the CDM-EB had early discussed banning the registration of newly established HCFC-22 facilities, however no final decision has been taken on this issue (UNFCCC, 2005e, 2007b para 86, 2011b).

[17] In the following, “expected” means always the volume of CERs that are documented in the project design document. Project documentation has often overestimated the amount of emission reductions, such that actually issued CERs are lower than projected. Only for solar projects the actually achieved issuance success was higher than documented before the project started- Renewables have an issuance success of 85% relative to project documentation (Risoe, 2011).

In its 51st session, the CDM-EB decided to reject ten Chinese wind farms because they could have been implemented without the CDM as a result of the feed-in tariff (He & Morse, 2010). The Chinese feed-in tariff had previously been decreased by the National Development and Reform Commission, and the CDM-EB feared that the CDM was replacing the feed-in support. However, the rejection based on this new tariff policy could be interpreted as a violation of the E+/E- rule. Even if the decision of the CDM-EB was correct in this case—in theory it would have prevented the approval of non-additional projects—it is not consistent with previous decisions, which deliberately ignored regulatory changes. This emphasizes the dilemma of the CDM-EB in deciding which projects to register. It also illustrates that credits are created from potentially non-additional projects, which are commercially feasible with available national support.

3.3.1.4 Executive Board reforms CDM guidelines to strengthen environmental integrity

To address the adverse development on the CDM market the executive board has reacted to these criticisms. First, in 2006, the Registration and Issuance Team has been established at the 29th meeting of the executive board (EB29) to "assist the Executive Board to consider requests for registration of project activities and requests for issuance of CERs submitted to the Executive Board by DOEs" (UNFCCC, 2007, Annex 14, para 1). On the basis of advice from the RIT, the CDM-EB registers or rejects CDM projects. Since the establishment of the RIT, rejection rates have gone up. By October 2007, the CDM-EB had registered 803 and rejected 36 projects (4.4%). By November 2011, the CDM-EB had approved 3,556 projects and rejected 204 (5.7%) (Risoe, 2007, 2011). The CDM-EB furthermore agreed to publish the reasons for rejections (UNFCCC, 2006, para 82). According to Schneider & Mohr (2010), failure to demonstrate additionality is the main reason for the rejection of projects.

Furthermore, the CDM-EB developed, together with DOEs, the validation and verification manual (VVM) in November 2008 (UNFCCC, 2008a). The VVM is especially relevant for projects that receive other revenues than CDM and thus use the investment analysis, for instance renewable energy projects (as will be discussed in Chapter 4).

According to the VVM (UNFCCC, 2008a, sec. Annex I para 98 & 109):

- For all new projects submitted after August 2nd, 2008 project developers need to substantiate to the DOE that the respective project was considered for CDM status prior to the start of the Kyoto commitment period (2008-2012).

- The main responsibilities of validators in terms of the evaluation of the benchmark test are to check all the parameters and assumptions behind the financial indicator (UNFCCC, 2010a).[18]

Furthermore, as suggested by (L. Schneider, 2007; Stehr, 2008), the CDM-EB further developed in the VVM the DOE accreditation standard and a policy framework to address non-compliance by DOEs in terms of issues arising from the registration and issuance process (Schneider and Mohr, 2010). This policy framework monitors the performance of DOEs and has applied sanction mechanisms. Schneider and Mohr (2010), in their rating of DOE performance, find that the three main reasons for deficiencies in DOE performance are a) lack of competence of the personnel in validation and verification teams, b) lack of evidence that the DOE actually undertook an independent technical review of the case; and c) DOEs did not follow internal review or audit procedures to ensure sufficient quality.

With the adoption of the VVM at EB44, the CDM-EB applied its first sanction of Det Norske Veritas (DNV) by temporarily suspending one of the largest CDM validator from operation (UNFCCC, 2008a, Annex 2). At the time DNV covered one third of all projects and 40% in terms of expected annual CER generation as documented in the Project Design Documents. The suspension was based on several non-conformities found by the CDM Accreditation Panel charged with accrediting validators (UNFCCC, 2007a, 2008a, Annex 2).[19] The DNV suspension was a strong signal to the validation market. Before the suspension, the CDM Pipeline database did not indicate any project that had received negative validation reports or whose validation was terminated by DOEs by October 2007, this situation changed significantly in November 2011.[20] By that latter date, the validation of over one thousand projects has been terminated by the validator, and 196 projects received a negative validation report (UNEP Risoe, 2007, 2011). Thus, the adoption of the VVM, issuance of the guidance of investment analysis and the suspension of the biggest validator can be taken as evidence that the CDM-EB took the findings and recommendations of the literature.

[18] Chapter 4 examines the choice of the benchmark rate over time and describes the responsibilities for validators regarding the benchmark test in section 4.2.4.

[19] The review of five samples project activities revealed that for these projects: 1) the sector expert's input and involvement with validation work was not documented, 2) a review of the contract was not available in three surveyed cases, 3) the constellation of the validation team was not documented in three surveyed cases (UNFCCC, 2007a, 2008a, Annex 2).

[20] Société Générale de Surveillance (SGS) and Tüv-Süd, two other major DOEs, were suspended from operations in 2009 and 2010, respectively (UNFCCC, 2009, 2010b). For instance, in the Tüv-Süd case, the CDM-AP found that personnel was not sufficiently trained in a competence area after three months experience, and that concerns about additionality by the DOE still resulted in positive validation.

3.3.2 Sustainable development

The theory in section 3.2.3 predicted regulatory competition as the result of a conflict of cost-effectiveness and sustainable development. This section examines: whether these predictions held in practice; how sustainability of projects developed over time, and; options to increase the benefits actually obtained from projects.

3.3.2.1 Regulatory competition and the absence of a price for sustainability in the CDM

The sustainable development criteria vary between CDM host countries. For example, Ghana, India, Indonesia, South Africa, and Tunisia each use different combinations of environmental, social, and economic aspects, including poverty alleviation and technology transfer, through different weightings, numerical scoring systems, and a minimum average score thresholds that must be reached for approval (L. Schneider & Grashof, 2006). The choice of these parameters is by their nature subjective, and some country DNAs have approved a range of projects that comply with only one of the criteria. This is potentially the result of a "race to the bottom" as several authors suggested (Gupta et al., 2008; Kelly & Helme, 2000; Nussbaumer, 2009; L. Schneider, 2007; Sutter & Parreño, 2007).

Countries that have more stringent sustainable development criteria compete with other CDM hosts that hold investors to less strict criteria, enabling the implementation of low-cost projects with larger rents and potentially lower risks (Schneider, 2007, p. 47). Furthermore, the differing sustainable development criteria make a pricing of the benefits into the carbon price difficult. Thus, investors will prefer cheap projects rather than sustainable projects priced at a premium.

3.3.2.2 Conflict between additionality and sustainability

Alexeew et al. (2010) demonstrate an inherent conflict between additionality and expected sustainable development benefits. They derive their conclusion from an extensive review of 40 (31 of which are large-scale) Indian CDM projects, using multi-criteria analysis of sustainable development claimed in the PDDs and the impact of the CER income stream on the internal rate of return (IRR) of the project.[21] The probability of additionality was measured by analysing the increase in profitability due to revenue from the CDM. The

[21] The sample used was chosen from the pool of 379 Indian projects registered in January 2009 and represents 90% of the main project types (number of projects): biomass (15), wind (12), hydro (7), energy efficiency (4) and HFC-23 (2). Sustainability benefits taken from Project Design Documents were assessed in economic development, environmental and social dimensions, following the criteria in Olsen & Fenhann (2008). Economic criteria include sustainable and innovative technology, employment generation, financial benefits of the project, and cost-efficiency of GHG abatement. Social criteria analysed include stakeholder participation, social benefits for poorer parts of society, development support for poorer regions and impact on quality of life. Environmental criteria included project impact on air, soil and water.

assumption is that, the more the cash flow from CER sales increases profitability, measured by the internal rate of return, the greater the probability that the project is additional.[22]

In line with the findings of other authors on the additionality of a share of renewable projects, Alexeew et al. (2010) find that for hydro and wind projects the IRR without the CDM is already relatively high and that the CDM does not increase it significantly. Furthermore, in line with their hypothesis, they find that projects with an above-average sustainability performance were more likely to be non-additional, and vice versa. The authors conclude that any reform or minor change to address one of the goals of the CDM – additionality or sustainable development – must be taken with due regard to the impact of the other mechanism.[23]

3.3.2.3 Actual versus claimed sustainability benefits of CDM projects

Scholars and CDM experts analysing the sustainable development impact of the CDM come to the conclusion that out of a sample of 200 (Olsen, 2007) and in-depth review of 16 CDM project documentation (Sutter & Parreño, 2007) the CDM contributes only marginally to sustainable development. Olsen & Fenhann (2008) analyse the sustainable development benefits of a sample of 296 PDDs out of a total of 744 projects submitted to the CDM project cycle till May 2006. They count the various benefits each PDD mentions per project type. This method allowed projects to be ranked by their total number of potential sustainability benefits.[24] However, the benefits documented in the PDD are expected, rather than realized benefits. Thus, according to Olsen & Fenhann (2008) to ensure that benefits materialise in practice, an institution is needed that compare the estimated benefits in the PDD and actually realised benefits. Since international carbon markets do not attribute a price premium to the total number of sustainable development benefits per project (Nussbaumer, 2009; Olsen, 2007; Sutter & Parreño, 2007), Olsen & Fenhann (2008) propose an international sustainable development standard in addition to national criteria.

[22] Thus, the authors only analyse projects that claim investment additionality.
[23] Chapter 4 analyses the benchmark rates used to prove additionality for hydro and wind projects in China.
[24] See Appendix 1 for a ranking and categorization in three sustainability levels. The largest number of sustainable development benefits per project is provided by renewable energy projects, energy distribution and clinker replacement in cement production. The authors explain the latter with high environmental (air, water, land and conservation of natural resources) benefits linked to clinker replacement in comparison to socio-economic benefits such as employment, welfare, health and learning that are the strength of renewable energy projects. Coal bed methane, fugitive emission projects and industrial gas projects receive the lowest sustainability ranking.

Currently, CDM host countries' Letters of Approval comply with the national definitions of sustainable development.[25] Thus, establishing additional international criteria for sustainable development, especially the verification of the achievement of sustainable development benefits claimed, could help to prevent a regulatory "race to the bottom" and could increase the share of long-term benefits achieved through projects (Olsen & Fenhann, 2008). The imposition of sustainable development criteria through buyer (e.g. European Union) Letters of Approval might be viewed critically by some CDM host countries if vested interests are suspected. Thus, common criteria and verification methodologies to examine actual achievement of sustainability criteria could be developed by both parties together. This is subject to high demand for negotiation resources and information needs, which the CDM must deliver. The high informational costs, combined with weak incentives for project developers to provide information, have been pointed out by Wara & Victor (2008).

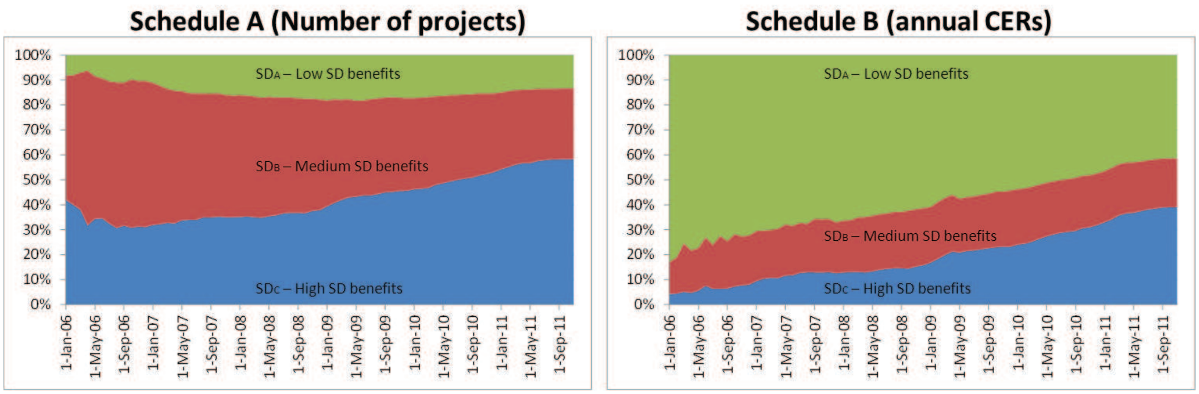
3.3.2.4 Sustainability development of project over time

Based on the sustainability ranking by Olsen and Fennhan (2008) it is possible to show the evolution of sustainable development for registered and declined projects over time.[26] This is done by distinguishing project sustainability in three categories: high, middle and low sustainability (SD_C, SD_B and SD_A, respectively). All CDM projects are labelled according to these criteria using the CDM Pipeline (Risoe, 2011). The project sustainability is assessed over time, as well as all decisions on CDM projects between October 2007 and November 2011. This time frame is chosen because few projects were declined and no project had received a negative validation from auditing firms before that date.

The analysis suggests that the share of projects with a high number of sustainable benefits has increased over time. Figure 3.4 depicts that 58% of all project in November 2011 are high-SD type projects (denoted by SD_C). Figure 3.4 shows that the share of high SD-projects has grown over time. In terms of the annual CER volume, high SD-type projects cover 39% of all expected annual CERs, almost the same share, however 41%, is commanded by low-SD-type projects. This is mainly due to the large size of industrial gas projects (HFC and N2O) which are small in project number but generate large amounts of CERs (Wara, 2007).

[25] Letters of Approval are issued by the host and the buyer country (Step 2 of the CDM project cycle in Chapter 2 Section 2.2.1).
[26] See Appendix 1: Overview of sustainability criteria.

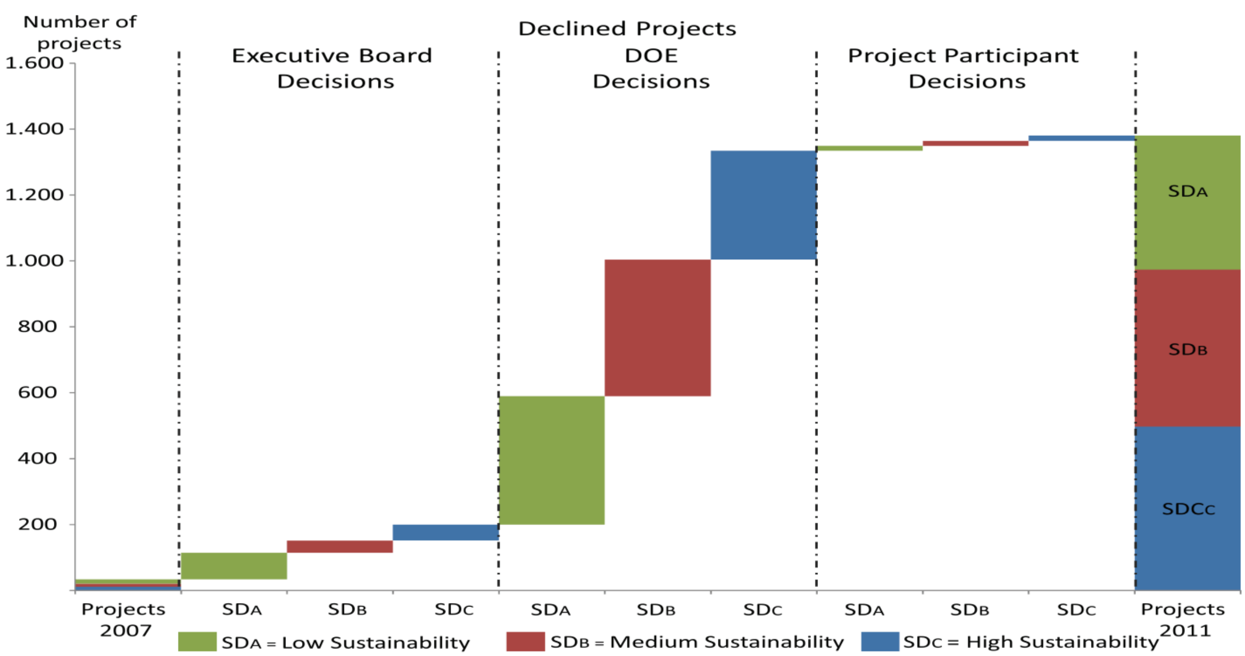
Figure 3.4 Number and expected CERs of projects by impact sustainable development benefits and date of registration



Source: Risoe (2007, 2011); author calculations

Figure 3.5 illustrates how the sustainability of projects that have been declined by actors in the CDM project cycle between October 2007 and November 2011. The decisions are distinguished between decisions taken by the CDM-EB (rejection of the project), DOEs (the sum of termination of and negative validation) and project participants (voluntary withdrawal). Figure 3.5 shows the number of decisions taken between October 2007 and November 2011.

Figure 3.5 Declining decisions by sustainability of projects by CDM actors between October 2007 and November 2011



Source: Risoe (2007, 2011); author calculations

Table 3.1 Decisions on projects between October 2007 and November 2011.

	October 2007 - November 2011				
	Registered projects	Rejected	Validation terminated or negated	Withdrawn	Total Decisions Oct. 2007-Nov. 2011
Low SD benefits (SD_A)	320 (45%)	48 (7%)	330 (46%)	16 (2%)	714 (100%)
Medium SD benefits (SD_B)	549 (54%)	37 (4%)	415 (41%)	15 (1%)	1016 (100%)
High SD benefits (SD_C)	1653 (77%)	81 (4%)	390 (18%)	15 (1%)	2139 (100%)
Total	2522	166	1135	46	3869

Source: Risoe (2007, 2011); author calculations

Figure 3.5 and Table 3.illustrate that the CDM-EB is responsible for rejecting 166 projects, with the largest share, 81 projects, covered by high SD-type projects. However, high-SD type projects have also exhibited the largest registration success rate during that time (77%). Compared with all projects with decisions in the four years assessed, the share of high SD-type projects rejected by the CDM-EB is low (4%). Low-SD projects have been rejected at a higher rate of 7% compared to all projects with decisions.

The largest number of declining decisions (1,135) has been issued by DOEs. The decisions aggregated both the negation and termination of projects.[27] Most of these projects were for more than three years in the CDM pipeline and were unlikely to be registered. High SD-type projects make up a significantly lower share, 18%, compared to the other SD categories for all DOE decisions. These range between 41% for medium and 46% for low SD projects. That suggests that DOEs were reluctant to terminate or negate the validation of high SD projects. This can be explained by the fact that the largest share of high SD type projects are renewables and thus also use the benchmark analysis. Given the experience with the benchmark analysis in the literature above, DOEs are rational in keeping these projects in the project cycle if they expect the registration of these projects and commission fees linked to the success of project registration.

In summary, the analysis above suggests that the number of registered high sustainability projects has grown over time. These projects have been preferred in the registration decisions of the EB. Auditors also rejected proportionally more projects with low-sustainable development benefits, somewhat shielding high-sustainability projects. Given that most of the projects in the high sustainability category are renewables, this is rational. Proving additionality for these projects is difficult, however, but the majority of renewables projects

[27] No such decision was made by DOEs prior to December 2008 (Risoe, 2008).

were registered in the past.[28] Thus, these projects have a high probability to get registered and thus are protected by rational auditors, who want to maximise commission fees. Still, for a considerable number of high-SD projects auditors have terminated validation. These projects however, were mainly old projects with a low probability of getting registered.

3.3.2.5 Increasing sustainability through fees and taxes

To increase the number of high-sustainability projects, Michaelowa (2005) had proposed to levy a higher adaptation fee for non-CO2 projects (HFC, N2O and methane) relative to the usual 2% adaptation fee charged on each CDM project.[29] This proposal is similar in effect to the Chinese sustainability tax differentiated by project type. China taxes the proceeds of projects differentiated by the sustainability of projects. HFC projects for instance get taxed at a rate of 65%, N2Os at 30% while renewable energy projects need to forgo 2% of their revenue (Olsen and Fenhann, 2007). The difference is the recipient of the revenue, the government in the Chinese example and the UNFCCC adaptation fund as suggested by Michaelowa (2005). The establishment of the Chinese CDM fund started in October 2005, and indicates that the Chinese government acted rationally by starting the collection of revenues on projects pursued in China, rather than be subject to the collection and disbursement system of the UNFCCC.

3.3.3 Cost-effectiveness – the difference between abetment costs and the market price

In the CDM, there is no institutional body that ensures cost-effectiveness. A high market price for CDM credits leads to large rents and potential market entry as discussed in section 3.2.2.[30] The theoretical prediction is that the rent creates interest groups that will oppose regulation as long as a subsidy such as the CDM is in place, and meanwhile the rent cannot be used to pursue higher cost-projects. However, if the rent is reinvested in mitigation projects, the overall system can achieve a high cost-effectiveness.

3.3.3.1 Industrial gas projects – low cost and large rents

[28] See Figure 4.2 and
Figure 4.3 4.3 in Chapter 4.
[29] See Project cycle Step 7 (Issuance) in Chapter 2 Section 2.2.3.
[30] The price paid for project credits is either set by demand and supply or set by host countries as is the case of China, which set an floor price between 8 Euro per CER to be paid for credit generated from Chinese projects (Schroeder, 2009). In January 2012, China has lowered the CDM floor price to 7 Euro per CER due to a CER and EUA price crash (Point Carbon, 2012). In the following calculations this move by the Chinese government is not taken into account and the lowest price is kept at 8 Euro per CER.

The CDM has been successful in terms of finding least-cost abatement opportunities. A small number of industrial gas (HFC-23 and N2O) projects (93 projects total registered) make up 38% of total expected CERs by 2012. Industrial GHGs have high global warming potentials, acting as a multiplier to each tonne of the respective GHG destroyed, so such projects can provide a large number of certifiable emissions reductions at a low price, for HFCs below €1 per CER (Wara, 2007). These projects are clearly additional, as the implementation of the project entails costs but no revenue (these projects use the simple cost approach explained in section 2.3 of Chapter 2) (Schneider, 2007). However, the market price paid for credits is between €8 and €12 per CER and thus these projects create a large rent.[31]

If the destruction of industrial gases had been implemented differently – for instance by national regulation – a large part of the cost of these projects could have been saved and reinvested in other mitigation projects. Wara (2008) has calculated that the yearly costs for abating all developing country HFC-23 would be about €26 million, while through the CDM, Annex I buyers paid between €250 and €750 million in total. The Chinese government has recognized the large windfall profit from this project type and taxes CER revenues at 65% to create a sustainable development investment fund from the revenues (Liu, 2010).

However, as Muller (2007) observes, the Chinese government has not taken steps to implement national legislation addressing HFC projects. In the meantime, the Chinese CDM fund that collects the tax revenue has started discussions on how to use the funds for mitigation purposes (China CDM Fund, 2011).

3.3.3.2 Case studies of abatement costs per project type

The cost-effectiveness of different CDM project types has been analysed by Green (2008) and by Castro (2010). Green examines 912 projects registered by January 2008 according to the costs needed to reduce one tonne of CO2- equivalent. The lowest median costs, below €1 per tonne of CO2e, are HFC, N2O, and fugitive projects (the latter of which recover methane (CH4) from oil wells, gas pipeline leaks and charcoal production). The highest emission reduction costs, between €10-13 per tonne of CO2e, are commanded by wind and hydro projects; geothermal projects are about 50% more costly than these project types. The "middle ground", €3-6 per tonne of CO2e, is taken by methane avoidance and biomass energy projects.

[31] A distinction has to be made between primary and secondary CER prices. For the rent calculation in this chapter primary CER prices are used. Primary CER prices reflect the price of CER for credits that are not issued yet and thus still carry risks of non-issuance (see Step 7 (Issuance) in Chapter 2). Secondary CER prices refer to CERs which have already been issued, and thus can already be used for compliance. These generally have a higher price. See Chapter 4 for a development of the CER price over time.

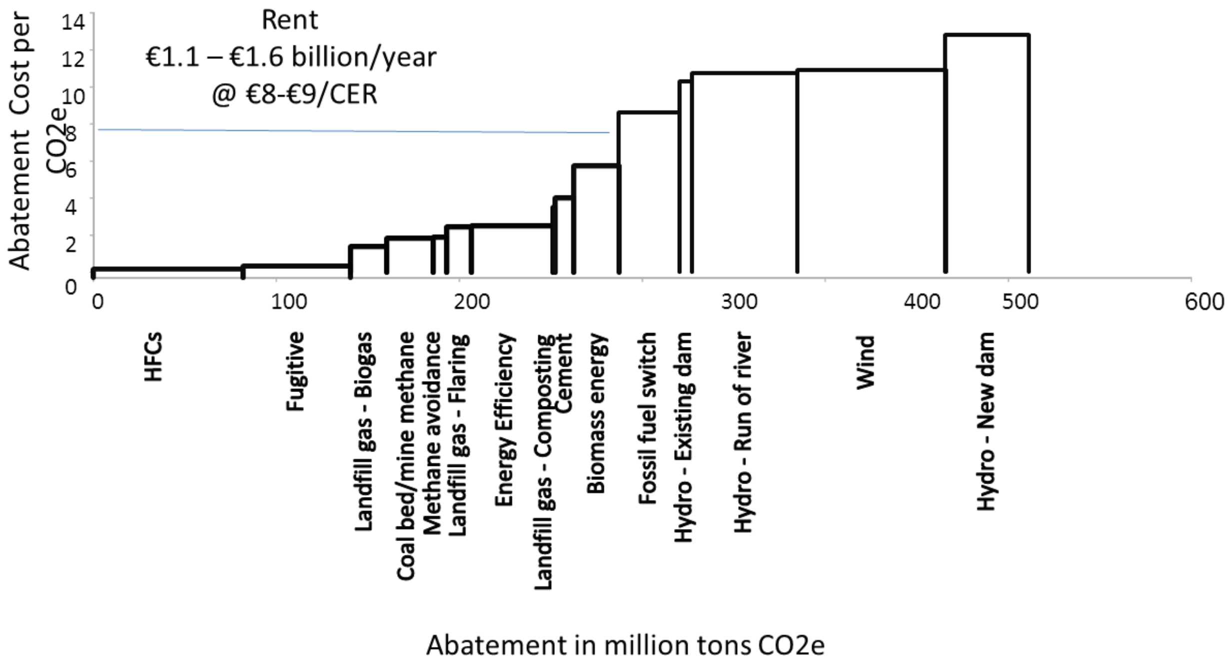
Castro examined 252 registered projects from the main CDM host countries except India and Brazil, according to their costs of generating emission reductions. Castro finds that solar CDM projects are most expensive, well above €300 per CER. Cement plants, have “medium” abatement costs close to biomass energy projects in Green (2008). Green concludes on the basis of his analysis that the examined projects were cost-ineffective and suggests that the price paid for emission reductions shall be pegged to the actual costs of reducing emissions. These cost-ineffective projects confer rents that could be used to leverage mitigation.

3.3.3.3 Estimation of the annual rent transfer for project registered November 2011

To assess the rent conferred to host country actors, abatement cost estimates are used by Green (2008) and (Castro, 2012). The rent is calculated as the difference between these abatement costs and CER prices of €8 to €13. Figure 3.6 shows that projects that need the least CER revenue to become operational are renewables, these are cost-effective from a global perspective, as they convey the smallest rent. At low CER prices of below 10 Euro many of these are not even financially feasible. This suggests that the CER price was not the sole determinant for project implementation. Biomass energy, cement and flaring projects create “medium” rents, and cost-ineffective projects from the global perspective include industrial gas projects and landfill gas and methane avoidance projects with a power component. The latter projects also receive revenue from the sale of power and are thus cheaper and less cost effective than their flaring (landfill and methane) counterparts.

Figure 3.6 further illustrates that at an assumed carbon price between €8 and €9 per CER, the CDM leads to rents between €1.1 and €1.6 billion per year transferred to developing countries. This figure increases by about €500 million for each €1 increase in the assumed CER price. If these rents are used for mitigation purposes, they can significantly support the reduction of emissions beyond those offset by increases in industrialised countries (Cameron Hepburn, 2009). In many cases, this rent is captured by businesses and intermediaries. While it can be assumed that renewables project developers reinvest the rents in renewables, the same cannot be expected from owners of coal bed methane projects for instance. These latter project developers will use the rent to increase fossil-fuel based activities where these are profitable. The rent created for China, India and Brazil is illustrated in Table 3.2. The three countries, China, India and Brazil make up about 70% of the rent created by the CDM.

Figure 3.6 Abatement quantity in CO2-equivalent for registered projects by November 2011, project-type specific abatement costs, and potential rent generated



Source: Castro (2012); Green (2008); Risoe (2011); author calculations

Table 3.2 Overview of rent at different CER prices

Rent in million Euro	All projects	China		India	Brazil
	Rent	Rent	Tax revenue	Rent	Rent
€8 per CER	1,672	551	370	461	126
€9 per CER	2,716	1,116	420	661	169
€10 per CER	3,760	1,682	469	862	213
€11 per CER	4,804	2,248	519	1,063	256
€12 per CER	5,848	2,813	568	1,263	300
€13 per CER	6,892	3,379	618	1,464	343

Source: Author calculations based on abatement costs from Castro (2012) and Green (2008)

To the author's knowledge only China imposes tax on the proceeds of projects. The tax is based on the sustainability of the projects and taxes low-sustainable projects at a higher rate (see section 3.3.2.5). The revenue is channelled into the China CDM fund from which it should be distributed for mitigation purposes. With the tax, China makes sure that part of the rents of the CDM remains in the host country (Liu, 2010; Muller, 2007). The largest revenue share comes from industrial gas projects, HFCs and N2Os, and is between €366 and €415 million per year at carbon prices of €8 and €9 per CER, respectively. Liu (2010) arrives at similar rent estimations and argues that the CDM tax revenue is small (about 0.1%) relative to annual national tax revenues of €520 billion.[32]

The effectiveness of mitigation using these funds depends on whether the fund can leverage mitigation projects better than the market can. The fund would need a similar approval system to disburse funds as the CDM-EB to ensure cost-effectiveness. While the taxation is a rational choice for China, it creates strong incentives against domestic regulation of industrial gases and even blocking attempts to increase the speed to phase-out HCFC-22 for developing countries in the Montreal Protocol (Schapiro, 2010). The HCFC-22 gas (which generates HFC-23 as a waste gas) is governed under the Montreal Protocol and has a phase-out schedule that is binding for developed countries. The presence of HFC-23 credits and tax revenue disincentivises domestic regulation of these gases. In the meantime, the European Union has taken action on this issue and has banned the use of credits from industrial gas credits, HCFs and N2Os, in the EU ETS from 2013 onwards.[33]

The estimates in Figure 3.6 and Table 3.2 have to be taken with caution as they are based on median rates of examined projects by Green (2008) and Castro (2012) and exclude transaction costs (see limitations in Appendix 2). The actual abatement costs including transaction costs could be higher. However, even with higher actual abatement costs due transaction costs, the annual rent created by the CDM remains substantial. Furthermore, also a higher market price incentivises more submissions of CDM projects. However, the supply of industrial gas projects is fixed as no new plants can apply for CDM registration.

Summarising, the cost-effectiveness of projects has increased as low-cost projects have decreased in number. The impact in terms of CER volume is however not as pronounced due to the weight of projects with high global warming potentials (see also Chapter 1 footnote 1). The rent created by these latter projects is in the order of €1 billion per year. Only China captures a large share of the rent created through the Chinese CDM projects. China is thus in the position to expand its mitigation activities with this revenue.

The literature review above has shown that the CDM faced considerable difficulties in practice to achieve cost-effectiveness and sustainable development. Furthermore, the literature has detected that several projects did not require the CDM to become operational and would have happened anyway. These projects actually lead to global emission increases. The next section analyses whether an alternative to the CDM, a fund-approach that collects

[32] The US$ 690 billion cited in Liu (2010: page 1875) are converted into Euro at a Euro exchange rate of 1.3 US dollar.
[33] The implications of the use of CERs in the EU ETS are the subject of the Chapter 5.

penalties from industrialised countries, would perform better on the dimensions of cost-effectiveness, sustainable development and environmental integrity.

3.4 Clean Development Fund

The CDF allows countries with a cap to emit more than their emission reduction limit allows.[34] The country has to pay a penalty fee (F) for each tonne of CO2e emitted in excess of the emission limitation (e.g. the Kyoto target). These penalty fees are collected by a so-called Clean Development Fund.[35]

This system thus follows three steps:

Step 1: (Industrialised) Country A emits more than its emission limit

Step 2: Fee is distributed to country B

Step 3: (Developing) Country B conducts emission reduction activities on its territory

In the following, this section will assess each step. However, the order of the presentation is altered. First, step 1, then step 3, and then step 2 will be explained. This order allows the analysis of step 1 and 3 if only two countries A and B exist, while Step 2 describes the additional challenges that arise if more than one (developing) country B exists.

3.4.1 How does country A decide how many emissions to reduce?

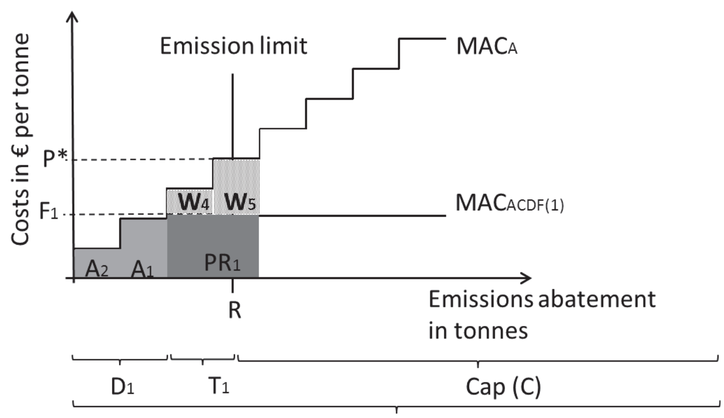
3.4.1.1 Interaction of marginal abatement cost curve with penalty fee

Country A bases its decision how much to emit domestically on its marginal abatement cost curve (MAC_A) combined with the penalty level. This new MAC curve is called MAC_A-CDF in Figure 3.7. Thus, faced with the target to reduce emission by R units, country A would abate domestically D_1 units and pay the penalty for T_1 emission units. The sum of D_1 and T_1 units equals country A's original emission reduction target R. Country A abates only D_1 units, because abating more than D_1 is more expensive than paying the fine F per additional emission unit. The cost to country A is the sum of the areas A_1, A_2 and PR_1. The areas A_1 and A_2 are paid for by domestic abatement and PR_1 are the aggregate penalties, which is equal to the fine F multiplied by T_1. Country A emits T_1+C emissions and thus more than its cap. The

[34] In the following it is assumed that the Clean Development Fund actually becomes operational and examines the effects of its implementation.
[35]The proposed penalty fee per tonne of CO2.equivalent in Brazil's submission was US$ 10. (UNFCCC, 1997b, p. 24). Average CER prices observed in practice were above €10 or US$13 (see section 5.1.1 of Chapter 5 for a development of CER prices over time).

funds PR_1 from the compliance fund are channelled to country B.[36] A higher penalty fee, all else equal, will lead to higher domestic abatement and higher total abatement costs to be paid by country A (this is illustrated in Figure 3.8).

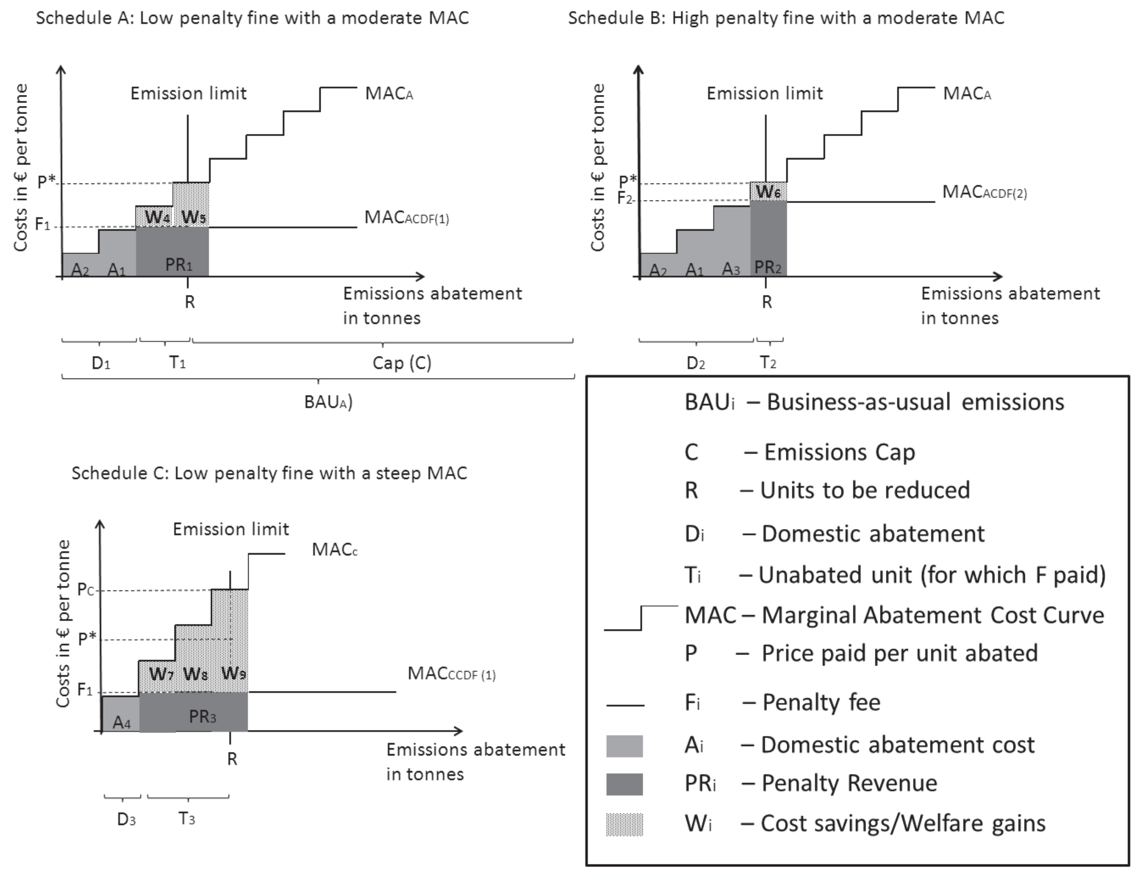
Figure 3.7 Penalty payments and domestic abatement – the combined $MAC_{A\text{-}CDF}$ curve



In the CDF approach, the funds generated through the penalty and transferred from country A to country B, are independent of the marginal abatement cost curve in country B. The penalties paid into the fund solely depend on the size of the fine F and the shape of the marginal abatement costs curve in country A (MAC_A). Figure 3.8 illustrates this for two different fines F_1 (Schedule A) and F_2 (Schedule B) holding the MAC curve of country A constant in schedules A and B, respectively. The level of the fine has a direct consequence on domestic abatement (D), the number of emission units that remain unabated and for which the penalty is paid for (T) and the proceeds from the fund (PR) channelled to country B.

[36] For simplicity we assume here that there is only one developing country, country B. We will relax this assumption below.

Figure 3.8 Interaction between the level of the fine and MAC curves in country A



A higher fine F does as Schedule A and B in Figure 3.8 illustrates, all else equal, increase domestic abatement ($D_1<D_2$) and decrease correspondingly the units the penalty is paid for ($T_1>T_2$). The size of the absolute penalty (PR) paid, depends on the level of F, the marginal abatement costs curve and the overall reduction target R. Depending on who sets F, assuming that R and the marginal abatement costs curve are fixed, has incentives to maximize (country B) or to minimize (country A) the total penalty to be paid (PR). For instance, country A would, all else equal, prefer to minimize F. Because it can thus lower its total abatement costs and increase welfare gains (the sum areas denoted by W in Figure 3.8). Country B would prefer to maximize the proceeds (PR) to use them for mitigation or other purposes.[37] A marginal abatement cost curve, with a steeper slope than MAC_A (e.g. MAC_C) does decrease domestic abatement ($D_1>D_3$) and increases the number of units ($T_1<T_3$) country A pays the penalty for (Schedule C) The proceeds flowing to country B increase in Schedule C compared to Schedule A. Thus, in short, domestic abatement and the proceeds channelled to the fund depend on the marginal abatement costs curve in country A, the emissions limit R and the level of the fine F.

[37] Section 3.4.3.2 describes incentives to bargain over the level of the fee.

The costs of compliance for country A are the sum of domestic abatement and the penalties paid for the fund. For instance in schedule A, country A's compliance cost are the sum of A_1, A_2 and PR_1. Compared to the domestic abatement case with abatement costs A, country A benefits from welfare gains equal to the sum of W_4 and W_5. A higher penalty, such as in schedule B, increases total abatement costs for country A to the sum of A_1, A_2, A_3 and PR_2 because the additional abatement from D_1 to D_2 induced through a higher fine ($A_3 + PR_2 > PR_1$ for $F_2 > F_1$). This is because a higher fine approaches domestic abatement costs. The effect of a steeper marginal abatement cost curve keeping all other variables, R and F, constant increases total compliance costs with increasing penalties going to the fund. Thus, a country with a steeper marginal abatement cost curve has, all else equal, larger cost savings in penalty-regime but also larger total abatement costs.

3.4.1.2 Timing

In the CDF approach, Country A pays the penalty *after* it breached its obligation to reduce R emissions units. The payment leads to emission reductions in country B *after* the excess emission units occurred in country A. For country A the payment of the penalty relieves it, unless otherwise specified, from further obligations to ensure environmental integrity.[38] In contrast, in the CDM, country A can only increase its emissions beyond the cap *after* emission reductions were generated and issued from implemented projects in country B.[39] Thus, in the CDM, emission reductions in country B have to have occurred first and only then can country A buy credits and reduce the effort to reduce R units. In the CDM, country A needs to pay to implement emission reduction projects in country B first, before it can increase emissions in its territory. This difference between the CDF and CDM can significantly weaken environmental integrity within the CDF (as defined by Figure 3.1).

Despite the timing issue, country A can have incentives that country B actually engages in abatement or spending the funds on products if country A is an exporter of technology.[40] Country A wants to sell this technology to country B. These technologies can either be GHG relevant (high-, or low-carbon intensity) or GHG neutral. Environmental integrity is dependent on the relative carbon-intensity, price and availability of the technology between country A and B. Exports of technology from country A to country B can thus change the impact regarding environmental integrity either positively (reduce global emissions) or

[38] In the CDF system it has to be determined who pays the penalty fee. In the CDM it is country A or country emitters. Similarly in the CDF country A needs first to distribute emission reduction responsibilities to individual emitters to collect potential penalties for non-achievement of the individual reduction goals.
[39] See Step 7 (Issuance) in Chapter 2 for details.
[40] The focus here is on technology but the analysis holds for any other exported good.

negatively (increase global emissions). Thus, incentives of country A to export technology could improve environmental integrity.[41]

Summarising, this section illustrated the actions taken by country A to determine optimal abatement strategies. First, country A decides on the basis of its domestic MAC curve how much to abate at home. Where the MAC curve crosses the fee, country A starts paying fee up to R to fulfil its emission reduction target. The decision in country A is similar to the one taken under the CDM. However, under the penalty approach country A does not need to know marginal abatement costs in country B, it just needs the level of the fee to decide domestic abatement. This substantially lowers the information costs imposed upon country A but also means that country A forgoes the benefits of lower abatement costs in country B. Furthermore, this section raised the timing issue, which differentiates the CDF from the CDM. In the CDF, emission increases in country A happen before any emissions are reduced in country B. The next section continues with the use of the penalty proceeds by country B (Step 3).

3.4.2 How does country B decide on emission reductions in its territory?

Country A pays the penalty PR_1 to country B.[42] Assuming no transaction costs, country B receives funds equal to PR_1.[43] If country B uses the funds to reduce T_1 units, the amount of unabated emissions in country A, global emission decrease in total by R and thus achieve the emission reduction target imposed on country A. For this to occur, the funds collected through the penalty have to be equal to the aggregate costs for abating T_1 emission units in country B.

There are three dimensions that distinguish the CDM from the CDF presented in the following section.

[41] The prospect of gaining from the export of technologies could be a reason for countries to agree to both the CDM or a penalty fund system. If country A type parties know that their technology will be purchases with the funds, they will support such a scheme. Sunstein (2007, p. 14) shows that this was the case in the Montreal Protocol and the phase out of ozone depleting substances chlorofluorocarbon CFCs. The author shows that while American CFC producers such as DuPont, lobbied against domestic controls on CFCs, these companies supported an international freeze on CFCs once safe substitutes were discovered. DuPont and other producers would benefit in the future from the sale of these substitutes.

[42] Step two the distribution of the fund is discussed below.

[43] Potential transaction costs could be administration fees of the fund. These generally increase with the complexity of the distribution formula and the information required to calculate the outputs of the formula. Inputs could be for instance historical gross domestic product or emissions. Projected emissions were suggested as an indicator in the Brazilian Proposal (Cole, 2010).

These are:

- Sufficiency of funds
- Abatement in country B
- Country B choices on sustainable development

3.4.2.1 Sufficiency of funds

The level of environmental integrity of the CDF depends on how much abatement the proceeds from the fund can "buy" in country B. Abatement in country B, absent of transaction costs, thus depends on country B's marginal costs and the proceeds from the fund. For instance, the steeper the marginal abatement cost curve in country B[44], the more difficult it will be to cover the same amount of excess emissions (T) for which the penalty was paid for by emission reductions in country B.

In Figure 3.9 we illustrate three cases, using the variables PR_1, PR_2 and PR_3 from Figure 3.8 to assess the level of environmental integrity these funds enable. In schedule A and B of Figure 3.9 the funds are enough to more than offset the emissions increase in country A. The excess emissions in country A, T_1 and T_2, are more than offset by reductions T_{X1} and T_{X2} in country B as $T_1 < T_{X1}$ and $T_2 < T_{X2}$, respectively. However, schedule C shows that the penalty revenue PR_3 is insufficient to abate T_3 emission units. Only T_{X3} units are abated in country B, while emission increases in country A were equal to T_3 units such that $T_{X3} < T_3$. Thus, the level of environmental integrity is negative by the difference between T_3 and T_{X3}. For illustration we have used a steep marginal abatement cost curve MAC_D (schedule C) in country B, but it is essential to note that the main reason for a lack of environmental integrity is the absence of a direct connection between abatement in country A and country B and thus a disconnect between both countries marginal abatement costs curves.[45]

[44] For consistency, we assume that the slope of MAC_B is lower than the slope of MAC_A and MAC_C., but this is not necessarily true in practice, there are countries which are classified as developing and thus do not have caps, but whose MAC curve slopes can be above those of developed countries (reference). This would just strengthen the argument in this section.

[45] However, for consistency, the slope of MAC_D is (slightly) lower than that of both MAC_A and MAC_C in country A.

Figure 3.9 Penalty proceeds and abatement in country B (proceeds from penalty in grey)

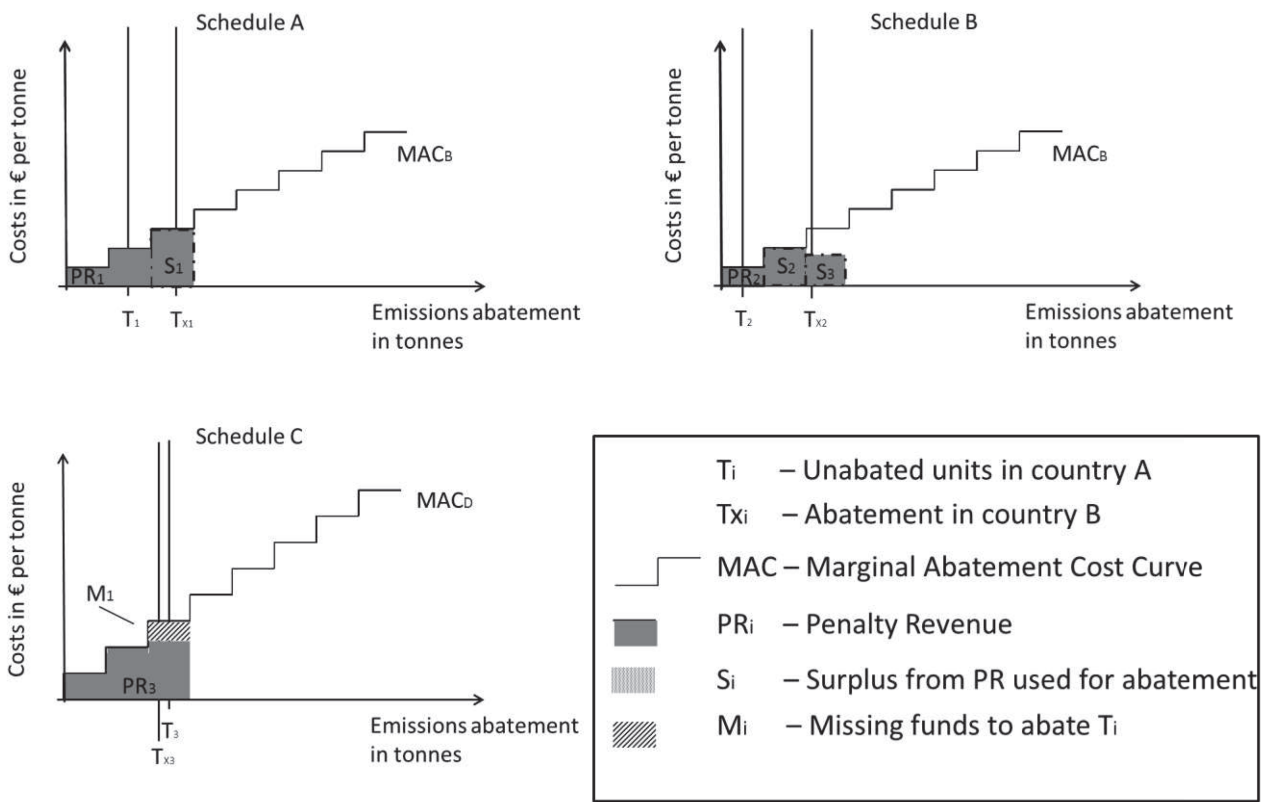


Figure 3.9 shows that the proceeds PR_1 and PR_2 are sufficient to establish positive environmental integrity. The funds actually create surpluses of S_1 (schedule A) and the sum of S_2 and S_3 (schedule B), for country B respectively depending on the level of the fine. These surpluses suggest that a lower penalty would have sufficed to ensure both environmental integrity and achieve cost-effectiveness. If these surpluses are invested in mitigation, as suggested in Figure 3.9, they can increase emission reductions beyond the level necessary to establish environmental integrity (i.e. T_i unabated emission units in Country A). Schedule C paints the opposite picture. There are not sufficient funds for environmental integrity; funds equal to M_1 are missing to establish neutral environmental integrity. Environmental integrity cannot be restored unless either country A transfers the missing funds M_1 to abate the difference between T_3 and T_X, or country B pays this from its own budget.

3.4.2.2 Abatement in country B

The CDF raises a public choice problem of choosing in which sector to abate within country B. If the government is composed of different ministries or more general interest groups, these groups will compete for the use of these funds. The result could be that the ranking of abatement could be decided on another basis other than environmental integrity and cost-effectiveness. For instance, the government in country B could employ sustainability criteria to decide where to invest the funds. Depending on the design additional decision criteria could lead to non-cost-effective abatement and a decrease in the environmental integrity level. For instance, imagine that there are three technologies, which can each abate one emission unit, and have increasing abatement costs are represented by three interest groups that produce these technologies. If the interest group with the most expensive technology receives most funds for abatement and insufficient funds are left to abate with the cheaper technologies, environmental integrity might become negative (as illustrated by Schedule C in Figure 3.9).[46]

The problem just described had assumed that the government of country B fully channels the funds PR to mitigation action. However, a case can be made that the funds are diverted directly to other priorities such as health, education or other issues without any direct abatement impact. Here we can distinguish two cases: a) no abatement and no investment in GHG relevant sectors, and b) no abatement and investment in GHG sectors that increase emissions. In reality, both are extreme cases, but they help to illustrate the impacts on environmental integrity.

No abatement and no GHG investment case: In this case, the government does not abate at all, but invests the money for instance in healthcare, education and other issues.[47] That means that because the investments in GHG unrelated sectors do not reduce emissions, global emissions increase by T, the volume of units that country A paid the penalty for but which are not offset by reductions in country B. Thus, the volume of non-additionality is limited to T.

No abatement and GHG investment case: In this case, the government does invest in GHG relevant sectors such as fossil fuel power plants which affect emissions. In this case, the level of non-additionality would not be limited to T but is subject to, and could well exceed T, depending on the carbon intensity of the fund. For instance, in the extreme case, the country could use the proceeds from the fund to invest in a coal-fired power plant due to regulatory capture by interest groups, or availability of the resource (i.e. coal). This coal-fired power plant was not projected under the country's BAU_B scenario but due to the proceeds from the

[46] The CDM has similar challenges for setting international standards for technologies and baselines, however it is assumed that regulators at the international level are less sensitive to local national stakeholders and interest groups. This also means that only well-financed and well-equipped interest groups get an opportunity to contribute to the system in case of the CDM relative to a national CDF approach. Flues, Michaelowa, & Michaelowa (2009) show that also the CDM regulator has not decided always independently. Some CDM-EB members have shown a reluctance to reject large-scale projects if these where located in the CDM-EB member's country of origin.

[47] The effects of investments in healthcare and education are assumed here to be GHG neutral, thus not having any effect on emissions. This effects in practice are not necessarily so. For instance, Shepardson et al. (2011) investigated the perceptions and misconceptions of 51 secondary students about climate change. Based on their finding, the authors draw recommendations for a curriculum. Such a curriculum, if well designed and implemented can have a long-term emission reducing effect.

CDF could be realised as a prestige project. The availability of funds thus, draws attention by interest groups and thus potentially increases emissions, similar to the subsidy effect suggested by Tirole (2008).

Nevertheless, if the funds are channelled to mitigation as is assumed throughout this section, global emissions can be reduced (Figure 3.9 Schedules A and B). This for instance is the case, if the "winning" interest group is providing renewables technology and thus lowers emissions in country B. Depending on the abatement cost per tonne of the technology, the funds could still be insufficient to establish neutral environmental integrity in the short run. However, renewables can provide the basis for long-run, deeper emission reductions which are not captured by the static perspective of the marginal abatement cost curve. Thus continuous support for renewables could support learning curve effects, which already have been observed for solar photovoltaics and other renewables (BMU, 2007).

3.4.2.3 Country B choices on sustainable development

The previous section has analysed the effects of the CDF on cost-effectiveness and has concluded that it depends on four variables: the marginal abatement cost curves, the emissions limit R and the penalty level F, in addition to the distribution formula, which we briefly discussed in the section on environmental integrity. This section assesses the impact the CDF has on sustainable development. In the following it is assumed that the government in country B is benevolent and aims at maximizing social welfare.

We recall that each country has different priorities and interpretations in terms of sustainable development depending on its position along the development spectrum.[48] The direct transfer of funds to governments in countries without a cap enables these countries to follow their own sustainable development priorities. Countries in general have an information advantage in what regards their national circumstances and needs. Thus, they are in a better position to judge where funds should be invested to catalyse their own sustainable development priorities and other national priorities. The government is also better equipped to change the sustainability criteria once new priorities arise.

The distribution formula for funds plays a role for sustainability.[49] If the CDF distributes funds independently (without condition) of any domestic policy in country B, a benevolent country B government can act strategically for the long-term without the concern of losing funds due to regulatory competition between countries as within the CDM. Thus, depending on the fund distribution formula, from a sustainable development point of view, the CDF

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[48] See Chapter 2 Section 2.1.2 on sustainable development.

[49] Different distribution formulae are discussed below in section 3.4.3.1.

allows the government to act independent of international developments. For instance, the funds could be used to provide long-term support for renewables or a training programme for engineers and craftsmen to energetically retrofit buildings. If the fund leads to predictable monetary streams to country B, such expenditure can be better managed, in comparison to a fluctuating carbon price under the CDM. However, the long-term impact of investment in renewables is likely large due to learning curves effects, the immediate effects are difficult to quantify.[50]

To what extend the country's sustainable development criteria involve GHG abatement priorities determines the environmental integrity and cost-effectiveness of the instrument. The transfer receiving country can commit to ensure environmental integrity. Such a system would involve voluntary commitment or sanctions for non-compliant developing country governments. This would shift the responsibility for reducing emissions to developing countries, which is a paradox as the absence of developing country emission reduction responsibilities is the main reason for a compliance fund in the first place, and thus is not practicable.

This section illustrated the actions taken by (developing) country B upon receipt of the proceeds from the fund. It showed that the environmental integrity of the CDF depends on the interaction between the funds channelled and the abatement opportunities in country B. If funds are insufficient to cover emission increases in country B, global emissions increase. Thus, in addition to the additionality challenges that face both the CDM and CDF, the CDF suffers from a lack of environmental integrity if funds are insufficient. In addition, global emissions increase if the funds are diverted to non-GHG activities. However, the CDF is potentially better suited to achieve long-term strategic growth and sustainable development criteria if country B governments are free to decide about the use of the money. This presumes, however, that the government is benevolent.

3.4.3 Fee is distributed to country B

3.4.3.1 Distribution of funds to more than one country

The analysis of steps 1 and 3 compared the effect of the CDF in only two countries, a penalty-paying country (A) and a penalty-receiving country (B). All the penalty payments are in this case fully channelled to country B, absent transaction costs. However, if more B-type countries exist, a distribution formula for funds from the CDF is necessary. The Brazilian Proposal suggested a formula based on projected emissions of countries without a cap to

[50] Nevertheless, for example Germany, which has an increasing share of renewables deployment, has built considerable monitoring and reporting capacity that allows the quantification of GHG and employment benefits from renewables (BMU, 2007).

distribute the penalties collected by Country A. For example, if two countries, B and C, both without an emissions cap, have projected emissions of 30% and 70% of all emissions among the two countries respectively, the penalties should be distributed in the same proportions to these countries. Other distribution formulas could be based on, for instance, gross-domestic product (GDP), GDP per capita or population to name a few. However, it is important to note that some of these distribution formulae actually incentivise an increase in emissions to profit from distributed funds. This is the moral hazard problem discussed by Tirole (2008) and confirmed in the CDM (L. Schneider, 2011).

For environmental integrity and cost-effectiveness purposes, the funds should be channelled to the countries with the largest low-cost abatement potential accounting for technology cost-reduction potential. Projected emissions and GDP per capita could be a proxy indicator for abatement opportunities, as higher emissions also indicate a large absolute reduction potential. None of the indicators, except abatement potential itself, is a good guide for distribution of the CDF proceeds, if environmental integrity and cost-effectiveness matter. The information needed to assess such potential is difficult to gather and might induce moral hazard on the side of countries to act inefficiently and increase emissions to claim funds in a second step.[51] This is the same challenge encountered in the CDM with the incentives to exaggerate projected baseline emissions, and pointed out by Faure & Lefevere, (2005) and Shrestha & Timilsina (2002).[52]

If emission projections are used for the distribution of funds, this will create incentives to keep emissions high. Because if actual BAU emissions in countries without a cap turn out to be lower than expected, the country should in theory pay back funds received in excess to the pool or not receive as large a transfer in the next period. While this is difficult to implement in practice it illustrates the incentives to keep emissions at or above projected level.

Another indicator to channel funds could be advances and stringency of domestic climate policy actions taken by governments in countries without caps. For instance, all else equal, a country which already implements GHG-reducing policies domestically could receive more funds. While the assessment and ranking of such policies and their performance is difficult, it would also encounter political difficulties due to both the “conditionality” of funds distribution (Sippel & Neuhoff, 2009) and the absence of requirements in the UNFCCC for industrialised countries to report regularly on domestic policies and measures. Currently developing countries only have to report infrequently on their emissions and policies

[51] Building technical capacity to monitor, report and verify (MRV) GHG emissions and policies at that have an impact on emissions at the national or sectoral level is an important first step towards effectively reducing emissions (Hogan et al., 2012).
[52] Chapter 4 provides a short literature on moral hazard related to the CDM to assess the level of benchmarks used in additionality testing.

through National Communications, while industrialised countries report annually on emissions and every four to five years on policies and measures (UNFCCC, 1992). Biennial reports are currently under discussion for both developed and developing countries (Moncel, 2011; UNFCCC, 2010c).

Thus, in short, the distribution formula will induce rent-seeking behaviour by countries which benefit from one distribution formula over the other. In aggregate, this endangers the environmental integrity of the instrument.

3.4.3.2 Bargaining over the fee level

In the section above, it was assumed that the penalty F is set exogenously. However, in practice it is likely that the fee is set through a political bargaining process. Naturally, country A bargains for a low penalty fee and country B bargains for a penalty fee that maximises penalty revenue (PR), as discussed around Figure 3.8 and Figure 3.9. Thus, the fine setting process will become a bargaining coordination game. The resulting fine is unlikely to be set optimally, as the information needed on marginal abatement cost curves between countries is not taken into account.

Summarising, this section illustrated the challenges to distribute the funds of the CDF if more than one recipient (i.e. developing) country is involved. Depending on the nature of the formula recipient countries have incentives to keep emissions at high levels to continue receiving funds (moral hazard). Abatement costs in these countries are a good indicator for distribution of funds, but would require an assessment of the MAC curve in country B. The CDM fares better in this regard as the price paid for abatement is determined by the two MAC curves of country A and B. Furthermore, this section showed that setting the penalty fee is likely to involve bargaining by countries, which want to minimise abatement costs (country A) and to maximise penalty transfers (country B), respectively. Political decisions on the fee level cannot arrive at an optimal solution because the fee level is not connected to the MAC curve of both countries, as is the case for the CDM.

3.5 Discussion

Our analysis above has shown the various benefits and challenges of the CDM and the CDF. The CDM was examined from a theoretical and a practical perspective. The review of the literature on the performance of the CDM focused on the three criteria of environmental integrity, cost-effectiveness, and sustainable development. Additional analysis was conducted to illustrate the development of sustainability of registered and rejected CDM projects over time. The rent transferred to CDM host countries was quantified to estimate the cost-effectiveness of the CDM. Both the theoretical and the practical examination of the

CDM suggest that the instrument is not effective in achieving its stated objectives of environmental integrity, cost-effectiveness, and sustainable development. The literature shows that many projects were registered and gained CDM support although they would have happened anyway. This supports the moral hazard hypothesis that project developers aimed at maximising CER revenue by misrepresenting the viability of a project. Particularly challenging project types are renewable technologies because they benefit already from other revenue streams in the absence of CDM support. Auditing firms charged with cross checking the data provided by project developers were unable to conduct their tasks properly. Negative validation opinions and the termination of proposed projects by auditors increased after the release of new guidance and the suspension of the biggest auditor in 2008. This supports the hypothesis that the mere threat of sanctions did not work properly before and that auditors had maximised commission fees from project validation until the probability of being sanctioned by the EB's Accreditation Panel increased.

Regarding sustainable development, the literature finds some evidence in favour of the "race to the bottom" proposition. In the absence of a price after-project implementation for sustainable development benefits, host countries competed for projects on the basis of costs. To the author's knowledge only China has implemented a tax on low-sustainable project types to skim the high rent from these projects. Depending on how this tax revenue is used, China is able to leverage abatement efforts and thus decrease global emissions. The analysis has shown that sustainability has in general increased over time, and that decisions by the EB, auditors and project developers to stop projects, somewhat protected high-sustainable projects. One potential reason is that most of these projects apply renewable technologies and their additionality test method is difficult to validate in practice.

Regarding cost-effectiveness, the literature review shows that a large portion of projects could have been achieved at a much lower cost, for instance through command and control regulation of industrial gases. The large rent that this project type exhibits has led to an increase in emissions by projects to subsequently claim credits from reductions. This is in line with theoretical predictions. The analysis has quantified the rent transferred to developing countries. Despite CDM rules to protect domestic policy being influenced by the rent from the CDM (see section 3.2.2), the trade-off between domestic policy and the CDM rent is illustrated with two cases: 1) the rejection of Chinese wind projects by the CDM regulator, who suspected the Chinese government of acting strategically by lowering the domestic financial support for wind, and 2) the reluctance of the Chinese government to regulate industrial gas projects more cost-effectively directly or through a faster phase-out schedule in the Montreal Protocol.

An alternative to the CDM, a fund-approach is presented and analysed to determine whether the CDF is better suited to achieve the objectives of cost-effectiveness, sustainable development and environmental integrity. Both instruments are preferable to domestic abatement in terms of cost-effectiveness and sustainable development. From an environmental integrity perspective both mechanisms create incentives for the generation of non-additional emission reductions. The CDM creates these incentives for both country A and B. In the CDF, the degree of non-additionality depends on the level of the fine, the revenue received and the potential for funds being diverted to non-mitigation ends.

The main challenge of the CDF is its cost-effectiveness and environmental integrity, as the marginal abatement cost curves of different countries and the level of the penalty fee are not connected in any way. As the level of the fee and the formula on how to distribute the funds from the CDF are likely to be decided on political and subjective grounds, environmental integrity will suffer. The CDF is particularly favourable relative to the CDM on grounds of sustainable development and by removing the perverse incentive to delay domestic policy, as funds from the CDF can be used to leverage already existing or even motivate new domestic policies if the flow of finance is predictable. This is true as long as the distribution of funds is positively correlated or alternatively totally independent of domestic climate policy, as country B is encouraged to engage in domestic climate policy without concern to lose funds as is the case in the CDM (as discussed above).

The analysis has shown that ensuring environmental integrity is the main difficulty under both alternative approaches. Both the CDM and the CDF require a system to assess and reduce non-additionality. The CDM needs an additional system to ensure that domestic climate policy is not discouraged, while the CDF needs an additional system to ensure enough funds are transferred to enable environmental integrity and that funds are not diverted to non-mitigation means that may endanger environmental integrity. Such controlling systems entail institutional transaction costs.[53] From our analysis, it appears that the CDM requires a less costly institutional framework compared to the CDF, because decision parameters such as the level of the fine, insufficiency of funds, and incentives to divert funds require more administrative layers compared with the non-additionality and sustainable development deficiencies of the CDM.

3.6 Conclusion

Summarising, this chapter has revisited the emergence of the CDM as a rational choice between two alternatives. It has presented the two original proposals to address GHG emission reductions in developing countries at the time the Kyoto Protocol was adopted and

[53] See for instance, Dutschke & Michaelowa (1998) and Woerdman (2001)

provided an overview how the CDM performed in practice. The chapter analysed these instruments against the criteria of environmental integrity, cost-effectiveness and sustainable development. The choice between the CDM and the CDF does not come to one single answer; there are trade-offs between the two instruments. The analysis has shown that the CDF's main strength is sustainable development and the potential leverage of domestic policy as developing country governments can independently decide on the use of the funds. This benefit has also a potential its drawback if funds are diverted away to meet other non-climate goals. The CDM's main strength is cost-effectiveness in theory. However, the literature examined and analysis in this chapter have shown that the CDM creates large rents which hinder more stringent domestic climate policy in developing countries and have led to the entry or inefficient increase in production of polluting companies. Thus, cost-effectiveness, the main argument in favour of the CDM turned into a lock-in effect of the CDM subsidy. Future policy design cannot deny these perverse incentives, as they are detrimental to the goal of decarbonising the global economy by 2050.

Appendix 1: Overview of sustainability criteria

Based on the SD benefits counted in PDDs by Olsen and Fenhann 2008, three groups were defined on the basis of sustainable development benefits for the project types listed in and also categorized in the previous section categorized according to Schneider (2007):

- Low sustainable development benefits (SD_A)
- Medium sustainable development benefits (SD_B)
- High sustainable development benefits (SD_C)

Table A 3.1 shows the categorization by SD-type allocated on the basis of similar number of project types in each category.

Table A 3.1 SD benefits and categorization

	SD Benefits	SD Labels
Energy distribution	550	SD_C
Solar	400	
Cement	373	
Hydro	354	
Wind	354	
Geothermal	350	
Methane avoidance	341	SD_B
Landfill gas	330	
Tidal	300	
Transport	300	
Biomass energy	280	
CO2 usage	280	
Fossil fuel switch	274	
Coal bed/mine methane	250	SD_A
EE Industry	200	
EE own generation	200	
EE supply side	200	
Fugitive	200	
HFCs	185	
N2O	100	

Source: Olsen and Fenhann (2007); author calculation based on Risoe (2011)

For the categorisation into SD_A, SD_B, and SD_C a simple differentiation was chosen in which first six project types were allocated to SD_C and the remainder equally split between category SD_B and category SD_A, respectively. All renewables except tidal are labelled with high sustainability (SD_C). Coal bed methane, energy efficiency projects in industry and supply side, as well as industrial gas projects are labelled with the lowest category SD_A. Medium sustainable projects, category SD_B, includes methane avoidance, landfill gas and biomass energy projects. The allocation of hydro projects to the high sustainability category might be contentious for some observers. Large hydro projects, above 20 Megawatts, can have adverse effects on the environment and the living conditions of the population affected by the project. One-third, about 300 projects, of all hydro projects are large-scale. These projects are included in the high-SD category.

Appendix 2: Abatement cost estimates per project type

To assess the rent conferred to host country actors, abatement cost estimates are used Green (2008) and Castro (2012). Green (2008) has quantified abatement costs for almost all registered CDM project types except for solar, cement, reforestation, tidal, energy distribution and transport. The abatement costs for the first two project types have been taken from Castro (2010), while the others are excluded from the analysis. This analysis assumes that all the abatement costs need to be covered through the CER price. In practice this is not always true, especially for renewables, which have other income streams. Due to this income from the sales of electricity or subsidies, these project types can also be financially operational at lower CER prices than abatement costs. Still for the purpose of rent calculation, project types with higher abatement costs than the CER price lower the rent.

Table A 3.2 Abatement costs per project type in €/tonne of CO2-equivalent

Project Type	Euro/t CO2-equivalent
HFCs	0.5
Fugitive	0.65
Landfill gas - Biogas	1.38
Coal bed/mine methane	1.8
Methane avoidance	1.86
Landfill gas - Flaring	2.42
Energy Efficiency	2.5
Landfill gas - Composting	3.5
Cement	4
Biomass energy	5.7
Fossil fuel switch	8.6
Hydro - Existing dam	10.3
Hydro - Run of river	10.7
Wind	10.9
Hydro - New dam	12.79
Geothermal	18.77

Source: Castro (2012) and Green (2008)

Limitations

Some limitations of this methodology apply. The data in Table A 3.2 excludes transaction costs and thus the figures quoted in Table A2 could be higher for some project types in reality. The largest share of CDM-specific transaction costs arises in the documentation of additionality (Fichtner, Graehl, & Rentz, 2003; Michaelowa & Stronzik, 2002; Woerdman, 2001). For the purpose of categorizing project types, the analysis excludes transaction costs as it is assumed that these costs do not alter the ranking of projects significantly. For the calculation of the aggregate calculation of the rent created, both the median and the high cost-estimates from Green (2008) are used. Energy efficiency projects have been bundled together, thus energy efficiency for industry, own generation and households have the same abatement costs in Table A 3.2. Furthermore, new projects do not necessarily have the same costs relative to older projects if technology is expected to become more efficient and thus cheaper over time. These limitations are likely to alter the size of the total rent. However, they do not alter the conclusion that the presence of the rent can adversely affect domestic climate policy in developing countries.

4. WHAT INCENTIVES EXIST TO SET THE BENCHMARK RIGHT FOR THE CDM ADDITIONALITY TEST? A CASE STUDY OF INDIAN AND CHINESE RENEWABLE PROJECTS

The first Kyoto commitment period is coming to an end in 2012 and climate negotiators are discussing mechanisms and modalities for a follow-up commitment period. The Clean Development Mechanism is one key element of the first Kyoto commitment period, and currently the only operational mechanism that supports mitigation of emissions in developing countries under the UNFCCC. It also allows developed countries to lower their Kyoto compliance costs. CDM projects are conducted according to an institutionalised procedure (as outlined in Chapter 2). The analysis in Chapter 3 has shown that renewable energy projects under the CDM fulfil the criteria of sustainable development and cost-effectiveness required in the CDM. At the same time, it is difficult to prove additionality (i.e. that a project would not have happened without support) for renewables CDM projects because of the different revenue streams these projects receive.

Renewables have the largest expected sustainable development benefits and need the least incremental CER revenue to make them operational relative to other project types (Castro, 2010; Green, 2008; Olsen & Fenhann, 2008). Most renewable projects, especially wind and hydroelectric (henceforth 'hydro')power plants are located in China and India (Risoe, 2011). These two countries make up more than half of all projects. Wara & Victor (2008, p. 13) argue that project developers proposing new hydro capacity in China have applied for CDM status. Thus, analysing whether these projects would have occurred also without CDM is important to safe-guard environmental integrity in terms of additionality.

The revenue streams for renewables include cash flow from the sale of electricity and potential promotional subsidies. These are furthermore dependent on the availability and reliability of the respective energy source (e.g. wind, hydro, solar radiation).[1] However, Alexeew et al. (2010) point to the trade-off between sustainable development and additionality, using a case study of 40 Indian CDM projects.[2] Renewables might also be subject to technological barriers, such as the absence of a well-functioning grid. Thus, illustrating that a particular renewables project would not have happened without CDM support is challenging (Michaelowa, 2005). Furthermore, arguing that most large hydro plants require long-lead times and government involvement Haya & Parekh (2011) questions the additionality of these projects in China. However, if the institutional framework of the CDM is able to filter truly additional renewable energy projects, it can fulfil all three criteria

[1] The non-continuous availability of renewable energy sources is called intermittency.
[2] See Section 3.4.2.2 in Chapter 3 for further detail.

of sustainable development, cost-effectiveness and environmental integrity.

The CDM has allowed the choice of either the barrier test or the investment analysis to demonstrate the additionality of renewables projects.[3] The barrier test aims at demonstrating that the CDM support can overcome any financial or technological barriers that the proposed project faces. The investment analysis allows the investment comparison approach and the benchmark approach to be used. Within the investment analysis the benchmark approach has been the most frequently used test for renewables (Schneider, 2009 p. 247). While previous research has focused on the possibilities to manipulate the benchmark, this chapter looks at how benchmark rates were chosen over time to better understand the incentives to set the benchmark rate.

The benchmark test requires the project developer to show that the proposed project is not financially viable without CDM support. To demonstrate this, the project developer needs to calculate the internal rate of return of the project without CDM support ($IRR_{no\ CDM}$) and compare it with a benchmark rate. To be deemed additional, the project needs to show that the benchmark rate is higher than the return without CDM support.[4] Rational project developers calculate the profitability rate of the project without CER revenue and then select a benchmark rate that is above this rate to demonstrate additionality.

Setting the benchmark rate thus has direct implications for the number of projects deemed additional. Greiner & Michaelowa (2003, p. 1012) write that the "[...]standard argument against the criteria is the difficulty in fixing the [benchmark] threshold values." A high benchmark rate deems more projects additional, all else equal. Each individual activity faces project-specific and technology-specific risks so that in the ideal case the benchmark rate needs to account for these risks. The question then arises as to who should set the benchmark rate? Two options are allowed in the benchmark test according to guidance by the CDM regulator: Either the benchmark rate is set by the government or by the project developers. However, both actors might have an incentive to set benchmark rates strategically so as to maximise project inflow and to gain CDM support.

If the government sets the benchmark rate, it has an incentive to set it high enough so as to maximise the number of projects supported by the CDM so as to maximise the wealth, monetary cash flow and power that comes along with these projects. Each project that is supported through the CDM does not need to be financed through expenditure from state budgets. Shrestha & Timilsina (2002) and Faure & Lefevere (2005, p. 168) point to this

[3] For an explanation of these additionality tests, see Chapter 2.
[4] The project does not need to show that the project is more profitable with CDM support than with the benchmark rate.

moral hazard challenge. The authors claim that countries have an incentive to misrepresent their financial capacity to conduct emission reduction projects on their own. Determining misrepresentation in practice is difficult. To misrepresent the financial profitability of projects, governments have two possibilities: they can either set the benchmark rate high enough so as to show that projects would not happen, or they can alter the revenues of certain projects. For the latter possibility, He & Morse (2010) discuss a case of the decreasing Chinese support rate for wind projects, which triggered a rejection of proposed wind projects by the CDM regulator. The CDM-EB feared that the Chinese government deliberately lowers feed-in-tariffs so as to make wind projects viable under the CDM.

If the project developer sets the benchmark rate, it has incentives to choose high rates to render its project additional. Schneider (2007) illustrates, based on a sample of 93 registered CDM projects, that 60% of projects have used company internal benchmarks to assess profitability. These rates are in general higher than average market rates. Michaelowa (2009) discusses the paradox for the project developer. To secure loans from banks or other lenders the project developer will want to show that the income streams from the project will be enough to pay back the loan and thus, represent the project as positive as possible (Pearson, 2007).

However, to receive CDM support the project developer needs to show the opposite, i.e. that the project is not viable on a stand-alone basis. Michaelowa (2009: p. 258) cites an example where this has happened with two Indian wind projects, which were the first projects to be rejected. In the annual reports, the project developer bragged that the rate of return is in excess of 28% and includes income tax shields, while in the CDM project documentation, the project was depicted as not financially viable. The author claims that many projects with the same characteristics, which have avoided bragging publicly, have achieved registration, partly because they omitted tax-benefits in their revenue calculations (Michaelowa & Purohit, 2007). This suggests that projects were able to game the benchmark, by misrepresenting an otherwise financially profitable projects as not financeable.

When this gaming of the benchmark became apparent, the CDM-EB issued additional guidance on the investment analysis to be followed by project developers. This guidance restricted the use of company internal benchmark rates to cases where the project developer is the only actor that can implement the project (e.g. retrofitting or upgrading an old wind park) (Michaelowa, 2009; UNFCCC, 2008b). Furthermore, large renewable energy projects should use the investment analysis (e.g. benchmark or investment comparison test) to determine additionality, and should not use the barrier test (UNFCCC, 2008, Annex 10 para.

5).[5] Small-scale projects can continue to use either one of both the barrier or the investment analysis test. The guidance of the CDM-EB is aimed at diminishing the subjectivity of the benchmark test, which requires a transparent identification of benchmark rates.

The aim of this chapter is to assess the choice of benchmark rates over time in China and India and analyse whether and how the level and origin of benchmark rates changed over time. The chapter aims at answering the questions: "What data and information is available on benchmark rates used in the past to determine the additionality of renewables projects?" and "What can be concluded from the data available?" The focus of this chapter is on China and India since these are the two biggest host countries for CDM projects in general and for renewable energy projects in particular (UNEP Risoe, 2011). Comparing the approaches of these two countries in setting the benchmark rate yields several advantages. China imposes a government rate, while India leaves it to project developers to choose the benchmark rate. An analysis of how the level and origin of these rates between government, market, and risk-adjusted or company rates differs is expected to provide insights into benchmark setting. The analysis does not detect non-additionality for the projects examined. It aims to provide an overview of the data which are readily available and of open questions arising from the analysis.

To answer this research question the chapter proceeds as follows: the section 2 following the introduction is split into three sub-sections. First, it provides an overview of CDM projects registered by November 2011 and of the use of the benchmark test by these projects. Second, it reviews the benchmark approach and the key parameters used to determine additionality. Third, it describes the responsibilities of auditing firms with regards to the benchmark rate. Section 3 provides the methodology and the data sources used to examine benchmark rates. Section 4 presents the results of the analysis and is split in two sub-sections. The first provides an overview of the sample used in the analysis and the second sub-section illustrates the findings of the analysis. Section 5 discusses the results and limitations of the analysis, and section 6 concludes.

4.1 Why are renewables and the benchmark approach important?

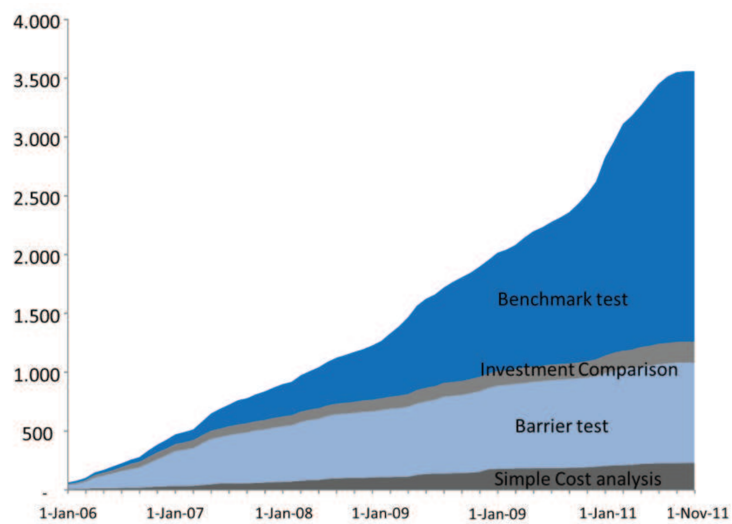
4.1.1 Overview of CDM projects and the use of the benchmark approach

The benchmark test has replaced the barrier test as the predominant method to determine additionality. Figure 4.1 illustrates the number of registered CDM projects and their use of

[5] Large scale renewable projects are denoted by their use of the baseline methodology ACM2 "Consolidated baseline methodology for grid-connected electricity generation from renewable sources". Small scale-projects are denotes by their use of baseline methodology AMS-I.D. "Grid connected renewable electricity generation" (UNFCCC, 2011c).

different additionality tests over time by date of registration. The benchmark test, the investment comparison and the simple cost analysis all belong to the investment analysis test.[6] The barrier test is the alternative to the investment analysis test. Highlighted in blue are the most frequently applied approaches, the barrier test and the benchmark test.[7] The barrier test was prominent from the beginning of the CDM, however following reports of gaming (e.g. (Michaelowa & Purohit, 2007; L. Schneider, 2007) and more generally the literature review in Chapter 3), the executive board has made criteria stricter. The executive board issued guidance on both the barrier and the benchmark test in 2008 (UNFCCC, 2008b; Michaelowa, 2009). The application of the benchmark test increases significantly thereafter. Thus, the application of this approach merits further attention.

Figure 4.1 Number of registered projects and additionality tests over time



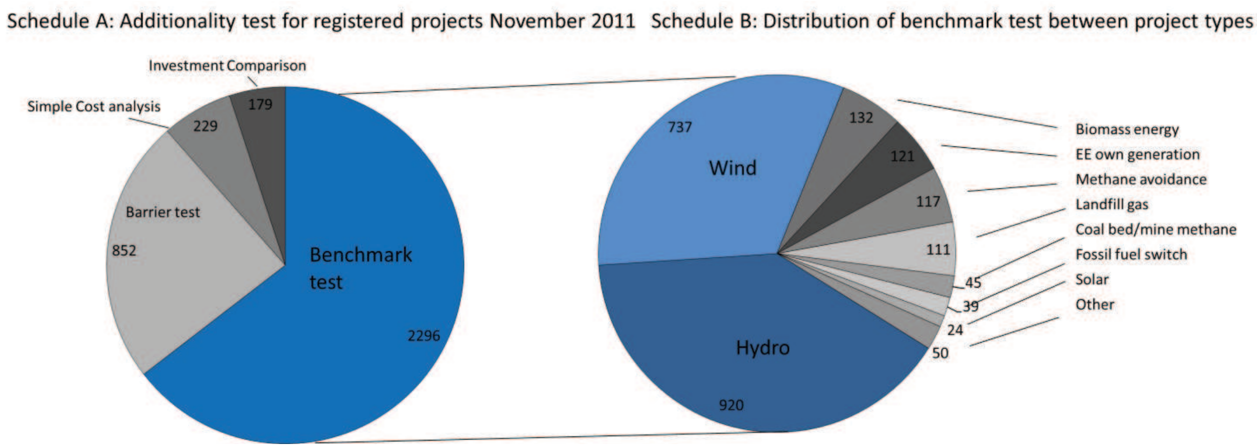
Source: IGES, 2011; author calculations

The benchmark approach is mainly applied by wind and hydro projects. Figure 4.2 shows that of the 2,296 projects registered by November 2011 and applying the benchmark test(Schedule A), more than half of the projects fall into the project types wind and hydro (Schedule B).These project types have been identified in chapter 3, applying criteria identified by earlier research, to exhibit high sustainability benefits and high cost-effectiveness.

[6] See Chapter 2 – Section 2.3 for details.

[7] The simple cost analysis is primarily used for industrial gas projects, and the investment comparison has mainly been used by methane avoidance and biomass energy projects. In total, thirteen wind and eleven hydro projects have applied the investment comparison approach. Of these five projects were conducted in India (4 Wind and 1 Hydro) and one Wind project was conducted in China. These projects are not subject of the analysis in this chapter.

Figure 4.2 Overview of application by benchmark test by different project types

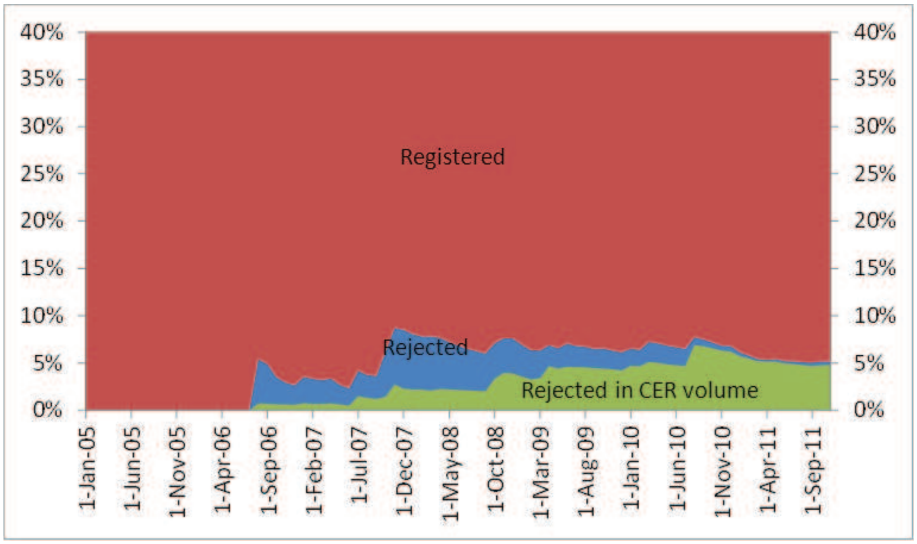


Source: IGES, 2010; author calculations

However, projects applying the benchmark test have been rejected more often relative to others. By November 2011, in total 206 CDM projects were rejected by the executive board. However, as Figure 4.3 shows, of all projects submitted for registration under the benchmark test, 95% of projects (red) have been registered.

At the beginning of November 2011 both the number of rejected projects (blue) and the corresponding CER volume of these projects (green) are about 5%, which means, still 95% of all projects with a benchmark test have been registered by November 2011. Projects rejected before September 2010 where on average smaller than their registered counterparts as shown by the difference between the number of projects rejected and the corresponding CER volume. That suggests that when the CDM-EB and its panels rejected a project before September 2010, it was likely to be a small project. Flues, Michaelowa, & Michaelowa (2009) point to the political interests of board members, who were sometimes reluctant or unwilling to reject large scale-projects if these projects were situated of the board members origin.

Figure 4.3 Registration (red) and Rejection (blue) rates of benchmark test project (rejected CER volume in green)



Source: IGES, 2010; author calculations

This section provided an overview over the use of the benchmark test for projects registered by November 2011. The application of the benchmark test has increased over time, and has replaced the barrier test as the predominant means to prove additionality. The largest project types that apply the benchmark test are hydro and wind. Combined with their low additional incremental costs necessary to make them competitive with fossil-fuel based alternatives, wind and hydro projects are an important project category that can pave the way towards a long-term decarbonisation of the electricity sector. Thus, these project types merit further attention and are the focus of the analysis in following sections.

4.1.2 Benchmark approach and key parameters

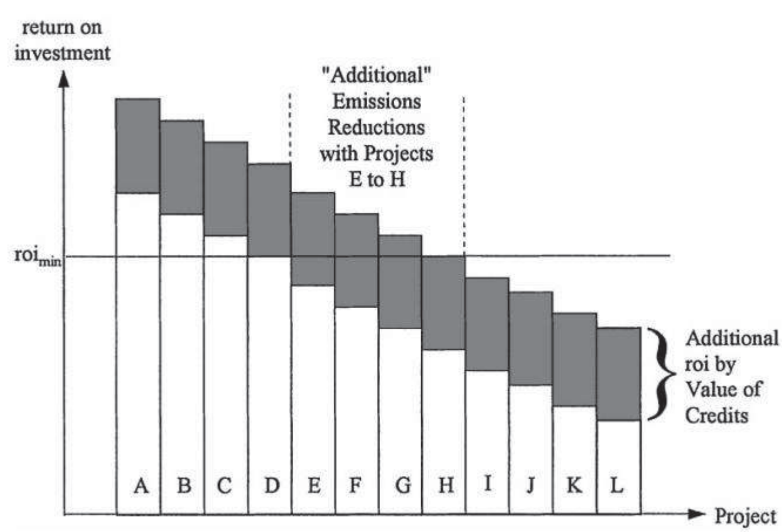
The previous section examined the application of the benchmark test in practice and over time. This section describes the parameters applied in the benchmark test. Project developers use the benchmark approach to demonstrate additionality by showing that the financial returns of the proposed CDM project activity are insufficient to justify the required investment. That means that the proposed project is not financially attractive when compared to a benchmark return on investment (ROI).[8] This benchmark rate of return is usually a national or sectoral profitability rate achieved by similar projects. The benchmark test does not require that the project reaches the benchmark rate with the extra CDM

[8] These rates vary between and within an industry. A coal-fired power plant has a different risk-return profile than an industrial cement plant. One potential reason is that the cement plant is subject to global competition all else equal. However, also different cement plants might exhibit different risks, depending on their access to and cost of transportation.

revenue, the project's profitability should only be below the benchmark rate without CDM support.

Figure 4.4 illustrates the functioning of the benchmark test. Readers familiar with the benchmark text can skip to section 4.1.3.[9] The figure shows several projects A to L and their profitability in terms of return on investment (ROI) without and with the extra revenue (in grey) from CERs. For a firm to conduct a project, the ROI of a project needs to be above a minimum threshold $ROI_{min,}$ the benchmark rate. In Figure 4.4, the ROI of projects A to D is already equal or above ROI_{min}. These projects are financially viable without CDM support and will not be registered under the CDM. The CDM revenue provided to projects E to H pushes these projects beyond the ROI_{min} threshold. These projects would not happen without the CDM because they do not reach the benchmark ROI. These projects are thus additional. Projects I to L are not financially viable even with CDM support. The incremental ROI from the CDM is still not enough to reach the ROI_{min}. While these projects would in theory not be implemented, in practice the benchmark test does not require that the project reaches the ROI_{min} benchmark threshold. Thus, the benchmark test would render all projects from D to L additional.[10]

Figure 4.4 Benchmark approach to determine additionality



Source: Rentz (1998)

[9] The effect of the benchmark rate on additionality has been illustrated in Chapter 2, but is reviewed here for convenience.

[10] There is thus an incentive for both project developers and host countries to choose a high benchmark rate so as to render more projects additional. Chapter 4 assesses the importance of benchmark parameters applied for registered Chinese and Indian CDM projects that have supported wind parks and hydroelectric power plants.

By choosing a higher benchmark, more projects become additional according to the benchmark test. While Rentz (1998) has assumed that only projects E to H are deemed additional, the benchmark test would render all projects E to L as additional. Projects without CER revenue need to be below the benchmark to be additional. If the benchmark (ROI_{min}) is increased also projects to the left of project E become additional. Thus, the choice of benchmark rates matters for additionality determination.

4.1.3 Net present value and the internal rate of return

To calculate the profitability of a project the project developer discounts all revenues and costs expected from the proposed project. The discount rate that makes the net present value (NPV) equal to zero is called the internal rate of return (Brealey & Myers, 2003). Equation 1 shows the NPV formula and the various parameters needed to calculate the IRR. To pass the benchmark test, the project developer has to show that the IRR without CDM support is below the benchmark rate b. According to guidance for additionality determination, the benchmark rate should be based on government or market rates (UNFCCC, 2008).

Equation 1 Net present value and internal rate of return[11]

$$NPV = -I_0 + \frac{(R_t - C_t)}{(1 + IRR_{noCDM})^t} = 0 \qquad (1)$$

Rule: Project is additional if $IRR_{noCDM} < b$

Where:

I	=	Initial investment
R	=	Revenue (Cash flow from sale of electricity, subsidies)
C	=	Costs (Operation, Maintenance, Depreciation, Debt)
$IRR_{no\ CDM}$	=	Internal rate of return without CDM (NPV = 0)
b	=	Benchmark rate
t	=	Time of project duration

Each of the parameters in Equation 1 determines the IRR. The initial investment (I) is for instance the cost to build a new renewables site (e.g. buying and installing wind turbines) or the cost to retrofit an existing site. This investment is usually made at the beginning of the project. The revenue (R) includes all positive cash flows that the renewable project receives,

[11] The description of the net present value calculation is based on simplified assumptions. In practice many variables such as different return rates for debt and equity holders enter the calculation. These rates are usually used to calculate a weighted cost of capital (WACC), where the debt and equity rates are weighted by the respective shares of debt and equity. The capacity to receive favourable debt and equity rates depends on the risk of the underlying activity to be undertaken (Brealey& Myers, 2003).

for instance from the sale of electricity for the time interval t, the duration of the project. If the project receives any subsidies or a feed-in-tariff that grants any additional income from the sale of renewable electricity, this should be accounted under revenues. On the cost side (C), the project developer needs to expense the operation and maintenance cost of the project. Furthermore, taxes and the costs of servicing the debt should be accounted for. Any tax benefits that the project faces, should be accounted by reducing costs. The IRR is then calculated by setting the NPV equal to zero.

The parameters described above are not always easily quantifiable in practice. For instance, revenues for the sale of electricity depend on the availability of for example wind and the efficiency of the turbines. Thus, revenues are likely to fluctuate over time and are difficult to predict. Costs are dependent of the projects access to the grid. Where a wind park operated by a utility, costs are likely to be different than for an independent power producer that produces electricity for its own use and sells the remainder to the grid. Large projects are likely to be able to diversify their risks better than small-scale projects. The IRR will vary depending on the level and certainty of investment, costs and revenues.

In comparison to the parameters just described, the benchmark rate is chosen either by the government or supposed to be set by project developer according to market rates (UNFCCC, 2008). As experience with a technology increases, risks, revenues and costs get more predictable (Junginger, Faaij, & Turkenburg, 2005), project developers are able to assess better what rate of return can be expected from a particular project. The project developer will communicate this rate to its debt (e.g. a bank) or equity-holders (e.g. shareholders) and thus promise a certain rate of return. The average market rate promised to these stakeholders is the rate which the CDM guidance expects as a benchmark rates. Government rates are sometimes offered by some host country governments, e.g. China. Where project developers can show that government rates are used in the profitability calculation, these rates should be used. The next section determines the method and data needs to analyse the choice made by project developers for benchmark rates.

4.1.4 Responsibilities of auditing firms with respect to the benchmark

Following criticism on the benchmark test in the literature (Chapter 3), the executive board has established a validation and verification manual to be applied by DOEs that validate the accuracy of the information by project developers.[12] With regard to the investment analysis (e.g. benchmark test), the project documentation has to justify that the project is not "the most economically or financially attractive alternative" or the "economically or financially feasible, without the revenue from the sale of certified emission reductions." Specific to the

[12] DOEs enter the project cycle at Step 3 (Validation). See Chapter 2 for details.

benchmark test, project participants can show that the "financial returns of the proposed CDM project activity would be insufficient to justify the required investment." (UNFCCC, 2008a, sec. Annex 3 para 107).

The main responsibilities of validators in terms of the evaluation of the benchmark test are to check all the parameters and assumptions behind the financial indicator (i.e. IRR) and the benchmark rate (UNFCCC, 2011-EB55). The DOE shall cross-check the parameters used in the benchmark test using third-party publicly available sources, including invoices and price indices, as well as feasibility reports, public announcements and annual financial reports related to the proposed CDM project activity and the project participants. The DOE shall, furthermore assess the correctness of calculations and assess whether the sensitivity analysis conducted by project participants is credible.

With regard to the benchmark, the DOE shall determine that the chosen benchmark is suitable, and "ensure" that risk premiums that are applied also reflect project related risks. In addition, the DOE shall "determine" whether no investment would be made at a rate of return lower than the benchmark. This can be done by analysing previous investment decisions. The guidance on the investment analysis mandates that where an entity other than the project participant could develop the project, the benchmark should be based on publicly available data sources. This regulation aims at isolating the unwillingness of one investor to assume the associated project risks from the justification of additionality, because the unwillingness might be based on the subjective profit expectations (UNFCCC, 2008, Annex 35 para 11).

The three sub-sections above have illustrated the importance of the benchmark test in practice, the key parameters, and the responsibility of validators to check claims in the benchmark test by project developers. The benchmark rate has been identified as a crucial component of the benchmark calculation (section 4.2.2). The next section describes the methods to analyse the choice of benchmark rates over time.

4.2 Methods and Data

To answer the research question regarding how benchmark rates were chosen, this chapter divides benchmark rate between the following criteria:

- Source of benchmark rate (government, sector etc)
- Level of benchmark (in percent)
- Project type (hydro or wind)

- Location of the project (China or India)

- Project size (small or large)

These criteria are used to assess the use of a benchmark over time. It is expected that the number of sources of the benchmark rate used decreases with time as the CDM regulator has made guidance more stringent. The level of the benchmark is also expected to decrease over time due to the same reason. These findings do not necessarily mean that projects that have used a higher benchmark have been non-additional, or that conversely projects with a lower benchmark are additional. As the discussion in section 4.2.3 shows, benchmarks vary with risk and potentially also with project size. Thus, the analysis also aims at showing the level and sources of benchmark rates for small versus large-scale projects. According to the guidance issued in 2008 by the CDM executive board, large-scale projects should only need to conduct the investment analysis. This implies that small-scale projects can still use the barrier test. Finally, the benchmark rates are expected to vary with project type and host country.

The data used for this analysis are publicly available in the IGES CDM Database (henceforth: IGES), which is updated monthly. Table 4.1 provides an overview of the data parameters used in the analysis. The sample chosen aims at including the main renewable technologies that apply the benchmark test. From the data in the IGES database a sample will be drawn on the basis of data availability for the benchmark rate and source of the benchmark. The sample will be discussed in the following results section.

Table 4.1 Data requirements

Data	**IGES Database**
Status of projects	Registered, Rejected, Withdrawn
Project type and size	Biomass, Industrial Gas, Methane, Renewables
Benchmark rate	in per cent
Benchmark source	Government, sectoral or and risk premium rate
Registration date	by month
Start comment date	by month
Host country	

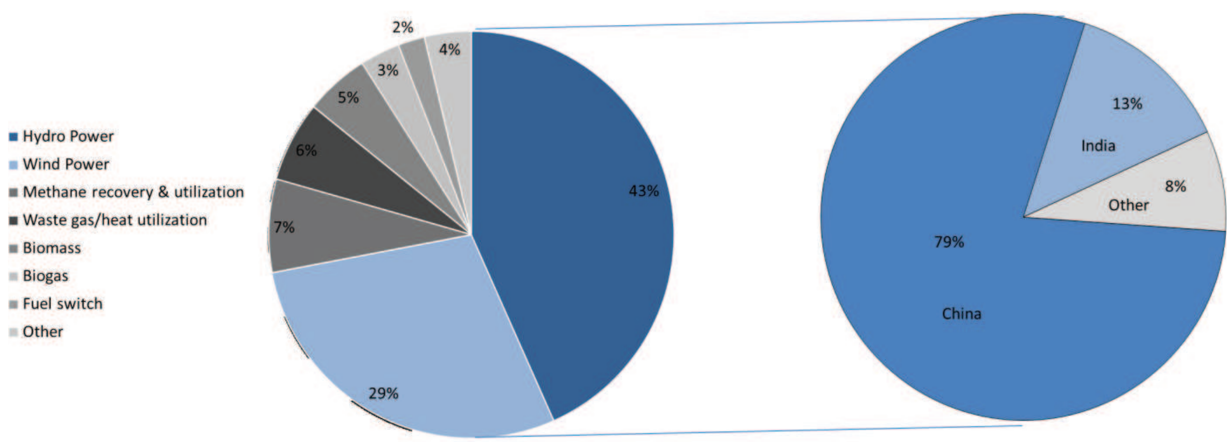
4.3 Results

This section provides a brief overview of the sample used in the analysis and the findings.

4.3.1 Sample overview

In total, there are 3,556 CDM projects registered by November 2011. Of these IGES provides benchmark data for 1,216 projects registered by September 2010. As Figure 4.5 illustrates, over 70% of the projects registered by September 2010 are either hydro or wind projects, with hydro capturing the larger share (43%). These two technologies are mainly implemented in two host countries, China and India, as the right pie chart indicates. Other countries make up a significantly lower share for these projects. Thus the analysis will focus on hydro and wind projects conducted in China and India to avoid the influence of single outliers.

Figure 4.5 Registered projects using benchmark test



Source: IGES, 2010; author calculations

Within the two selected host countries, the distribution of projects varies significantly between project size and technologies. Table **4.2** shows that China and India have implemented both large-scale and small-scale projects. Most projects in China are large for both hydro and wind projects. Over 200 projects are conducted for both of these technologies. Still China also hosts a considerable number of small hydro projects (188), while small wind projects seem side-lined as only five projects are conducted in this category. India in general hosts less projects than China, and most of these projects are wind power projects with a focus on small scale projects. For instance, the largest project category in India is small-scale wind with 59 projects, followed in number by large wind projects

(29).[13] Summarising, most renewable CDM projects occur in China, while only small wind power projects are more numerous in India. The analysis in the following section examines both small and large project types with a focus on wind projects, where Indian data is relatively more numerous compared to hydro projects.

Table 4.2 Number of registered projects (Sept. 2010)

	Hydro Power		Wind Power	
	small	large	small	large
China	188	243	5	233
India	18	11	54	29
Total	**206**	**254**	**59**	**262**

Source: IGES, 2010; author calculations

4.3.2 Findings

The projects in Table 4.2 use benchmarks from different origins to demonstrate additionality. Table **4.3** illustrates that despite the larger number of projects in China, the number of benchmarks is considerably lower. China has issued official government benchmark rates, either the government code or the "power industry sector's benchmark," which project developers can use.[14]Most all of these benchmarks precede both the ratification of the Kyoto Protocol in 2005.[15]The number of benchmarks in India is considerably larger. Alone for large scale wind projects, Indian project developers have applied 18 different benchmark sources. Most projects use a weighted average cost of capital (WACC) rate, where debt and equity costs are weighted with their respective share.[16]This is true for all Indian projects, but for large wind projects, which have applied the return on equity more often.[17] Thus, Table 4.3 suggests that benchmark sources in China are exclusively based on government figures, while in India project developers have enjoyed considerable leeway to choose from a range of sources.

[13] China has an estimated potential of 675 GW of hydroelectricity. (Crompton & Wu, 2005) India has an estimated potential of 150 GW of which 20% was exploited in 2009 (Madan, 2009).

[14] One large hydro project, applies a rate calculated through a feasibility study, but the rate is also equal to the power industry sector's benchmark. Two large Chinese hydro projects and one large wind project have not specified the benchmark origin. This explains the total number of benchmark sources for Chinese projects in Figure 4.3.

[15] Only thirteen projects use a benchmark issued in the year 2006.

[16] Appendix 1 to this chapter provides a detailed table on the different benchmark sources applied.

[17] See Appendix 1.

Table 4.3 Number of benchmark sources used

	Hydro Power		Wind Power	
	small	large	small	large
China	2	4	1	3
India	8	4	18	14
Total	**10**	**8**	**19**	**17**

Source: IGES, 2010; author calculations

Table 4.4 presents the average levels of the different benchmark rates used. The aim is to show how levels vary between project types, project size, and project location. The table presents the benchmark rates in percentage terms. This profitability rate is expected by the project developer to be achieved on an annual basis. First, it is interesting to note that in general average benchmark rates are lower in China than in India. Thus, the rate chosen by the Chinese government is smaller than the rate chosen by Indian project developers. Second, it is interesting to note that while Indian project developers have freely chosen the benchmark rate, the average benchmark rate is similar for both hydro and wind projects across project sizes. All Indian projects use on average a benchmark rate of around 14%. Third, the variability of benchmark rates is much higher in India than in China indicated by the higher standard deviations (in brackets in Table 4.4). In summary, Table 4.4 suggests that Indian projects have applied on average higher benchmark rates, and that rates varied more in levels than for Chinese projects.

Table 4.4 Average benchmark level (standard deviation in brackets)

	Hydro Power		Wind Power	
	small	large	small	large
China	9,9% (0,4%)	9% (1,0%)	8% (0%)	8% (0,2%)
India	14,1% (2,9%)	14,7% (2,3%)	14% (1,9%)	14,3% (1,8%)

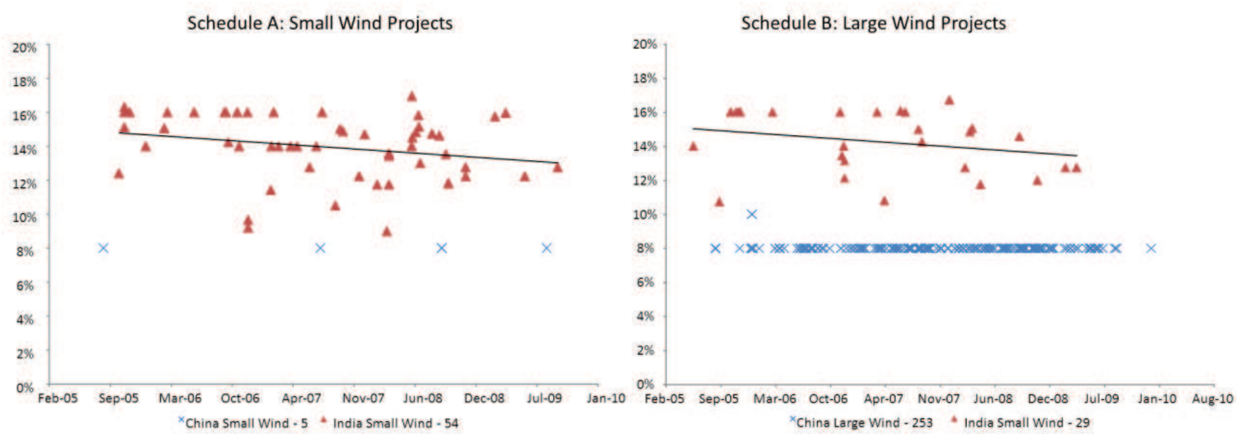
Source: IGES, 2010; author calculations

Figure 4.6 shows the development of benchmark rates in the wind sector over time.[18] The figure illustrates the level of benchmark rates in China (blue) and in India (red), as they have been mentioned in the project documentation. The date on the x-axis is the date of submission for comments.[19] Schedule A shows the development for small wind projects and schedule B for large wind projects. Due to the fixed Chinese government rate, the benchmark rate for Chinese wind projects, both small and large, is constant over time, except of two

[18]The wind sector is chosen here for illustration because it offers the best data availability (Table **4.2**). The figure for the hydro sector (not shown here) indicates a similar development as Figure 4.6. However, it is based on much less data observations.
[19] This is described as Step 3 (Validation) of the project cycle in Chapter 2.

outliers, which have a higher benchmark rate of 10%.[20] The situation in India is different. Benchmark rates applied vary in level and have declined over time as the trendline in Schedule A and B suggests. This trendline has to be taken with caution, as the number of observations, and the influence of large differences in benchmark values can have a strong influence on the trend. However, Figure 4.6 confirms and expands the findings of Table 4.4. Benchmark rates in India have been consistently and without exception higher than rates used in China. Furthermore, while there is some evidence of the decline in benchmark rates over time, this is based on only few observations.

Figure 4.6 Development of benchmark rates over time for wind projects in China and India



Source: IGES, 2010; author calculations

4.3.3 Discussion

This chapter set out to contribute to an understanding of the evolution of benchmark rates over time. The findings in this chapter fulfil this aim to some extent. The data examined illustrates that there is a general difference between the benchmark rate setting in China relative to India. Chinese project developers apply a government rate, while Indian project developers can choose market or sectoral rates. This leads to a high variability between the benchmark rates for projects conducted in India. The analysis furthermore finds, through the example of small and large wind projects, that benchmark rates have fluctuated over time and exhibit a decreasing trend. This could suggest that guidance by the executive board, which increased the demand on benchmark rate setting and auditing of rates, was successful in reducing the subjectivity of the benchmark rate setting.

[20] These two wind projects are registered under the name "Liaoning Zhangwu 24.65 megawatt Wind Farm Project" and have the registration numbers 537 and 539 with the CDM executive board, respectively (IGES, 2010).

However, this result needs to be taken with caution as the findings in Figure 4.6 are based on a small number of observations. Even if changes in benchmark rates can be observed and proven this could have at least three alternative explanations which take into account the riskiness of projects and information costs. First, it could be that learning curves for wind technology drive down the risk of the technology and thus lower benchmark rates are naturally required. Second, an *increase* in benchmark rates could be a signal that all low-risk wind capacity suitable for CDM status is already registered and that future wind CDM projects require higher benchmark rates as they are located in locations with less wind availability. Third, it could be an indication that the guidance by the executive board is too stringent and weeds out actual additional projects due to the increase in information costs.

While the first two explanations are subject to market developments, the third would lead to an adverse selection of non-additional projects. The information needs and costs for auditing firms and the regulator to verify information necessary for the benchmark test are increasing with the new guidance and might become too onerous for some project developers to invest in the CDM registration process. Unfortunately, projects that are profitable without the CDM can bear these costs better, as giving up part of the profitability due to information and transaction costs might be outweighed by the potential benefit of receiving CDM support. Additional projects which, by definition are not financially viable without support, will not apply for registration if information costs are too high. The adverse selection result of too stringent a regulation has been discussed in the framework of transaction costs (Michaelowa &Jotzo, 2005). It however still remains a difficult challenge for the regulator.

The chapter however draws on an additional question, namely whether a fixed benchmark does solve the moral hazard problems of the benchmark test. While the findings of the chapter cannot answer this question, they can guide future analysis. Taking the example of the Chinese government benchmark rate, the question is whether it precludes gaming by the government, as the government can set the benchmark strategically so as to render more projects additional (Faure &Lefevere, 2005; Shrestha&Timilsina, 2002).

Equation 1 and Figure 4.6 illustrate the dilemma of the benchmark test. The question that arises from this analysis is, why should a government choose a benchmark rate that makes a large share of its nations' projects non-additional? Proving that governments have strategically set benchmark rates to make projects additional is beyond the scope of this chapter. Furthermore, most benchmark rates set by the Chinese government precede the CDM and Kyoto Protocol, which make strategic benchmark setting unlikely. However, the Chinese wind support example by He & Morse (2010) indicates the difficulties for governments in designing national policy without losing CDM revenue. So while the benchmark rate is fixed in China, other support mechanisms' rates, such as a feed-in-tariff, are not, and thus can alter the additionality determination of a project. Further research is needed to analyse the strategic interaction between national policy and domestic policy so as to maximise the benefits of national and international climate cooperation.

4.4 Conclusion

The analysis in this chapter has provided an account of benchmark rate setting in India and China for wind and hydro projects. The literature suggests that the determination of investment additionality and specifically the setting of the benchmark rates is complex. The analysis in this chapter has shown that the benchmark rate varies greatly between the two countries examined. Still China, with a lower benchmark rates has managed to register substantially more projects. The question however arises as to whether, even if the level of the benchmark is fixed, other parameters in the benchmark test are subject to estimations by project developers and thus potentially prone to gaming. The findings of this chapter confirm the earlier results in the literature that benchmark setting is an important issue, as well as drawing tentative conclusions for future research. The setting of the benchmark by governments instead of project developers can have potential strategic interactions with domestic energy and climate policy. If this is the case, the CDM does actually increase global emissions and hinders a transition to a low-carbon economy in developing countries. The findings of this chapter can serve as a starting point for further examination of this important issue.

Appendix 1 Benchmark sources used

Table A 4.1 Benchmark sources and number of applications for Chinese projects

China			
Hydro		Wind	
Small	Large	Small	Large
Power industry sector's benchmark (5)	Power industry sector's benchmark (220)	Government code (182)	Government code (134)
	Government code (11)	Power industry sector's benchmark (6)	Power industry sector's benchmark (106)
	NA (2)		NA (2)
			Feasibility study report (1)

Source: IGES, 2010; author calculations

Table A 4.2 Benchmark sources and number of applications for Indian projects

India			
Hydro		Wind	
Small	Large	Small	Large
Weighted average cost of capital (WACC) (16)	Return on equity (ROE) (5)	Weighted average cost of capital (WACC) (10)	Weighted average cost of capital (WACC) (7)
Return on Equity (RoE) (8)	Weighted average cost of capital (WACC) (4)	Prime lending rate (PLR) (2)	Prime lending rate for public sector bank (2)
Required rate of return (RRR) (7)	Prime lending rate (PLR) (3)	Prime lending rate (PLR) + Risk premium (1)	Government bond rate + Risk premium (1)
Prime lending rate (PLR) (3)	Internal hurdle rate (2)	Prime lending rate (PLR) (1)	Government bond rate + Country risk premium (1)
IPP industry Hurdle rate (3)	Required rate of return (RRR) (2)	Government bond rate + Risk premium (1)	
Prime lending rate (PLR) (2)	Confirmation letter (2)	Required rate of return (RRR) (1)	
Required return of equity (RoE) (2)	Return of Equity in IPP (2)	Commercial lending rate (1)	
Interest rate (2)	IPP industry Hurdle rate (2)	Cost of debt (1)	
Internal hurdle rate (2)	Power industry sector's benchmark (2)		
Required return on equity (RoE) (1)	Prime lending rate (PLR) (1)		
Cost of equity (1)	Commercial local lending rate (1)		
Commercial local lending rate (1)	Government bond rate + Risk premium (1)		
Government bond rate + Risk premium (1)	Cost of equity (1)		
Lending rate (1)	Lending rate + risk premium (1)		
Commercial lending rate (1)			
Interest rate + inflation rate (1)			
NA (1)			
Power industry sector's benchmark (1)			

Source: IGES, 2010; author calculations

5. Certified Emissions Reductions and CDM limits in the demand market: Implications for the EU Emissions Trading Scheme

The EU has agreed to cut its GHG emissions by 20% by the year 2020 relative to 1990 emissions.[1] Part of the emissions reductions can be achieved outside the EU in developing countries. In its efforts to reduce emissions, the EU distinguishes between the emissions trading sector and those sectors not covered by the EU emissions trading scheme (see section 1.1). In the period 2008-2012, installations are freely allocated EU Allowances (an allocation mechanism known as 'grandfathering'). In addition, to cover their emissions each installation can use, subject to a country-specific limit, CERs generated through the Clean Development Mechanism in developing countries.[2] If an installation has emissions of 100 emission units, it can use as many EUAs as it wants, but only a limited amount of CERs to cover these 100 units. This country-specific limit of CERs is currently expressed as a percentage of freely allocated EUAs to the relevant installation and is differentiated between EU Member States, with limits ranging from 0% in Estonia to 22% in Germany.[3] Thus, installations in Germany can use more CERs than installations from the same sector in Estonia.

These limits have been and continue to be the basis for heated debate within the EU. A higher limit, *ceteris paribus*, suggests that EU ETS installations could use more of the relatively cheap abatement options in developing countries, thus enabling them to achieve their compliance target at a lower cost.

CDM limits are differentiated between EU Member States in order to cater to the varying levels of emissions reduction ambitions, the progress made when the limits were established, and the ability each Member State to reduce their emissions. The financial transfers created, however, are potentially substantial and in 2008 the EUA-CER arbitrage rents reached about €250 million.

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[1] This chapter is a slightly reworked version of an article recently published in Climate Policy (Vasa, 2011).
[2] Flues (2010) assesses the political economy of CER limits and finds that while CER import limits increase with the sector's emissions, government valuation of lobby contributions and voter's budgets decrease with the voter's valuation of consumption over environmental integrity and abatement costs.
[3] The limit on the use of CERs is imposed to fulfil the supplementarity condition of the Kyoto Protocol. The supplementarity condition is a normative concept that states that CERs should only be used to achieve only part of the overall mitigation effort (UNFCCC, 1997, Article 12) and is designed to ensure that significant abatement occurs within the EU, while emitters can profit in a limited way from the cost-reducing nature of cheaper CDM credits. The EU implemented the supplementarity condition under Directive 2004/101/EC (European Parliament and the Council of the EU, 2004). Woerdman (2004) explains that the EU committed to supplementarity partially due to equity concerns.

The current rule potentially leads to a distortion of the internal market, when emitters that compete in the same market are treated differently in different EU member states. From a legal and economic perspective, interference in the market is only warranted if the market cannot solve the issue by itself, and the interference substantially improves the situation.[4]

Specifically, the decision parameters for an implementation of the CDM limit and the efficiency gains expected are analysed. The gap in the literature on this issue is surprising since, as mentioned above regarding the free allocation of allowances, large rents conferred to emitters have encouraged rent-seeking behaviour Hepburn et al. (2006). Zhang (2001) and Tol (2009) confirm that rents are created by CDM usage limits. Tol (2009) draws attention to the literature gap regarding the allocation of the usage limit to emitters in non-ETS sectors.[5] Also, De Cendra de Larragán (2006) points to the allocation of rent established through the right to use offsets, as does Gorecki et al. (2010) for the non-ETS sector.

This article attempts to fill the gap in the literature on the interaction of offset mechanisms with ETSs and potential options in the implementation of limits to the CDM, on the compliance side, are analysed. This article extends the analysis of Gorecki et al. (2010) to the EU ETS sector, and focuses on the existing rules in Phase II to illustrate current challenges. The following questions regarding the CDM limit allocation for the period 2008-2012 are addressed:

- What are the effects of a CDM limit?
- Which options exist to implement CDM limits?
- How has the CDM been used in the EU ETS?
- What is the value of rents created through the CDM?

Three options for the allocation of this rent, which arises from reducing compliance costs through the CDM, are assessed: 1) the status quo, 2) establishment and allocation of CDM usage rights and 3) the pre-commitment option. In the first case of *status quo*, the right to use CERs is freely allocated, proportional to the allocation of allowances. Alternatively the limit can be allocated proportional to the verified emissions of an installation. Trading of the

[4] It could be argued that the supplementarity criterion, the limit on the use of CERs, is the cause for the inefficiencies. However, the supplementarity condition has been aimed at maintaining significant domestic effort and the supplementarity criterion ‘does not significantly decrease the economic benefits from project-based crediting, as the respective thresholds of CDM imports are generally not yet reached under unlimited CDM access’ (Anger, 2008: 2046).

[5] For an analysis of the impact of the use of CERs in the non-ETS sector, see Neuhoff and Vasa (2010). The use of CERs in the non-ETS sector has to take into account the supplementarity criterion and the use of CERs in the ETS sector. Thus, it is not explicitly limited to the period 2008-2012.

right to use CERs is not allowed under these options. Secondly, the right to use CDM credits can be established as a property right and be auctioned or freely allocated (grandfathered), and subsequently traded between EU ETS participants. A third option is for the EU to sell allowances for the same amount of the aggregate CDM limit granted, and then subsequently buy the amount in the CDM market.

It is found that making the right to use CERs tradable or pre-committing the regulator to buying CERs at the level of the relevant limit reduces the inefficiencies connected to the current regulation. Auctioning CER usage rights and pre-committing furthermore shift the rents created through the CER-EUA spread to the relevant Member State itself and thus can potentially enhance mitigation efforts.

Some background on the legal foundations of the allowed use of the CDM within the EU ETS is presented in Section 2, and it is shown in Section 3 how access to CERs affects abatement and compliance decisions. In Section 4 data on the surrendered CERs in the EU ETS for 2008 are analysed. In Section 5 three options on how to give access to the CER limit to participants in the EU ETS are discussed, while a conclusion is offered in Section 6.

5.1 Background: legal foundations of the CDM in the EU ETS

5.1.1 EU Kyoto targets and compliance options

The EU is bound by its own Council Decision 2002/358/EC to reach its emissions reduction goal jointly under the ‘Bubble’ mechanism.[6] If the EU fails to deliver the agreed joint emissions reductions, each EU Member State is responsible for its own target (CEC, 2002).

In order to achieve the emissions reduction targets of the Kyoto Protocol and the EU’s Energy and Climate Package (also known as ‘the 20-20-20 targets’) cost-effectively[7], the EU divides emitters into two categories: those covered by the EU ETS and those that are not

[6] Article 4 (sometimes called the `bubble mechanism´) of the Kyoto Protocol allows parties to fulfil their commitments jointly, where emission reduction targets of individual parties can be differentiated, but in sum are equal to an overall (e.g. European Union) commitment. If the EU, which applies Article 4 of the Kyoto Protocol, does not reach its reduction target, compliance is evaluated according to individual party commitments (UNFCCC, 1997).

[7] The Energy and Climate Package is an integrated approach to climate and energy policy endorsed in March 2007. The `20-20-20 targets’ refer to three separate targets to be attained by 2020: a) the reduction of EU GHG emissions of at least 20% below 1990 levels, b) covering 20% of EU energy consumption with renewables, and c) reducing primary energy use by 20% (through increased energy efficiency) compared with projected levels.
The packages comprises four core components: the revision of the EU ETS, the effort sharing decision for non-ETS sectors, binding national renewable energy targets and a legal framework for Carbon Capture and Storage (http://ec.europa.eu/clima/policies/package/index_en.htm).

(non-EU ETS sectors).[8] The EU ETS and its rules for the period 2005-2020 are established through the 'ETS' Directive 2003/87/EC (Council of the European Union & European Parliament, 2003) and the 'Linking' Directive 2004/101/EC (Council of the European Union & European Parliament, 2004).[9] The EU ETS Directive sets up a cap-and-trade system, which runs in three distinct phases: Phase I from 2005 to 2007, Phase II from 2008 to2012 (the Kyoto commitment period), and Phase III from 2013 to 2020.[10]

For compliance purposes, installations in the EU ETS can use EUAs, and CERs, which are subject to country-specific limits. The use of offset credits within the EU ETS sector lowers an installation's average compliance costs and is thus likely to be a critical decision element for individual emitters. The chapter focuses on the EU ETS sector in Phase II.[11]

5.1.2 Establishment of Phase II CER limits

In Phase II, the allocation of EUAs and the CER limit itself are set through individual Member State National Allocation Plans (NAPs). The sum of these constitutes the total cap in the EU. According to the Linking Directive, the National Allocation Plans need to specify the maximum annual amount of project-based (JI and CDM) credits which may be used by operators as a percentage of allocation of the allowances to each installation (Council of the European Union & European Parliament, 2003, 2004).

The main reason for differentiated CDM limits are different emission reduction targets by each Member State. The Linking Directive implements the supplementarity criterion of the Kyoto Protocol (UNFCCC, 1997: Article 12). While the Kyoto Protocol and the Marrakesh Accords do not define supplementarity, according to the Linking Directive, at most half of the abatement effort can be conducted through CDM and JI (Council of the European Union & European Parliament, 2004; UNFCCC, 1997a, 2005a).[12]

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[8] The economic impact of the separation of emissions reduction targets into a trading and non-trading sector is covered in Böhringer, Koschel, & Moslener (2008), Kallbekken (2005), and Michaelowa & Betz (2001).

[9] According to the revised EU ETS Directive 2009/29/EC (European Parliament and the Council of the EU, 2009a), the emissions cap beyond the year 2020 decreases with a linear factor of 1.74% of mid-2010 emissions per year (Article 9). The linear factor is subject to revision by 2025.

[10] The rules governing these phases differ, so that for instance the banking of EU allowances is not allowed between Phases I and II; auctioning is mandatory in Phase III for power installations; and energy-intensive industry emitters are exempt from auctioning subject to benchmarks, when they are found at risk of carbon leakage (European Parliament and the Council of the EU, 2003, Article 10a). The list of sectors exempt from auctioning and subject to free benchmark allocations can be found in Official Journal of the European, (2010).

[11] In the non-ETS Sector, the government has a mandate to buy CERs. Gorecki et al. (2010) and Tol (2009) assess the use of the CDM within the non-ETS market and reach similar conclusions to those presented in this article regarding the EU ETS.

[12] The text of the Marrakesh Accords was finished at the seventh Conference of the Parties to the UNFCCC in 2001, but only entered into force in 2005, when the Kyoto Protocol was ratified.

A more stringent emission reduction target leads to a higher allowed volume of project credits. If for instance country A has agreed to reduce emissions to a level Y_A from level X. The difference between these two levels is the reduction R_A. According to the supplementarity criteria ("half of the effort through project credits"), this country can use project credits to achieve $R_A/2$ of the whole reduction target R_A. The percentage allowed P_A will be equal to $R_A/2$ divided by the level Y_A. Correspondingly, if country B has a higher target, where $R_B > R_A$, P_B the share of project credits allowed in country B will also be higher than P_A.[13]

The final Phase II CDM limits approved by the European Commission vary considerably between countries, as can be seen in Table 5.1.[14] The figures suggest that company installations in the EU ETS are potentially treated differently. For example, in Phase II, if a Belgian installation receives 100 EUAs free, it can use about 8 CERs (8.4%) towards compliance. If the same installation is situated in France, it can use about 14 CERs (14%) towards compliance.[15] In the presence of the free allocation of the allowance to use offsets, this difference is likely to enhance the competitive distortions originally created by the free allocation mechanism, as CERs are cheaper than EUAs.

[13] For a numerical example, assume that X = 100 emission units in both countries, and that Y_A and Y_B are 90 and 80 emission units, respectively. P_A and P_B will be 5.5% and 12.5%, respectively.

[14] In what follows, only the CDM limit is analysed, while it implies the limit on emissions reduction credits from Joint Implementation. Due to its late start, the JI market is considerably smaller than the CDM market in terms of volume. Nevertheless, some observers see the potential for a prosperous JI market (Hobley & Roberts, 2009; Hoogzaad, 2009).

[15] See section 5.1.3 for an explanation of the CER limit.

Table 5.1 Member State National Allocation Plan CER limits approved by the EU Commission

	(I) Annual Cap allowed in 2008-2012 in Mt	(II) Absolute annual CDM limit in 2008-2012 in Mt	(III) = (I)*(II) CDM limits as share of allocation
Austria	30.7	3.1	10.0%
Belgium	58.5	4.9	8.4%
Bulgaria	42.3	5.3	12.6%
Cyprus	5.5	0.5	10.0%
Czech Republic	86.8	8.7	10.0%
Denmark	24.5	4.2	17.1%
Estonia	12.7	-	0.0%
Finland	37.6	3.8	10.0%
France	132.8	17.9	13.5%
Germany	453.1	99.7	22.0%
Greece	69.1	6.2	9.0%
Hungary	26.9	2.7	10.0%
Ireland	22.3	2.2	10.0%
Italy	195.8	29.3	15.0%
Latvia	3.4	0.3	10.0%
Lithuania	8.8	1.8	20.0%
Luxembourg	2.5	0.3	10.0%
Malta[a]	2.1	0.2	10.0%
The Netherlands	85.8	8.6	10.0%
Poland	208.5	20.9	10.0%
Portugal	34.8	3.5	10.0%
Romania	75.9	7.6	10.0%
Slovakia	30.9	2.2	7.0%
Slovenia	8.3	1.3	15.8%
Spain	152.3	31.4	20.6%
Sweden	22.8	2.3	10.0%
UK	246.2	19.7	8.0%
Total	2,080.9	288.5	13.9%[16]

Source: Europa (2007).[17]

The European Commission assessed the EUA allocation and CER limits in Member States' National Allocation Plans with regard to the competitive effects of allocation and the potential for reduction.

[16] The average for the EU is calculated by dividing the sum of allowed project credits (column II) by the amount of EUAs (column I of Table 5.1).

[17] Note: [a] The European Commission stated in its NAP II decision that Malta did not specify its maximum CER limit. For the purpose of this analysis the limit is assumed to be 10%.

> "For greater flexibility, Member States are recommended to apply the [CDM] limit for the entire trading period and collectively to all installations" (European, 2005: para. 3.5.25)

The annual CDM amount, approved by the European Commission, can be spread over the whole trading period in Phase II. Entities are thus entitled to bank their CDM usage until later in the period. All Member States define the offset usage entitlement as a percentage of allocation rather than as percentage of actual verified emissions. As a result, installations that receive an over-allocation of allowances also profit from the resulting generous CDM and JI limit.

5.1.3 CER limit formula

The European Commission formula applied for setting the CDM limits can be found in Article 2.3 of (European Commission, 2006a). In order to reach the Kyoto targets, the CDM limit is based on half of the highest reduction effort needed from either 1990, 2004, or 2010 emissions, (European Commission, 2006b). For instance if the highest emissions in these three years for one particular country is equal to 100 units and the Kyoto target emissions are equal to 80 units, the total effort for the country to achieve its target is equal to 20 units. Half of this effort, 10 units, can be covered through the CDM. Hence, the CDM limit as a percentage of allocation is equal to 12.5% (10/80 units). For another country with emissions of 100 units but a less stringent Kyoto target of 90 units, the effort is 10 units (the difference between highest emissions and Kyoto target) while the absolute CDM limit, equal to half of the abatement effort, is 5 units. As a percentage of the target the CDM limit is 5.6% (5/90 units).

Each Member State then allocates the absolute limit to the ETS and non-ETS sectors. All CDM credits that are not allocated by the government to the non-ETS sector can be used by the ETS sector. If the percentage to be used by ETS installations is below 10% as a percentage of allocated emissions within the ETS, the respective Member State can choose 10% as its offset import limit to support the promotion of the carbon market.[18] The following section provides a theoretical framework as to how the allocation of CERs leads to reductions in average abatement costs and the transfer of rent.[19]

[18] In at least one case, the European Commission agreed to allow CDM limits equal to the difference between 2005 verified ETS emissions and the proposed cap for Phase II of the EU ETS (European Commission, 2007).

[19] See also the discussion on cost-effectiveness and rent in Chapter 3.

5.2 Effect of CERs on abatement and compliance decisions

5.2.1 Rent transfer through CDM limits

The option to use CERs reduces average abatement costs. Schedule 1A of Figure **5.1** shows a stylised marginal abatement cost curve for the EU ETS. The domestic carbon price P_D is a function of the demand for emission reductions and the supply of abatement opportunities. The demand for emission reductions is given by the target, denoted by the reduction effort *R*. The supply curve of abatement MAC_{EU} is the aggregation of the individual MAC curves for all ETS emitters in the EU. The costs to fulfil the target domestically are equal to the area *B*, the area under MAC_{EU} up to *R* on the x-axis.[20] To the right of *R*, denoted *verified emissions* are the remaining actual emissions that are not abated and for which allowances have been allocated.

Schedule 1B assumes that in a non-Annex B (developing) country, the opportunity to produce abatement in the form of CERs exists at a flat fee of P_{CER} (i.e. the MAC curve in the non-Annex B country is flat) for a certain volume.[21] Hence, the EU faces a new *MAC**, a combination of MAC_{EU} with the flat rate CER abatement options. This leads to a price of *P** and abatement costs equal to the sum of the areas below the new *MAC** curve ($D + E + F + G$). Abatement conducted within the EU is equal to the sum of *A1* and *A2*. Abatement conducted externally through the CDM is denoted C1. Total costs ($D + E + F + G$) in schedule 1B are smaller than total costs (*B*) in schedule 1A.

In schedule 1C, the supplementarity limit is introduced, which reduces the volume of CERs allowed to be used from C1 (schedule 1B) to C2 and increases the price to P_L. Furthermore, the limit increases compliance costs in comparison to schedule 1B, by the amount denoted by area *H*. Domestic abatement is higher in schedule 1C relative to 1B by the amount *A3*. External abatement through the CDM is now limited to C2. Actual emissions under all three schedules are the same, as the country has a binding reduction target. Only compliance costs vary with highest costs in schedule 1A (only domestic abatement) and lowest in Schedule 1B (unlimited CDM access).[22]

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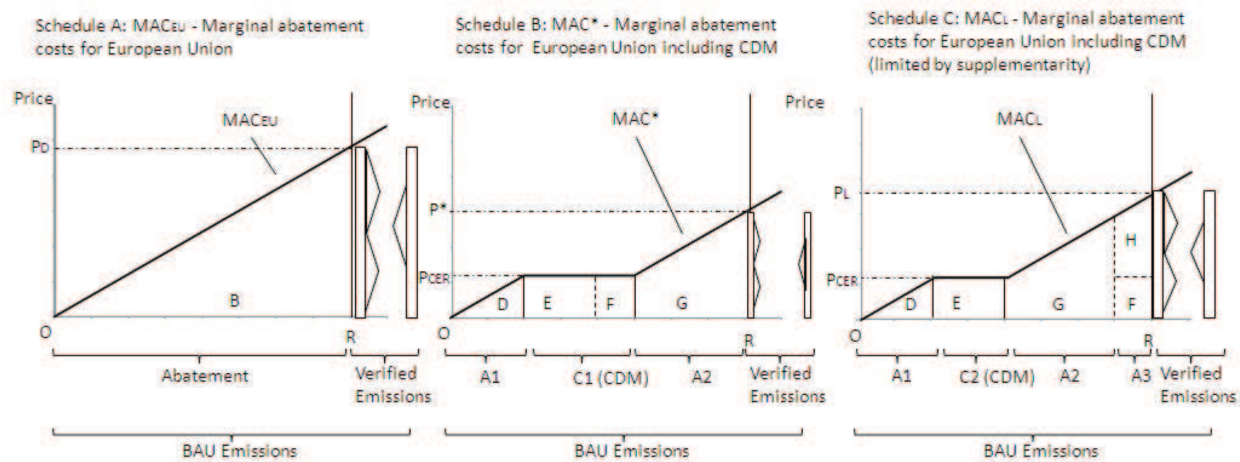
[20] In mathematical terms, total costs B are equal to the integral of the MAC curve between the origin O and the reduction target R.

[21] In practice, CER prices vary in the primary market where projects are conducted, while they are uniform on the secondary market prices. For simplicity, it is assumed that most EU ETS participants buy CERs on the secondary market.

[22] If the target R is low, or conversely unlimited, CDM is allowed and only the amount *A1* will be abated with the remainder covered through CERs. In this case, the CER price equals the EUA price.

The price P_L in schedule 1C will be the EUA price in the EU ETS, which accounts for the increased but limited (due to the supplementarity criterion) supply of abatement opportunities through the CDM. The CER price in the EU ETS will be the flat price P_{CER}.[23]

Figure 5.1 Domestic and aggregate marginal abatement curves with and without supplementarity limit for the European Union



The EU's CDM limit, equal to *C2* in Figure 5.1, is transferred through the CDM limit formula to Member States, who translate the country limit to CDM limits for installations. Member States with more stringent targets have a higher CDM limit.

5.2.2 Compliance and abatement strategy

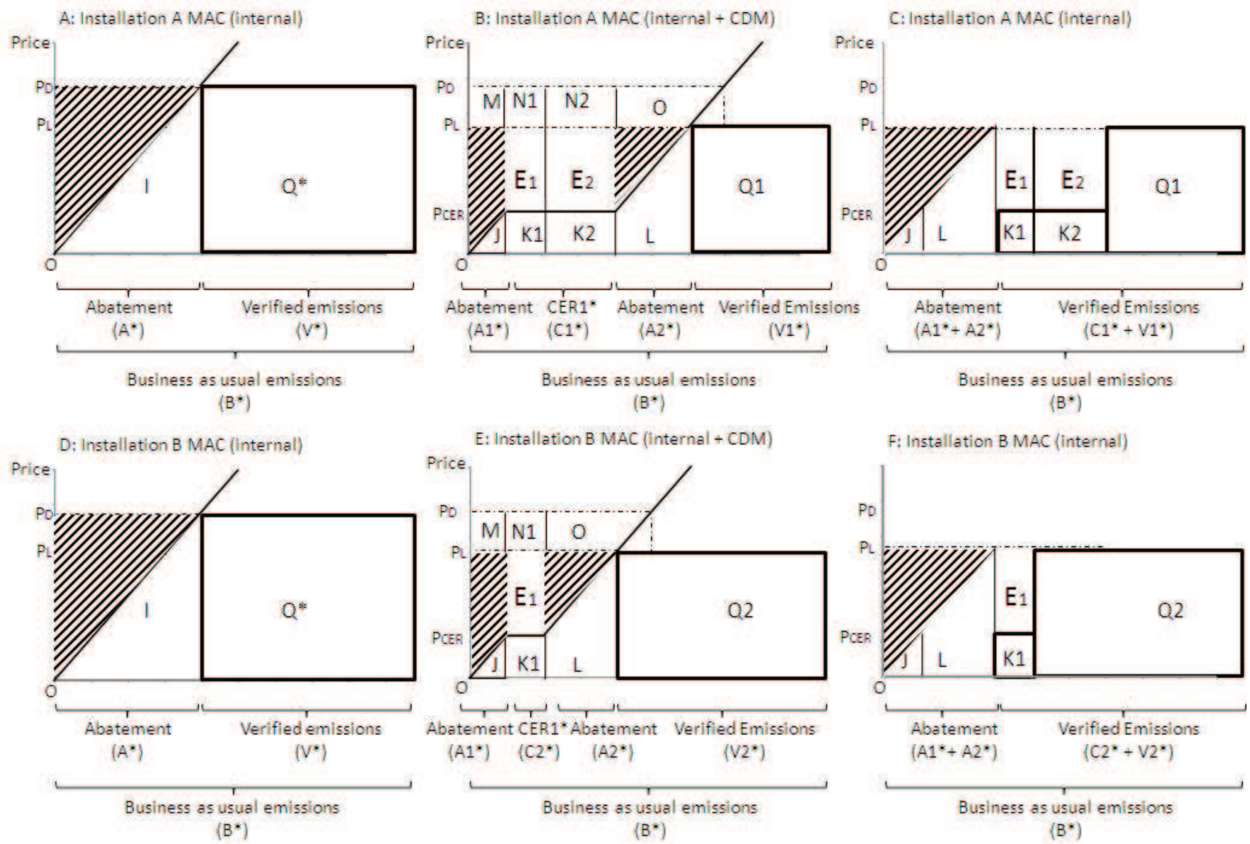
Installations compare their marginal abatement costs of internal measures and allowed external abatement measures (i.e. CERs) with the EUA price P_L and abate up to where the marginal abatement costs are equal to the EUA price. Firms whose MAC curve starts above the price P_L do not abate internally, because using EUAs and CERs will be cheaper. If installations have surplus allowances, they can sell them on the market. Surplus allowances can be generated through internal abatement, an exchange of EUAs for CERs, or initial free allocation. If after abatement, installations need more allowances they can buy them on the market once internal abatement opportunities below the EUA price have been harvested (see also Gorecki et al., 2010).

[23] The discussion assumes an absence of Assigned Amount Units supply at zero marginal cost, which is only the case if 'hot air' AAUs are scrapped. In the presence of 'hot air', a new marginal abatement cost curve MAC_{AAU} is introduced, is horizontal and shifts the MAC in all schedules of Figure 5.2 to the right. I am grateful to Axel Michaelowa for drawing attention to this restriction.

5.2.3 Effect of CER use on compliance strategies

Figure 5.2 compares two identical installations A and B that face the same internal abatement opportunities (i.e. their MAC curves are equal). The two installations differ only with respect to their CDM limit as the installations are situated in different Member States.

Figure 5.2 Installation specific MAC curves - compliance strategies with and without CDM



Schedules 2A to 2C in Figure 5.2 denote the installation A, and Schedules 2D to 2F denote installation B. Schedules 2A and 2D illustrate the baseline case in which no installation in the EU ETS, thus also neither installations A nor B, can use CERs. Initially, without a carbon price, installation A emits business-as-usual emissions equal to B^* units. With a carbon price P_D (the same price as in schedule 1A in Figure 5.1), installation A emits verified emissions equal to V^* units and abates A^* units. The verified emissions V^* are covered through EUAs. The EUAs can either be taken from the free allocation or can be bought on the market if allocation is lower than V^*. The total compliance cost for installation A is the sum of the areas I and Q^*, equal to the abatement cost and the cost of EUAs to cover remaining emissions (V^*).

5.2.4 Impact of CER use

Introducing the possibility of using CERs reduces average compliance costs for installations. The compliance strategy, which uses a limited volume of CERs, is illustrated in schedule 2B for installation A. Using CERs, the MAC curve in schedule 2B is the result of a combination of the installation's MAC curve, the flat MAC curve for CERs, the flat price P_{CER} and the EUA price P_L.[24] Installation A now abates the sum of A1* and A2* internally. Installation A abates externally *C1** units in a developing country by buying (or conducting the project in a developing country which generates) *C1** units of CERs. For the remaining verified emissions *V1**, installation A uses the corresponding amount of EUAs. The total compliance cost is the sum of internal abatement costs (areas *J*, *L*), external abatement costs (areas *K1* and *K2*) and the area *Q1* for buying *V1** EUAs.

Schedule 2C is a rearrangement of schedule 2B. It illustrates, from left to right, the amount of abatement, the number of CERs used, and the amount of EUAs used. The sum of EUAs (*V1**) and CERs (*C1**) equals the verified emissions of the installation. Schedule 2C illustrates that abatement (A1*+ A2*) in schedule 2C is lower than A* in schedule 2A. Thus, verified emissions in schedule 2C are also higher than in schedule 2A. This is not surprising as it results from the lower price P_L relative to the price P_D in schedule 2A.

A lower CER limit, *ceteris paribus*, leads to higher compliance costs but not to lower verified emissions. Schedules 2D to 2F illustrate the situation for installation B, which has the same internal MAC but a smaller CDM limit relative to installation A.[25] When CERs are allowed, the new MAC curve for installation B results from a combination of the installation's MAC curve, the flat MAC curve for CERs, with the flat price P_{CER} and the EUA price P_L. The rearrangement of schedule 2E in schedule 2F illustrates that the difference between installations A and B is the greater reduction in abatement costs created for installation A due to the larger CDM limit.

Interestingly, verified emissions of installation B (C2*+V2*) are the same relative to verified emissions for installation A (C1*+V1*). A larger share of total verified emissions is covered through CERs in installation A (C1*) than in installation B (C2*). Due to the fact that

[24] The possibility of using CERs lowers the carbon price from P_D to P_L as illustrated in Schedule 1A to Schedule 1C in Figure 5.1.

[25] In the situation without the CDM, both installations face the same price P_D and thus abate the same amount A* internally. The compliance costs are equal (areas I and Q*) for both installation without the use of CDM. The rent from internal abatement is equal to the sum of the difference between the price P_D and the internal marginal abatement costs, equal to the hatched areas. This rent is the same for installations A and B and is generated by exploiting internal abatement measures within the installations.

Installation B cannot use as many CERs as installation A, it has to cover this part of emissions with EUAs.

Installation A has an advantage relative to installation B in terms of the reduction in compliance costs (equal to the area *E2* in schedule 2C). The area *E2* is equal to the difference in the amount of CERs allowed, multiplied by the difference between the EUA price P_L and the CER price P_{CER}. Depending on the difference in C1* and C2* the analysis in Figure 5.2 shows that installation A can gain a competitive advantage merely by its location in a specific Member State, rather than one based on any emission reduction or innovative effort.[26]

As the preceding sections have shown, the compliance strategy of installations is determined by their internal and external abatement opportunities. If allocation of allowances is free, as is the case in Phase II of the EU ETS, a profitable arbitrage opportunity exists for some installations. The conditions for arbitrage are illustrated in the next section.

5.3 EUA-CER Arbitrage

With free allocation of EUAs and CDM limits, installations can lower compliance costs by engaging in arbitrage. Arbitrage involves the sale of previously freely allocated allowances and purchase of CERs with the sales proceeds. This gives a tangible cash-inflow to installations that engage in such a strategy. Equation 1 illustrates the condition for arbitrage:

$$A_{EUA}*(1+CER_i) > V_i \qquad \text{given } CER_i > 0 \qquad (1)$$

Where:

A_{EUA} = Free initial allocation of EUAs

V_i = Verified Emissions of installation i

CER_i = Percentage of CERs that can be used, differentiated by installation i's Member State limit

Arbitrage is possible, if the sum of freely allocated allowances (A_{EUA}) and the amount of allowed CERs (CER_i*A_{EUA}) is higher than verified emissions (V_i). Actual arbitrage occurs, however, only if $A_{EUA}*(1+\text{Actual } CER_i) > V_i$, where: 'Actual CER_i' is positive and equal to the actual CERs used as a share of free allocation of installation i.

[26] It is not clear if this case in which an installation in country A has an advantage over an installation in country B, meets the criteria for state aid. However, in light of the competitiveness effects and the difference between existing entities and new entrants, it is interesting to analyze this issue. To the authors' knowledge, this analysis has not yet been conducted.

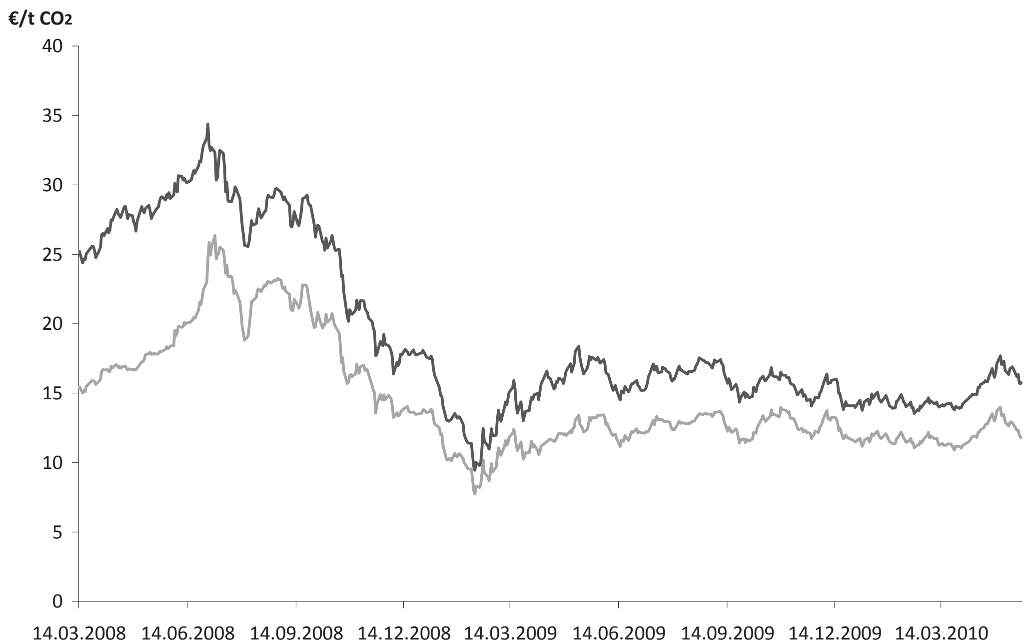
It has been shown in Figure 5.2 how differential access to CERs can lead to different reductions in abatement costs for the same installation. Hence, this suggests that two similar installations from the same sector located in different countries are treated differently. The next two sections briefly explore the CER spread and the way EU Member States pass on the CER limits to EU ETS installations.

5.3.1 Experience with the CDM in the EU ETS

5.3.1.1 Historical EUA-CER spread

CERs trade at a discount to EUAs in the market.[27] Figure 5.3 shows the co-movement and historical spread between EUA and CER December 2012 futures prices. The spread, assuming equally distributed trade over the three years, is €4.67.[28]

Figure 5.3 EUA (black) and CER (grey) December 2012 futures prices in €/tCO_2



Source: ECX (2010)

Regulators are faced with the decision on how and to whom to give access to the opportunity to lower compliance costs, hence to the rent created by the price spread. On the one hand, lower mitigation costs might protect the competitiveness of the industry from unilateral shocks. On the other hand, the profit from the regulation could distort EU-internal competition. The rent, *E1* and *E2* in schedules 2C and 2F, could similarly be assigned to

[27] Mansanet-Bataller et al. (2010) find significant evidence that this spread is influenced by three factors: 1) the uncertainty inherent in CER project delivery relative to EUAs, 2) the limit imposed on the usage of CERs, and 3) the non-fungibility of CERs and EUAs for speculative traders (relative to compliance buyers, who can profitably arbitrage between CERs and freely allocated EUAs).

[28] Transaction costs are not accounted for here. Furthermore, using the direct purchase of CERs from project developers might increase the spread relative to the spread between EUA and CER futures contracts.

national governments, if the revenue were used to enhance mitigation or lower distortionary taxes. The following section explores how the CDM has been used in 2008, and which sectors have profited most from the CDM limit allocation.

5.3.1.2 Empirical Results– CERs surrendered in 2008

In the discussion so far, it t was assumed that the right to use CERs is valuable and will be used to the upper limit by each installation, to fully capture the opportunity to reduce compliance costs through the CDM (Figure 5.2). However, in 2008, for reasons to be discussed, EU ETS installations did not use CERs up to the full volume allowed.

The EU ETS data for 2008 covers 12,114 installations: 9,970 installations (82% of all EU ETS installations) – were allocated EUAs, while 10,397 had verified emissions, i.e. they participated in the EU ETS.[29] Of these 10,397 installations 1,737 installations have used CERs (Table 5.2). Using the ten sectors distinguished in the EU ETS, it is possible to assess the extent of CER usage by sector relative to the allowed volume (illustrated in Table 5.2 for the EU-27).[30] Notably not all installations used their allowed CDM limit fully. For instance, in the power sector, 1,115 installations used 55 million CERs, each allowing for the emission of one ton of CO_2-e. This means that only 16% of all installations that could have used CERs did so.[31] Furthermore, only 31% of all CERs allowed in 2008 alone were used by all the installations. This is a rather low number, given the potential of installations to reduce their average abatement costs by using CERs.

[29] About 2/3 of the 2,144 installations that did not receive any allocation in 2008, were allocated EUAs in Phase I of the EU ETS.

[30] The ten sectoral scopes for Annex I are: Power, Refineries, Coke Ovens, Metal Ore, Iron and Steel, Cement and Lime, Glass, Ceramics, Pulp and Paper, and installations that 'Opted in' (see Council of the European Union & European Parliament (2003). Most of the information to calculate these measures is available in the EU ETS registry, the Community Independent Transaction Log (CITL). Each April, EU ETS verified emissions data is published for the preceding year, indicating, for instance, the installation name, the Member State the installation is located in, the sectoral scope, the verified emissions of the installation, the EUAs freely allocated to the installations, and the CERs and emission reduction units used by the respective installation for compliance. It is not readily observable what the business-as-usual emissions are, i.e. what would have happened in the absence of the EU ETS. Hence the abatement conducted as the difference between BAU and actual verified emissions, cannot be calculated without additional data.

[31] Potential reasons for this low usage of CERs are elaborated below in Section 5.3.2 and include: expected higher CER-EUA spread in the future, the lack of either sufficient CER supply or competition from public (government) buyers, and a lack of (financial) management attention to arbitrage and profit opportunities and transaction costs.

Table 5.2 CER actual versus allowed use in 2008

	Installations using CERs (as share of total installations in the respective sector)	Used CERs 2008 in Mt (as share of allowed annual CERs)	Rent conferred to installations in € (millions) at average EUA-CER spread of €4.67
Power	1,115 - (16%)	55.21 - (31%)	257.85
Refineries	36 - (25%)	4.53 - (20%)	21.14
Coke ovens	4 - (19%)	1.41 - (52%)	6.58
Metal Ore	3 - (11%)	0.17 - (7%)	0.79
Iron or steel	31 - (13%)	8.92 - (31%)	41.66
Cement and Lime	158 - (30%)	8.19 - (27%)	38.26
Glass	44 - (10%)	0.96 - (27%)	4.48
Ceramics	189 - (19%)	0.59 - (22%)	2.77
Pulp and Paper	146 - (19%)	2.27 - (40%)	10.62
Opted-in	11 - (3%)	0.02 - (9%)	0.08
Total	**1,737 - (17%)**	**82.28 - (29%)**	**384.23**

Source: CITL (2010)

Table 5.2 also indicates the reduction in abatement costs that was granted to installations in 2008. Using the average price spread of €4.67 between EUAs and CERs for the year 2008, the actual advantage conferred to installations is equal to €384 million.[32] For instance, the iron and steel, and cement sectors have profited from reductions in average abatement costs by €42 and €38 million, respectively.

5.3.1.3 EUA-CER arbitrage

Table 5.3 indicates that in 2008, 1,353 installations actually engaged in arbitrage, satisfying Equation 1.

[32] That is, the product of €82.3 million and €4.67.

Table 5.3 EUA-CER actual versus potential arbitrage in 2008

	Installations arbitraging (share of total installations able to arbitrage)	Volume of EUAs arbitraged for CERs in Mt (share of total arbitrage possible)	Arbitrage rent in € (millions) at average EUA-CER spread of €4.67 (share of total rent conferred through CER limits)
Power	809 - (15%)	29.0 - (29%)	135.6 - (53%)
Refineries	23 - (20%)	3.8 - (19%)	17.7 - (84%)
Coke ovens	3 - (17%)	1.3 - (55%)	6.1 - (93%)
Metal Ore	2 - (9%)	0.1 - (7%)	0.7 - (86%)
Iron or steel	25 - (14%)	8.7 - (30%)	40.7 - (98%)
Cement and Lime	140 - (30%)	7.6 - (26%)	35.5 - (93%)
Glass	39 - (10%)	0.9 - (28%)	4.4 - (97%)
Ceramics	174 - (19%)	0.6 - (22%)	2.6 - (95%)
Pulp and Paper	133 - (20%)	2.1 - (40%)	9.9 - (93%)
Opted-in	5 - (5%)	0.02 - (9%)	0.1 - (92%)
Total	**1,353 - (17%)**	**54.2 - (28%)**	**253.2 - (66%)**

Source: CITL (2010).

Thus, a majority of the 1,737 installations that used CERs arbitraged. However, only 17% of all installations that were able to arbitrage due to their free allocation and their CDM limit did in fact do so. In terms of volume, 54.2 Million CERs were arbitraged, with most of this amount falling in the Power sector. In total, 28% of all possible arbitrage actually occurred. Given the assumed EUA-CER price spread of €4.67 for 2008, arbitraging installations benefited from a financial transfer of €253.2 million. Thus, 66% of the total rent of €384 million (Table 5.2) was transferred as profit to installations. This amount is equivalent to the loss in revenue for the regulator from not selling the right to use CERs to EU ETS installations. This revenue could be used to enhance high cost mitigation, in the EU or developing countries, conducting low-carbon projects which are not feasible at current carbon prices.

The Iron and Steel, and the Cement and Lime, sectors were most effective in employing the economically rational arbitrage strategy, with almost all (98% and 93%, respectively) rent granted through the CER allowance ending up as arbitrage profits. The discussion indicates that a substantial rent transfer occurred from the government to installations. A large share of installations reacted rationally and exchanged freely allocated EUAs for CERs at a profit. However, not all installations used their arbitrage opportunities.

5.3.2 Reasons for CER use below maximum

There are at least four reasons for not fully using the whole CDM entitlement in one year and to bank it for subsequent years: expected higher CER-EUA spread in the future, the lack of either sufficient CER supply or competition from public (government) buyers, and a lack of (financial) management attention to arbitrage and profit opportunities and transaction costs. First, entities that expect the spread between CERs and EUAs to widen could profit even more from using CERs when EUAs are priced higher relative to CERs. The right to use CDM credits thus entails a rent equal to the price spread between allowances and CERs. The value of this rent has varied over time within the second trading period, from a peak of €11.50 in April 2008 to €1.58 in February 2009. The spread, assuming equally distributed trade over the three years, is €4.67. However, historical data does not support the hypothesis that installations speculated on a higher spread as the gap between EUA and CER prices narrowed rather than increased (Figure 5.1).[33] Second, it could be that the supply of credits does not meet demand by the EU ETS. Although at the beginning of 2010 there were more than 400 million CERs (225 million by the end of 2008) issued through the CDM, a large share could already be contracted by public funds for use in non-ETS sectors or other Annex B countries such as Japan. This is a temporal problem, because the registered CDM projects are expected to issue more than one billion CERs by the end of 2012 (Risoe, 2010). Thus, the potential current supply gap can arguably vanish till the end of the commitment period so that installations can use CERs to a higher extent. Third, it may be that the current economic slowdown has not warranted the extensive use of CERs for compliance and hence reduced competition for CERs. This is not relevant however in the continuing presence of the price spread. Fourth, it is possible that operators of installations are not attentive to the compliance cost-decreasing impact of the CDM and thus have not yet used the CDM to the allowed extent. In addition, transaction costs for using CERs are not zero and can play a significant role for smaller installations. Transaction costs involve, for example, the setup of a procurement or trading desk for CERs. Furthermore, CER procurement always entails counter-party risk, i.e. the risk that one the party supplying the credits will fail to generate the credits and thus break the contract provisions. Larger installations are better equipped to deal with and diversify such risks. Hence, smaller installations that do not use CERs for the above reasons, might want to sell their rights to others. Opportunities to address these issues are examined in the next section.

[33] Transaction costs are not accounted for here. Furthermore, using direct purchase of CERs from project developers might increase the spread relative to the spread between EUA and CER futures contracts.

5.4 Allocating the rent

Allowing EU ETS companies' installations to use CERs is valuable. Figure 5.2 indicates that the entitlements to use CERs have a value equal to areas E1 and or the sum of E1 and E2, respectively. If these entitlements are tradable, the cost of using EUAs and CERs is the same, in the absence of transaction costs.

Currently under the *status quo*, limits are not tradable i.e. each installation can use up to a certain volume of CERs equal to a share of freely allocated EUAs. After describing the *status quo*, three possibilities are presented to address rent allocation: 1) Changing from the current allocation base to the verified emissions base for allocating CDM entitlements, 2) the 'CER usage option', and 3) the 'pre-commitment option'. The last two options cater to economic efficiency and to potential enhanced mitigation through revenue recycling.

5.4.1 Compliance strategies and installation-based limits rules

Under installation-based limitations, there are two options: 'allocation-based' and 'compliance-based' limits. Allocation-based limits (the *status quo*) stipulate that a certain percentage of allocation – the amount A_{EUA} distributed freely through the regulator – may be covered through CERs. If the allowed CDM limit CER_i, for instance, is 10% and allocation A_{EUA} is 100 units, 10 units ($CER_i \times A_{EUA} = C1^*$) can be covered through CERs, independent of verified emissions (V). Thus, the absolute CER limit ($C1^*$) increases in both the free allocation (A_{EUA}) and the CDM percentage allowed (CER_i). The allocation option is currently used for existing installations that have been granted an entitlement under their Member State National Allocation Plans or Article 11a, paragraph 8(1) of Directive 2009/29/EC (Council of the European Union & European Parliament, 2009).[34]

The compliance option stipulates that a certain percentage of compliance needs – i.e. actual verified emissions (V) – may be covered through CERs. If the allowed CDM limit is 10% (CER_i) and verified emissions are 80 units (V), 8 units ($CER_i \times V = C_V1^*$) can be covered through CERs, independent on how many EUAs (A_{EUA}) were freely allocated. This rule is used for new entrants under Article 11a, paragraph 8, of the new EU ETS Directive. Thus, under the compliance option absolute CER limit (C_V1^*) increases in both verified emissions (V) and CER_i.

The allocation option, currently employed by the EU ETS gives rise to substantial arbitrage profits, which are due to the initial allocation of EUAs (A_{EUA}) as shown in Table 5.3. Where

[34] In this case the CDM limits, no matter how defined, are not tradable. This assumption is crucial as, in its absence, the efficiency gain is equal to the CER usage right and the pre-commitment options described above.

installations do not receive any EUA allocation (i.e. where $A_{EUA} = 0$), they are excluded from profiting from the price spread, which is likely to worsen their competitive position. The compliance option treats each installation equally, independent of allocation, in terms of access to CDM credits. While there is a potential to increase verified emissions (V) due to the production of emission-intensive goods, it is unlikely that installations increase their verified emissions only to get more access to CERs as it comes at a significant cost (unless the price spread between P_{EUA} and P_{CER} is large). Arbitrage under the compliance option occurs if the sum of allocated EUAs (A_{EUA}) and allowed CERs (V x CERi) is greater than verified emissions (V).[35] Equation 2:

$$A_{EUA}/(1\text{-}CERi) > V \qquad (2)$$

If the regulator chooses CER_i so as it to be equal to the limit under the allocation option, the installation can still increase its use of CERs by emitting more and abating less.[36]

Under the allocation rule, entities have an incentive to lobby both for increased free allocation and for a higher percentage of CER use (Equation 1). The former effect is absent when the compliance option is chosen (Equation 2). Depending on the price spread between P_L and P_{CER}, the difference between the compliance and the allocation option can be substantial. Note that the analysis above is static and does not take into account price effects of selling and buying allowances for arbitrage.

It has been shown how the allocation option, as a basis for calculating the CER limit, increases the distortions created by free allocation. However, while the change from the allocation option to the compliance option, to some extent, allows access to a more equal distribution of the right to use CERs, it does not account for transaction costs and counter-party risk. These issues can only be addressed if others are able to absorb this risk, either other EU ETS installations or the government, which are discussed in the next section.

5.4.2 CER usage rights

Figure 5.2 suggests that installations use all of their allowed CER volume. As the shown in the discussion of section 5.3.1 (Table 5.3), however, not all installations have fully used their allowed CER volume. These installations should want to sell their CER usage rights. In turn,

[35] That is, when A_{EUA} + V x CERi > V⇔ A_{EUA} > V x (1-CERi) ⇔ $A_{EUA}/(1\text{-}CERi) > V$.
[36] The profit also arises in the absence of over-allocation. The condition for arbitrage profit is that the installation is allocated more allowances than the compliance needs, minus the allowed CER use. This could therefore also arise if free allocation is contingent on benchmarking, as is the case in the EU ETS (Council of the European Union & European Parliament, 2009: Article 10).

installations with a MAC curve starting above the prevailing EUA price and installations and traders who can swap EUAs for CERs, could buy the right to use CERs from other installations. Thus trading of the right to use CDM credits brings a trade benefit for both (Coase, 1960; Dales, 1968).

The right to use CERs could be traded, with the rent going either to the emitter or to the relevant state, depending on how the right is allocated. The proposal is as follows: Each offset right carries the right to use one CER, equivalent to the abatement of one ton of CO_2e. The 'CER usage rights' option allows each installation to use as many CERs as it wants, as long as it holds, and is able to surrender, an equivalent amount of CER usage rights. Thus, CER usage rights and the underlying CERs are complementary instruments. Due to the tradability of the entitlement to use CERs, the price of EUAs is equal to the price of CERs plus the price of the CER usage right. Thus, the cost of using the two instruments – EUAs and CERs – is equalized, assuming zero transaction costs.

Thus, an installation needs to surrender a corresponding CER usage right, for each CER surrendered. Economically, this does not result in an efficiency loss, because the installation sells a corresponding amount of EUAs, providing liquidity to the market and making compliance easier for the other entities that do not use CERs.

The right to use CERs could be allocated for free or auctioned. The regulator is faced with the same challenge as with the initial allocation of allowances in an ETS. Each right would carry an opportunity cost, a rent, irrespective how the right is allocated, on a spectrum between free allocation and auctioning of the rights. Thus, the allocation mechanism distributes wealth, i.e. the reduction of average abatement costs, among entities and the regulator. This is likely to encourage and strengthen rent-seeking behaviour by entities.[37]

5.4.2.1 Free allocation of CER usage rights

Free allocation of CER usage rights transfers rents to installations. If the CER usage rights are freely handed out to entities, the question arises as to how this is done. If the basis is historical emissions the risk of 'perverse incentives' arises (as it does in the case of allowance allocation in emissions trading) such that increased historical emissions yields access to more CER usage rights (K. Neuhoff, Martinez, & Sato, 2006). If the basis is sector benchmarks (e.g. the product-based benchmarks in Phase III of the EU ETS), while there is a fairer distribution, compared to using historical emissions, the regulator makes an implicit assumption about the needs of the installation for compliance.

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[37] Coase (1959 p. 27, fn. 54) admits that, in the presence of rent-seeking behaviour, the Coasian solution does not hold. Medema (1997) first pointed to this 'missing' footnote.

The idea behind allocation benchmarks for Phase III of the EU ETS, for example, is to allocate allowances at a level equal to the best 10% in the specific sector (See article 10 in Council of the European Union & European Parliament, 2009). Due to this ambitious level, benchmarks entities must buy some allowances in the market. Using the same basis for CER usage rights allocation as that for the allocation of allowances, entities are potentially allocated more allowances and CER usage rights than they need. Although all entities must acquire offsets in the market, holding an offset confers a benefit and a rent. So, although the CER usage rights are freely allocated, they carry an opportunity cost, which is (absent transaction costs) equal to the spread of the allowance and the CER price. This is the same as the price difference between P_L and P_{CER} in Figure 5.2.

5.4.2.2 Auction CER usage rights

If the regulator chooses to auction the CER usage rights, the amount of rights purchased by entities will depend on their expectation about the future need to use CERs to comply with their obligations. An installation with high marginal costs could buy as many CER usage rights as it expects CERs to procure, as long as the sum of the CER price and the CER usage right price is below the EUA price P_L.[38] Thus, firms which already hold or plan to buy CERs in the CDM market have an incentive to also purchase and hold CER usage rights. Auctioning CER usage rights distributes the rent to the regulator, rather than to entities, as would occur under free allocation. If there is already an auctioning mechanism for allowances, a second, separate auction would create an additional layer of complexity. This could be a particularly important point in terms of transaction costs for smaller installations. Auctioning these rights reduces arbitrage opportunities for installations that received generous free allocation.

Auctioning of CER rights will not change total abatement by installations, but it can change overall abatement by the EU depending on how the revenue is channelled through supporting mechanisms, such as national or EU funds targeting higher cost mitigation or infrastructure projects (which are more expensive than the EUA price and would thus not be conducted by EU ETS installations).

[38] Market power can be prevented if CER usage right auctions are held periodically, with access for all entities. If the market power effect is small, the CER usage rights option minimizes the amount of CERs that remain unused.

5.4.2.3 Pre-commitment option

The third option involves the active participation of the regulator. Under this approach, the regulator issues additional allowances to the volume, equal to the allowed CER limit. The allowances can be sold through an auction or distributed freely among existing installations. Thus, there are no CERs in the secondary market. Entities can use as many allowances as they need, without the need for the regulator to check or enact an installation-based limit. The regulator then issues the additional allowances, for instance, through an auction. At the same time, it signs an agreement to buy the same volume of offsets in the international market. Private actors can then use EUAs for their compliance without the complexity of using and procuring CERs.

By acting as a large CER buyer, the regulator minimizes transaction costs and can impose certain quality purchasing standards on the CDM market. The regulator can sign long-term CER purchasing contracts to mitigate its own risk. This serves as a credible signal to project developers in the CDM market, and enhances certainty in the CDM market as to which projects are acceptable to both the CDM Executive Board and the compliance market.

According to European Commission (2008), the quality of offsets to be imported must be reviewed before the start of Phase III of the EU ETS. Harmonizing the rules for approved CERs is a complex task, as demonstrated by the difficulties of agreeing on harmonized criteria for the application of the World Commission on Dams (WCD) guidelines on CDM projects from large hydroelectric power plants (See amendments to Article 11b (6) of Directive 2003/87/EC amended in the 'Linking Directive', Council of the European Union & European Parliament, 2004).[39] However, once the quality criteria are agreed upon, the EU regulator will be able to consistently influence the quality of CERs for one segment of the market.[40]

The European Commission has banned the use of CDM credits from industrial gas projects for compliance in Phase III from 2013 to 2020 (European Commission, 2011). The ban is effective as of May 2013 and does not allow operators from that moment to use these credits for compliance. At the same time, this option might lead to tensions in UNFCCC fora if the EU unilaterally decides to define quality in the CDM, thus overstepping the decisions taken

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39 Different Member States applied different interpretations to Article 11b(6), European Parliament and the Council of the EU (2004), which resulted in regulatory competition. One Member State, the Netherlands, received most requests for approval of large hydro-projects.

40 This requires that other Annex I compliance markets apply similar quality standards, in order not to start a 'race to the bottom' of approval criteria.

by the CDM Executive Board.[41] It however also illustrates the bargaining power that the EU has gained by being the largest demand market for the CDM.

5.4.3 Discussion

The three options presented above can be assessed in terms of efficiency, practicability and feasibility. In some cases, the efficiency and practicability gains have to be paid for by the regulator. Installations have different abatement opportunities; thus, fixing a non-tradable CER amount that an installation can use is inefficient. Changing from the current allocation option to the compliance option decreases the distortive effects from EUA allocation and is thus an overall improvement, albeit the incentive to increase emissions to profit from increased CER use. However, this change potentially carries a transaction (negotiation) cost if the limits have to be negotiated again (Flåm, 2009). The CER usage rights and the pre-commitment options address this challenge.

Setting up a CER procurement or trading desk is costly and is often pursued only by large power installations that are used to trade electricity. The CER usage rights, and especially the pre-commitment option, benefit operators for whom the benefit from using CERs is itself eliminated by the cost of procurement and the delivery and counter-party risk.[42] This is especially relevant for smaller installations. If the CER usage rights are auctioned through the same mechanism as EUAs, this mechanism does not necessarily increase costs relative to a situation where only EUAs are procured through an auction. Using the CER usage rights, however, installations need to procure CERs, which increases transaction costs.

In the case of the procurement option, the regulator has to set up an institution for procuring CERs and negotiates the quality accepted at the EU level. Subsequent auctioning of EUAs can be done through the auctioning structures, which are to be implemented fully by 2013. The pre-commitment option is advantageous as only one instrument, EUAs, is used for compliance, thus reducing the complexity and transaction costs. This can potentially increase certainty for EU ETS participants as only the original ETS concepts are at work.

The regulator carries the risk of large-scale speculative investments in CER and non-delivery of CERs.[43] If the procurement interval is long enough, speculators are unlikely to lock-up funds for so long, decreasing the price risk. There is a drawback, not to be underestimated, as transactions become political, as in the example of Assigned Amount Unit ‘hot air’ sales

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[41] See for instance the concern by Wang (2011).

[42] The KfW CO_2 barometer assesses the use of CERs for German ETS installations. Small installations have used their CER limit sparingly (KfW/ZEW, 2009).

[43] The average time for a CDM project, from the submission for comments stage to the registration request, is more than eight months for most project types (Risoe, 2011).

(ENDSEurope, 2009). Moreover, the biggest upswing in the CDM market has been due to the increase in liquidity when many private CER buyers entered the market.

The pre-commitment option is feasible under the revised EU ETS Directive 2009/29/EC, as the auctioning revenue can be used for the mitigation projects in developing countries (Council of the European Union & European Parliament, 2009). The Preamble to the Directive encourages the use of auctioning revenues to provide certainty for the CDM market in the Least Developed Countries (See Preamble 31, Council of the European Union & European Parliament, 2009). Although no direct mention is made of the use of auctioning for the acquisition of CERs, the Directive earmarks 'at least 50% of the revenues generated from the auctioning of allowances' for support of mitigation in developing countries (Council of the European Union & European Parliament, 2009: Article 10, paragraph 3). This could be taken to mean support of highly sustainable CDM projects and improving the efficiency of the EU ETS itself.

The CER rights option gives the same positive signals to the CDM market as the pre-commitment option. The EU ETS (2003/87/EC) and the Linking Directive (2004/101/EC) carry no provisions against implementing such a rights approach. The approach, however, would introduce a trading system within a trading system. The capacity needed for trading and deciding optimal compliance strategies increases under the CER rights option. This impacts the proposal's feasibility.

Thus, harmonising the CDM limit rules before the start of Phase III would reduce the complexity for EU installations and decrease the uncertainty in the CDM market.

5.4.4 Limitations

The analysis presented here is static and the empirical data covers only one year. Furthermore, it mainly covers the limits awarded to installations for Phase II of the EU ETS which is already running. Any change in the way CER usage rights are allocated would face substantial political difficulties. However, the analysis is helpful for future periods and upcoming emissions trading schemes that allow offsets.

For instance, in absence of CDM limit harmonisation between new and existing installations, new entrants will be at a disadvantage due to the different calculation basis (allocated allowances vs. verified emissions) and the CDM limits set at a lower level than for existing installations.[44] In addition, the Revised EU ETS Directive (2009/29/EC) makes further use

[44]This issue is beyond the scope of this article. However in light of increased auctioning in Phase III, the discussion here reopens the debate on whether allocation or verified emissions is more efficient as a basis for the right to use CDM credits.

of offsets in Phase III (2013-2020) contingent upon international agreement.[45] In detail, for the period after 2012, if no satisfactory international agreement increases the EU emissions reduction target to 30%, eligible credits from CDM projects registered and issued after 2012 can come only from projects in Least Developed Countries (Council of the European Union & European Parliament, 2009). In addition, the European Parliament decision on the ban, starting from May 2013 of the use of CERs generated from industrial gas (i.e. HFC and adipic/nitric N_2O) projects does affect a large part of the CDM supply (European Commission, 2011). These two project types make up 36% of expected credits by 2012 from registered projects.

Allowing for inter-period flexibility (i.e. banking of CER limits) and the ability to sell CER usage rights if they are not needed leads to economic efficiency gains and makes planning easier for entities, as they do not have to plan offset use for each year ahead. The results of inflexibility are sub-optimal investment decisions, due to uncertainty (Lecocq, Hourcade, & Ha Duong, 1998).

At the same time, increasing abatement flexibility decreases political flexibility. Other stakeholders might be concerned that CERs are used excessively in later periods, decreasing the incentive to innovate in the current period. The EU ETS has opted for inter-period flexibility, stating that the CER limit can be used in the period 2008-2020, while conversions from some CERs are only possible until the end of March 2015 (Council of the European Union & European Parliament, 2009: Article 11a).

5.5 Conclusion

Different options to distribute and administer the valuable CER limit have been discussed. The CER price spread between EUAs and CERs translates into a rent for installations in countries with a generous CDM limit. The rents created through this limit are in the order of €250 million for the year 2008. Three mechanisms for distributing access to the CER limits and the underlying compliance cost reduction were discussed: free allocation, auctioning, and pre-commitment. The current application of installation-specific limits within the EU is inefficient and gives rise to competitive distortions. This has implications for applying the limit within the EU. The EU can improve the current system by either shifting to auctioning CER usage certificates or pre-selling allowances in the amount equal to the CDM limit, and subsequently buying CERs. The main advantages of these approaches are achieving the lowest compliance costs across the EU and decreasing the rents and arbitrage opportunities awarded to participants in the EU ETS. These options have transaction cost limitations as

[45] The creation of Joint Implementation credits will not be allowed post-2012 (European Parliament and the Council of the EU, 2009, Preamble 28).

they require that either the regulator participate actively in the market or limits be allocated (freely or by auction), for subsequent trading. A change in the baseline for allocating the limits from EUA allocation (status quo) to one of verified emissions leads to an efficiency improvement and mitigates the distortive effects of EUA allocation, while at the same time providing potential lower incentives to increase emissions to profit from increased CER use.

The rents collected in a fund could be used to finance more costly emission reductions such as through grid expansion or renewables deployment. When the funds are used to increase investments in the CDM, the same challenges, such as regulatory capture are concerned as discussed in Chapter 3. If the funds are used to increase financing of emission reductions that are not used for offsetting purposes, global emissions can actually decrease. The German International Climate Initiative is such an approach where auction revenue from the sales of EUAs is used to finance emission reduction activities in developing countries which are not used for offsetting. The largest challenge in such program is to quantify the emission reductions and sustainable co-benefits achieved through the funding. However, this is beyond the scope of this chapter and is left for future research.

6. SUMMARY AND OUTLOOK

The Kyoto Protocol sets binding emission reduction targets for industrialised countries. These targets are to be achieved in the period 2008-2012. The Kyoto Protocol was established on the vision of a global emissions trading scheme, where targets are set top-down at the global level and distributed to emitters at the national level. The Kyoto Protocol does not define emission targets for developing countries, but still envisages that developing countries pursue mitigation action with the support of industrialised countries. One mechanism to facilitate this cooperation is the Clean Development Mechanism. It is the only market-based instrument that encourages emission reductions in developing countries to be pursued by industrialised countries. Industrialised countries – and their companies – benefit from lower compliance costs of achieving their Kyoto targets. Emission reductions generated by CDM projects can be used to lower the emission reduction effort for industrialised countries. The decrease of emissions in developing countries is offset by allowing industrialised countries to keep emissions above the Kyoto emission limit. Therefore emission reductions generated by a CDM project have to be additional to any reduction that would have happened anyway to avoid global emissions increasing. Furthermore, CDM projects should contribute to sustainable development in the countries hosting the projects and be cost-effective.

In the absence of any emission reduction targets for developing countries, the CDM is an important instrument to address high emissions growth in developing countries. The CDM was intended as a transitory instrument until developing countries take on individual emission reduction targets. As developing countries are on a course of strong economic growth, this carries large investments in energy and industrial infrastructure with it. These investments are usually long-lived and thus there is a risk that carbon-intensive choices made today, can make it expensive in the future to replace or retrofit this infrastructure with less carbon and energy-intensive alternatives. However, in the absence of any financial support and in the presence of other barriers many of the low-carbon investments might not be pursued. The CDM aims at identifying these "additional" projects, i.e. which are not financially viable without support, and paying the incremental finance needed to make low-carbon projects operational.

This book analyses whether the CDM is effective in detecting and supporting these projects. In particular, the main research question of this book is whether the CDM achieves its objectives of cost-effectiveness, the promotion of sustainable development, and additionality? If the CDM is found to be ineffective in promoting its goals, the book analyses what can be done to align the instrument with its objectives? To answer these questions, the

CDM is analysed from two perspectives. The first perspective is the supply-dimension which answers the question of how the CDM system identifies suitable projects and generates emission reductions in theory and practice. Suitable CDM projects should be additional, cost-effective, and sustainable. The second perspective is the compliance-dimension, which answers the question whether the CDM was effectively used by industrialised countries for compliance with the Kyoto targets. The application of the CDM in the European Union Emissions Trading Scheme is used as a case-study.

6.1 Findings

In particular, the book is structured as follows around the following three chapters which address the research question:

1) Chapter 3: How did the CDM perform in practice? Can potential inefficiencies be addressed by an alternative approach?
2) Chapter 4: What incentives exist to set the benchmark right for the CDM additionality test – a case study of Indian and Chinese renewable projects
3) Chapter 5: Did the EU implement the CDM efficiently?

The analysis to answer these questions was guided by six hypotheses:

> *Hypothesis I: The project developer maximise the profit from project registration by optimising the volume of CERs, the CER price, and the probabilities of approval by the DOE, the approval by the DNA, and by the EB.*

> *Hypothesis II: The DOE will maximise project business, while minimising the risk of losing its operating license.*

> *Hypothesis III: DNAs compete for project inflow and will thus engage in regulatory competition that leads to a "race to the bottom" of sustainability criteria, unless the DNA country holds a monopoly/oligopoly position in the low-cost abatement market.*

> *Hypothesis IV: Executive board members maximise the volume of additional project to be registered subject to their expertise and avoiding any costs imposed by a conflict of interest with their country of origin.*

> *Hypothesis V: Compliance buyers aim at minimising the target compliance costs. Doing so can be achieved through arbitrage of emission rights against CERs.*

> *Hypothesis VI: Governments aim at minimising the costs imposed from emission reduction targets on society, by aiming for the lowest cost policy and maximising the revenue available for climate and non-climate issues so as to be able to compensate potentially adverse effects from the emissions policy.*

These hypotheses were used to assess whether the CDM achieved its goals of environmental integrity (i.e. additionality), sustainable development and cost-effectiveness. These goals were essential elements to ensure the cooperation of industrialised and developing countries. Industrialised countries were interested in achieving their target at lowest costs and developing countries were interested in pursuing economic growth in a sustainable manner funded with the support of industrialised countries. Environmental integrity is the back bone of the instrument: projects that would have happened anyway should not be financed, as this would increase global emissions

The main findings of the book are as follows:

This book finds that the CDM has not achieved its goals of environmental integrity, sustainable development and cost-effectiveness. Furthermore, the book shows cases, where the CDM conflicts with national climate policies in developing countries, for instance in China, the biggest CDM host country, and thus has an adverse effect on the global effort to reduce emissions. An alternative fund-approach, where developing countries are free to choose their long-term abatement strategy to be pursued by the funds received, could remedy some of the difficulties of the CDM, but creates potential trade-offs with cost-effectiveness. The CDM has not been implemented efficiently at the compliance-stage within the EU ETS. The result is that large wind-fall rents have been conferred to participants of the EU ETS. In the following these findings are described in chronological order of the book's main chapters excluding the introduction of the first chapter.

Chapter 2 was a background chapter and characterised the procedures of the CDM, the effectiveness criteria applied to the CDM and the compliance market at the example of the EU ETS that were explored in more detail in Chapter 3, 4 and 5. The procedures of CDM project are conducted in seven steps. There are four main actors that were distinguished in the context of the CDM excluding the ultimate credit buyers in industrialised countries. Within these procedures the regulator and private auditing firms are responsible for ensuring additionality of projects and emission reductions, while the project developer is responsible for cost-effectiveness and the host country is responsible for sustainable development. To register a project, project developers need to demonstrate to the CDM regulator that the project is additional to any activity that would have happened anyway. The regulator needs to collect information on the viability of the project without CDM support from the project developer, who is the better informed party. This information collection is done through the barrier or the investment analysis test (section 2.3 in Chapter 2). The information asymmetries between the regulator and project developers lead to potential moral hazard, which was examined in Chapter 3. The EU ETS and its quantitative and qualitative rules to use emission reductions generated through the CDM were briefly introduced to provide the background for Chapter 5.

Chapter 3 showed the impact of information asymmetries between project developer and the CDM regulator in theory and that the resulting adverse selection and moral hazard challenges could often only be diminished in practice. The literature supported Hypothesis I and II and suggests that many registered CDM projects did not meet the criteria of additionality, sustainability and cost-effectiveness, as the regulator had fewer information and resources than market participants. Therefore the fund-approach, an alternative to the market based CDM was discussed. The clean development fund would collect penalty fees from industrialised countries, which emitted more than their emission limits and channel these fees to developing countries for emission reducing activities.

Following the detection of non-additional registered projects, the CDM regulator had implemented stricter and clearer guidance over time and had sanctioned auditors, the latter which led auditing firms to increasingly decline validation of projects, thus suggesting that the guidance was effective (Hypothesis II and IV). Regarding sustainable development, the literature review has shown that CDM projects often focused on low-sustainability projects, as these were more profitable, than high-sustainability projects (Hypothesis III). In contrast to other countries, China was able to avoid regulatory competition and a “race to the bottom” of sustainability criteria. China imposed a tax on low-sustainable industrial gas projects without the concern of losing funds (Hypothesis III). However, the presence of the tax revenue limited its willingness to directly regulate industrial gas emissions through command and control regulation. Such regulation could have been pursued at a much lower cost but would have eroded the income from taxes. This interaction between the CDM and domestic policy in developing countries is particularly concerning as industrial gas projects make up the largest share of emission reduction credits expected from the CDM.

Furthermore, the high revenue from the selling of project credits has been shown to create perverse incentives to increase production and thus increased global emissions from the industrial gas sector (Hypothesis I). Instead of fostering cooperation and evolution on domestic climate change policies, thus the CDM hindered these opportunities through the rent it created for involved countries. The chapter furthermore showed that an alternative fund-approach would potentially resolve the regulatory competition issue (Hypothesis III). It would enable developing countries to align incentives provided by international funds with domestic policy. This is true if funds were conditioned on long-term observable sustainable development policy or not at all dependent on national policy so as to avoid strategic behaviour. Environmental integrity (additionality) and cost-effectiveness however could be potentially at risk due to insufficiency or diversion of funds.

Chapter 4 examined the effectiveness of the benchmark test to prove additionality based on case studies in China and India. The analysis assessed whether benchmark rates have changed over time as a response to stricter guidance by the CDM regulator. The moral hazard problem predicted that project developers will choose high benchmark rates to render their projects unprofitable on a stand-alone basis (Hypothesis I). The analysis provided in this chapter came to mixed results. On one hand, consistent with rational choice theory, the analysis showed that the level of the benchmark chosen varied with the freedom to set benchmark rates. Project developers in India were free to set the benchmark rate and have used a variety of benchmark sources and levels. In comparison, China had used steady government rates. On the other hand, while benchmark rates have dropped in India following guidance from the CDM regulator, it cannot be concluded that the guidance by the CDM regulator was effective in reducing subjectivity, because these findings are based only on few data observations. The reduction in benchmark rates could also reflect learning and lower risk for the renewable technology involved over time so that lower profitability was required from these projects in general. To assess whether the benchmark test had become more objective over time, further analysis will have to analyse the simultaneous impact of risk factors and regulator guidance on benchmark rates. The findings in this chapter were consistent with previous research which has shown that project developers frequently chose internal company benchmark rates, which were generally higher and more difficult to assess in practice than sectoral rates.

However, even in the presence of lower benchmark rates, for instance through a benchmark imposed by the government, as was the case in China, the question remained whether there is not a strategic choice by the government to game the benchmark test, i.e. to misrepresent the financial profitability or projects through the choice of other parameters in the benchmark test (Hypothesis III). While this was not been examined in this chapter, some previous empirical research conducted suggested that this is the case, when the CDM regulator rejected Chinese wind projects suspecting that these projects were “made” additional by the Chinese government through the decrease in the feed-in-tariff for wind. Understanding the strategic interaction between international support and domestic policy is the basis for future policy design within and beyond the CDM. The findings of this chapter can serve as a starting point for such examination.

Chapter 5 examined how the European Union has implemented the limits on the use of certified emission reduction credits from CDM projects for compliance in the EU ETS. As the right to use CER conferred a value to its holder, emitters in countries with a generous CDM limit benefited from higher arbitrage rents. These rents arose through the profitable sale of previously freely allocated EUA (European Union Allowance - the currency of the EU ETS) with CERs (Hypothesis V). The higher CDM limits were the result of more stringent reduction targets in some EU Member States relative to others. The chapter quantified the rents created through this limit for the year 2008. The chapter showed that the current application of installation-specific limits within the EU was inefficient and gave potential rise to competitive distortions.

Three alternative mechanisms for distributing access to the CER limits and the underlying compliance cost reduction were discussed: free allocation, auctioning, and pre-commitment. This had implications for applying the limit within the EU. The EU can improve the current system by either shifting to auctioning CER usage certificates or pre-selling allowances in the amount equal to the CDM limit, and subsequently buying CERs (Hypothesis VI). The main advantages of these approaches were achieving the lowest compliance costs across the EU and decreasing the rents and arbitrage opportunities awarded to participants in the EU ETS. These options have transaction cost limitations as they require that either the regulator actively participates in the market or limits were allocated (freely or by auction), for subsequent trading. A change in the baseline for allocating the limits from the current status quo EUA allocation to one of verified emissions leads to an efficiency improvement and mitigated the distortive effects of EUA allocation, while at the same time providing potential lower incentives to increase emissions to profit from increased CER use.

Summarising, the Clean Development Mechanism is a useful example of the opportunities and challenges of using market instrument to support mitigation action in developing countries. The offsetting mechanism succeeded in creating some attention and engaging new public and private actors, and also delivered initial low-carbon projects. But the analysis also demonstrated that the mechanism inherently carries the risk of global emission increases. Furthermore, even in the presence of perfect information, the incremental emission reductions by the CDM are not sufficient to achieve the deep emission reductions consistent with reducing global emissions by 80% by the year 2050. Thus, solving the challenges and up-scaling the CDM cannot address the problem of decreasing global emissions beyond the Kyoto Protocol targets.

6.2 Limitations

The findings of this book are subject to several limitations which are outlined in the following:

The analysis in chapter 3 on the cost-effectiveness and sustainable development of projects is based on earlier CDM case-studies. For instance, abatement costs for different project types are extrapolated from a smaller sample to all projects registered by the year 2011. Abatement costs could have decreased in the meantime due to learning or have increased due to the move along the marginal abatement cost curve. This, however, does not alter the conclusion that rents between abatement costs and market price, could be used to leverage mitigation, and that the presence of these rents can hinder domestic policy. Similarly, the ranking applied to sustainable development benefits from different project types assumes that sustainability benefits announced during project documentation reflect actual benefits observable after implementation of the project (Appendix 1 of Chapter 3). This need not hold true in practice. Project developers can easily exaggerate sustainable development benefits when there is no penalty after implementation for “optimism” as the literature has shown. However, it was assumed that all project types overestimate benefits in project documentation, such that this is expected not to change the actual ranking of the sustainability of projects.

The benchmark analysis in chapter 4 focuses on the absolute benchmark rate without taking account of the underlying risk of the project. Only a few observations indicate that rates have declined following regulatory guidance. The findings of the chapter, thus call for further research to be able to draw any inference whether examined projects are additional or not, and whether the benchmark test incentivises strategic behaviour for host country governments.

The main limitation of the analysis on the use of CDM in the EU ETS is that the policy recommendations cover the limits awarded to EU ETS installations for a period which is already running. Changing the rules for these limits as suggested in the analysis would face substantial political barriers. However, the analysis is hoped to contribute to the effective implementation of future periods and the eventual phase-out of offsets, as a rights approach allows rights to be withdrawn from the market if necessary.

6.3 Outlook

The CDM is based on a top-down approach in a global climate change regime, i.e. setting targets globally and distributing them to individual emitters. This approach is gradually replaced by a bottom-up approach, where national, bilateral and regional cooperation play an increasingly stronger role (Buchner & Carraro, 2007). The CDM is an element of the top-down approach. Even if the CDM could be improved by addressing its weaknesses analysed in this book, the incremental changes offered by the CDM are not sufficient to reduce global emissions by 80-95% by the year 2050. Originally it was envisioned that the CDM is a transitory mechanism. Developing countries were expected, given experience with the CDM, to move to binding targets, which would enable a global emissions trading scheme. The global emissions trading vision did not materialise in practice, partly because the CDM provides incentives for developing countries to resist such a change to renounce CDM revenue, and because both industrialised developing countries did not accept binding emission reduction targets compatible with a decarbonisation by 2050.

New approaches need to be developed which go beyond offsetting and account for the massive efforts that are required to decarbonise the economy in the next forty years as well as address the shift in power structures between countries at the global level. The decarbonisation efforts include infrastructure investments in electricity grids to enable decentralised renewable energy deployment, renewable technologies, electricity storage facilities, and incentives for energy efficiency in industry and buildings. An institutional framework that encourages such investment by private actors will facilitate the process. This is true for both industrialised and developing countries. At the same time, national circumstances and challenges vary between countries. For instance, in Brazil and Indonesia forestry and agriculture sectors account for the largest portion of greenhouse emissions. These sectors are also an important source of food provision as well as for economic growth and are thus highly sensitive to change. The tasks thus vary from country to country due to the economic structure and deserve a closer look at the national circumstances rather than a one-size fits all global emissions trading scheme.

Furthermore, the Kyoto split between industrialised and developing countries is blurring. Increasingly, developing countries such as China, India, Brazil, Russia and South Africa play an increasingly important role both politically and economically. A large middle-class is emerging in these countries, whose consumption patterns and wants are influenced by examples from industrialised nations. At the same time, industrialised countries struggle beyond the emissions challenge with a budgetary and financial crisis. Resolving these crises at the same time in industrialised countries will take considerable economic and political effort and slowly balances the power between industrialised and emerging (also called newly industrialised) economies.

Thus, the challenges to develop a growth paradigm to achieve low-emissions growth vary to some degree with the national context. It is thus difficult to sketch a complete roadmap of what approach to take. However, some of the following building blocks will facilitate the transformation to a decarbonised economy in all countries[1]:

1) Evidence-based decision-making
2) Understanding of financial flows and their structure
3) Adaptive, iterative and collaborate learning
4) Political accountability at the national level

First and foremost, decisions taken on activities connected with decarbonisation are more stable and effective over time if they are based on evidence. Basing decisions on evidence is an over-arching theme that entails the aspects of finance, collaborative learning and accountability. Gathering evidence requires the availability of data and an analysis of this data to understand what did work in the past and what did not? The CDM data analysed in this book is a prime example. Due to the availability of data, the CDM regulator could change the framework and thereby improve performance of the system. This is even more important in the national context. An example is the German feed-in-tariff that provides an incentive to German households to install photovoltaic technology on the roof. Did this policy instrument work? The German government reports every four years to the German parliament on deployment rates, the cost evolution of the technology, and employment effects. Some of this data is collected on an annual basis (Hogan et al., 2012). This enables the German government to take decisions on this policy instrument on the basis of evidence and experience.

Second, most governments are interested in the financial burden that such a transformation to a low-carbon economy requires. Mapping the financial flows of previous and current decisions enables to understand which actors invested how much, and how these flows finally enable the building of energy infrastructure or the increase in energy efficiency. The experience with the CDM has shown that in order to achieve CDM status, private actors need to document precisely their investment decision process, financial flows and the identification of risks. Public regulators can do a similar mapping at a nationwide scale. Also at the national level most investments have both a public and a private component. The share of each of these components is dependent on the institutional framework as private actors compare the risk of any undertaking with the return they can earn. Understanding these components and their structure allows governments to better tailor the institutional framework to optimise the ratio between public and private money invested in low-carbon infrastructure and technology. An example of this is the connection risk from offshore wind

[1] These building blocks are similarly important for good policy in general, but are especially conductive to long-term transformative changes.

parks. Who is liable in the case of a connection loss? Answering these questions can help governments to speed up investments in renewable technologies. Law and economics is well-suited to help answer some of these questions.

Third, adaptive, iterative and collaborate learning requires that countries and regions try different approaches in a trial and error fashion for some policies. This enables learning and improvement based on evidence. The findings in this book show that the rules governing the CDM have been constantly improving over time based on evidence. The identification of weaknesses was however a collaborative effort between academics, civil society, the CDM regulator, and sometimes national governments and CDM consultants. This requires the open sharing of information through open consultation processes, which allow public actors to tailor low-carbon policies better to the realities of private actors. With the participation of civil society better results can be achieved to balance the information provision by industry. Trial and error entails the risk of "betting too much on the wrong horse." The Chinese government reduces this risk by trying out new policies in one province first before they are scaled up at the national level. Many regions around the world take a similar approach. Thus, sharing information of successful policies can be helpful for other countries to adapt the experience to their own situation. Law and economics research can help measure the performance of a particular policy, analyse the reasons, and make improvement suggestions. Furthermore, law and economics can help to translate the findings from a national country context to another.

Fourth, accountability allows public actors to measure their performance in achieving their goals. While some policy-makers will naturally shy away from direct performance measurement, it is an important yard stick to improve policy. The CDM experience has shown that auditing firms that do not conform to the rules are sanctioned. Indeed in the private sector in general performance measurement is often immediate. This poses a challenge in the public sector as a low-carbon transformation requires long-term decisions and as mentioned some trial and error, inevitably leading to sub-optimal performance at first. Public actors should have the freedom to take decisions on the basis of well-founded evidence and data, and take responsibility for the outcomes. The accountability system should enable improvement over time rather than induce sanctions or punishment, as optimal results are rarely achieved at the first trial.

These four criteria will play an important role in the national context as well as in bilateral interaction between countries. For instance, the Copenhagen Accord foresees a transfer from industrialised to developing countries of US$100 billion a year from the year 2020 onwards and "fast-start finance" of US$30 billion a year between 2010 and 2012. These funds are to be spent so as to align long-term climate, economic and social goals in emerging economies. The Green Climate Fund is currently under discussion at the UNFCCC and can channel the aforementioned funds into low-carbon activities. Spending by the Green Climate Fund should be based on evidence, experience with financial flows and structure, enable cross-country learning, and ensure accountability. One channel is the currently discussed concept of nationally appropriate mitigation actions. It is an umbrella term for potential projects being pursued unilaterally or with international support. These nationally appropriate mitigation actions are essentially plans by developing countries which are submitted for international support for instance directly to the Global Climate Fund. It is important to analyse what kind of cooperation between donor and implementing country governments is necessary and possible to design effective emission reduction activities (Upadhyaya, 2012). Such cooperation requires a better understanding of national circumstances in developing countries rather than a tick-box approach used in the CDM, as climate is a cross-cutting issue and countries' concerns over food and energy security, as well as poverty reduction come first. Making the ground rules of managing the nationally appropriate mitigation action process clear is where the future of mutual responsibility of industrialised and emerging economies for a shift towards a low carbon path lies. The four criteria of evidence, finance, collaborative learning and accountability facilitate this process.

The research findings of this book, based on law and economics analysis, contribute to the evolving knowledge that a large decarbonisation transformation needs to be based on long-term goals beyond short-term cost advantages and beyond offsetting. Future climate policy research should focus on the optimal design and interaction between public and private funds to leverage decarbonisation projects where long-term climate, social and economic goals are maximised. Taking such a holistic approach requires potentially the collaboration of law and economics scholars with other disciplines. The research stemming from such collaboration will inevitably allow an effective and socially-acceptable transformation of our economies and societies.

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ENGLISH SUMMARY

Climate change has been acknowledged as a threat to humanity. Most scholars agree that to avert dangerous climate change and to transform economies into low-carbon societies, deep global emission reductions are required by the year 2050. Under the framework of the Kyoto Protocol, the Clean Development Mechanism (CDM) is the only market-based instrument that encourages industrialised countries to pursue emission reductions in developing countries. The CDM aims to pay the incremental finance necessary to operationalize emission reduction projects which are otherwise not financially viable. According to the objectives of the Kyoto Protocol, the CDM should finance projects that are additional to those which would have happened anyway, contribute to sustainable development in the countries hosting the projects, and be cost-effective. To enable the identification of such projects, an institutional framework has been established by the Kyoto Protocol which lays out responsibilities for public and private actors. This thesis examines whether the CDM has achieved these objectives in practice and can thus be considered an effective tool to reduce emissions.

To complete this investigation, the book applies a rational choice approach and analyses the CDM from two perspectives. The first perspective is the supply-dimension which answers the question of how, in practice, the CDM system identified additional, cost-effective, sustainable projects and, generated emission reductions. The main contribution of this book is the second perspective, the compliance-dimension, which answers the question of whether industrialised countries effectively used the CDM for compliance with their Kyoto targets. The application of the CDM in the European Union Emissions Trading Scheme (EU ETS) is used as a case-study. Where the analysis identifies inefficiencies within the supply or the compliance dimension, potential improvements of the legal framework are proposed and discussed.

The book finds that the CDM has not achieved its goals of additionality, sustainable development nor cost-effectiveness. In some cases the CDM incentivises governments such as the Chinese government, to forgo the implementation of national low-carbon policies in specific sectors so as to maintain financial support provided through the CDM. These adverse interactions reduce the global effort to reduce emissions. To overcome the pitfalls of the current CDM approach, a fund-approach, is discussed which would collect penalty fees from industrialised countries, which emitted more than their emission limits and channel these fees to developing countries for emission reducing activities. The fund-approach results in developing countries being free to determine their long-term abatement strategy and thus potentially strengthening national domestic climate and energy policy. While this could remedy some of the difficulties of the CDM such as the absence of sustainable

development, it potentially creates trade-offs with project cost-effectiveness in the short-term.

The CDM has also not been implemented efficiently at the compliance-stage within the EU ETS. The right to use CDM has been allocated to participants of the EU ETS free of charge and has led to large wind-fall rent gains to these emitters. The book outlines different options to correct for this inefficiency and collect these rents to leverage for further mitigation in Europe or developing countries. In light of these findings, the book concludes by discussing emerging alternative approaches and future research required to support the restructuring of our economies to become low-carbon societies in the coming decades.

NEDERLANDSE SAMENVATTING

Klimaatverandering wordt algemeen erkend als een bedreiging voor de mensheid. De meeste wetenschappers zijn het erover eens dat grote emissiereducties moeten zijn gerealiseerd in het jaar 2050 en dat de economie koolstofarm moet zijn zodat een gevaarlijke klimaatverandering kan worden voorkomen. Het mechanisme voor schone ontwikkeling (Clean Development Mechanisme, CMD), ingevoerd door het Kyoto Protocol, is het enige marktinstrument waarmee geïndustrialiseerde landen worden aangemoedigd om in ontwikkelingslanden emissiereducties te bewerkstellingen. Het doel van de CMD is het financieren van de oplopende kosten die worden gemaakt voor uitstootbeperkende projecten die anders financieel niet haalbaar zouden zijn. Volgens de doelen van het Kyoto protocol moeten met CMD projecten worden gefinancierd die een aanvulling zijn op de projecten die toch al zouden zijn uitgevoerd en waarmee een bijdrage wordt geleverd aan duurzame ontwikkeling van rendabele projecten in de landen waar de projecten worden uitgevoerd. Het Kyoto protocol heeft een institutioneel kader in het leven geroepen voor dergelijke projecten waarin de verantwoordelijkheden van publieke en private partijen zijn neergelegd. Dit proefschrift onderzoekt of deze doeleinden met CMD worden bereikt, met andere woorden of CMD een effectief middel is om de uitstoot te verminderen.

Om dit onderzoek compleet te maken, wordt in dit boek een rationele keuzebenadering gevolgd en wordt CMD geanalyseerd vanuit twee perspectieven. Het eerste perspectief is de vraagdimensie die erop gericht is om te zien hoe met CMD aanvullende, rendabele en duurzame projecten kunnen worden gevonden die de emissie beperken. De belangrijkste bijdrage van dit boek is echter het tweede perspectief, de nakomingdimensie, waarmee de vraag wordt beantwoord of geïndustrialiseerde landen CMD daadwerkelijk hebben gebruikt om aan hun Kyoto doelen te voldoen. Als case study voor de CMD is gekozen voor het Europese emissiehandelssysteem (European Union Emissions Trading Scheme, EU ETS). Het doel van de analyse is het aangeven waar de vraagdimensie en de nakomingdimensie tekort schieten en hoe het juridische kader mogelijkerwijs kan worden verbeterd.

De conclusie is dat met CMD de doelen van additionaliteit, duurzame ontwikkeling en rendabiliteit niet worden gehaald. In sommige gevallen, zoals in China, zorgt CMD ervoor dat de overheid geen landelijk beleid voert om emissies in bepaalde sectoren tegen te gaan teneinde de financiële voordelen van de CMD te behouden. Deze acties hebben een tegengesteld en nadelig effect op de wereldwijde pogingen om emissies tegen te gaan. Om de nadelen van de huidige CMD benadering tegen te gaan, wordt aangegeven hoe heffingen kunnen worden geïnd van geïndustrialiseerde landen die meer uitstoot hebben geproduceerd dan is toegestaan. Deze heffingen moeten ten goede komen aan de ontwikkelingslanden voor maatregelen om de uitstoot te beperken. De fondsbenadering geeft ontwikkelingslanden de vrijheid om hun langetermijn strategie voor de vermindering van uitstoot te bepalen, waarmee het nationale klimaat- en energiebeleid kan worden versterkt. Met deze benadering kunnen sommige problemen van de CMD, zoals de afwezigheid van de duurzame ontwikkeling, worden opgelost en op korte termijn kan de rendabiliteit van de projecten mogelijkerwijs worden verbeterd.

De CMD is evenmin op efficiënte wijze ingevoerd in de EU ETS. Het recht om CMD in te zetten is kosteloos voor deelnemers van de EU ETS en heeft geleid tot grote financiële meevallers voor de uitstootveroorzakers. In dit boek worden de verschillende opties besproken om deze inefficiëntie tegen te gaan, zodat deze opbrengsten ten goede kunnen komen aan het beperken van de uitstoot in Europa en ontwikkelingslanden. In het licht van deze conclusies wordt het boek afgesloten met een bespreking van de alternatieven en onderzoek dat verder nodig is om onze economieën de komende decennia om te vormen in een koolstofarme maatschappij.