Clean Development Through Cogeneration

Combined Heat and Power Projects in the Clean Development Mechanism

WADE

WORLD ALLIANCE FOR DECENTRALIZED ENERGY

www.localpower.org

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About WADE

WADE is a non-profit research and advocacy organization that was established in June 2002 to accelerate the worldwide deployment of decentralized energy (DE) systems. WADE is now backed by national cogeneration and DE organizations, DE companies and providers, as well as a range of national governments. In total, WADE's direct and indirect membership support includes over 200 organizations around the world.

WADE believes that the wider use of DE is a key solution to bringing about the cost-effective modernization and development of the world's electricity systems. WADE's goal is to increase the overall proportion of DE in the world's electricity generation mix. To work towards its goal WADE undertakes a growing range of research and other actions on behalf of its supporters and members:

- WADE carries out promotional activities and research to document all aspects of DE, including policy, regulatory, economic and environmental aspects in key countries and regions.
- WADE works to extend the international network of national DE and cogeneration organizations. Current WADE network members represent Australia, Brazil, Canada, China, Europe, India and the US. We are continually working to extend this network.
- WADE provides a forum for DE companies and organizations to convene and communicate.
- WADE jointly produces an industry journal: "Cogeneration and On-Site Power" (published by Pennwell in association with WADE).

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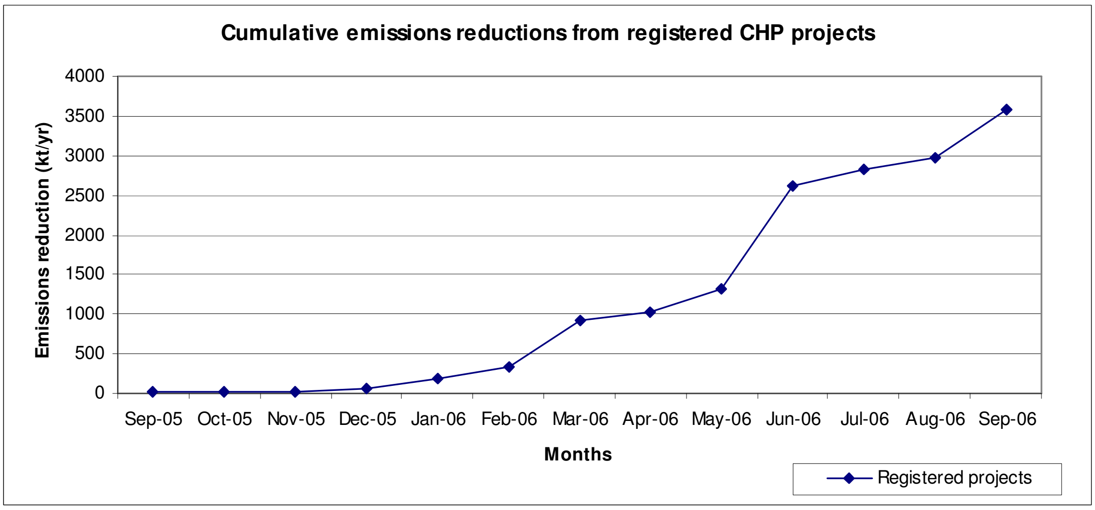
Executive Summary

Combined Heat and Power (CHP) applications provide cost-effective opportunities for reducing greenhouse gas (GHG) emissions in developing countries. This makes them highly suitable for Clean Development Mechanism (CDM) projects.

TRENDS IN REGISTRATION OF CHP PROJECTS IN THE CDM

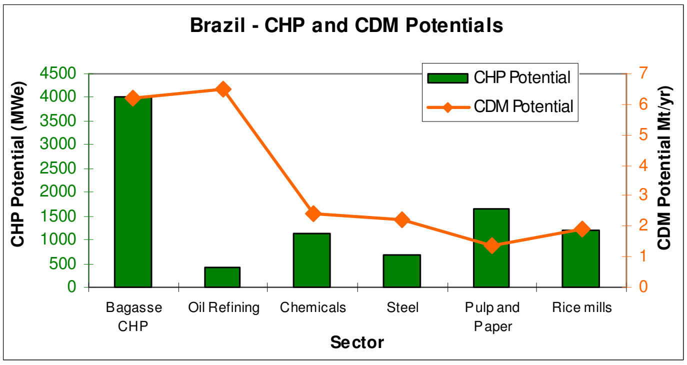


On 30 September 2006, 66 out of 326 registered CDM projects involved cogeneration (20%). Emission reductions from these reached over 3.5 Mt/yr, rising steadily. The average size of cogeneration projects is 54,000 t/yr. Most cogeneration CDM projects are in food-manufacturing and large industry in India and Brazil, but more industrial sectors and countries are becoming involved.

Brazil

In Brazil the CDM has been supported strongly by the government, and 26 cogeneration projects were registered by 30 September 2006, mostly bagasse-CHP. Many opportunities for projects in the sugar sector still exist, but potentials for CHP applications in oil-refineries and industry are also considerable.

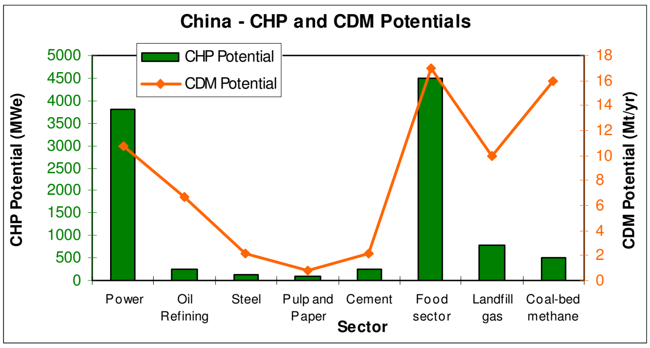
CDM potential in Brazil



China

China has been slow in implementing the CDM, and only one CHP project was registered on 30 September 2006. Industry and power generation are the main sectors for CHP in the CDM, with further opportunities in biomass-fired CHP. However, the strong centralised set-up and lack of clarity about China's CDM procedures are barriers to achieving this potential.

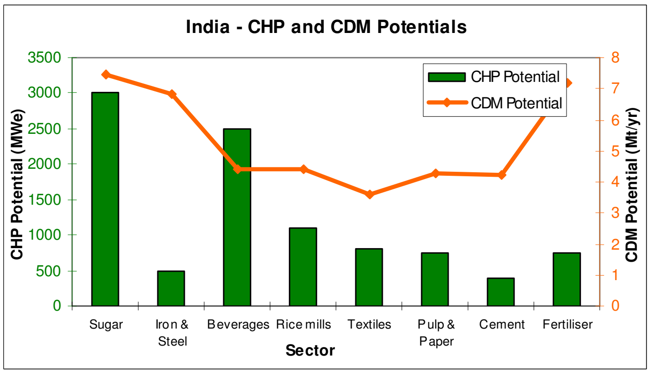
CDM potential in China



India

India represents over one-third of CHP projects in the CDM. Initially most applications were bagasse-CHP, but industrial waste-heat cogeneration is becoming more significant. Sugar manufacturing is likely to remain important for CDM cogeneration projects, but in the long term the larger potential is in major industries, including steel, fertilisers and cement.

CDM potential in India



Present Status

The present status of CHP projects in the CDM show their suitability, but the CDM is still at an early stage, so several opportunities have not been realised yet, and certain unresolved issues remain. Neglected opportunities for CHP projects include applications in buildings; emission reductions from avoided network losses; and cogeneration replacing combined cycle power plants. The main outstanding issues are the creation of additional emission quota through the CDM; the difficulty of proving additionality of the CDM project; uncertainties about post-Kyoto arrangements; and risks associated with carbon market developments.

Potential

The overall potential for the CDM is large, though, and cogeneration can play a major part in its future development. Consequently there has been much interest in participating in the CDM from project developers, equipment manufacturers, governments, investors and brokers. However, many of these players do not have the time or expertise to analyse the rules and procedures of the CDM, and assess how they can benefit from the CDM.

This report aims to provide a practical guide for developing CHP projects in the CDM. It explains the specific procedures considerations for cogeneration projects, describes their current status, and assesses their future potential. Country profiles for Brazil, China and India give country-specific information and projections for these important CDM markets.

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1. Introduction

Cogeneration is a cost-effective way of reducing CO_2 emissions from power generation. The combined use of the heat and power outputs of the generation process increases its efficiency, and thereby reduces the fuel input and emission output. As a decentralised energy (DE) technology, cogeneration also reduces transmission and distribution (T&D) losses. Cogeneration is a flexible technology, which can use various fuels, and be adapted to local circumstances. The possibility of using biomass fuels or agricultural residues makes Combined Heat and Power (CHP) particularly effective in reducing CO_2 emissions. Cogeneration technologies are well established, and therefore reliable and competitive in most markets. Cogeneration is therefore a prime candidate technology for carbon emission reduction projects.

The Clean Development Mechanism (CDM) is part of the Kyoto Protocol for reducing global greenhouse gas (GHG) emissions to mitigate anthropogenic Climate Change. Opportunities for emission reduction are generally large in developing countries, so that these can be met at lower costs than in developed countries. The CDM recognises this, and provides an opportunity for developed countries (Annex I) to meet part of their GHG emission target through projects in developing countries (non-Annex I). This benefits Annex I countries by reducing the cost required to meet their emission target, and benefits non-Annex I countries by facilitating investment and technology transfer and sustainable development. Overall, this approach aims to ensure that GHG emission targets are met quickly and cost-effectively.

CHP technologies are well suited for CDM projects, because they are generally economically attractive and technologically mature and reliable, so that they contribute directly to CDM's aim of reducing GHG emissions cost-effectively. Furthermore, they are flexible and can be adapted to local circumstances. In developing countries cogeneration can easily be integrated in many industries, including food-processing, taking advantage of the biomass residues of the production process. This has the dual benefits of lowering fuel costs and solving a waste issue. Cogeneration projects address both energy supply-side and demand-side, and therefore have a wider impact than most CDM technologies. Furthermore, they provide a long-term solution, as the resulting CO_2 savings are reliable and predictable over the project's lifetime, unlike some other project types.

This report discusses the implementation of CHP projects within the CDM. It aims to provide a practical guide for CDM project participants, outlining the CDM's organisational structure (Chapter 2), and describes the project cycle for cogeneration projects (Chapter 3). Last, it will outline the present status of CHP in the CDM and country-specific information for Brazil, China and India (Chapter 4).

2. The Clean Development Mechanism

2.1 Introduction

The Clean Development Mechanism (CDM) is part of the Kyoto Protocol, adopted in 1997 at the 3rd Conference of the Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC). The CDM itself was decided on at the 7th COP in Marrakech in 2001, as outlined in the Marrakech Accords. The Kyoto Protocol aims to stabilise GHG concentrations in the atmosphere to a level that would prevent dangerous anthropogenic interference with the climate system. The target for the first commitment period (2008-2012) is to reduce global GHG emissions to 5% below 1990 levels. Reduction targets differ between parties to the conference, reflecting their 'common but differentiated responsibilities', so that Annex I countries will reduce their emissions, while no such commitments exist yet for non-Annex I countries.

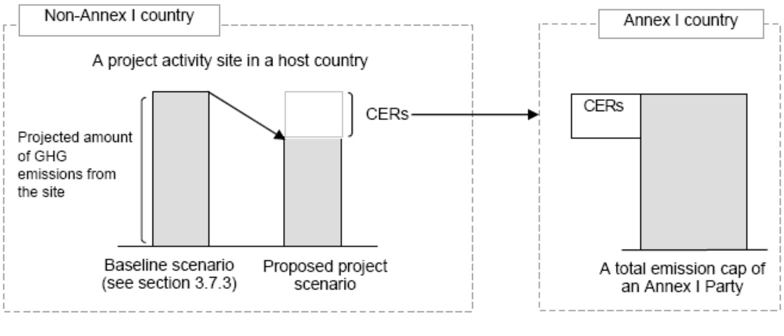
The CDM, together with Joint Implementation and International Emissions Trading, is one of the three market mechanisms that enables Annex I countries to meet their targets in the most cost-effective way[1]. The CDM procedures were approved and adopted during the 11th COP in Montreal in 2005. Through the CDM, Annex I parties help implementing GHG emission reduction projects in non-Annex I countries, for which they will obtain emission reduction credits. These credits, Certified Emissions Reduction (CER) can then be used to contribute to meeting the Annex I country's target. Annex II countries also benefit through the investment and technology transfer that are part of the project implementation.

This chapter will give an overview of the working of the CDM. First, it describes the general principles, the project types included, and how emission reductions are measured and verified (Section 2.2). Then it will explain the organisational structure of the CDM (Section 2.3), and discuss the carbon market (Section 2.4) economics of the CDM (Section 2.5).

2.2 General Principles of the Clean Development Mechanism

PRINCIPLES

FIGURE 1
GENERAL CONCEPT OF THE CDM



INSTITUTE FOR GLOBAL ENVIRONMENTAL STRATEGIES, CDM IN CHARTS, 2006

1 The Kyoto Mechanisms are Emission Trading, the Clean Development Mechanism and Joint Implementation.

The Clean Development Mechanism (CDM) allows Annex I countries of the Kyoto Protocol to meet part of their GHG emission reduction target through projects in non-Annex I countries. By funding and implementing projects, the Annex I country reduces GHG emissions in the non-Annex I country. The emissions saving, expressed in Certified Emission Reduction (CER) credits, will be added to the total emission cap of the Annex I country, helping it to meets its target (figure 1). In effect, this increases the total Annex I emission allowance, because non-Annex I countries do not have emissions reduction targets.

The CDM is based on three global principles:

1. Participation of the project partners is voluntary.
2. The project results in real, measurable and long term benefits related to the mitigation of climate change.
3. The reduction of emissions through the CDM project must be additional to reductions that would occur without the CDM project (*Additionality principle*).

The implication of principle 2 is that the emission reductions that can reasonable be attributed to the project activity must be directly quantifiable, and long-term. The Additionality principle implies that the project would not be implemented in absence of CDM revenue, because of economic or other barriers, and contributes to a net reduction in emissions from a concrete baseline scenario, in which the project would not happen.

PROJECT TYPES

TABLE 1
TYPES OF CDM PROJECTS

Type I. Renewable Energy Projects
♦ I-A. Electricity generation by the user
♦ I-B. Mechanical energy for the user
♦ I-C. Thermal energy for the user
♦ I-D. Renewable electricity generation for a grid
Type II. Energy Efficiency Improvement Projects
♦ Supply side, Demand side and Fuel switching
Type III. Other Projects
♦ Methane recovery, Transport, Agriculture and Land use

Any project reducing GHG emissions is eligible for the CDM, but they are classified in four categories (table 1). Cogeneration projects are normally classified as Type I, category A, C or D, depending on the main energy output of the project. However, in specific cases cogeneration can be considered as part of Type II or Type III projects too. For example, an industrial waste-heat recovery and power generation project (bottom-cycle CHP) could include replacing boilers by CHP generators, and therefore be Type II. Cogeneration projects can be combined with fuel switching, for instance from oil to bagasse in a sugar mill. As for Type III projects, methane recovered from a landfill can be used as fuel for CHP generation.

SMALL-SCALE CDM PROJECTS (SCC)

Small-scale CDM projects are a special category, for which the registration, validation and verification procedures have been simplified to reduce the procedural cost relative to the project costs. For instance, a number of SCCs can be bundled in a single application, and SCCs have special simplified baseline and monitoring methodologies. A project qualifies as a

SCC project if the energy output or energy efficiency gain is smaller than 15MW. For example, a microturbine application using biogas from agricultural waste, with an installed capacity of 2 MWe would qualify as a SCC.

2.3 Organisational Structure of the Clean Development Mechanism

CDM PROJECT PARTICIPANTS

Various participants are involved in the development of CDM projects (table 2).

TABLE 2
PARTIES INVOLVED IN THE CDM

Global	National	Project
♦ Conference of the Parties (COP ♦ CDM Executive Board (EB)	♦ Designated National Authority (DNA)	♦ Annex I Party ♦ Non-Annex I Party ♦ Investors (CER buyers)
Designated Operational Entity (DOE)		

The parties involved in the CDM have different motives for participating in CDM projects:

- Annex I countries: cost-effective way of meeting their emission reduction commitment
- Non-Annex I countries: local sustainable development and climate change mitigation.
- Host-country participants: CER revenues
- Annex I participants: business opportunities and a corporate social responsibility strategy.
- Investors: investment opportunities in sustainable energy projects
- Institutional investors: investment opportunities, portfolio diversification and socially responsible investments[2].
- Equipment manufacturers: indirect benefits from news market for renewable energy and energy efficiency equipment, application of emerging technologies, and opportunities for developing special CDM packages.

CDM EXECUTIVE BOARD (CDM-EB)

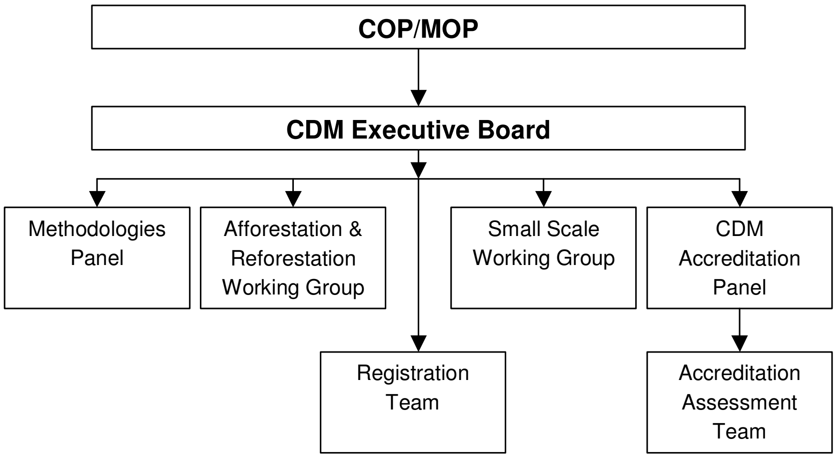
At a global level, the COP has the overall authority over the CDM, but the CDM Executive Board (EB) carries out its actual operation. The EB is responsible for the accreditation of Designated Operational Entities (DOE) and methodologies, keeps a project registry, publishes technical reports, and issues CERs. These tasks are delegated to two Panels and two Working Groups, which set procedures and offer guidance in their field of expertise. The Accreditation Panel, responsible for accrediting methodologies, is assisted by the Accreditation Team. A separate Registration Team of the EB processes the applications for

[2] Getulio Vargas, The Clean Development Mechanism – A Brazilian Implementation Guide, 2002.

project registration (figure 2).

FIGURE 2

INSTITUTIONAL STRUCTURE OF THE CDM



INSTITUTE GLOBAL ENVIRONMENTAL STRATEGIES, CDM IN CHARTS, 2006

DESIGNATED OPERATIONAL ENTITIES (DOE)

The CDM EB has the authority to accredit Designated Operational Entities (DOEs). These are independent organisations that validate CDM project proposals before they are submitted to the EB, and verify the emission reductions achieved by the project, before CERs are issued. This facilitates the EB's work, and streamlines CDM procedures. Sixteen DOEs were accredited at the end of September 2006, but the methodologies that each is allowed to validate and verify differ. A list of accredited DOEs can be found on the UNFCCC CDM website[3].

DESIGNATED NATIONAL AUTHORITY (DNA)

At a national level, the Designated National Authority is responsible for implementing the CDM. DNAs are generally set up by the government, and supervised by a ministry of natural resources or environment. Non-Annex I DNAs specify the exact procedures for CDM project activities in the country, and create the local organisational structure for the CDM. DNAs report back to the CDM EB. Non-Annex I DNAs have to approve a project before it can apply for registration at the EB, and both the Annex I and non-Annex I DNAs have to give approval before credits can be issued. A list of DNAs can be found on the UNFCCC CDM website[4].

CDM projects are proposed and developed by the local and Annex I project participants, often the site-owner or specialised energy project developers. DNAs can be directly involved in project development, but generally they authorise private or public entities to operate for them. These entities are responsible for the actual implementation of the project. Apart from these participants, multilateral funds or other investors can participate to provide funding, and one or more DOEs are involved in validating and verifying the project.

3 http://cdm.unfccc.int/
4 http://cdm.unfccc.int/

2.4 The Carbon Market

WHAT IS THE CARBON MARKET?

The carbon market, which was established as part of the Kyoto Protocol, is the business of buying and selling greenhouse gas emissions. The main trading unit is one metric tonne of carbon dioxide equivalent (t CO2e). Two commodities are traded in this market:

- Emissions allowances: allowances to emit GHG allocated to companies by national governments of Annex I countries. Companies that emit less than their allowances can sell these to companies emitting more than their allocation, or to trading companies. In the European Union Emission Trading Scheme (EU ETS) the allowances are called EU Allowances (EUAs).
- Project-based emissions reductions: emission reduction generated by project activities, which are certified by an independent auditor. Certificates are called Certified Emission Reductions (CERs) or Emission Reduction Units (ERUs), depending on the origin. CDM projects generated CERs.

The carbon market covers the three Kyoto Mechanisms: the CDM, for emission reduction projects in non-Annex I countries; Joint Implementation, for emission reduction projects in Annex I countries for which the emission reductions are credited to another country than the host country; and International Emission Trading, for direct trading of emission allowances between Annex I countries.

SIZE OF THE CARBON MARKET

The carbon market is growing at an extraordinary pace. In 2005, about 800 Mt CO_2 eq. was transacted with a value of € 9.4 billion (INR 527 billion) according to Point Carbon (Carbon 2006). This is an eight-fold increase in volume and 25 times more financial value than the previous year. The CDM represented 400 Mt CO_2 eq., with a total value of €1.9 billion.

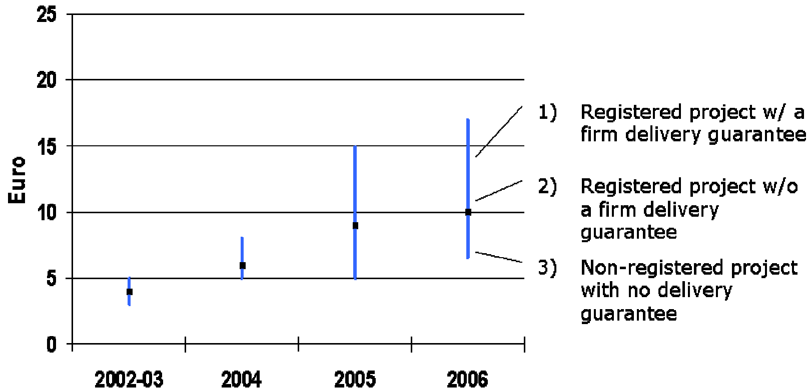
This rapid growth can be explained by accelerating government efforts to implement the Kyoto Protocol and the start of the European Union Emissions Trading Scheme (EU ETS) in particular. The EU ETS limits the emissions of 10,000 large-scale emitters in the 25 EU Member States to 2.2 billion t CO_2 eq., allowing reduce emissions internally, or trade allowances with other emitters to meet their quota. Emitters may also purchase CERs / ERUs from CDM / JI under certain conditions.

Several European financial institutions have set up procurement vehicles designed to purchase CERs / ERUs directly from project developers and sell them to emitters under the EU ETS. Similar vehicles have been set up in Japan. In addition to private sector funds, publicly funded government-led procurement programmes have been set up throughout Europe and in Japan to purchase CERs from project developers in order to support national level compliance efforts under the Protocol. Over €3 billion in total has been raised in private and public funds in Europe and Japan to purchase CERs at the time of writing.

PRICES FOR CERS

Point Carbon, a news provider for the carbon market, estimated that the volume weighted average price for the 400 million CERs transacted in 2005 was € 7 / t CO2e. This is a marked increase from 2004 and 2003, when CERs traded for around €4-5 / t CO_2e, as shown in Figure 3, and is driven by increased demand from Europe and Japan.

FIGURE 3:
HISTORICAL CER PRICES



POINT CARBON, 2006.

The range of CER prices reflects differences in the delivery. CERs that are available for immediate delivery are priced in the range of €12-€15, whereas for future delivery are discounted about €10-12. There are also price differences between countries. Generally, sellers in China and other countries are willing to accept lower prices than those in India.

2.5 Economics of the Clean Development Mechanism

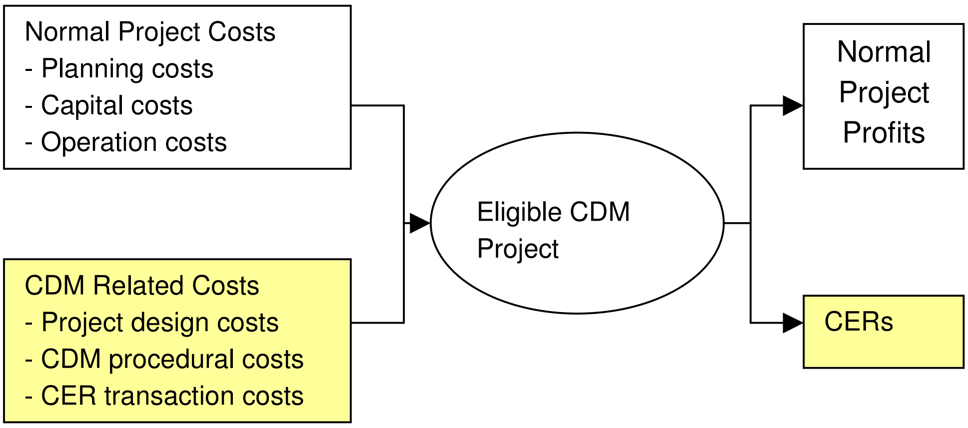
GENERAL ECONOMICS OF CDM PROJECTS

In many respects the economics of CDM projects are the same as that of other energy projects. Project planning, implementation and operation costs are similar, as are normal project profits. However, CDM projects incur a range of additional costs associated with the documentation, application, registration and transaction procedures of the CDM (figure 4). CDM projects also differ from ordinary projects because of the additionality requirement, which states that the project would not be economically attractive in absence of the CDM. The value added to the project by the CDM (i.e. the CER value) aims to bridge this gap, but the additional risk involved still poses barriers for obtaining funding for CDM projects.

CDM RELATED COSTS

The CDM procedures add to the overall project costs in several ways. At the preparation phase there are the costs for preparing a Project Design Document (PDD) and other documentation, requiring research and administrative work. Validation, verification and certification by a DOE entail certain costs, and the CDM EB also requires a registration fee for CDM projects. Furthermore, the purchase agreement for the CERs needs to be arranged, with associated legal and contractual costs. During project operation the monitoring requirement of the CDM adds to operational costs. The broker for the sale of CERs generally also incurs a success fee of 5-10% of the total value. Finally, the CDM EB, and possibly the host DNA, takes a share of the proceeds of CDM projects. Table 3 summarises these costs and their estimated values. Generally these costs constitute around 12% of total project costs

FIGURE 4 :
COSTS AND OUTPUTS OF A CDM PROJECT



WADE, 2006

for small projects, and 3% for large projects[5]. Project participants normally incur these costs, but the distribution of the costs over the various partners depends on the arrangements made between them.

TABLE 3:
COSTS RELATED TO THE CDM REQUIREMENTS

CDM Project Cycle	Carbon Transaction Consultant's Estimate of Costs (US$)
Up-Front Costs:	
1. Feasibility Assessment	5,000 – 20,000
2. Preparation of the PDD	25,000 – 40,000
3. Registration	10,000
4. Validation	10,000 – 15,000
5. Legal Work	20,000 – 25,000
Total Up-Front Costs	70,000 – 110,000
Operational Phase Costs	
1. Sale of CERs	Success fee of 5 – 10% of CER value
2. Risk Mitigation	1 – 3% of CER value annually
3. Monitoring and Verification	3,000 – 15,000 per year

ECOSECURITIES, 2003; QUOTED IN UNEP ENERGY AND ENVIRONMENT GROUP, THE CDM – A USER'S GUIDE, 2003.

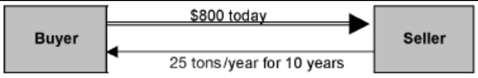
FINANCING STRUCTURES FOR CDM PROJECTS

Different transaction structures for the sale of CERs from CDM projects are possible, depending on the type of project and project participants. The relationship between the CER seller and CER purchaser is vital in this. CER purchasers are generally large multinationals with extensive experience in project financing, while CER sellers are often small local industries or community groups, with little financial expertise. It is therefore essential to create a reliable and fair legal agreement between the two. Figure 5 outlines popular financing mechanisms, using some price examples.

5 UNEP Energy and Environment Group, The CDM – A User's Guide, 2003

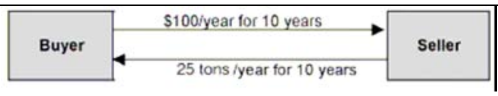
FIGURE 5:
POSSIBLE TRANSACTION STRUCTURES FOR CDM PROJECT INCLUDE

♦ Upfront payment for future stream of CERs



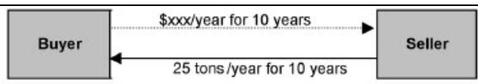
Upfront payment is attractive for small developers, generally lacking funds to carry the investment. This clearly establishes additionality, directly removing a barrier to the project. Purchasers often require a share of equity for upfront payment to mitigate the risks.

♦ Forward contract for delivery of CERs at fixed prices



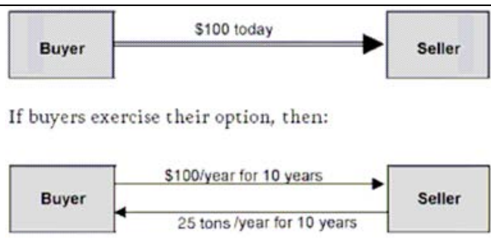
In this common structure the seller agrees to deliver a fixed number of CERs at the end of the contract, which the purchaser will buy on delivery at an agreed price. It reduces risks for both parties, but is complicated if the contract period is not the same as the CDM crediting period.

♦ Forward contract for delivery of CERs at floating prices



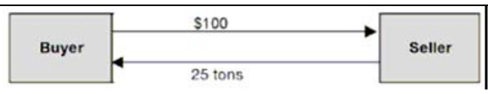
This structure is similar to the previous, but the price paid on delivery of the CERs is based on a market index, rather than advance agreement. This is attractive for sellers who expect carbon prices to rise, but most buyers prefer fixed-price contracts.

♦ Option payment for future delivery of CERs



For maximal flexibility buyers may prefer to buy an option on CERs purchases in the future. This requires an up-front payment for the option, and a purchase of CERs at a fixed price if the option is taken. Sellers may be left unable to sell their CERs, though, increasing risks.

♦ Future spot market trades



Sellers may choose to sell their CERs on the open market in a one-off transaction without previous commitments. This gives both buyers and sellers much flexibility, but sellers risk not being able to find purchasers for their CERs.

UNEP ENERGY AND ENVIRONMENT GROUP, THE CDM – A USER'S GUIDE, 2003.

CDM PROJECT RISKS

Investors will always evaluate a project in terms of its economic viability and risks. For normal projects this is the viability and risks of the project itself, but for CDM projects viability assessment must account for the CER value and associated risks too. CDM-related risks are:

- Registration risk
- Performance risk
- Counter-party risk
- Market risk

Registration Risk

Registration risk refers to the likelihood that the project will not be validated by a DOE and registered by the CDM EB. There can be several reasons for this to happen:

- Non-approval of a new baseline methodology

- Unsuccessful validation of methodology of calculating emission reductions
- Non-approval by the host country
- Request for review at registration by CDM-EB
- Request for review at CER issuance by CDM-EB

These risks are directly related to the CDM project cycle, and will therefore be highlighted when this is discussed in detail below.

Performance Risk

In addition to registration risk, CDM projects pose risks similar to those faced by conventional projects, representing technological and financial uncertainties. All of these risks will in turn influence whether the project will produce the volume of emissions reductions that are estimated in the PDD. Typical risks include:

- Delays in Commissioning: Will the project start as planned?
- Unreliability of Fuel Resource Supply: Will sufficient fuel be available at affordable price for the project throughout its lifetime?
- Breakdown in Technology: Will the technology remain reliable throughout the project lifetime?
- Unreliable Financial Flows: Will the project face problems through unreliable cash-flows?

For cogeneration projects technological risks are smaller than for other project types, as CHP is a mature technology. CHP projects using biomass residues generally also have low fuel-supply risks.

Counter-party Risk

The CERs from projects are generally transacted through forward contracts in which the Buyer agrees to pay the Seller for delivery of a specific volume of CERs on a specific date at a price negotiated at the time of initial contract. Because contracts are private agreements between two parties there is always a risk that a party may default on its side of the agreement. Some of the issues relating to the likelihood of default are:

- Insolvency: Will the project proponent remain financially solvent for the duration of the contract?
- Fraud / Wilful misconduct: Will the Buyer and the Seller follow through on the contract?
- Political and Regulatory Instability: Will changes in the political situation in the host-country affect the CDM project performance?

For CDM projects the risk of wilful misconduct can be higher than for other projects, because of the potential of dissatisfaction with the price negotiated in the forward contract. On the sell-side the project developer commits to deliver the CERs at a pre-negotiated price but if market changes, and CER price goes up significantly in relation to the price in the contract, the Seller has a strong incentive to default on the contract at the time of delivery and transact in the open market. The same is true from the Buyer’s perspective in the event that CER prices drop below the price negotiated in the contract.

Political risk of the host-country is similar to non-CDM projects, but it is further complicated by the issue of legal status and rights of ownership of the CERs. As a general rule the CERs arise from activities within a project, it is assumed that they belong to the owner of the project in the absence of an agreement to the contrary. The owner of the project therefore has the right to the CERs and the right to transfer them as an exercise of the right of ownership. However, arrangements differ between host countries.

From the buying countries' perspective there is a risk that CERs will not be fully convertible, with other compliance units. This issue is relevant within the EU ETS which allows regulated emitters to purchase CERs and use them for compliance only under certain conditions. The EU has stipulated, for instance, that hydro-electric projects above 20MW must meet certain environmental and social criteria before the CERs from such projects can be used for compliance purposes.

Even more importantly, some Member Statues have proposed placing an upper limit on the amount of CERs that can be used by regulated emitters for compliance in the EU ETS. If such limits were put in place, the attractiveness of CERs would be reduced and a Buyer may be tempted to default on its contract or renegotiate a lower price with the Seller since CERs are no longer equivalent with EUAs.

Market Risk
In addition to the uncertainty in financial flows faced by conventional project developers, CDM projects face an additional risk associated with the income they will receive from the sales of CERs, based on carbon market developments.

CER prices are determined by the supply and demand in the market for emissions reductions. Since market conditions change, prices fluctuate and as a result project developers are not certain of the additional income they will earn from CER sales. This can endanger the viability of CDM projects, if they rely heavily on the CER revenue.

3. CDM Project Cycle for Combined Heat and Power Projects

3.1 Introduction

CHP technologies can deliver GHG reductions from energy generation, and are therefore eligible for the CDM. Cogeneration projects are attractive, because in many developing countries their potential is large. However, the procedures and requirements for planning, developing and implementing cogeneration projects in the CDM can be complicated and cumbersome, particularly for non-experts. It is therefore important that the procedures are clear and that information about these is easily available for project developers.

The CDM project cycle is similar for all project types, and much information is available on the standard procedures, both from the UNFCCC and from research organisations. Every project type and technology has its own particularities, though. It is therefore important to analyse these in detail, and provide technology specific information for project developers. In particularly, applicable baseline methodologies, accredited DOEs and monitoring requirements for specific topic types are invaluable. This chapter discusses the issues relevant to cogeneration systems.

This chapter will first describe the general CDM project cycle (Section 3.2), and then address specific issues and questions for developing CHP projects and drafting a PDD, including baselines and additionality assessment (Section 3.3).

3.2 The CDM project cycle

Figure 6 outlines the CDM project cycle, showing the seven stages, and the participants involved and documents produced at each stage.

FIGURE 6
The CDM project Cycle

Project Stage	Party	Output	
1. Screening and Planning CDM Project	PP		Measurable emissions savings & additionality
2. Preparing the Project Design Document (PDD)	PP	Project Design Document	Baseline & monitoring methodologies
3. National Approval of Involved Parties	DNA PP	Letter of Approval	Host-country approval
4. Validation and Registration	DOE 1 CDM-EB	Validation Report	Validation of proposed methodologies
5. CDM Project Activity and Monitoring	PP	Monitoring Report	Monitor emissions from the project
6. Verification and Certification	DOE 2	Verification and Certification Reports	Verify emissions reductions
7. Issuance of CERs	CDM-EB	CERs	

WADE, 2006; BASED ON IGES, CDM IN CHARTS, 2006; AND DTI, A CLIMATE CHANGE PROJECTS OFFICE GUIDE, 2004

1. Screening and Planning a CDM Project
Developers interested in registering their project for the CDM must first check that they meet the criteria of the CDM. The additionality of the GHG emissions savings over the baseline is especially important for a project to be eligible.

2. Preparing the Project Design Document (PDD)
The PDD is the standardised application format for CDM projects, available from the CDM EB. The PDD describes the project activity, the baseline methodology and additionality of the project, the monitoring methodology, and the project's contribution to sustainable development. The PDD is the central part of a CDM registration application, and will therefore

be explained in more detail.

A CDM Project Design Document has a standard format, and consists of 7 sections (table 4). It is important to follow the proscribed structure in order to apply for CDM registration successfully. The CDM Project Design Document form outlines the structure, and is available from the UNFCCC website[6].

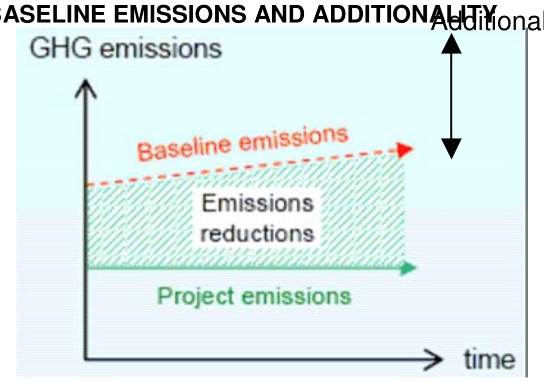
TABLE 4:
ELEMENTS OF A CDM PROJECT DESIGN DOCUMENT

A. Description of the Project Activity B. Application of the Baseline Methodology C. Crediting Period D. Application of the Monitoring Methodology and Plan E. Estimation of the GHG Emissions by Sources F. Environmental Impacts G. Stakeholder Comments
UNFCCC CDM, PROJECT DESIGN DOCUMENT FORM

A. Description of the project activity
The Project Design Document starts with a description of the project, covering its location, its aims, the local circumstances, the technology used and the type of project activity.

B. Baselines and additionality
The baseline methodology explains how the project activity will be compared with baseline scenarios "that reasonably represent the anthropogenic emissions by sources of greenhouse gases that would occur in the absence of the proposed project activity"[7]. The baseline methodology describes how to establish this baseline, against which the GHG emission savings of the CDM project can be measured (figure 7). This is the foundation of establishing the additionality of the CDM project, and is therefore essential for project approval.

FIGURE 7:
BASELINE EMISSIONS AND ADDITIONALITY



INSTITUTE FOR GLOBAL ENVIRONMENTAL STRATEGIES, CDM IN CHARTS, 2006

The baseline methodology should be project specific, cover all significant emissions within the project boundary that are in control of the project participants and can reasonable be attributed to the project. These should be adjusted for leakage – anthropogenic emissions of GHG outside the project boundary that can be reasonable attributed to the CDM project activity. The baseline should reflect local standards and policies, to give a reasonable business-as-usual case. The methodology and data used should be transparent, and specified in the PDD.
The CDM EB has approved standard baseline methodologies for various types of projects. These can be used directly and applied to comparable projects. Alternatively, a project proponent can propose a new methodology, which needs to be approved by the CDM EB. Baseline methodologies generally take one of three approaches:

6 http://cdm.unfccc.int/Reference/Documents/cdmpdd/English/CDM_PDD.pdf
7 UNFCCC, CDM Modalities and Procedures, paragraph 44.

- Using actual or historical GHG emissions (i.e. extrapolation)
- Using the emissions data of a technology that represents an economically attractive course of action (e.g. Cost Benefit Analysis)
- Using the emissions data from similar projects undertaken in the previous 5 years, in similar social, economic, environmental and economic circumstances

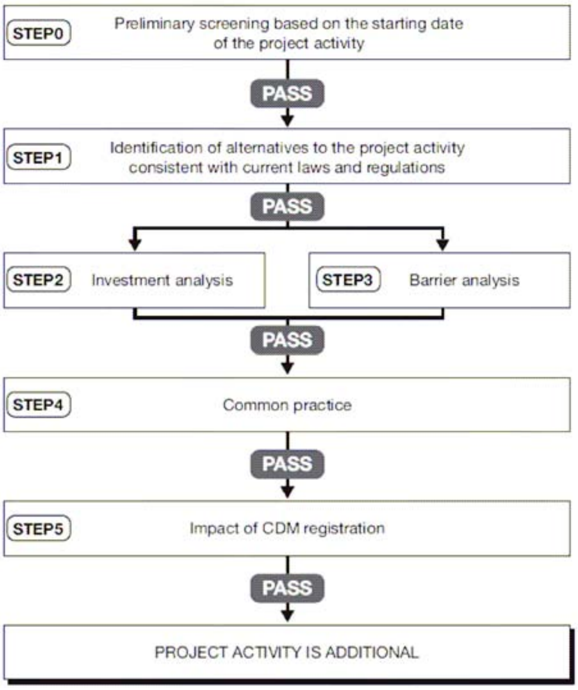
A number of baseline methodologies have been proposed for cogeneration projects, so generally it should be possible to find a methodology applicable to a new CHP project. Consolidated methodologies are general versions of project-specific methodologies, so they are easy to replicate. Approved methodologies are project-specific, but this can be an advantage if used for projects with similar circumstances. Each baseline methodology outlines the criteria for its application. Table 5 outlines baseline methodologies used for cogeneration projects. Most cogeneration projects to date have use methodology AM0015, which has now been replaced by ACM0006.

TABLE 5:
CDM METHODOLOGIES FOR COGENERATION PROJECTS

Methodology	Name	Applicability to CHP projects	Emission Reduction	Comments
Consolidated Methodology				
ACM0001	Consolidated baseline methodology for landfill gas project activities	Landfill gas capture CHP projects	Methane capture and grid-electricity displacement	Not used for cogeneration projects yet
ACM0004	Consolidated baseline methodology for waste gas and/or heat and/or pressure for power generation	Industrial waste heat recovery for heat and power generation	Displacement of on-site generated electricity or grid electricity	
ACM0006	Consolidated baseline methodology for grid-connected electricity generation from biomass residues	Grid-connected biomass CHP projects	Displacement of grid electricity	Replaces AM0004 and AM0015
ACM0008	Consolidated baseline methodology for coal bed methane and coal mine methane capture and use for power (electrical or motive) and heat and/or destruction by flaring	CHP projects using coal-bed methane	Methane capture and grid electricity displacement	Not used for cogeneration projects yet
Specific Methodologies				
AM0007	Analysis of the least-cost fuel option for seasonally-operating biomass cogeneration plants	Refurbishment and fuel-switching for biomass CHP projects	Technological improvement and/or fuel-switching	Refurbishment only
AM0014	Natural gas-based package cogeneration	Non grid-connected natural-gas fired CHP projects	CHP replacing separate heat and power generation	Cogeneration system must be owned by third party
AM0024	Baseline Methodology for GHG reductions through waste heat recovery and utilisation for power generation at cement plants	Waste heat recovery for heat and power generation in cement plants	Displacement of grid electricity	
UNFCCC, APPROVED BASELINE AND MONITORING METHODOLOGIES, 25 JULY 2006				

The additionality of CDM projects is established in comparison with the baseline scenarios. Firstly, the PDD should show that the project activity is not one of the baseline options. This is the case if the project is not the most economically attractive option, it is not common practice, it is not economically viable without CDM registration, or faces other barriers. Secondly, additionality requires that the estimated GHG emissions of the project activity are lower than any of the baseline cases. The UNFCCC has developed the 'Tool for Demonstrating Additionality', which is available on the UNFCCC CDM website[8]. Figure 8 illustrates the steps outlined by this tool.

FIGURE 8:
ADDITIONALITY ASSESSMENT PROCESS FOR CDM PROJECTS



MINISTRY OF THE ENVIRONMENT JAPAN AND GLOBAL ENVIRONMENT CENTER FOUNDATION, CDM MANUAL FOR PROJECT DEVELOPERS AND POLICY MAKERS, 2005.

C. Crediting period

The crediting period for a CDM project, during which CERs are issued, is either 7 years, with the possibility to renew twice, or 10 years without the possibility of renewal.

D. Monitoring methodologies

Monitoring methodologies explain how the GHG emissions from the project activity will be measured during implementation and operation. Monitoring methodologies are part of baseline methodologies, so the choice of baseline methodology also determines the monitoring methodology. They are approved by the CDM EB in the same way as baseline methodologies are. New monitoring methodologies can also be submitted for approval.

Monitoring methodologies for energy generation projects generally require measuring the fuel used for electricity and heat generation from the project activity, as well as the electricity and heat output of the process. These then serve to calculate the emissions reductions from the project activities and the baseline alternatives.

E. Estimation of the GHG Emissions by Source

In the PDD the project proponent must give an initial estimate of the GHG emissions by source for the project scenario and baseline alternatives. This enables the calculation of the expected emissions reductions from the project, based on the formulas described in the baseline methodology.

For energy generation GHG emissions from the project activities are normally calculated on a fuel-consumption basis, while baseline emissions are based on the electricity and heat output, and the alternative processes through which these would be generated.

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8 http://cdm.unfccc.int/methodologies/PAmethodologies/AdditionalityTools/Additionality_tool.pdf

F. Environmental Impacts
In the PDD the project proponent must indicate the environmental impacts of the project activity other than GHG emissions. For example, a project that includes the creation of a palm oil plantation could reduce GHG emissions, but entail the clear cutting of virgin forest, and thereby affect biodiversity. A project using sewage waste as energy source could improve water quality by reducing the sewage effluent that is discharged. Both positive and negative impacts should be included.

G. Stakeholder Consultation
The project proponent must consult various local stakeholders during the project development process, and account for their involvement and feedback in the PDD. Any concerns raised by stakeholders must be addressed in the project's design. Consultation takes place throughout the project scooping and development stage.

3. Obtaining National Approval
Once the PDD is ready it must be approved by the host country, for which the project participants submit the PDD to the DNA. The DNA will check if the project complies with all local procedures and regulation. There is therefore the possibility that the host country will not grant or delay host country approval such that the project cannot go forward, which is part of the registration risk of CDM projects (see Registration Risk, Section 2.5).

4. Validation and Registration
After the project is approved by the host-country DNA, the PDD and letter of approval from the host country are submitted to a DOE, which will validate the PDD and the methodologies proposed. The DOE will evaluate whether the project proponent: 1) has calculated the baseline in a conservative and transparent manner and made a reasonable estimate of the volume of emissions reductions; and 2) convincingly demonstrated that the project is additional. There is a risk that the project is not validated if the baseline calculations are inappropriate or inaccurate, or if the project is not deemed to be additional (see Registration Risk, Section 2.5). Once validated, the DOE will send the PDD, letter of approval and its Validation Report to the CDM EB for registration.

5. Project Activity and Monitoring
The participants can now proceed with the project activity, while monitoring the emission reductions during operation for the Monitoring Report.

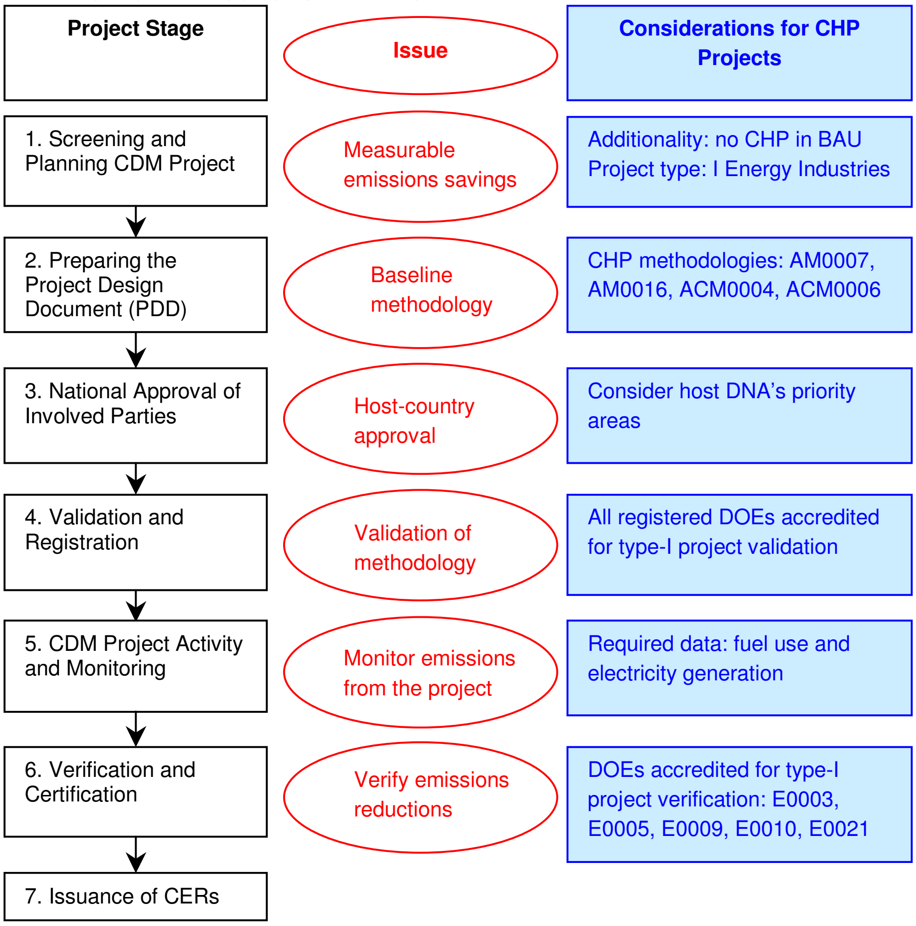
6. Verification and Certification
At the end of the CDM credit period the project participants submit the Monitoring report to a DOE for verification of the achieved emission savings. The DOE produces Verification and Certification Reports, which its sends to the CDM EB with a request for issuing the CERs.

7. Issuance of CERs
The CDM EB issues the CERs to the Annex I party involved in the project.

3.3 Special Considerations for CHP projects

Figure 9 illustrates the issues addressed above, and highlights the main points relevant to cogeneration projects in the flow chart of the CDM process.

FIGURE 9:
FLOW CHART FOR CHP PROJECTS IN THE CDM



WADE, 2006

The following section specifies the issues relevant for cogeneration projects in the CDM. It lists common questions that may be asked by project participants, answers these. It also highlights specifics for cogeneration, and gives examples.

1. Screening and Planning a CDM Project

Considerations for CHP: Additionality – No CHP in the baseline scenario

Is the project eligible for CDM?

A project is eligible for CDM if it satisfies the three global criteria (voluntary participation, real and measurable emissions savings, additionality), and the host-country's criteria for sustainable development.

Can the project benefit from CDM?

The additionality requirement means that the project cost/benefit balance of the project *activities is generally negative without CER revenue. For the project to be economically viable with CDM revenue, this must outweigh the CDM-related costs, and the net CDM benefit must exceed the negative project cost/benefit balance. Things to consider include:*

The size of the project (for larger projects CDM costs are relatively smaller)

The CER delivery risk (if delivery is uncertain, viability may suffer)

The CER delivery timing (inappropriate timing can lead to cash-flow problems)

Is the project big enough to benefit from CDM?

*For large projects the CDM-related costs represent a smaller share of the total project costs, reducing their impact on overall viability. Projects with emission savings larger than 50,000 t CO2-eq over the project lifetime are generally considered economically attractive*9*. Smaller projects can be viable, but are more affected by unforeseen changes in costs and revenues. To reduce the impact of the CDM costs, small projects can register through simplified Small CDM procedures, and can be bundled together.*

2. Preparing the Project Design Document (PDD)

Considerations for CHP: CHP methodologies: AM0007, AM0016, ACM0004, ACM0006

In which languages can a PDD be written?

All PDDs must be written in English for the CDM-EB. Some countries also require a translation in the national language for national approval.

A. Description of the project activity

Should the project register as a normal CDM project or a small CDM project?

CHP projects with an installed capacity smaller than 15 MWe can register through the simplified procedures of Small CDM.

What are the project types appropriate for CHP?

CHP projects normally fall within type I: Energy Industries. For small projects, cogeneration for on-site use only is classified as I-A (Electrical energy for the user) or I-C (Thermal energy for the user), depending on whether the project is heat-driven or electricity-driven. CHP for export to the grid falls under I-D (Renewable electricity generation for a grid). A project can be registered in more than one category. For example, a CHP project could be both I-A and I-C.

Can the project be registered without an Annex I party involved?

It is not necessary to have secured involvement of an Annex I party, who will buy the CERs when registering a CDM project. However, the CER revenue is less certain if no purchasing contact has been agreed on yet, so risks are higher.

What should the technology description include?

The technology description usually contrasts the prevalent local practice or current technology on-site with the best technology available. This helps establishing the additionality of the project later on. For biomass CHP the standard technology is a Rankine Cycle Steam Turbine, which can be compared to a boiler for combustion of biomass for heat only, combined with grid electricity.

B. Baselines and additonality

Is it best to use an approved baseline methodology, or propose a new methodology?

Proposing, submitting and registering a methodology is a time-consuming, work-intensive and expensive programme, so if possible, it is easier to use an existing approved *methodology. This facilitates finding a DOE approved to validate the project PDD, and reduces registration risks (see Registration Risk, Section 2.5). Proposed new methodologies are not always approved, as by June 2006 the CDM-EB had received proposals for 170 methodologies, but approved only 50, with 40 were under consideration and 65 rejected[10]. So project developers should check the available approved and consolidated methodologies to see which is applicable to their project. If no suitable baseline methodology exists, a new methodology will have to be prepared and registered. More information on how to do this can be found in the CDM User Manual[11].*

Which approved baseline methodology is most appropriate for CHP projects?

A methodology is suitable for a cogeneration project if the project satisfied the application criteria listed in the methodology description. In addition, methodologies that have been used for comparable projects are generally very useful, as they also show how it can be applied. For instance, for a bagasse cogeneration project at a sugar-processing factory in China could use baselines of similar registered projects in Brazil.

How is the additionality of the project activity demonstrated?

The best way to demonstrate the additionality of a project is by using the UNFCCC 'Tool for Demonstrating Additionality', developed by the UNFCCC[12].

How are project alternative scenarios identified?

*Alternative scenarios to be considered in the baseline include: the same project outside the CDM; other projects that deliver the same energy outputs and services; and continuation of the current situation*13. *For CHP projects alternatives must indicate how heat and power are normally generated. This can be the use of grid-electricity or the separate generation of heat and power on-site. All alternatives must comply with existing legislation.*

What existing laws and regulations should be considered for the baseline?

Four types of legislation should be considered in the baseline methodology[14]:

Type E+: Legislation that gives competitive advantages to more GHG-intensive practices

Type E-: Legislation that gives competitive advantages to less GHG-intensive practices

Type L-: Sectoral mandatory regulations that internalise environmental externalities and incidentally reduce GHG emission

Tyoe L+: Sectoral mandatory regulations that internalise environmental externalities, and prevent implementation of less GHG-intensive technologies

How are barriers to the project activity identified?

The CDM project activity must face barriers to meet the additionality requirement of the CDM. There are three steps in assessing these barriers[15]:

1. Investment analysis: the project is not a financially attractive option.

2. Barrier analysis: the project cannot secure investment, infrastructure or the local skill-base is insufficient, or the project is 'the first of its kind'.

3. Common practice analysis: similar projects are not already occurring in the area.

Investment analysis provides the strongest case for additionality. For cogeneration projects the fact that there is no previous expertise with such projects in the country or sector can also be important.

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9 Michelowa and Stronznik, 2002.

10 Brett Orlando, Factor Consulting+Management, personal communication, 2006.

11 Ministry of the Environment Japan and Global Environment Center Foundation, CDM Manual for Project Developers and Policy Makers, 2005.

12 Available from the UNFCCC CDM website: www.cdm.unfccc.int

13 UNFCCC, Tool for the demonstration and assessment of additionality (version 2), 2005.

14 UNEP Energy and Environment Group, The CDM – A User's Guide, 2003.

15 UNFCCC, Tool for the demonstration and assessment of additionality (version 2), 2005.

How can be shown that the project removes these barriers?

The final step in proving additionality is showing that the benefits of the CDM remove the barriers identified. The primary benefit is the CER revenue, but also the opportunity to attract new players able to provide funding or technical expertise, and reduced investment risks. Cogeneration projects are often cost-effective, making additionality difficult to prove. In such cases additionality assessment can focus on the up-front capital required, which is often unavailable to small manufacturers. Projects can sometimes not achieve the required rate of return to pay back commercial loans, unless CER revenue is included. Baseline methodology AM0007 proves additionality by showing that biomass is not the cheapest available fuel for cogeneration.

How is the project boundary defined?

The project boundary is defined so that it covers all emissions that can reasonably be considered direct result of the project activities. Emissions not directly resulting from the project are outside the boundary. For cogeneration projects emissions within the boundary include those from the generation process and heat and electricity distribution.

Is there any leakage from the project?

Leakage is the net change of anthropogenic emissions by sources of GHG, which occurs outside the project boundary, and which is measurable and attributable to the CDM project activity. Generally this means imports and exports of fuels. For cogeneration projects, particularly biomass-fired ones, the transport of biomass is normally the main type of leakage, assuming that the transport vehicles run on fossil fuel.

C. Crediting period

What crediting period is most appropriate for the project?

Crediting periods can be 7 years, with the option to renew twice, or fixed for a maximum of 10 years. The crediting period can only start after the start of the project, and may not extend beyond its operational lifetime. The choice of crediting period depends on the project's lifetime and expected timing of delivery of emission savings. The project developer will clearly aim to choose the crediting period that optimises the CER revenue. Fixed-term crediting periods are useful for short projects, or projects with high future uncertainty. Renewal crediting periods are suitable for long-term projects, such as CHP, for which the local circumstances may change. At renewal, the baseline methodology and alternatives must be re-validated by a DOE, and can therefore be adapted to reflect changes. This also adds to the CDM-related costs, though.

D. Monitoring methodologies

What does monitoring require from the project developer?

Monitoring of a CDM project requires the collection and archiving of three kinds of data: estimate or measurement of GHG emissions from the project activity; measurement of electricity and heat output of the project activity; calculation of emissions from the baseline; and identification of emissions outside the project boundary. All the data must be archived and kept until two years after the end of the crediting period. For CHP projects the project developer is responsible to measure the GHG emissions from the cogeneration system.

E. Estimation of the GHG Emissions by Source

How are the GHG emissions from CHP projects calculated?

GHG emissions from the project activity are calculated according to the formula specified in the baseline methodology. For cogeneration projects this is generally this is done on a fuel-input basis, taking into account the efficiency and operational conditions of the *technology used (for instance in AM0007).*

How are the GHG emissions from the baseline options calculated?

GHG emissions from the baseline are calculated according to the formula specified in the baseline methodology. For CHP projects baseline emissions can be calculated from the heat and electricity output of the project, and the GHG emission factor of the baseline-technologies used to generate these. Different baseline alternatives can therefore have different total GHG emissions.

What is the total GHG emission saving from the project?

The GHG emission saving of the project is the difference between the baseline emissions and the project emissions.

F. Environmental Impacts

What impacts of the project should be considered?

All impacts that are considered significant must be included in this section. To establish which impacts are significant the developer can conduct an Environmental Impact Assessment. The required procedures, and the definition of sustainable development, differ between host-countries, so the assessment must follow local guidelines. Assessments done for similar projects are a useful source of information. For CHP projects possible impacts include air pollution, soil degradation, biodiversity impacts, and socio-economic impacts such as employment or displacement.

G. Stakeholder Consultation

What are the requirements for stakeholder consultation?

Stakeholder consultations are required for CDM projects. Responses from stakeholders must be collected, reviewed, and incorporated in the PDD. These requirements vary between countries, so it is important to check with the DNA.

How does the consultation process usually take place?

The process normally has five stages:

1. *Identify important stakeholders;*
2. *Devise a consultation programme;*
3. *Invite comments;*
4. *Record comments;*
5. *Produce a written consultation report.*

At the validation of the CDM project, the DOE can request a copy of the consultation report.

Which stakeholders should I approach for consultation?

Local stakeholders must be actively approached. Consultation meetings are an effective way of involving them in project development. Local stakeholders that should be approached include local residents, local authorities and community groups. International stakeholders do not need to be actively approached, but can be invited to comment by correspondence.

3. Obtaining National Approval

Considerations for CHP: Consider host-country's national priority areas

How do project proponents apply for host-country approval?

The project proponent applies for host-country approval by submitting to the DNA the PDD, an application form, and, if necessary, additional information requested.

How does the approval process work?

The Marrakech Accords do not offer guidance on host-country approval, apart from the requirement for a written approval document, so the exact procedures and requirements vary between countries.

How long does the approval process take?

The length of the approval process depends on the country procedures and on the type of project. Generally approval takes two to three months, unless additional information is requested.

What is the best way to ensure approval for a CHP project?

To ensure a CHP project is approved by the host-country it is important to thoroughly check the DNA's requirements. Host-country approval assesses the project's compliance to local laws, regulations, and national sustainability criteria. Many countries have indicated priority areas for CDM projects, so if CHP is one of these, this can be emphasised. Support and involvement of local organisations also bolsters the project proposal.

4. Validation and Registration

Considerations for CHP: All registered DOEs accredited for type-I project validation

Which DOE is most appropriate to validate the project?

Different DOEs are approved for validating of different baseline methodologies. The choice of DOE therefore primarily depends on the methodology chosen. All DOEs registerer are accredited for type-I project validation. Other considerations can include previous experience of the DOE in the host-country, or with similar projects and the validation costs charged. Some DNAs have established their own DOEs, and require projects to be validated by a DOE based in the country itself.

What are the responsibilities of the project proponent during the validation process?

The project proponent must arrange and pay for the validation process. For application for validation the PDD and written host-country approval must be submitted to the DOE.

What are the responsibilities of the DOE during the validation process?

The DOE will assess the PDD, check whether it complies with the CDM requirements, and validate the baseline scenarios, additionality, and emission reductions formulas of the PDD. The DOE writes a validation report, which it must make available for 30 days for public consultation, and records comments.

How long does the validation and registration process take?

The time of the validation period depends on the DOE, but generally not less than two months should be reserved for it, as the validation report must be publicly available for at least 30 days. Project registration takes 8 weeks. If no objections from the CDM-EB have been made within that period, the project is officially registered. For small-scale projects this period is reduced to 4 weeks.

5. Project Activity and Monitoring

Considerations for CHP: Monitoring data requirements – fuel use and electricity generation

When can the project activity start?

The start date of project operation can be chosen as is convenient for the parties involved. It is not necessary to wait for project registration for the CDM. However, for projects that have not been approved yet, there is a risk of failing to meet the CDM criteria, and therefore not receiving any CER revenue. The choice of start date could be *influenced by the desired start of the crediting period.*

Can a project still register for CDM if it has already started?

Projects that have been started between 1 January 2000 and 18 November 2004 can request retroactive credits, if they have submitted a new methodology or requested validation with a DOE before 31 December 2005, and are registered by the CDM-EB no later than 31 December 2006. Projects that have not requested for validation yet are not eligible for retroactive credits.

How should data be processed and stored?

All monitoring data must be stored electronically and kept until 2 years after the end of the crediting period.

What information should the monitoring report include?

The information required for the monitoring report is specified in the chosen methodology

6. Verification and Certification

Considerations for CHP: DOEs accredited for type-I project verification – E0003, E0005, E0009, E0010, E0021

Which DOE is most suitable for project verification?

The DOE that validated the PDD cannot verify the project emission reductions, so another DOE accredited for the chosen methodology must be selected.

What does the verification process require from the project developer?

For verification of the GHG emission reductions the project developer must submit the monitoring report to the DOE, and pay for verification. The monitoring report will be made publicly available on the CDM website.

How does the DOE verify the GHG emission savings?

The DOE checks if the submitted information meets the requirements of the monitoring methodology, verifies the monitoring results to check that the methodology has been applied correctly, and determines the GHG emission reductions achieved by the project activity. If necessary, the DOE can conduct site-visits or request additional information. It can also recommend changes to the monitoring methodology for future applications. All information is included in the verification report, which will be made publicly available.

How are the emission reductions from a verified project certified?

The DOE certifies the amount of CERs based on the verification report. This is made publicly available and submitted to the CDM-EB. CERs are issued if no requests for review are made within 15 days.

How long does the Verification and Certification process take?

The time required for the verification and certification process depends on the DOE. There are no specific guidelines or time limits.

7. Issuance of CERs

When will the CERs be issued?

CERs are issued each time GHG emissions reductions are verified and certified. The project developer can choose when and how often to have this done. Clearly, more frequent verification increases the verification costs, but it ensures a steady issuance and revenue from CERs. A single verification is cheaper, but also reduce the occasions CERs are issued and can be sold. The choice depends therefore on the cash flow of the project, and on the CER purchasing agreement with the buyer.

What happens if the project is unable to deliver the emissions reductions?

If the project fails to deliver its emission savings, the verification report will recognise this, and no emission reductions will be certified.

Who owns the CERs?

The regulations and laws of the host country determine the ownership arrangements. CERs are normally issued to the project proponents, but the national government can claim national ownership. If the project proponents receive the CERs, their legal ownership is determined by the contractual arrangements between the project proponent, investors, and CER buyers.

4. Status and Prospects for Combined Heat and Power Projects in the Clean Development Mechanism

4.1 Introduction

CHP projects are considered an attractive option for CDM activities, and registration of such projects has been increasing. Most are in the sugar industry in India and Brazil. The potential for CHP in developing countries is large, the expertise is available, and interest is rising, so the trend is likely to continue. Cogeneration projects could therefore represent a large share of the GHG emissions reductions from the CDM in the future, and facilitate significant investment in the power sector of developing countries.

The Clean Development Mechanism has only just been adopted, and the first commitment period has not yet started, so a number of outstanding issues and potential barriers for CDM projects remain. There are concerns about the reliability of measuring and verifying GHG emissions savings from CDM projects, and about the long-term effectiveness of CDM measures. The paperwork and bureaucracy involved in CDM project registration is the main barrier for project developers, while investors are worried about the risks of CDM project financing, due to uncertainties in deliverability of CERs and carbon market developments.

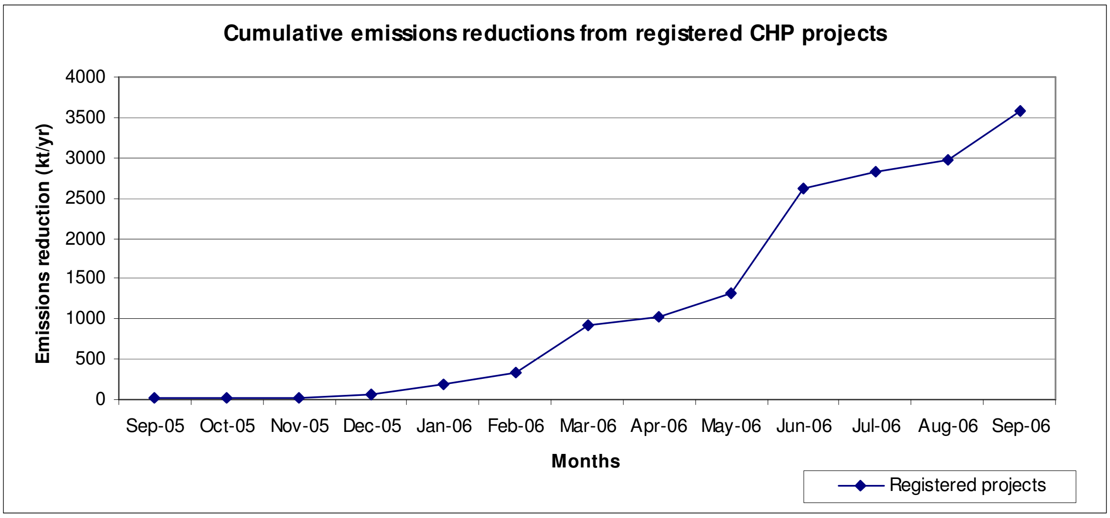
This chapter will discuss the prospects of CHP projects in the CDM, based on current trends and future projections (Sections 4.2 to 4.5). It will also discuss neglected CDM opportunities for cogeneration (Section 4.6) and outstanding issues (Section 4.7).

Sections 4.3 to 4.5 are country profiles for Brazil, China and India. These describe the organisational structure and procedures of the CDM in these countries, and provide the CDM status and projections in different sectors. The CDM and CHP potentials and projections in these country profiles are based on different sources, which may have different approaches, but the data presented aim to give a consistent overview. The cogeneration potentials reflect market projections and technical potential, while the CDM potential shows the total GHG reduction potential. In the cases where either of these was unavailable, it has been derived from the other figure. Combining the cogeneration and CDM potentials in the same graphs allows the reader to assess the importance of CHP for GHG mitigation within that sector.

4.2 Overall trends of CHP projects in the CDM

The total number of cogeneration projects registered for the CDM by the end of September 2006 was 66, out of 326 (20%). This has been increasing by about seven per month, except in March, when the Brazilian DNA released 19 projects for registration.

FIGURE 10:
TRENDS IN REGISTRATION OF CHP PROJECTS IN THE CDM



WADE, 2006

The total registered emissions reductions from cogeneration projects are increasing by roughly 350,000 t/yr each month. Again March shows a sharp increase due to the 19 Brazilian projects, and in June four large industrial projects raised the total emission reductions registered significantly. The total amount of registered emissions reductions from CHP at the end of September 2006 was 3,574,148 t/yr, out of more than 580 Mt/yr. The average emissions reductions per project are therefore 54,154 t/yr (figure 11).

FIGURE 11:
REGISTERED CHP PROJECTS IN THE CDM BY SIZE

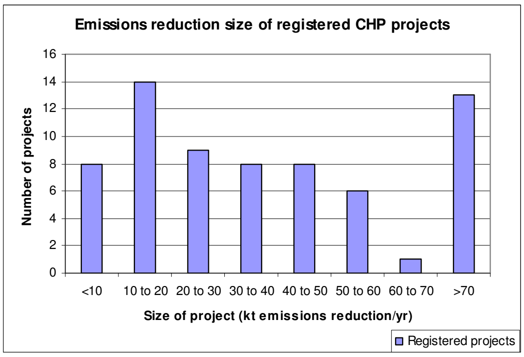
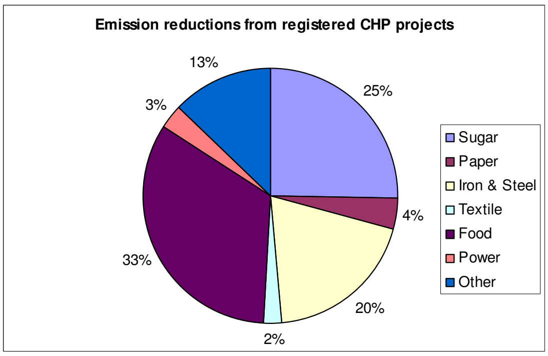


FIGURE 12:
EMISSION REDUCTIONS FROM CDM-REGISTERED CHP PROJECTS BY SECTOR



WADE, 2006

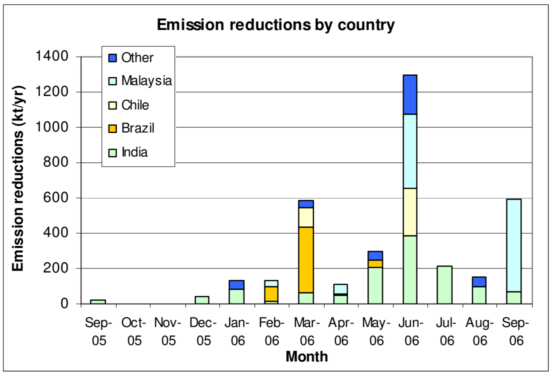
TYPES OF COGENERATION PROJECTS IN THE CDM

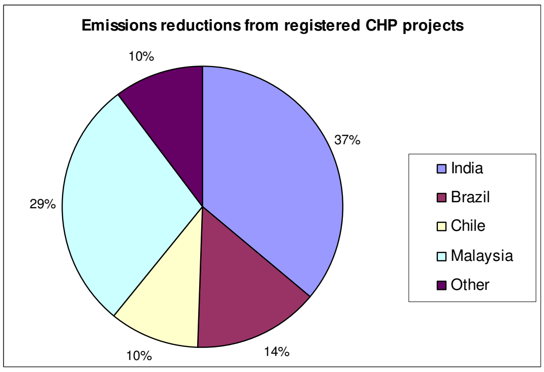
Initially most cogeneration projects registered were biomass-fired applications in small food manufacturing. Particularly the sugar industry was strongly represented. Recently the types of projects registering have been diversifying, and a number of other biomass CHP projects have been registered (figure 12).

From April 2006 industrial waste-heat recycling projects have been registered as well. These represent a different type of cogeneration projects, but they can deliver many of the same benefits. All at these are in India, except the system at the Jinwen cement plant in China. These projects are generally larger, and located at heavy industrial sites, rather than small manufacturing facilities. It has taken longer for the first of these projects to register, because they are larger and drafting the PDD can be complicated, but they represent a huge potential for energy efficiency improvement in large industry, so the emission reductions obtained through these is likely to overtake those from conventional biomass CHP in the near future.

PROJECT ACTIVITIES IN DIFFERENT COUNTRIES

FIGURE 13:
EMISSION REDUCTIONS FROM CDM-REGISTERED CHP PROJECTS BY COUNTRY





WADE, 2006

The CHP projects registered for the CDM are mainly located in Brazil and India, with 26 and 23 projects respectively (figure 13). Brazil represents 14% of emissions reductions, and India 36%. Other countries with significant project activity are Chile with 4 projects but 10% of emissions reductions and Malaysia with 7 projects and 29% of emissions reductions. This distribution of projects over different countries is likely to change, though, as India and Brazil have a well-established CHP tradition in the sugar industry, and therefore took advantage of the CDM early. The location of registered projects is gradually diversifying, though, as other countries also start to develop CHP projects for the CDM. Good examples of such countries are Malaysia, Chile and Indonesia.

The absence of China is remarkable. China has been relatively slow in implementing and clarifying its CDM procedures, and Chinese projects only represent a small share of registered CDM projects (20 projects out of a total of 326 registered projects). There is only one registered CHP CDM project in China, though there is significant potential for such projects. The importance of China in the CDM is likely to increase, though, as its procedures for the country are clarified and structure and processes become more established.

CER MARKET DEVELOPMENTS

The size of the CER market is growing as well as the CDM project registration. The CERs from CDM projects are traded in the general carbon market, which also include emission reduction credits from the Joint Implementation mechanism (JI) and the European Union Emission Trading Scheme (EU ETS). Trade in CERs from CDM is still small compared to EU Allowances (EUAs, the ETS's emission reduction unit). Presently there is no mechanism in place to make CERs from CDM projects compatible with EUAs for trading in the EU ETS.

Projections for the size of the CER market vary widely, from 270 Mt CO_2 eq to over 1000 Mt CO_2 eq. in 2010[16], with Pointcarbon giving an average of 610 Mt. Estimates for the CDM component of this range from under 100 Mt CO_2 eq to over 700 Mt CO_2 eq, representing 30-40% of the total carbon market[17].

The main supply of CERs comes from energy efficiency improvement projects, renewable energy projects, and industrial projects. Cogeneration projects will represent a significant share of these. Demand for CERs comes primarily from the EU-15, particularly the Netherlands and Spain, with Japan and Canada as the other main buyers[18]. Most analysts expect demand to exceed supply, as the total emission reductions required are generally more than double the projected supply.

The price of CERs is subject to uncertainties. The carbon price of EUAs in the ETS was around €25/t C until May 2006, when the prices fell to around €16/t C. The expected prices for CERs from CDM projects are lower, though, because of added uncertainties. CER prices depend on the project type and contractual arrangements. Currently typical prices are in the range of €10 – 12 per ton C, but there future projections vary. The initial estimates projected prices of \$2/t CO_2 eq. to \$3/t CO_2 eq. (\$6.7 - \$10/t C)[19], but present price trends suggest higher prices. Projects that involve much capacity building require prices of \$3/t CO_2 eq to \$5/t CO_2 eq (\$10 – \$16.7/tC), so these would be viable if current developments continue.

The main threats to a stable high CER price are the absence of the US from the Kyoto agreements, and the large amount of excess emission quota from former Soviet countries. However, even at low prices the annual value of CER trade is in the range of \$2.9 million to \$4.3 million.

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16 The Delphi Group et al., Analysis of the International Market for Certified Emissions Reductions, 2004.
17 Dhakal, S. CDM Market: Size, Barriers and Prospects. 2001; Jotzo, F. and Michaelowa, A. Estimating the CDM Market under the Bonn Agreement. 2001.
18 The Delphi Group et al., Analysis of the International Market for Certified Emissions Reductions, 2004.
19 Jotzo, F. and Michaelowa, A. Estimating the CDM Market under the Bonn Agreement. 2001.

4.3 Country Profile – Brazil

GENERAL INFORMATION

Ratification: 23 July 2002
Reason for Ratification: Brazil was one of the countries proposing the CDM, because it can benefit through investment and technology transfer through GHG reduction projects.
Priorities:

- Renewable energy sources
- Energy efficiency/conservation
- Reforestation and establishment of new forests
- Other emission reduction projects: landfill projects and agriculture projects

Total GHG emissions: 2,081 Mt CO_2 eq (1994)

CDM IN BRAZIL

Organisational structure
CDM regulation in Brazil is part of its wider Climate Change Programme. The Brazilian DNA is the Interministerial Commission on Global Change (CIMGC), established in 1999 to coordinate the government's activities in combating climate change. It is chaired by the ministry of Science and Technology, and includes representatives from several other ministries (table 6).

TABLE 6:
THE NCA BODIES, MEMBERS AND TASKS

Body	Represented Parties	Responsibilities
CIMGC	Ministry of Science and Technology (president) Ministry of Environment (vice-president) Ministry of Foreign Affairs Ministry of Agriculture and Food Supply Ministry of Transport Ministry of Mines and Energy Ministry of Planning Ministry of Budgeting and Management Ministry of Development, Industry and Commerce Civil House of the Presidency of the Republic	• Set national climate change policies, including CDM • National authorisation of CDM projects • Report to the UNFCCC-EB • Information dissemination
BFCC	CIMGC Government Private sector NGOs Academics	• Discuss climate change policy, including CDM, with a wider range of stakeholders
Getulio Vargas, The Clean Development Mechanism – A Brazilian Implementation Guide, 2002		

Other relevant organisations
The CIMGC works with representatives from government, private sector, NGOs and local communities through the Brazilian Forum on Climate Change (BFCC). The BFCC is the main platform for other organisations involved in the CDM in Brazil to contribute to the CDM process in the country.

In 2000 the Ministry of Environment established the Integrated Studies Centre on Environment and Climate Change (Centro Clima), which supports the Brazilian climate change programme through research, information dissemination and stakeholder participation.

The Brazilian National Fund for the Environment, established in 1989, and the Brazilian National Development Bank are governmental organisations involved in funding CDM projects. Ecosecurities Ltd is a private finance and trading company, which has been very active in financing Brazilian CDM projects.

Sustainability Criteria
The Brazilian government has set out clear priorities for the CDM, including sustainability criteria for project eligibility. Four types of projects are ineligible for CDM: forestry projects other than forestation and reforestation; nuclear energy projects; unsustainable biomass projects; and hydropower projects larger than 30 MW. For cogeneration projects the third categories is particularly important, as it stresses that for biomass-CHP projects the source of biomass must be sustainable.

TABLE 7:
SUSTAINABILITY CRITERIA FOR CDM PROJECTS IN BRAZIL

Category	Criteria
Environmental Sustainability	Mitigation of global GHG emissions Local environmental sustainability
Economic Sustainability	Contribution to the sustainability of balance of payments Contribution to macro-economic stability Cost effectiveness
Social Sustainability	Net employment generation Impacts on rent distribution
Technological Sustainability	Contribution to technological self-reliance
Ministry of Science and Technology Brazil, CDM Project Eligibility Criteria, 2006.	

The sustainability criteria for eligible projects are shown in table 7. In Brazil the emphasis is on the economic benefits of CDM projects for the local and national economy. This is highlighted by three additional criteria, which have multiplying potential:

- Internalisation of the possible CER revenue in the national economy
- Possibility of regional integrity or interaction with other planned activities
- Potential of technological innovation

Country approval application process
For application for national approval for a CDM project the project proponent must submit the documents shown in table 8 to the CIMGC, both in electronic and paper format. The description of the project’s contribution to sustainable development must directly address the environmental sustainability criteria, and be based on the PDD or other relevant works. Invitation letters must include letters addressed to the City Hall, the City Council, the State and Municipal Environmental Agencies, the Brazilian Forum of NGOs, the Public Prosecution Office, and Community Associations. The declaration of the project participants should state

the organisation in charge of the project, the means of communicating with the CIMGC, and the commitment to sending the distribution document of the CERs when they are issued. The Statement of DOE must prove that the DOE that will validate the project is approved by the CDM-EB, and that the DOE is located in Brazil, because the CIMGC will not accept validation or verification by foreign DOEs.

TABLE 8:
REQUIRED DOCUMENTATION FOR NATIONAL APPROVAL IN BRAZIL

- PDD (English)
- Project Design Document (DCP), translated in Portugese
- Description of the project's contribution to sustainable development (Annex III)
- Invitation letters for comments from stakeholders
- Validation report (English version and Portuguese translation
- Declaration of the project participants
- Conformity with the Environmental and Labour Legislation
- Statement of DOE
- Additional documents (optional)

MINISTRY OF SCIENCE AND TECHNOLOGY BRAZIL, 2006.

The CIMGC will check the eligibility of the proposed project based on the submitted documents, and assess whether the project fulfils the global and national CDM criteria. They also evaluate the PDD before it is submitted to the CDM-EB. There is no indication of the length of the approval process.

Government Incentives

The Brazilian government has a range of policies to promote energy efficiency and clean energy generation, some of which are directly related to cogeneration (table x). The Programme to Encourage Alternative Sources of Electricity (PROINFA) is the most significant of these, and aims to develop 3300 MWe of renewable energy capacity, 1100 MWe of which biomass fired. Feed-in tariffs are guaranteed by the government to support the development of this capacity, and the tariff for 2005 was R$132/MWh. Other policies relate to energy efficiency and renewable, but are also relevant to cogeneration, including:

Cogeneration and Independent Power Production

- Law 10848 sets efficiency standards for electricity generation, and creates incentives for electricity utilities to buy electricity from CHP plants.
- Programme to Encourage Alternative Sources of Electricity (PROINFA) (2002)
- VAT reduction on cogeneration equipment in some states
- Independent Power Producers are legally permitted to sell electricity to licensed electricity supply companies, large electricity users, consumers of cogenerated electricity, and consumer co-operatives.

Energy Efficiency

- The Brazilian National Electricity Conservation Programme (PROCEL) promotes electricity savings on both demand side and supply side.

Renewable Energy

- The Energy Reallocation Mechanism allows producers of renewable energy technologies, including biomass cogeneration to establish central dispatching systems in order to mitigate financial risks.
- The Global Reversion Reserve, managed by Electrobras, promotes renewable energy projects.

Financial and legal arrangements

There have been proposals in Brazil to establish a national CDM financing institution that would provide initial funding for CDM projects. The institution would pay project proponents a certain price for the emission reductions, and then keep the CER portfolios to offer to buyers abroad. This would facilitate the purchase of Brazilian CERs by foreign parties, reduce the

CER risk for project proponents, and allow for fast tracking of Brazilian CDM projects.

POTENTIAL FOR CHP PROJECTS IN THE CDM IN BRAZIL

Cogeneration status and potential

At present only 3.3% of total electricity generation in Brazil is from cogeneration, and cogeneration facilities represent 4.4% of installed capacity[20]. However, in the sugar sector and oil and gas sector there is considerable experience with CHP projects, particularly in Sao Paolo state. These are also the sectors with the largest potential for further CHP development (table 9).

TABLE 9:
CHP POTENTIAL IN BRAZIL BY SECTOR

Sector	Potential (MWe)
Sugar	4,020
Oil and gas	4,283
Chemicals	1,581
Pulp and paper	1,740
Steel	875
Rice mills	1,200
UNIDO INVESTORS GUIDE, 2003	

CDM status and potential in Brazil

TABLE 10:
CDM STATUS IN BRAZIL

	Approved Projects	Installed Capacity (MWe)	GHG Emissions Reductions (t/yr)
All CDM projects	71	-	14,320,881
CHP projects	26	1066.1	506,962
Sugar	25	991.1	462,936
Steel	1	75	44,026
UNFCCC, 2006			

The Brazilian government has actively promoted CDM projects, and sees it as a major opportunity to develop sustainable energy resources. As a result, 71 projects have been registered; more than one third are CHP projects, mostly bagasse-fired (table 10). This dominance of bagasse-CHP reflects the technological expertise and economic attractiveness of these projects, as well as the large potential for energy efficiency improvements through cogeneration in small food-processing facilities.

The potential for further cogeneration projects in the CDM in Brazil is substantial (figure 14). Biomass-fired projects in the food sector will remain attractive due to the large potential and existing expertise. There is further potential for CDM projects in the sugar sector, but many attractive projects have already been registered. In addition, rice-husk based cogeneration is also attractive for CDM cogeneration projects in Brazil.

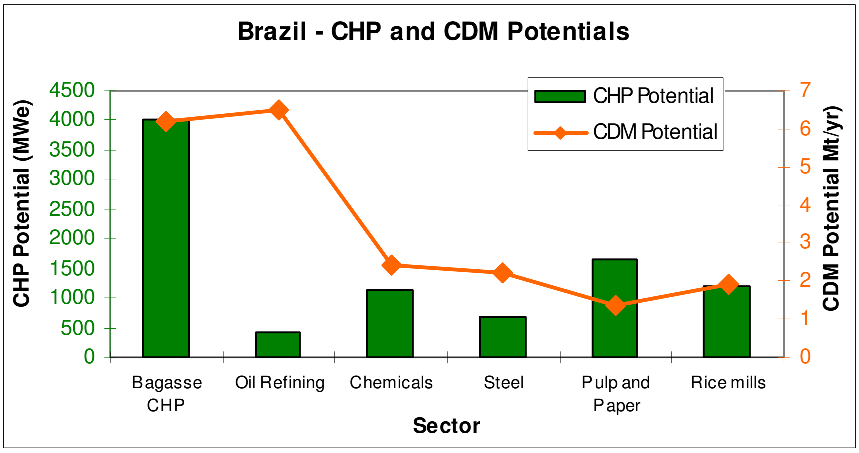
Energy efficiency measures in large industries provide a more significant and long-term potential for CDM cogeneration projects in Brazil. The most significant sector is oil refining, where there is a considerable cost-effective potential for heat-recovery, cogeneration and methane capture and utilisation: installing CHP systems at refineries can lead to energy savings of up to 30%[21]. Realising this requires on the possibility to export to the grid to be cost-effective, so the directly marketable potential is still limited. Other sectors with large potentials are the pulp and paper industry and the chemical industry. In the Iron and Steel

20 WADE, DE World Survey 2006.

21 Center for Clean Air Policy, Identifying Investment Opportunities for the Clean Development Mechanism in Brazil's Industrial Sector, 2001.

sector large energy efficiency savings can be made, but only a relatively small part of this is cost-effective[22].

FIGURE 14:
CDM POTENTIAL IN BRAZIL



CENTER FOR CLEAN AIR POLICY, 2001; WADE, 2004; UNIDO INVESTORS GUIDE, 2003.

The potential for GHG emissions reductions in the power sector through cogeneration in Brazil is relatively small, because most of the country's electricity is generated by hydropower.

Drivers	**Barriers**
• Large potential for cogeneration sugar sector and major industries • Guaranteed feed-in tariffs through PROINFA • Energy Law 10,848 sets efficiency index and creates market for cogeneration • Strong government support for CDM	• Low electricity prices not reflective of true environmental costs • Insufficient gas distribution infrastructure • Centralised governance of CDM procedures • Requirement to use Brazil-based DOE for validation and verification

Prospects

In the near future bagasse cogeneration is likely to remain the main source of CDM projects in Brazil. Opportunities in larger industries, like petrochemicals, will probably be exploited next, diversifying the types of CHP projects registered for the CDM. The CDM's organisational structure in Brazil is very centralised, and the application process can be cumbersome. However, as the country originally proposing the CDM in Kyoto in 1997, Brazil recognises it can benefit significantly, and will strongly stimulate the realisation of this potential.

[22] Center for Clean Air Policy, Identifying Investment Opportunities for the Clean Development Mechanism in Brazil's Industrial Sector, 2001.

4.4 Country Profile – China

GENERAL INFORMATION

Ratification: 30 August 2002
Reason for Ratification: CDM considered a major opportunity to reduce GHG emissions and increase the efficiency of China's fossil-fuel based energy sector.
Priorities:

- Energy efficiency
- Renewable energy
- Methane recovery and utilisation

Total GHG Emissions: 3650 Mt CO2 eq (2004)

CDM IN CHINA

Organisational structure
The CDM in China is regulated through the Measures for Operation and Management of Clean Development Mechanism Projects in China, (12 October 2005), which specified the National Development and Reform Commission (NDRC) as the country's DNA, supervised by the National Coordination Committee on Climate Change (NCCC) and the National CDM Board (NCB).

TABLE 11:
THE CDM BODIES, MEMBERS AND TASKS IN CHINA

Body	Represented Parties	Responsibilities
NCCC	NDRC (chair) Ministry of Foreign Affairs (vice chair) Ministry of Science and Technology State Environmental Protection Administration China Meteorological Administration	• Review national CDM policies • Approve members of NCB • Review other relevant issues
NCB	NDRC (chair) Ministry of Foreign Affairs (vice chair) Ministry of Science and Technology State Environmental Protection Administration China Meteorological Administration Ministry of Agriculture	• Review project applications • Report overall progress of CDM activities to NCCC • Recommend interim measures
NDRC		• Assess and approve project applications • Supervise implementation of CDM projects • Establish CDM management institute
INSTITUTE FOR GLOBAL ENVIRONMENTAL STRATEGIES, CDM COUNTRY GUIDE FOR CHINA, 2005.		

The NDRC is central in the CDM process in China, and manages the involvement of the relevant ministries and other government organisations (table 11). It functions as a one-stop-shop for project application and approval, and regulates the implementation of CDM projects in China through the CDM Management Institute.

Other relevant organisations
The main parties involved in the CDM in China are state-organisations, both at national and

local level. However, any foreign company doing business in China needs to work with a local partner company, and the applicant for CDM endorsement must be a Chinese company, so CDM projects necessary involve local industries and manufacturers as well.

Sustainability Criteria

TABLE 12:
SUSTAINABILITY CRITERIA FOR CDM PROJECTS IN CHINA

Category	Criteria
Environmental Sustainability	Reduce GHG emissions Maintain resource sustainability and avoid degradation Maintain biodiversity
Economic Sustainability	Additional investment consistent with needs of the people Funding additional to ODA
Social Sustainability	Alleviate poverty by generating employment Remove social disparities Contribute to the provision of basic amenities
Technological Sustainability	Transfer of environmentally safe and sound technologies

INSTITUTE FOR GLOBAL ENVIRONMENTAL STRATEGIES, CDM COUNTRY GUIDE FOR CHINA, 2005.

The Chinese government's sustainable development strategy emphasises the harmonic development of the economy, society and the environment (table 12). Social aspects are important, but for CDM projects the focus is on the environmental criteria. Projects are evaluated primarily on the basis of their impact in the three designated priority areas: energy efficiency; renewable energy; and methane recovery. The NDRC focuses on CO_2 and CH_4, rather than the other four GHG. Cogeneration projects improve energy efficiency of generation, and can use renewable fuels or recovered methane, so they are suitable for meeting these criteria.

Country approval application process

TABLE 13:
REQUIRED DOCUMENTATION FOR NATIONAL APPROVAL IN CHINA

- CDM project application letter
- Completed application form
- PDD
- General information on project construction and financing
- Certificate of the applicant's enterprise status

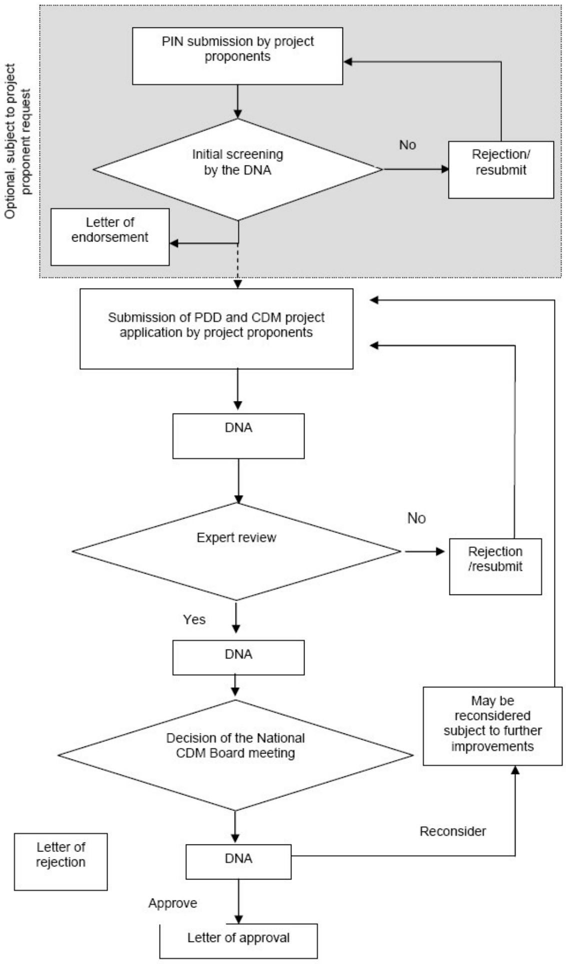
INSTITUTE FOR GLOBAL ENVIRONMENTAL STRATEGIES, CDM COUNTRY GUIDE FOR CHINA, 2005.

The NDRC regulates the CER value for Chinese CDM projects, to avoid unacceptably low prices. Project developers must indicate the CER price agreed with the buyer in their project application. However, without government approval it is difficult to find a buyer. To avoid this 'catch-22', the NDRC has an initial screening process to provide preliminary endorsement for projects before they are officially approved.

To apply for national approval in China the project developer must submit the required documentation to the NDRC (table 13). After endorsement, the NDRC will review the PDD and consult experts to reach its decision, which is communicated to the project developer within 50 days. If further review is needed, additional information may be requested, but otherwise an approval letter is issued (Figure 15).

After registration by the CDM-EB the project developer must notify the NDRC within 10 days. During project operation the developer must submit the implementation report and monitoring reports to the NDRC, so that the NDRC can check that the project meets the criteria set for CDM projects.

FIGURE 15:
THE CDM PROJECT APPROVAL PROCESS IN CHINA



INSTITUTE FOR GLOBAL ENVIRONMENTAL STRATEGIES, CDM COUNTRY GUIDE FOR CHINA, 2005.

Government Incentives

The Chinese government has been increasing its support for energy efficiency and renewable energy in recognition of their importance for the country's development. The adoption of market-based economic mechanisms also stimulates energy efficiency, and renewable energy has enjoyed long-term government support, despite the absence of a comprehensive support policy. Government incentives relevant to CDM cogeneration projects are:

Energy Efficiency

- Favourable pricing for Independent Power Producers
- 2-year tax-breaks for cogenerators and energy-saving generators
- Favourable rates on loans for energy efficiency projects (30% lower on average)
- Graded quotas for energy consumption in key industries

Renewable Energy

- Subsidies (overhead, R&D, capital costs, project support)
- Reduced VAT and income tax rates
- Favourable custom duties for biogas equipment

Financial and legal arrangements

The NDRC regulates the CER price for Chinese CDM projects to ensure that it does not fall below a set minimum. This aims to secure a good CER revenue for Chinese projects, but it also complicates the contractual arrangements between the project developer and the CER buyer. To guarantee the minimum set price there needs to be an advance contract, which specifies this price before a project can apply for national approval. However, contracts are hard to agree without national approval, and rules out certain CER contract types, like market price based agreements. This complicates the implementation of CDM projects in China.

The Chinese banking system is traditionally centralised and state dominated, but it is gradually being restructured and Chinese banks are increasingly able to provide financing and services to foreign investors. However, for CDM financing the problem remains that most knowledge concentrated in government offices, not banks. This situation is gradually improving, and as a result of the government's encouragement of Foreign Direct Investment (FDI)\ different kinds of financing available from Chinese and international institutions. However, the complicated international and national rules pose a major obstacle.

The Measures for Operation and Management of Clean Development Mechanism Projects in China specify that the CER revenues from CDM projects belong to the Chinese government and enterprises implementing the project. The government fixes the distribution proportions of the revenue and before the fixation, the revenue shall belong to enterprises. The CER revenue is subject to government levies (table 14), additional to normal taxes for foreign-led projects.

TABLE 14:
LEVIES ON CER REVENUE IN CHINA

GHG	Regulated base price +
HFC and PFC	65%
N_2O	30%
Other	2%
INSTITUTE FOR GLOBAL ENVIRONMENTAL STRATEGIES, CDM COUNTRY GUIDE FOR CHINA, 2005.	

POTENTIAL FOR CHP PROJECTS IN THE CDM IN CHINA

Cogeneration status and potential

The present installed cogeneration capacity in China is 48.1 GWe, 10,9% of total capacity, which generates 10% of the country's electricity[23]. There is still ample potential for further cogeneration development, though, to as much as 80 GWe by 2015. Table 15 shows the potential for a number of industrial sectors.

TABLE 15:
CHP POTENTIAL IN CHINA BY SECTOR

Sector	Potential (MWe)
Power	3,800
Oil and gas	260
Chemicals	1,000
Pulp and paper	102
Steel	115
Cement	246
Biomass	5,500
Coal-bed methane	500
Landfill gas	800
WADE, 2004; KEIO, 2003; IGES, 2005.	

CDM status and potential in China

TABLE 16:
CDM STATUS IN CHINA

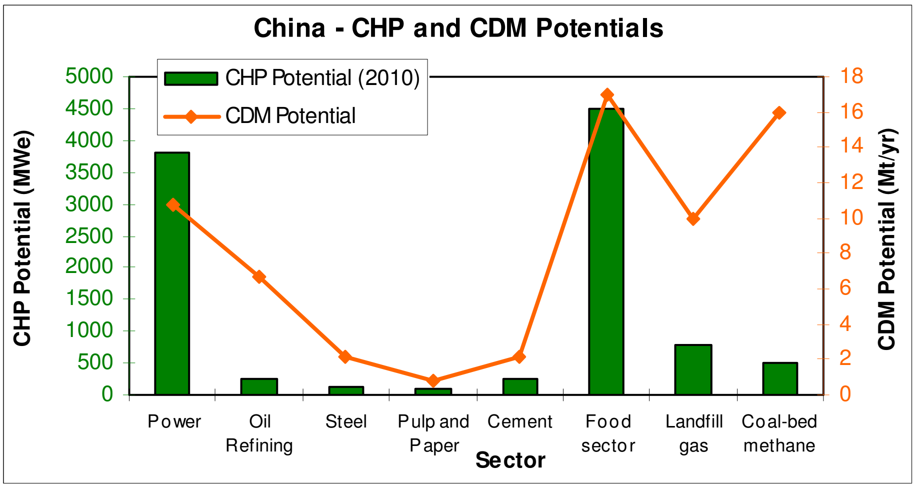
	Approved Projects	Installed Capacity (MWe)	GHG Emissions Reductions (t/yr)
All CDM projects	20	-	36,806,034
CHP projects	1	13.2	105,894
WADE, 2006			

The number of registered CDM projects in China is surprisingly small (20 out of 334), considering that the country is thought to represent half of the global CDM potential (table 16). Projects in China are generally large, though, with an average of over 1.8 Mt/yr. The one CHP project registered is a waste-heat-driven electricity generation project in a cement plant.

[23] WADE, DE World Survey 2006.

Figure 16 illustrates that the cogeneration and CDM potentials in China are large. Biomass availability and potential is significant, but the main sectors for CHP in China are industry and power generation. Industrial cogeneration projects are generally large, and therefore economically attractive, both for the project's basic profitability and the potential CER revenue. In the power sector many old power stations need to be upgraded, and new plants are being built to meet growing electricity demand, providing opportunities for using CHP.

FIGURE 16:
CDM potential in China



WORLD BANK, 2005; IGES, 2005; WADE, 2004; KEIO, 2003.

The large potential for CDM projects in industrial energy efficiency reflects the large energy demand of China's industries (70% of total energy consumption) and inefficient production standards. Cogeneration and heat recovery can contribute significantly to increasing efficiencies, so that they are attractive CDM projects. The main industrial sectors for CDM cogeneration projects are steel (14% of industrial energy use), chemicals (16% of industrial energy use), pulp and paper, textiles, non-ferrous metals, and building-materials (23% of industrial energy use). The government has realised this and is promoting initiatives to improve the energy efficiency of the economy.

Biomass-fired cogeneration also provides opportunities for CDM projects, particularly in rural areas, where wood residues, bagasse or crop stalks are available. In 2004 only 2.0 GWe biomass-fired capacity was installed, but estimates indicate that this can increase to 20 GWe in 2020[24].

Drivers	**Barriers**
• Rapidly rising energy demand • Power market restructuring • Large CDM potential • Government's CDM policies prioritise energy projects • Large potential for industrial efficiency improvement through CHP	• Continued government control of power sector and slow liberalisation • Project developer must be local company • Government ownership of CER revenue • CER price regulation • Lack of financing opportunities for CDM

24 Institute for Global Environmental Strategies, CDM Country Guide for China, 2005.

Prospects

The potential for CDM projects in China is the largest of any country in the world: about 50% of the global CER potential. A large part of the potential can be achieved through CHP application in industrial energy efficiency and power generation projects. However, CDM project implementation has been remarkably slow, with only 20 approved projects so far. The strong centralised control of the CDM process in China plays a major role in this, as well as lack of funding for projects due to uncertainty and risks for potential investors. CDM implementation in China will undoubtedly accelerate in the future, but further clarification and liberalisation of CDM regulation in China is important.

4.5 Country Profile – India

GENERAL INFORMATION

Ratification: August 2002
Reason for Ratification: Climate Change is an important consideration in India's national planning and development aims (doubling income by 2012 and reducing poverty levels by 10%).
Priorities: Make CDM consistent with sustainable development principles
Total GHG Emissions: 1,229 Mt CO_2 eq (2001)

CDM IN INDIA

Organisational structure
The National Clean Development Mechanism Authority (NCA) is the Designated National Authority in India, supervised by the Ministry for Environment and Forests (table 17). The NCA consists of representatives from various ministries, and aims to ensure successful implementation of CDM projects that promote sustainable development. It set guidelines and administers the project approval process. It consults local experts for technological information, and works with stakeholders and other government organisations to allow for a wide range of inputs during the process. It reports to the Ministry for Environment and Forests at least once every 3 months.

TABLE 17:
THE NCA BODIES, MEMBERS AND TASKS

Body	Represented Parties	Responsibilities
NCA	Ministry of Environment and Forests (chair) Ministry of Foreign Affairs Ministry of Finance Industrial Policy and Promotion Ministry of Non-Conventional Energy Sources Ministry of Power Planning Commission	• Take measures to improve environment • Project evaluation and approval • Recommend additional requirements for CDM projects in India • Maintain a CDM registry
State-level CDM promotional cell	State-level government officials	• Capacity building • Creating a forum for parties involved in CDM projects • Help with project identification and planning • Analysing state-level potentials and sectors • Disseminate information
INSTITUTE FOR GLOBAL ENVIRONMENTAL STRATEGIES, CDM COUNTRY GUIDE FOR INDIA, 2005.		

Three states with a particular interest in the CDM have established state-level promotional cells: the Environmental Protection and Training Research Institute (EPTRI) in Andhra Pradesh; the Madhya Pradesh Pollution Control Board (MPPCB) in Madhya Pradesh; and the West Bengal Renewable Energy Development Agency (WBREDA) in West Bengal. Currently these focus mostly on capacity building and promotion, but they are expected to be involved in project identification and implementation in the future too.

Other relevant organizations

Currently the only India-based DOE accredited for project validation and emission reduction verification is the Indian Council for Forestry Research and Education, which only deals with afforestation projects. However, the NCA is expected to establish DOEs in other sectors as well to support local projects and reduce procedural costs. These would be relevant for cogeneration projects.

Most CDM projects in India are small-scale projects, which require bundling to keep CDM-related costs down. Several local bundling organisations have therefore emerged, most notably the Small Industries Development Bank of India and National Bank for Agriculture and Rural Development. These banks have strong links to small food production and processing, and can therefore provide valuable services for CHP projects in the sugar industry and other food manufacturing.

The NCA has been working closely with other stakeholders through sectoral initiatives, education and training. Organisations currently involved in the CDM in India include Apex industry bodies, NGOs, Consulting firms, ESCOs, private and public sector companies, International development organisations and International lending institutions.

Sustainability Criteria

TABLE 18:
SUSTAINABILITY CRITERIA FOR CDM PROJECTS IN INDIA

Category	Criteria
Environmental Sustainability	Environmental Impact Assessment
Economic Sustainability	Additional investment consistent with local needs
Social Sustainability	Generate employment Remove social disparities Improve quality of life
Technological Sustainability	Technology transfer
INSTITUTE FOR GLOBAL ENVIRONMENTAL STRATEGIES, CDM COUNTRY GUIDE FOR CHINA, 2005.	

The sustainability criteria used by the NCA to evaluate submitted CDM projects focus on the social benefits of the project (table 18). CDM projects are expected to have a direct positive effect on the lives of the local community, and promote development. This shows the importance of using local skills and resources, and working with local partners. It also suggests that CHP projects in food manufacturing using local biomass, like the sugar industry, are well-positioned for CDM approval.

The economic criterion for additional investment is also important, and implies that the CDM-related investment must be additional to normal Official Development Assistance (ODA).

Country approval application process

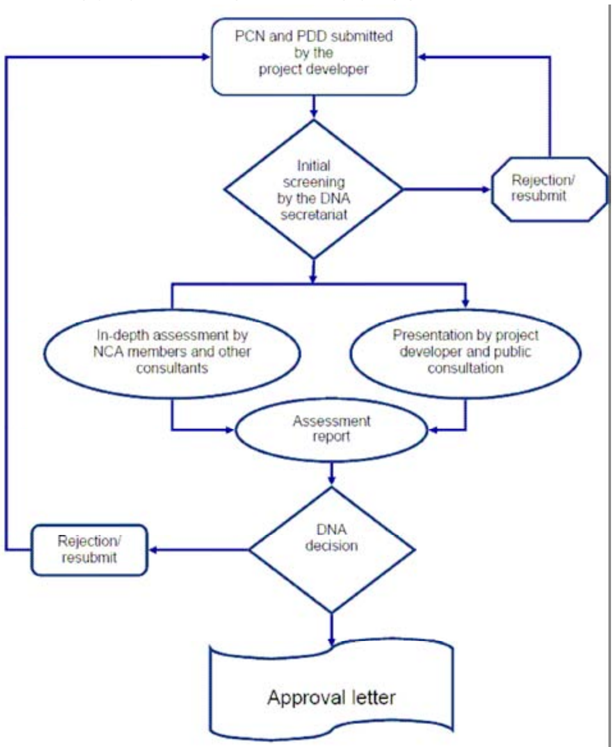
Table 19 shows the documents required for submitting a project for CDM approval in India. A Project Concept Note, as well as the PDD must be submitted, together with any supporting documents.

TABLE 19:
REQUIRED DOCUMENTATION FOR NATIONAL APPROVAL IN INDIA

Electronic copy of the Project Concept Note (PCN)
Electronic copy of the PDD
20 hard copies of the PCN and PDD each
Supporting documents
Two CDs containing all information
Cover letter signed by the project developers
INSTITUTE FOR GLOBAL ENVIRONMENTAL STRATEGIES, CDM COUNTRY GUIDE FOR CHINA, 2005.

The documents submitted are circulated among the members of the NCA for initial evaluation, and the developer is invited to present the proposal, so that NCA members can ask for clarification. Simultaneously NCA members and experts assess the PDD in detail, producing an assessment report (figure 17). The NCA will check that the CER revenue is additional to ODA (i.e. they are not sold to an organisation using ODA funds). Once the NCA is satisfied, Host Country Approval is granted. There is no indication of the length of the process.

FIGURE 17:
THE PROJECT APPROVAL PROCESS IN INDIA



INSTITUTE FOR GLOBAL ENVIRONMENTAL STRATEGIES, CDM COUNTRY GUIDE FOR CHINA, 2005.

Government Incentives

The Indian government considers the CDM as a promising opportunity to achieve its sustainable development goals and attract foreign investment. It therefore offers a number of incentives to promote CDM projects in the country. For CHP projects the most important of these are:

Biomass cogeneration incentives

- National Programme on Promotion of Biomas Power/Bagasse-based CHP (capital grants and interest subsidies)
- 80% depreciation on cogeneration equipment may be claimed in first year
- 5-year tax holiday with 30% exemption for projects with power purchase agreement

Renewable Energy

- Customs duty for RE projects <50MW of 20% ad valorem
- Central sales tax exemption, and general sales tax exemption in certain states
- Minimum purchase rates of Rs. 2.25 per unit (all renewable energy sources)
- Encouragement of bundling to bring down transaction costs
- Incentives to promote rural energy generation and village electrification

Financial and legal arrangements

The general investment climate in India is good, which facilitates Foreign Direct Investment (FDI) in CDM projects. The governments promotes FDI through the Foreign Investment

Promotion Board and Foreign Investment Implementation Authority. No government approval is needed, Indian capital markets are freely accessible, and tax incentives are available for investment in the power sector.

A more problematic issue is the legal status of CERs in Indian law. They are defined as "intangible assets that can be traded and transferred", but their ownership is not clearly defined. Investors have avoided this uncertainty through clear contractual arrangements with the project developers about the ownership rights of the CERs. However, the taxation of CERs is still unclear too, hampering CDM investment.

POTENTIAL FOR CHP PROJECTS IN THE CDM IN INDIA

Cogeneration status and potential

In India CHP facilities represent 16% of total installed capacity (18.7 GWe), and generate 12.1% of the country's electricity[25]. Most of this is located in food manufacturing plants, particularly in the sugar sector. There is therefore already a strong tradition and expertise with bagasse cogeneration, but in other sectors cogeneration is also used. The total potential for cogeneration is estimated at 20,000 MWe, most of which is in the food processing sector (table 20).

TABLE 20:
CHP POTENTIAL IN INDIA BY SECTOR

Sector	Potential (MWe)
Sugar	3,000
Iron and Steel	1,000
Dairies, Breweries and Distilleries	2,500
Pulp and paper	800
Rice mills	1,100
Textiles	800
Cement	800
Fertiliser	1,200
MNES ANNUAL REPORT, 2004.	

CDM status and potential in India

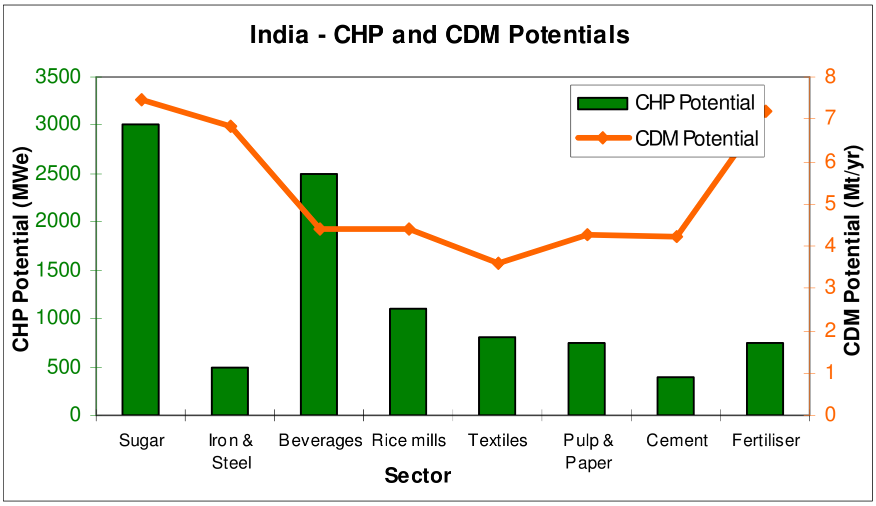
TABLE 21:
CDM STATUS IN INDIA

	Approved Projects	Installed Capacity (MWe)	GHG Emissions Reductions (t/yr)
All CDM projects	104	-	10,975,109
CHP projects	23	298.5	1,295,246
Sugar	8	91.8	340,526
Iron and Steel	7	158	653,466
Textiles	3	13.0	75,804
Pulp and Paper	1	3.0	14,744
Other	4	32.7	210,706
WADE, 2006			

India represents almost one-third of all registered CDM projects, and over one-third of registered CHP projects. Initially most projects were in sugar mills, but throughout 2006 the range of projects has diversified (table 21). The sugar sector still has most registered projects, but represents only 26% of GHG emissions reductions from approved projects, as most projects are small Since May various waste-heat driven energy generation projects in industry have been registered, lead by the iron and steel sector, which now represents over half of all registered emission reductions.

25 WADE, DE World Survey 2006.

FIGURE 18:
CDM POTENTIAL IN INDIA



INSTITUTE FOR GLOBAL ENVIRONMENTAL STRATEGIES, CDM COUNTRY GUIDE FOR CHINA, 2005.

Figure 18 shows that the CDM potential mirrors energy use in India: 65-70% of India's total energy use by 7 sectors: cement, pulp & paper, fertiliser, iron & steel, textiles, aluminium and refineries, all of which can benefit from CHP. The food sector is still the most significant, but many large industrial energy recovery projects are attractive as well. For food-processing cogeneration represents a large share of the CDM potential, while for industrial energy efficiency many more technologies and measures can deliver emission reductions, so cogeneration is a smaller segment of the total potential. However, potentials in industries are generally larger, so the opportunities for CHP are still significant.

Drivers	Barriers
• Large demand for new generation capacity • Low reliability of grid electricity • Strong government support for CDM • Good investment climate	• No clear time-limit on approval process • No clarity on ownership rights of CERs • Uncertainty about the taxation of CERs • CDM transaction costs

Prospects

The potential for cogeneration projects in the CDM in India is substantial, particularly in industrial and food manufacturing applications. Furthermore, the long tradition of bagasse CHP makes such projects relatively low-risk. However, there is no clarity yet about the legal and fiscal status of CERs, and the approval process and related costs. This needs to be resolved to reduce risks and make CDM more attractive for investors.

4.6 Neglected CHP project opportunities

The number of registered cogeneration projects in the CDM has been gradually increasing, representing around 20% of all projects, including biomass-fired applications in food-processing and waste heat recycling in industry. There are many more possible applications of cogeneration in the CDM, though, which are maybe not as established as the current project types, but represent large future opportunities nonetheless. Below three such neglected opportunities are discussed briefly.

COGENERATION IN BUILDINGS AND CCHP APPLICATIONS

Building-integrated CHP (BCHP) is not as common as industrial cogeneration applications, but it can deliver similar benefits. The on-site generation of heat and power, rather than using heat-only boilers and grid electricity can reduce energy costs and increase supply reliability in residential and commercial buildings, just as it does for industrial plants. Buildings normally represent a significant portion of a country's energy consumption, so the overall potential is large. Furthermore, buildings are well suited for CCHP systems as well, because much of the energy consumed is often for cooling purposes. WADE research has indicated that the potential emission reductions from BCHP in China are 135 Mt CO_2 eq/yr in 2020, and 40 Mt CO_2 eq/yr in 2020 in India[26].

BCHP projects can easily be made eligible for the CDM. The emission reductions compared to a baseline of continued use of grid electricity and heat-only boilers can be calculated in very much the same way as for other natural gas cogeneration projects (methodology AM0014). The case for additionality is possibly even stronger than for industrial cogeneration projects, because BCHP and CCHP are less common, and can face more significant cost barriers and regulatory obstacles.

EMISSION REDUCTIONS FROM ON-SITE GENERATION

One of the main advantages of cogeneration and other on-site generation is the avoidance of losses in the electricity network. However, most approved methodologies for CHP projects assume that this is negligible, and no emission reductions are credited for this. It would be possible, though, to develop a methodology that includes the emission reductions resulting from avoided network losses due to on-site generation of electricity. The calculation of emission reductions can be based on the total amount of grid electricity used, the average T&D losses of the local electricity network, and the average CO_2 emission factor of the grid electricity, as shown in the example below.

Calculating the CO_2 emission reductions from avoided T&D losses

This simplified example considers the CO_2 emission reductions from a hypothetical on-site generation project at an industrial facility in India. If we assume the facility currently uses 40 GWh/yr of grid electricity, local network losses are 20% and the average emission factor of the supplied electricity is 600t CO_2/GWh, then the resulting emission reductions from on-site generation of the same amount of electricity are:

40 GWh/yr * 0.20 * 600 t CO_2/GWh = 4800 t CO_2/yr

26 WADE, Building Integrated Cooling, Heat and Power for Cost-Effective Carbon Mitigation, 2005.

The example shows that the emission reductions from avoided T&D losses are relatively small, unless the total electricity consumption and gird losses are large. Emission reductions through on-site generation are therefore maybe not attractive as a stand-alone methodology, but it can form an important part of other methodologies for on-site generation projects. The incorporation of T&D losses in other methodologies would recognise one of the key benefits of on-site generation, and the additional emission reductions could improve the economic viability of decentralised energy projects.

COGENERATION REPLACING CCGT

Cogeneration projects currently registered for the CDM have particularly focussed on biomass CHP, so that fossil-fuel cogeneration has been very much neglected. There is one methodology for natural-gas based cogeneration (AM0014), but this is a very specific case, and the only relevant project in Chile has not been submitted to the CDM-EB yet. The potential for emission reductions from fossil-fuel CHP projects is significant, but for the number of applications to rise a general methodology for fossil-fuel cogeneration projects is required.

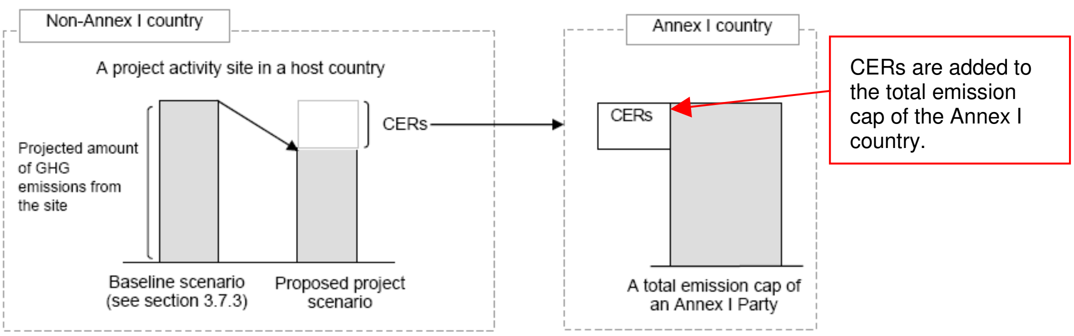
A methodology for fossil-fuel based cogeneration can be based on methodology AM0014, but it would also make sense to develop a methodology for CHP replacing CCGT, as there is already a methodology for conversions from single cycle to combined cycle power generation (ACM0007). The upgrade from CCGT to cogeneration is a similar improvement of efficiency of the generation system, so that the new methodology could be based on the existing methodology.

4.7 Outstanding issues for the CDM

The CDM has only been operating for less than a year, so many of the procedures are still being developed, and the experience of implementing projects is limited. This means that there are some issues that have not been resolved fully, and need to be clarified to make the CDM successful.

THE CDM CREATES ADDITIONAL EMISSION ALLOWANCES

FIGURE 19:
CERS AS ADDITIONAL EMISSION ALLOWANCES



WADE, 2006, ADAPTED FROM INSTITUTE FOR GLOBAL ENVIRONMENTAL STRATEGIES

One problem with the CDM is that it creates additional emission allowances for Annex I countries on top of the targets set by the Kyoto protocol. This results from the fact that CDM project host countries do not have emission reduction targets, so any emission reductions from a CDM project are effectively raising the emission target for the Annex I country involved, because it does not have to make those reductions at home anymore (figure 19).

The response to this claim is that globally it is unimportant where the emission reductions are made, so reductions in the emission growth from non-Annex I countries are equally significant as reductions in Annex I countries. However, the additional emission allowances created by the CDM still undermine the conceptual aims of the Kyoto Protocol, and can harm the credibility of the mechanism and the CER market.

ADDITIONALITY OF CDM PROJECTS DIFFICULT TO PROVE

The most problematic aspect of the CDM is the additionality principle, for several reasons.

Firstly, additionality must be proven in comparison with baseline alternatives. However, these alternatives to the project activity will not be implemented, and are therefore hypothetical scenarios. It is possible to make reasonable assumptions for these baselines, but even then it is possible that the actual scenario in the absence of the project activity would have been different.

Secondly, the methodologies for comparing baselines with the project activity to establish additionality entail many uncertainties. The strongest part of additionality assessment is the economic analysis, but even here many of the input data must be based on assumptions. For instance, capital investment costs can often be estimated relatively accurately, but operational costs, and particularly fuel costs are fairly unpredictable. For other additionality assessment methods, like barrier assessment, the results are more speculative. It is very difficult to show that a project faces particularly barriers for implementation, *and* that the removal of these particular barriers would make the project viable, *and* that the CDM would remove these barriers. In reality barriers to project implementation are multi-dimensional, and they are linked and influence each other. The removal of a single barrier may therefore be necessary for project viability, but it is hard to prove that it is sufficient.

Due to these problems in establishing project additionality it is likely that some CDM projects are not strictly additional, particularly projects that have been operating before the CDM became operational in 2005. The fact that these project were already implemented suggests that they are the baseline, rather than an additional alternative.

POLITICAL UNCERTAINTY: POST-KYOTO ARRANGEMENTS

The future development of the CDM is generally thought to be promising, but a number of uncertainties remain. On a political level it is not yet clear what kind of climate change agreement will emerge in 2012 after the first commitment period of the Kyoto Protocol. Negotiations are still taking place, and the main questions are whether the US will be involved, and whether developing countries will adopt emission caps. American participation would be a huge boost for the CDM, as it would raise the expected demand for CERs, and increase prices. The effect of emission caps for developing countries is more complicated to predict, because emission reductions currently in the CDM would then also have be used for meeting targets in the host countries themselves. This would not have to mean the end of the CDM, but it would be more like the Joint Implementation mechanism. It is therefore conceivable that the two will merge in the future.

Whatever happens after Kyoto, any future global climate agreement is likely to include international trading and project implementation mechanisms such as JI and CDM, because these are supported by all major parties in the negotiations.

FINANCIAL UNCERTAINTY: CARBON MARKETS AND CARBON PRICES

For investors the main problem with the CDM is its financial uncertainty. The risks related to the CDM's procedures, their costs, and the CER delivery risk still put off many financing organisations from investing in CDM projects. For project developers the availability of project funding is therefore limited, a problem the CDM was supposed to solve.

The future development of the carbon market is a second issue for investors. The estimates for the size market range widely, as do projections of carbon prices. The supply of CERs is mostly determined by the functioning of the CDM mechanisms and the carbon price, because the potential for emission reduction projects in non-Annex I countries is huge. The demand depends mostly on the emission caps set for Annex I countries, and the potential to meet these at home. Both demand and supply obviously influence the carbon price. For instance, when the US announced not to ratify the Kyoto Protocol the projections for carbon prices suddenly fell, because demand for CERs from the US would have been large. Furthermore, when it became clear in May 2006 that the emission caps for industries within the EU ETS were much more generous than intended, the European carbon price fell, because supply of emission allowances was much larger than previously thought.

In the context of the uncertainties in future carbon market trends it is important to realise that the CDM is not the only source of emission reduction certificates, and must therefore compete with other sources. Annex I countries have various options for meeting their reduction targets. Initially they will try to meet their commitments at home, if cost-effective. If it is deemed necessary to buy emission reductions abroad they can use the CDM or the JI, but they can also directly buy reduction certificates from other Annex I countries that manage to reduce emissions below their target. However, the mechanisms making emission reduction certificates from the different schemes compatible still need to be specified to create a global carbon market.

There are large amounts of emission reduction certificates available from former Soviet countries, as their targets are based on their emissions before the break-up of the USSR. These targets are therefore much higher than their actual projected emissions, so they will have many emission reduction credits available to sell to other Annex I countries. This 'hot air' is a major concern for the future development of the CDM, because it not only represents a competing source of emission reductions, but also undermines the credibility of the carbon market.

Much of the current uncertainties of the CDM are the 'toothing problems' experienced by any new global initiative. They can be resolved as project experience increases, the CDM procedures become established, and trust in CER markets becomes stronger. To make this happen it is important that all parties involved in the CDM have the political will to work towards the aim of the mechanism, and to make it a success.

5. Conclusion

The CDM provides a major opportunity for cogeneration projects in developing countries. The necessary conditions for cogeneration often do exist in these places, but project implementation is hampered by lack of experience or resources. The CDM can alleviate these problems by facilitating knowledge and technology transfer from Annex I countries, and giving the projects an additional source of revenue through CERs.

The CDM EB has established the general procedures for the CDM, though details still have to be specified. After initial screening of the project activity, the developers must compose a PDD, explaining the activity and its impacts, identifying the alternative scenarios, and establishing baseline methodologies and additionality. The PDD then has to be approved by the host country and validated by a DOE before it can be registered at the EB. During the project activity the developer has to monitor the emissions from the project based on the methodology of the PDD, in order to calculate the achieved emission reductions. Once these are verified by a DOE and certified by the CDM EB, CERs are issued, and can be sold to Annex I parties.

Currently the number of cogeneration projects in the CDM is about 20% of all registered projects, but most are smaller than the average CDM projects, so their share of emission reductions is smaller. Brazil and India are leading in implementing CHP projects, but more countries are becoming involved. Most early projects were in small food manufacturing plants, and biomass fired, but recently a number of large industrial waste-heat recycling projects have been registered too.

The potential for future cogeneration projects in the CDM is significant. Developing countries have both large CDM and CHP potentials, and many projects can be readily implemented The main two existing opportunities are biomass-based cogeneration in the food-processing sector, and industrial energy efficiency improvements through cogeneration, as shown by the cogeneration projects already registered. A number of different CHP project types also have significant potential in the CDM, including building-integrated CHP, but these have so far been neglected. In addition to India and Brazil the main potential for cogeneration projects in the CDM is in China, mostly in large industry. Other countries, like Indonesia and Chile are also attractive for developing cogeneration projects.

The overall prospects of the CDM in general, and cogeneration projects within it, are therefore very positive, and the mechanism will undoubtedly continue to grow as the global carbon market expands. The CDM still faces a number of issues, though, primarily relating to the reliability of the additionality assessment and the uncertainties involved in the procedures. These issues can be solved, though, and as the CDM matures confidence in the system will grow. The main challenge to achieve this is to get all players involved working towards the overall aims of the CDM: reducing global carbon emissions and promoting sustainable development.

Glossary

Additionality Principle – The requirement for CDM projects that 'the reduction of emissions through the CDM project must be additional to reductions that would occur without the CDM project'.

Annex I country – Country signed up to the Kyoto Protocol that has a GHG emission cap.

Baseline Methodology – Methodology for assessing the scenario and emissions for a project in absence of the CDM project activity.

Certified Emission Reduction (CER) – Tradable emission reduction certificates issued to CDM projects for GHG emission reductions achieved.

Clean Development Mechanism (CDM) – Mechanism that allows Annex I countries to meet part of their emission reductions through projects in non-Annex I countries.

CDM Executive Board (CDM-EB) – International supervisory board for the CDM, operated by the UNFCCC.

Combined Heat and Power (CHP) – The combined thermal generation of heat and electricity for local use.

CO_2 equivalent (CO_2-eq) – The effective global warming effect of a GHG expressed in the amount of CO_2 with equivalent warming effect.

Conference of the Parties (COP) – Annual meeting of the Parties of the Kyoto Protocol. Since ratification of the Protocol in 2005, this is combined with the Meeting of the Parties (MOP) of countries that have ratified the treaty.

Crediting Period – The period over which CERs are issued for a CDM project.

Decentralised Energy (DE) – Electricity generation at the point of use.

Designated National Authority (DNA) – National supervisory organisation, which regulates and manages the CDM procedures and implementation in a county.

Designated Operational Entity (DOE) – Independent organisation accredited by the CDM-EB to validate the baseline methodology for CDM projects, and verify the emission reductions achieved.

EU Emissions Trading Scheme (EU ETS) – European market-based mechanism that distributes emission quota between major GHG emitting industries, and allows trade between these to meet emission caps cost-effectively.

First Commitment Period – First period during which Annex I countries must meet their emission caps (2008 – 2012).

Greenhouse Gas (GHG) – Chemical substance, which has a net positive global warming effect when released into the atmosphere. GHGs covered by the Kyoto Protocol are: CO_2, CH_4, N_2O, HFCs, PFCs and SF_6.

'Hot air' – Excessive emission quota of former Soviet Union countries, which do not account for the sharp reduction in economic output during the collapse of communism.

Joint Implementation (JI) – Mechanism that allows Annex I countries to meet part of their emission reductions through projects in other Annex I countries.

Kyoto Protocol – International agreement adopted at the 3rd COP in Kyoto in 1997, which quantifies emission reduction targets and establishes the mechanisms to reduce global GHG emissions.

Leakage – 'Net change of GHG emissions which occurs outside the project boundary and which is measurable and attributable to the CDM project activity'.

Marrakech Accords – Agreements adopted during the 1st meeting of the CDM-EB at COP 7 in 2001 in Marrakech, which specify the procedures and rules for the CDM.

Monitoring Methodology – Methodology for monitoring the GHG emissions from CDM projects during project operation, including measurement of data required for calculating the GHGs that would have been emitted in absence of the project activity.

Non-Annex I country - Country signed up to the Kyoto Protocol that does not have a GHG emission cap.

Project Boundary – 'All anthropogenic GHG emissions by sources under control of the project participants that are significant and reasonable attributable to the CDM project activity',

Project Design Document (PDD) – Standard document describing the project activity, baseline methodology and emission reduction calculations for CDM projects.

Project Validation – Evaluation of the PDD of a CDM projects by a DOE, which checks its compliance with CDM procedures and requirements.

Project Verification – Evaluation of the Monitoring Report of a CDM project by a DOE, which checks the emission reductions achieved by the project.

Small CDM project (SCC) – CDM project with a energy output or efficiency gain equivalent to 15MW.

United Nations Framework Convention on Climate Change (UNFCCC) – International convention, which aims for 'stabilisation of GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system'.

CDM Information, Links and Sources

Comissão Interministerial de Mudança Global do Clima (CIMGC) – Brazilian DNA, with country-specific information for Brazil.

www.mct.gov.br

CD4CDM – Online platform for CDM capacity building, established by the UN Environment Programme and the RISO Centre. The site gives access to a large range of publications on CDM procedures, baseline methodologies, economic issues and environmental impacts. Probably the most useful source for CDM project proponents.

http://cd4cdm.org

CDM Brazil – Online platform established by the Environmental Department of the German Chamber of Commerce with information about the CDM in Brazil.

http://www.ahk.org.br/cdmbrazil

CDM India – Website of India's National CDM Authority, providing all information required for developing CDM projects in the country.

http://cdmindia.nic.in/

China Office of National Coordination Committee on Climate Change – The Chinese government's CDM website with information about China's CDM procedures.

http://cdm.ccchina.gov.cn/english

Institute for Global Environmental Strategies (IGES) – IGES has done extensive research on the CDM, and published a wide range of useful documents, including general guidance documents and CDM studies for Asian countries.

http://www.iges.or.jp

Kyoto Mechanims Information Platform – Online Platform hosted by the Kyoto Mechanisms Acceleration Platform of the Japanese government. Informtion includes CDM news, introductory guides, and links to other sources.

http://www.kyomecha.org

Pembina Institute for Appropriate Development – The Pembina Institute has published both general guides and country-specific documents on the CDM.

http://www.pembina.org

Point Carbon – The main source for information on the CER and carbon market, including price trends and future potentials. Much of the information is for subscribers only, though.

http://www.pointcarbon.com

United Nations Framework Convention on Climate Change (UNFCCC) – The UNFCCC CDM website provides guidance of all CDM procedures and regulations, an up-to-date overview of registered projects, and information about country DNAs and accredited DOEs.

http://cdm.unfccc.int/

WADE
WORLD ALLIANCE FOR DECENTRALIZED ENERGY

The World Alliance for Decentralized Energy
15 Great Stuart Street
Edinburgh
EH3 7TP
Scotland, UK
Tel: +44 (0)131 625 3333
Fax: +44 (0)131 625 3334
info@localpower.org
www.localpower.org

October 2006

www.localpower.org