Small-Scale CDM Projects: Opportunities and Obstacles

Can small-scale projects attract funding from private CDM investors?

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Study financed by
Swiss Agency for Development and Co-operation

Autors:
Factor Consulting + Management AG and Dasag Energy Engineering Ltd.

Zurich, November 2001
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1 Executive Summary

The following findings and recommendations are based on the analysis of sixteen small-scale CDM case studies in the Indian renewable energy sector. The data stem from already implemented projects which would most likely qualify as small-scale CDM (<15 MW\(^1\)) in the future.

Sustainability

On one hand, the majority of projects evidently contribute to local sustainable development (see Figure 1). This is especially true for social parameters of sustainable development. Often, ten times higher employment effects and a much more equal distribution of income are observed compared to the baseline case.\(^2\) For this reasons, small-scale CDM projects are highly valuable from a sustainability perspective.

![Figure 1: Overview on sustainability assessment of CDM cases analysed. Six different indicators were quantified for every project. Each beam represents an indicator of a particular project.](image)

Private investor's perspective

On the other hand, the majority of these projects will not be able to attract investments from commercial international CDM investors. Even if they show good financial returns, most of the projects will not be able to bear the additional transaction costs which appear when a

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\(^1\) Definition of small-scale according to the "Bonn agreement", Decision 5/CP.6

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commercial international investment takes place. The costs for a conventional due diligence
process and for additional CDM requirements such as validation, monitoring and certification
would be unbearable high for their small project size.

Figure 2: IRR and CER yield of CDM case studies. Each dot represents a case study.
Projects in section 1 are assumed to be attractive for private CDM investors.

Figure 2 shows that only two projects could be considered attractive for private CDM inves-
tors without any special procedures.3

Therefore we find a "small-scale CDM" dilemma. A high potential to contribute to sustainabil-
ity combined with the inability to attract private CDM investments. We propose two ways to
face this dilemma:

a) Project bundling

Transaction costs can be minimised by bundling similar projects together. The international
CDM investor only deals with the bundling organisation and not with individual projects. The
analysis shows that bundles of 10 or more units can turn several types of small-scale pro-
jects into viable CDM projects. But the increase of the bundle size from 10 to 100 projects
doesn't provoke a real change to the investment behaviour. To make use of this effect, we
suggest to allow bundling of small-scale CDM projects. The projects within a bundle shall
benefit from standardised baselines and streamlined procedures for validation, monitoring
and verification. If such measures to facilitate small-scale CDM are not approved, most

2 The baseline for the projects was defined as a new 520 MW coal fired power station, for details see Volume 2 of this
study.

3 Based on our experience in the current private carbon market, we consider projects with a Internal Rate of Return (IRR)
>15% and an annual CO₂-emission reduction > 5 t per 1000 USD invested attractive for private CDM investors under cur-
rent circumstances.
small-scale projects will not be able to bear CDM transaction costs and will therefore not be able to participate the CDM.

In the initial phase of CDM, several bundling organisations will need support to build up their capacity and to co-ordinate, train and assist local project developers. Such support could come from development agencies, which are interested to foster sustainable development by implementing small-scale projects.

b) Unilateral CDM

In an unilateral CDM model the project is developed, financed and implemented by the host. No foreign investment takes place. The project owner sells independently produced CERs to interested entities in Annex-I countries. Transaction costs linked to international investments are completely cut. Our analysis showed that unilateral CDM projects with local validation and verification can be a rewarding possibility for projects which would never attract international CDM investors, solely their size is too small. For many of these projects the unilateral model will be the only way to get a commercial CDM setting in place, because transaction costs involved for international investments would be unbearably high for the project’s size.

As CDM is a new concept to many local stakeholders thorough capacity building is needed in the emerging phase of CDM. Development agencies could initiate capacity building processes to ensure independent and locally driven small-scale projects will be able to participate the CDM. Areas of particular interest are:

- Training of project developers in CDM specific methodologies such as project description, elaborating baselines or monitoring protocols.
- Building local validation and verification capacity, which is internationally respected and gets accreditation.
- Facilitating the development of effective and streamlined local CDM institutions (e.g. approving body).
- Ensuring a reasonable CER price for local project owner through awareness building and market access.

In addition, a combination of unilateral CDM with project bundling will increase the competitiveness of small-scale projects within the CDM.
2 Introduction

The Clean Development Mechanism as defined in the Kyoto Protocol represents a novel instrument, which aims at combining cost efficient climate change abatement with sustainable development of host countries. It’s a project based instrument, which allows an Annex-I country to account emission reductions resulting from abroad (= Certified Emission Reductions, CER) for their own commitment. Without an appropriate general framework its foreseeable that small and medium scale projects will hardly profit from future CDM investments. Particularly, transaction costs (e.g. for project development, assessment, validation and verification) will be unprofitably high for projects of a smaller size. Therefore private investors will most likely chose projects of a bigger size.

On the other hand, indications are give which suggest that many small-scale projects contribute intensely to a sustainable development of the host country. Therefore it would be desirable that small-scale projects will profit as well from future international CDM investments.

The Conference of Parties (CoP) decided during its sixth session to adopt simplified rules and modalities for small-scale projects. "Small-scale" for renewable energy projects has been defined as smaller than 15 MW electrical output. This report looks at case studies of such potential small-scale CDM projects with two major questions:

a) How do the projects contribute to sustainable development?

b) Under which conditions are small-scale projects able to attract private international CDM investments?

Conclusions and recommendations are drawn for i) the CDM Executive Board, which will probably be formed at CoP-7, and ii) development agencies such as Swiss Agency for Development and Co-operation (SDC).

The study was jointly elaborated by an Indo-Swiss team and is document by three different reports with distinct lead-authors.

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<td>Ms. A. Sharan, WSD Mr. Ravichandran, Fichtner Engineering</td>
</tr>
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</table>

4 For an introduction to the Kyoto protocol and CDM see Oberthür and Ott 1999.
3 Objectives

A set of already implemented small-scale projects is analysed as if they were implemented under an emerging CDM scheme. Based on the findings of these case studies this report shall:

- Identify key opportunities and obstacles of small-scale CDM projects.
- Formulate a recommendation how to design international CDM procedures and requirements in order to facilitate small-scale projects.
- Suggest possibilities which role development agencies like SDC could play in the field of small-scale CDM projects.

4 Methodology

The methodology used and the working steps taken can be seen in Figure 3. The ellipses show in which chapter of the report the results of specific working steps are documented.

In a first step we analyse key elements of CDM projects and define the procedure to evaluate them in the case studies. In addition, concepts how small-scale CDM could be supported are described. Later these tools are tested by applying to the case studies.

In the second step, a set of case studies is described and analysed with regard to sustainability and from a private investor's point of view. The case studies focus on electricity generation with renewable energies in India. Conclusions and recommendations are drawn from the analysis and address the CDM Executive Board well as development agencies such as SDC.

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Figure 3: Applied methodology and references to corresponding chapters.
5 Key aspects of Small-Scale CDM

5.1 International Political Framework

The international framework for the Clean Development Mechanism is presently emerging. The purpose and the general principles of the Clean Development Mechanism are defined in the Kyoto Protocol Art. 12. (see UNFCCC 1997, Art.12). The "Bonn Agreement", which was agreed on in July 2001, reinforces those principles and adds some specifications. Nevertheless, the detailed rules which future CDM projects will have to fulfil are still under negotiation. Following we give a short overview on two key issues of CDM, where decisions were already taken and which do matter for the purpose of this study.

Sustainability

Art. 12 of the Kyoto Protocol (see UNFCCC, 1997) defines explicitly a twofold objective. Accordingly, the purpose of the CDM is

a) to assist Parties not included in Annex I in achieving sustainable development and in contributing to the ultimate objective of the Convention, and
b) to assist Parties included in Annex I in achieving compliance with their quantified emission limitation and reduction commitments under Article 3.

This shows clearly that the criteria of sustainability can't be considered as a minor issue or a secondary benefit of CDM. It has to be dealt with on the same level as its function of generating CERs.

According to the Bonn agreement "it is the host Party's prerogative to confirm whether a clean development mechanism project activity assists it in achieving sustainable development" (UNFCCC 2001a, p.8). Hence, the criteria for sustainability will be defined by the host countries. The only exception at the moment is the internationally set requirement that Annex I countries "are to refrain from using emission reduction units generated from nuclear facilities to meet their commitments".6

Prompt start for Small-scale CDM

In the "Bonn agreement" (UNFCCC 2001a) a prompt start for CDM is foreseen. For this reason, a CDM executive board will be elected at CoP-7 in November 2001. This executive board shall develop and recommend simplified modalities and procedures for small-scale CDM to the Conference of the Parties. The Bonn agreement defines small-scale CDM in the renewable energy sector "as project activity with a maximum output capacity equivalent of up

5 UNFCCC (2001b) shows the current status of the international negotiation process. It's a draft decision proposed by the Co-Chairmen of the negotiating group at the end of CoP-7.
6 See UNFCCC 2001a, VI.3.
to 15 megawatts”. The case studies analysed in this study fulfil these requirements. Therefore the simplified CDM procedures would apply for future projects of a similar type.

5.2 Sustainability of Projects

"The purpose of the clean development mechanism shall be to assist Parties not included in Annex I in achieving sustainable development …"

*Kyoto Protocol Art. 12.2*

As quoted above, the concept of sustainability is an explicit requirement of the CDM as defined in the Kyoto Protocol and in the subsequent documents. The concept is generally agreed on but clear definitions, criteria or procedures how to analyse the sustainability of a particular CDM project are missing to date.

After being applied in the management of forestry and fish resources for a long time, the concept was coined in a broader context by the report published by the Brundtland Commission "Our Common Future" (WCED, 1987). It defined it as a "development that meets the needs of the present without compromising the ability of future generations to meet their own need". Most often the concept is divided in three different aspects: environmental, social and economic aspects. Following this threefold concept we developed a set of indicators to assess the case studies in order to analyse their impact on sustainable development. As sustainability is of a very vague and complex nature, such a definition of indicators involves many normative decisions. A set of manageable indicators can't be deducted in a strict scientific way. Nevertheless the team evaluating the case studies chose two relevant and quantifiable indicators for every of the three sustainability dimensions. An overview on the indicators and the rationales why there were chosen are given in Figure 4.

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7 For detailed exploration and analysis of the concept on the macro level see Infras 1996 and SDC 2001.
5.3 Requirements of Private Investors

Private investor's view

The flexible mechanism CDM has mainly been defined to channel private investments into actions against global climate change. The main participants shall be private entities. Therefore private investor's view towards projects has to be looked when discussing CDM investments. Investment decisions often depend on many different factors which are linked in a complex way. Nevertheless, we look at two basic parameters which drive investment decisions: Expectation of return and perception of risks related to the project. Only if risks and

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**Dimension evaluation**

<table>
<thead>
<tr>
<th>Indicator for evaluation</th>
<th>Unit</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combating poverty</td>
<td>Net employment generation</td>
<td>manyear/year</td>
</tr>
<tr>
<td>Equal distribution</td>
<td>Ratio of income for poor women compared to total income generated by the project</td>
<td>%</td>
</tr>
<tr>
<td>Microeconomic efficiency</td>
<td>IRR</td>
<td>%</td>
</tr>
<tr>
<td>Contribution to balance of payments</td>
<td>Net foreign currency required/ MW installed capacity</td>
<td>USD / MW</td>
</tr>
<tr>
<td>Saving of resources</td>
<td>Fossil fuels used</td>
<td>t/year</td>
</tr>
<tr>
<td>Pressure release on local environment</td>
<td>SO2 emissions</td>
<td>tonnes</td>
</tr>
</tbody>
</table>

Employment provides people with a regular income which helps them to improve their personal economic situation.

Equal distribution is a crucial point for sustainable development. A project contributes to it when income flows to the group which currently has the least of all. In the cases analysed this group is formed by poor women.

The Internal Rate of Return measures the microeconomic efficiency of projects. It shows in which extent the financial flows on the project level produce revenues on the initial investment.

This indicator aims at the macro-level. If less foreign capital is needed to implement a particular project the national balance of payments improves.

The most important resource in the context of the particular projects has been chosen and its saving was evaluated.

The most important local pollutant in the context of the particular projects has been chosen and its reduction was evaluated.

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*Figure 4: Overview on sustainability indicators used to assess the case studies*
Small-scale CDM projects

return are in balance an investment will be done. CDM – especially in the evolutionary status we are in at the moment – is perceived within the business community as a business area with very high risks. Apart from project specific risks, which will occur in every project, CDM shows several additional risks as can be seen in Table 1.

<table>
<thead>
<tr>
<th>CDM risk</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>International political risk</td>
<td>The detailed rules for CDM are emerging. At the moment they can only be anticipated. The value of the CER depends on i) international regulations ii) host country and iii) donor country.</td>
</tr>
</tbody>
</table>
| Domestic political risk   | i) Investor's country has to ratify the Kyoto Protocol.  
                                ii) Private companies in most countries do not yet have fixed obligations to reduce their CO$_2$ emissions.                                      |
| Country risk              | i) Host country has to ratify the Kyoto Protocol.  
                                ii) CERs are produced in countries with relatively high country risks.                                                                                   |
| CER market risk           | At the moment no real market for carbon has been established. The prize of carbon on future markets is subject of highly speculative assumptions                                                                   |

Table 1: Major CDM specific risks for private investors faced at the moment.

CDM projects create a twofold return: i) conventional financial returns and ii) CERs, which can be used to ensure own compliance with emission reduction obligations or can be sold on the market. CERs do not yet have a clearly defined value and the risks related to them are still high. Therefore most commercial investors still expect not only a return in CERs but also (a moderate) financial return on their investment. To evaluate the case studies from an investor's point of view, we have to make simplified assumptions concerning their perception of projects. Based on our experience with investors interested in current CDM activities we assume three preconditions a CDM project has to fulfil in order to attract private CDM investments:

- IRR (including international transaction cost) > 15%
- Reasonable annual CER production: 5 t CO$_2$ reductions or more per1000 USD invested
- Reasonable project specific risks

**Transaction costs**

In addition to the project's financial flows which occur in the project without CDM component, we have to consider CDM specific costs when evaluating the case studies. For "conventional" cash flows real data were available as all case studies are based on already implemented projects. As all projects were not implemented as CDM, the CDM component had to be simulated. To date, there is not much experience how high CDM transaction costs will be. Nevertheless, some indications are given by experience from pilot projects and assumptions
drawn from comparable activities. Transaction costs of CDM can be divided into costs which occur during the pre-implementation phase (such as cost for searching, negotiating, validation and approval) and costs which occur regularly during project's lifetime such as monitoring and certification cost. 8

Table 2 shows transaction cost, which were either experienced during the pilot phase (PCF, Prototype Carbon Fund) or estimated (PWC, PriceWaterhouseCoopers). The last row in the table indicates transaction costs which were applied when analysing the project in this study. Please note that the estimations of PWC only include additional CDM cost. The pre-implementation transaction costs used in this study includes minimal cost for a due diligence of the project as a commercial investor will conduct it. A serious due diligence is essential for the investor to get a independent in-depth view of the project. Transaction costs related to CDM are due to procedures which ensure that the project meets the internationally set criteria.

<table>
<thead>
<tr>
<th></th>
<th>Experience PCF (in USD)</th>
<th>Estimation PWC (in USD)</th>
<th>Used in this study (in USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Implementation</td>
<td>290'000-570'000</td>
<td>57'000-103'000</td>
<td>200'000</td>
</tr>
<tr>
<td>(total cost)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post-Implementation</td>
<td>82'000-300'000</td>
<td>22'000-30'000</td>
<td>25'000</td>
</tr>
<tr>
<td>(yearly cost)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Table 2: Transaction cost of CDM per project in USD. The experience and estimation by PCF resp. PWC is based on projects in the range from 100kW-400MW. The case studies are analysed accordingly. Based on Stronzik, 2001.*

6 Supporting Tools for Small-Scale CDM

In this chapter two supporting strategies to address specific problems of small-scale CDM are presented. In order to design effective tools, the most relevant parameters for small-scale projects are identified in the first paragraph.

6.1 Relevant parameters

Figure 5 shows on which elements an international CDM investment decision depends. It presents the key issues which influence the investment decision. The elements which matters especially for small-scale projects are indicated in bold font. As described above, there a three main elements which are relevant to the commercial investor: perceived risks and financial as well as carbon returns. Risks are less size specific compared to returns. They are more related to different technologies and project's environment than to the size of the project.

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8 For more details about Transaction Cost of Project-based Kyoto Mechanisms see Stronzik (2001).
On the other hand, returns result from income and costs. As several project costs (e.g. transactions costs) do not depend very much on the size of the project, they can be a heavy burden for small-scale projects.

Therefore, when analysing small-scale projects, especially transaction costs for international finance as well as CDM specific transactions costs have to be considered with special care.

As shown below, transaction costs are a knock-out criteria for a huge number of small-scale projects. Therefore, we will test two different supporting concepts on the CDM case studies:

a) project bundling and 

b) enabling of multilateral CDM. 

They are briefly described in the following.
6.2 Tool 1: Project Bundling

Overall transaction costs and other more or less fixed costs of the project can be minimised by bundling similar projects together. The bundling organisation can be of various nature, e.g. project developer, equipment supplier, carbon fund etc. The essential fact is that the international CDM investor only deals with this bundling organisation and not with the individual projects.

The benefits of such bundling are expected to be as following:

- Reduction of project development costs
- Reduction of Engineering, Procurement and Construction (EPC) costs
- Reduction of Operation and Maintenance costs (O&M)
- Reduction of transaction costs (general and CDM\footnote{Cost for negotiation, validation, monitoring and verification cost of the CDM project.})
- Increase of total investment volume

The project bundling organisation collects projects and promotes the whole package to the investor (see Figure 6).

\begin{figure}[h]
\centering
\includegraphics[width=0.5\textwidth]{project_bundling.png}
\caption{Figure 6: Principle of Project Bundling. Several \textit{similar} projects are bundled together. \textit{The international CDM investor doesn't invest in individual projects but in a project bundling organisation (e.g. a fund) which deals with the single projects.}}
\end{figure}

Several experience with project bundling in the renewable energy sector has already been made. An example is the cluster approach of DESI Power (Decentralised Energy Systems India Private Ltd.), which bundles gasifier projects for rural electrification.\footnote{A description of the DESI cluster approach is described in Volume 3 of this study.}

\footnote{The difference between project bundling and project pooling is that the former consists of projects of the same type and scale and the latter of different type.}
In chapter 7.4 case studies are analysed how they would perform when bundled to packages of 10 or 100 projects.²

### 6.3 Tool 2: Cutting international transaction costs by enabling unilateral CDM

Analysing Figure 5 implies as a second strategy to foster small-scale CDM. Overall costs of small-scale projects can be reduced by cutting systematically transaction costs which occur due to an international CDM investment. This can be reached by enabling unilateral CDM. In a unilateral CDM the project is developed, financed and implemented by the host only (see Figure 7). No foreign investment takes place, the Annex-I party buys the CERs from the project’s host. Therefore all transaction costs linked with international investments are cut. Like any project, one financed through the unilateral model would need to have an independent third party approve the project design, including the baseline, as well as verify the claimed emission reductions. Once certified, the host can sell the produced CERs to an Annex-I entity. All project related risks stay with the host and its (local) financier.³

![Figure 7: Unilateral CDM. The project is developed, financed and implemented by the host only. No foreign CDM investment takes place. Source: World Resource Institute (2000).](image-url)

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² The development of transaction and project development costs for the bundle were estimated according to the linear formula: cost for bundle = (0.1* number of projects bundled + 0.9) * cost of single project.

³ For more details on different CDM models see World Resource Institute (2000).
In chapter 7.4 the case studies are evaluated without considering international transaction costs to see if they would be bankable within the local economy under a unilateral CDM model.

7 Findings based on Case Studies

7.1 Projects evaluated

Findings of this study are based on the analysis of a set of Indian case studies. They are listed in Table 3.

<table>
<thead>
<tr>
<th>Baseline</th>
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<tbody>
<tr>
<td>1. 520 MW Coal Fired Power Station</td>
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<table>
<thead>
<tr>
<th>Biomass gasification stand-alone Independent Rural Power Producers (IRPPs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. 100 kW DesiPower Orchha</td>
</tr>
<tr>
<td>3. 50 kW DesiPower Kosi</td>
</tr>
<tr>
<td>4. 120 kW Dev Power Corporation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Biomass combustion, steam cycle / co-generation grid connected medium sized power</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. 6 MW Ind Bharat Energies Private Limited</td>
</tr>
<tr>
<td>6. 5.5 MW Servall Paper Mills</td>
</tr>
<tr>
<td>7. 4.5 MW Matrix Biomass Power Plant</td>
</tr>
<tr>
<td>8. 17.5 MW Shamanur Sugar Ltd.</td>
</tr>
<tr>
<td>9. 41 / 8.5 MW Mysore Paper Mill</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stand-alone power stations: Photovoltaic power plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>10. 25 kW Mausuni Island, Sundarbans</td>
</tr>
<tr>
<td>11. 50 kW Mrityunjynagar, Sagar Subdarbans Island,</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Small photovoltaic systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>12. 10'000 * 70 PV Lighting Systems</td>
</tr>
<tr>
<td>13. 2 kW PV Water Pumping System</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Grid connected wind power plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>14. 250 kW Renuga Textiles Wind Generator</td>
</tr>
<tr>
<td>15. 13.5 MW Aban Energies</td>
</tr>
</tbody>
</table>

| Agro / energy forestry: biomass augmentation |
|--------------------------------|---|
| 16. Varlakonda Agro-Forestry |
| 17. Hosahalli Energy Forest |

Table 3: List of case studies analysed.
In the appendix you find a map with the specific locations. The first study serves as the reference case (baseline) which all the other case studies (CDM project simulations) are compared to. The potential CDM projects are all from the sector of renewable electricity production. Different biomass technologies, photovoltaic and wind power were looked at. The last two cases illustrate examples how to ensure a sustainable fuel production for biomass projects.

Volume 3 of this study gives a detailed analyses of all case studies, Volume 2 an elaborated synthesis.

7.2 Sustainability assessment

As described in chapter 5.2, the sustainability of all case studies was analysed with 6 chosen indicators (see Figure 4). The results are given as an overview in Figure 8. It shows the indicators of individual projects compared to the indicator values of the baseline (coal power plant). For detailed results see Appendix and Volume 3.

Most projects analysed do contribute clearly to sustainable development. They show the greatest benefits in the social dimension of sustainability. Due to their decentralised and often work intensive nature most of them contribute directly to diminishing of poverty and to a more equal distribution of wealth. The changes are less obvious when it comes to environmental or economic aspects. Virtually all environmental indicators show positive values. In most of the cases the vast majority of fossil fuel and SO2 emission of the baseline are saved.

When it comes to economic aspects the cases are less clear. In this area the results vary very much from project to project. Especially in the biomass sector better IRR and higher foreign currency savings are reached than in the reference case. On the other hand, PV shows clear negative economic impacts, cause IRRs are very low and the cells have been imported.
Figure 8: Overview on sustainability assessment of CDM cases analysed. 6 different indicators were quantified for every project. Each beam represents an indicator of a particular project.

Following the graphic approach of Swiss Development Co-operation (2001) one can use the "sustainability flower" to show the sustainability impacts of a single project at a glance. Therein the value of every indicator is compared with the corresponding value of the baseline project. The change of indicators can be given in a percentage of the baseline value. Therefore the baseline is represented by a symmetrical, circle-like line. Whenever the line of the CDM project analysed lies outside this circle, it shows a positive change. In the example of a 100kw Biomass gasifier CDM project as shown in Figure 9, 5 of 6 sustainability indicators show positive impacts. The social indicators show more than 200% improvement compared to the baseline. The vast majority of fossil fuels, SO2 emissions and also foreign currency is saved. Whereas the microeconomic efficiency, here measured in IRR, is showing a negative impact.

The detailed sustainability values of all case studies are listed in the Annex.
Figure 9: "Sustainability flower" of a CDM project compared to the baseline project. This example shows the result of a biomass gasifier project in rural India.
7.3 Private investor’s perspective

Even the highest potential for sustainable development would be no use if the particular project doesn’t find an investor who is willing to invest and therefore enables the implementation of the project. After seeing the important contribution of many small projects to sustainable development, we therefore have to ask: " Will they be able to attract CDM investments?". For such analysis we included the transaction costs for international investments and CDM procedures in the project's financial flows. The respective IRR and CER revenues can be seen in Figure 10. When looking at the set of case studies from a private investor’s perspective as defined in chapter 5.3, only two projects have a realistic chance of being considered as a commercial CDM investment opportunity. The overall IRR of all the others would be perceived as too low. The area which can be considered attractive for private CDM investors14 lies in the top corner on the right (marked with number 1). The two potentially viable projects are both biomass based power plants of medium size (6 and 5.5 MW). In this two could cases, the international CDM investor would conduct a in-depth due diligence including a risk assessment before an investment decision would be taken.

All other projects would probably not be able to attract private CDM investments under current conditions.

Figure 10 IRR and CER yield of CDM case studies. Each dot represents a case study. Projects in section 1 are assumed to be attractive for private CDM investors.

---

14 according to the assumptions made above
7.4 Supporting concepts for small-scale CDM

As seen in the last chapter, the majority of small-scale projects will have difficulties in finding commercial international CDM investment. In the following the above introduced supporting tools are tested on the set of case studies to see if they could make a difference for private investors.

Application of Tool 1: Project Bundling

When similar projects are bundled together, as described in chapter 6.2, especially costs for project development and transactions can be reduced in a relevant magnitude. The figures below show the implication of bundles of two different sizes (bundle of 10 and 100 similar projects). We see that projects which show good financial performance without being burdened by additional transaction costs become viable within a bundle. The transaction costs involved are shared by all projects included in the bundle. For example, well designed small biomass gasifiers (100 kW range) become viable within a bundle of 10 projects. Naturally, technologies which have a low IRR in any case (even without transaction costs) will not been pushed into the viable section by being bundled (e.g. PV).

![Figure 11 Effects of bundling similar projects. The dots on the right side represent each a bundle of 10 similar projects. Several projects (biomass gasifiers) enter the investor friendly zone due to cost savings (especially CDM transaction costs).](image)

The increase of the bundle size from 10 projects to 100 will not provoke major changes to investment behaviour within the analysed set of projects (compare Figure 11 and Figure 12). Even if the IRR of gasifier projects increases slightly, no additional project enters the yellow "investor friendly" area.
Figure 12 Effects of bundling similar projects. The dots on the right side represent each a bundle of 100 similar projects. Compared to the bundles of 10 projects certain IRR rise, but no new projects enter the investor friendly zone.

Application of tool 2: Cutting international investment transaction costs

A major burden for small-scale projects are the transaction costs which occur when an international investor analyses the concrete project and conducts an independent due diligence. He wants his expert judging the project and the environment where it will be located before he invests. The costs of this process can't be justified for smaller projects. Therefore, another strategy to foster small-scale CDM projects is to completely cut these transaction costs for international due diligence. This becomes possible, if no Annex-I investor takes part in the project as realised in the unilateral CDM model described in chapter 6.3. Several projects which would not be bankable in the international CDM market show interesting IRRs when financed by local means only. ¹⁵ Figure 13 compares two different IRR for every project:

a) IRR without international investment transaction costs, and
b) IRR with included international investment transaction cost.

The differences between this two IRRs are high, whenever a project is relatively small, but shows good financial performance. As an example we can see small biomass gasifiers (100kW). Even if they show interesting financial performance they are just too small to be analysed in detail by commercial international investors. For their size an international investment will not be appropriate. The whole project development and finance will be done locally and the produced CERs can be sold to Annex-I entities. For this kind of projects unilateral CDM will be the key model for CDM.

¹⁵ Note that in the analysis all international transaction costs (including cost for validation and verification) were cut. Of course an unilateral CDM also needs validation and verification. We assume that CDM transaction cost can be cut to a bearable level due to streamlined procedures for small-scale unilateral CDM. The detailed impacts of CDM transaction costs in the unilateral model will need further analysis.

Factor + Dasag
Figure 13: Effect of cutting international transaction costs on IRR of CDM projects.
8 Conclusions and Recommendations

Analysing the case studies following general obstacles and opportunities can be seen (for technology specific opportunities and obstacles please refer to Volume 2):

8.1 Small-Scale CDM: Obstacles

The major general obstacles and limitations are as follows:

- Most of the projects analysed would have difficulties to find international CDM investments. There are two major reasons for this:
  1. Transaction costs. Most of the projects will not be able to bear the additional transaction costs which rise when a commercial international investment takes place. The cost for conventional due diligence process and for additional CDM requirements such as validation, monitoring and certification would be unbearable high.
  2. Many project specific risks especially for projects with rural off-takers would be conceived as to high.

- CDM is not the instrument which will completely change the situation of renewable energy technologies (RET). On one hand, its additional financial flows are moderate. One the other hand, major barriers occur on the local political level (e.g. missing opportunities for independent power producers to sell their electricity). While CDM can play a role in the growth process of RET markets in developing countries by easing the problems of mobilising finance, it can never really achieve its goals unless the framework and the conditions for the growth of the home market is put in place by the national government.

- For small projects at the village level the plant load factor is the most critical parameter for financial success. If the needed load can't be created and maintained throughout the project's lifetime, the financial as well as the carbon revenues will go down.

- The major problem which occurred with regard to sustainability is the danger of overusing local biomass resources for energy production. Thus, when implementing modern, biomass based energy technologies one has to make sure the natural resources of fuel are managed in a sustainable way.

8.2 Small-Scale CDM: Opportunities

- The projects analysed do clearly contribute to sustainable development of the host country. The effect is the largest in the social dimension. Secondary environmental effects do
also often arise, but economic aspects (on the micro as on the macro level) do often show negative impacts.

- The process of building and running a renewable energy activity, including agro-forestry, provides numerous benefits not traditionally associated with modern centralised energy projects. These include enhanced capacities, acquisition of new management skills, new confidence in dealing with local and state authorities, and growth of responsible citizenship. This is in addition to the direct benefits of increased access to clean, cheap and reliable energy for domestic and economic improvement, and the consequent growth of local value-addition enterprises and jobs.

- All type of projects which were analysed could generate CO₂-offsets. As they are all smaller than 15 MWₑₑₑ, such projects will profit from simplified CDM procedures and requirements as expressed in the Bonn Agreement (UNFCCC, 2001a).

- Bundles of similar projects can reduce international CDM transaction costs of small projects significantly.

- Unilateral CDM projects with local validation and verification can be a rewarding possibility for projects which would never attract international CDM investors, solely their size is too small.

- The two support strategies bundling and enabling unilateral CDM can be easily combined. Hence, the effects can be harvested simultaneously.
8.3 Recommendations

Based on findings from the analysis we come up with following recommendations to i) CDM Executive Board and ii) development agencies:

**Recommendations to the CDM Executive Board**

When negotiating the detailed rules for CDM one should have in mind that simplified procedures for small-scale projects are really needed to ensure the participation in the mechanism for this group of projects. We suggest to formulate rules for small-scale projects, which allow for following points:

- Bundling of projects. Simplified procedures for validation, monitoring and verification of bundled projects shall be developed.
- Unilateral CDM. For several viable projects will simply be to small to bear costs for an international due diligence process.
- Standardisation of baselines to reduce transaction cost and to ensure a more transparent choice of reference.

The analysis shows that the current definition of renewable small-scale projects (< 15 MW) hosts a very heterogeneous group of projects. While a 14 MW biomass fired power plant would not really need special treatment, streamlined procedures are of vital importance for projects like a 100kW biomass gasifier in a village or a solar home system. Therefore an additional differentiation into small-scale and micro-scale (e.g. < 500 kW) with different rules and procedures could better meet the two targets of i) environmental integrity and ii) effective support of small projects.

**Recommendations to development agencies**

As many small-scale projects show clear benefits for sustainable development – especially in the social dimension- they deserve a certain support from development agencies. This is even of more importance in the light of the fact that private investors will turn probably only to bigger size projects. We suggest to promote a combination of the two supporting concepts discussed in this study in order to enable small-scale projects to profit from additional CDM revenues: Bundling of similar unilateral CDM projects. Local private entities shall be the initiators and driving force of such ventures. But in the initial phase of CDM assistance and co-operation will be needed. Development agencies should therefore evaluate if they want to contribute to the process of establishing CDM opportunities for small-scale projects. Possible contributions can include:

- Initiating / supporting organisations which bundle projects together and co-ordinate, train and support local project developers.
Enabling local stakeholders to undertake unilateral CDM projects. As CDM is a new and additional element for project developers thorough capacity building is needed. This shall include:

- Training of project developers in CDM specific methodologies such as elaborating baselines, monitoring protocols etc.
- Building local validation and verification capacity, which is internationally respected.
- Facilitating the development of effective and streamlined local CDM institutions (e.g. approving body).
- Ensuring a reasonable CER price for local project owner through awareness building and market access.

Financial support of pilot unilateral CDM projects (co-financing of CDM specific costs and parallel capacity building programs)

Initiating a institution which is securing CER purchase agreements between an Annex-I entity and the local project owner. Rational: Similar to a Power Purchase Agreement (PPA) a CER purchase agreement (CPA) can be used by the project developer as a security to get a loan from the local bank. As cash flows based on CERs are a completely new concept the local banks will ask for a counter guarantee in the initial phase of CDM. This guarantee could be given by a agency which is in favour of supporting small-scale CDM.
9  Annex

9.1  Locations of case studies
9.2 Summarised sustainability data of case studies

### A. Absolute data

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<tr>
<th>Case studies</th>
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<th>Hosur</th>
<th>Ind Bharat</th>
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#### Indicators

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<th>IRR</th>
<th>Net foreign currency required / MW installed capacity</th>
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For more details see Volume 2 and 3.
9.3 Glossary

Activities implemented jointly (AIJ)
The AIJ pilot phase was initiated at COP-1 in 1995 with the objective of gaining experience with projects which reduce, sequester, or avoid greenhouse gas emissions in a different country. Originally scheduled to end in 2000, the pilot phase was officially continued at COP-5. AIJ has evolved into joint implementation and the clean development mechanism under the Kyoto Protocol.

Additionality
According to the Kyoto Protocol articles on joint implementation and the clean development mechanism, emissions reduction units (ERUs) or certified emission reductions (CERs) will be awarded to project-based activities provided that the projects achieve reductions that are “additional to those that otherwise would occur”. The issue is subject to further clarification by the Parties. According to current usage, environmental additionality requires that emission reductions represent a physical reduction or avoidance of emissions over what would have occurred under a business as usual scenario. Under financial additionality, projects will only earn credit if funds additional to existing ODA commitments are specifically committed to achieve the greenhouse gas reductions. Financial additionality, along with investment additionality, is also used to denote that emission reductions exceed what would have been achieved in a commercial business as usual scenario; implying that the project would not have been commercially viable without the value of ERUs or CERs generated.

Annex I Parties
Annex I Parties are the 36 industrialized countries and economies in transition listed in Annex I of the United Nations Framework Convention on Climate Change (UNFCCC or the Convention). Their responsibilities under the Convention are various, and include a non-binding commitment to reducing their greenhouse gas emissions to 1990 levels by the year 2000. By default, the other countries are referred to as non-Annex I countries. Note that Belarussia and Turkey are listed in Annex I but not Annex B; and that Croatia, Liechtenstein, Monaco and Slovenia are listed in Annex B but not Annex I. In practice, Annex I of the Convention and Annex B of the Kyoto Protocol are used almost interchangeably. However, strictly speaking, it is the Annex I countries which can invest in joint implementation (JI) / clean development mechanism (CDM) projects as well as host JI projects, and non-Annex I countries which can host CDM projects. This is true, despite the fact that it is the Annex B countries which have the emission reduction obligations under the Kyoto Protocol.

Baseline and Baseline Scenario
The baseline represents the forecast emissions of a company, business unit or project, using a business as usual scenario, often referred to as the „baseline scenario“, i.e. expected emissions if the firm did not implement emission reduction activities. This forecast incorporates the economic, financial, technological, regulatory and political circumstances within which a firm operates.

Biomass
The total dry organic matter or stored energy content of living organisms. Biomass can be used for fuel directly by burning it (e.g. wood), indirectly by fermentation to an alcohol (e.g. sugar), or by extraction of combustible oils (e.g. soybeans).
Carbon Dioxide (CO₂)
A naturally occurring gas. It is also a by-product of burning fossil fuels and biomass, as well as other industrial processes and land-use changes. CO₂ is the principal anthropogenic greenhouse gas that affects the Earth’s temperature. It is the reference gas against which other greenhouse gases are measured and therefore has a global warming potential (GWP) of 1.

CDM Executive Board
The CDM Executive Board (EB) is expected to be created in the near future. Prospectively, the EB will assume an oversight role in the development and dissemination of standards to promote the consistency of CDM projects across the globe. What role it will have in enforcing those standards is yet to be determined.

Certification
The process by which an independent accredited body (operational entity) gives written assurance of the emission reductions that have been achieved. In the case of an activity under the clean development mechanism under the Kyoto Protocol, certification also gives assurances that the reductions occurred under the conditions (sustainable development objectives have been met) necessary for recognition by the Parties.

Certified Emission Reductions (CERs)
A tradable unit of greenhouse gas reductions that has been generated and certified under the provisions of Article 12 of the Kyoto Protocol, the clean development mechanism (CDM). In contrast, Emissions Reduction Units (ERUs) are used for joint implementation (JI) under Article 6 of the Protocol. According to Article 12, CERs must be „certified by operational entities to be designated by the Conference of the Parties (COP) serving as the Meeting of the Parties (MOP)“. 

Clean Development Mechanism (CDM)
Article 12 of the Kyoto Protocol provides for the clean development mechanism whereby developed countries are able to invest in emission reducing projects in developing countries to obtain credits to assist in meeting their assigned amounts. The details of the clean development mechanism have yet to be negotiated at an international level. However, it does allow Annex B countries to use credits obtained from the year 2000 for the purposes of meeting their national emissions targets under the Kyoto Protocol. Participation is voluntary, and open to private and public entities alike on a Party approved basis.

Cogeneration
This process involves the use of waste heat from electric generation, such as exhaust from gas turbines, for industrial purposes or district heating.

Credit
Originally defined as a „quantifiable and verifiable recognition of the reduction, avoidance or sequestration of carbon dioxide or other greenhouse gases as a result of carbon offset project“, the word „credit“ was discontinued in the official language of the climate negotiations after COP-3 in favor of emissions reduction units (ERUs), and certified emissions reductions (CERs).

Emissions
The release of gases from combustion of fossil fuels, industrial process sources, etc., as well as by living organisms.

Fossil Fuels
Energy rich substances created from the partial decomposition of prehistoric organisms over long periods of time. Examples are coal, natural gas and oil.
**Framework Convention**
See United Nations Framework Convention on Climate Change.

**Global Environment Facility (GEF)**
The multi-billion-dollar GEF was established by the World Bank, the UN Development Program, and the UN Environment Program in 1990. It operates the Convention's „financial mechanism“ on an interim basis and funds developing country projects that have global climate change benefits.

**Greenhouse Gases (GHGs)**
Any gases that absorb and re-emit infrared radiation into the atmosphere. The greenhouse gases regulated under the Kyoto Protocol are carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFC's), perfluorocarbons (PFC's), and sulphur hexafluoride (SF₆).

**Host Country**
The country where an emissions reduction project is physically located.

**Kyoto Protocol**
An international agreement reached in December 1997 in Kyoto, Japan, which extends the commitments of the UNFCCC. In particular, it defines binding and quantified greenhouse gas emission limits for each developed country.

**Monitoring**
In the climate change context, usually the periodic surveillance of greenhouse gas emissions.

**Official Development Assistance (ODA)**
Official Development Assistance is funding provided governments of developed countries to developing countries to assist in projects related to economic development, health, environment, etc.

**Offsets**
Offsets is a generic term for instruments used to compensate for own greenhouse gas emissions. For example, emission reduction units from Article 6 joint implementation, certified emission reductions from the clean development mechanism, and allowances acquired through emissions trading can be considered offsets.

**Ratification**
After signing the Convention or the Protocol, a country must ratify it, often with the approval of its parliament or other legislature. The instrument of ratification must be deposited with the depositary (in this case the UN Secretary-General) to start the 90-day countdown to becoming a Party.

**Renewable Energy**
Energy sources that are, within a short timeframe relative to the Earth’s natural cycles, sustainable, and include non-carbon technologies such as solar energy, hydropower and wind as well as carbon-neutral technologies such as biomass.

**United Nations Framework Convention on Climate Change (UNFCCC)**
The UNFCCC was established in June 1992 at the Rio Earth Summit. Its primary objective is the „stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic (man-made) interference with the climate system. Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened, and to enable economic development to proceed in a sustainable manner.“ While no legally binding level of emissions is set, the treaty states an aim by Annex I countries to return their emissions to 1990 levels by the year 2000.
The Convention entered into force in March 1994. Until today, over 180 nations have ratified. In March 1995, the UNFCCC held the first session of the COP, the supreme body of the Convention, in Berlin. Its Secretariat is based in Bonn, Germany.

**Validation**

In the context CDM and possibly also JI, validation involves an evaluation of the project design against criteria set by the Kyoto Protocol and national regulations. In particular, validation is to ensure that the reference scenario (baseline) is appropriate, and that greenhouse gas reductions to be calculated against this baseline during the lifetime of the project are additional to what would otherwise occur. Validators also check whether a CDM project complies with sustainable development criteria of the host country. Validators are accredited, independent operational entities. Validation occurs before a project starts operating. Detailed rules remain to be defined by the COP.

**Verification**

Verification involves a third party checking that the emissions reductions claimed in the national and international registers or „books“ have actually occurred and evaluating the results that have been achieved against pre-set criteria. Verification is a „reality check“ on the books. It could involve physical, on-site inspection, or where useful, deployment of techniques such as remote sensing, or interviewing relevant personnel in person or otherwise. It could be applied to each and every project or to a fraction of projects chosen randomly or selected according to agreed criteria.
9.4 Abbreviations

CDM           Clean Development Mechanism  
CER           Certified Emission Reduction  
CoP           Conference of the Parties  
DESI          Decentralised Energy Systems India Private Ltd.  
PCF           Prototype Carbon Fund  
PLF           Plant Load Factor  
PV            Photovoltaic  
PWC           PriceWaterhouseCoopers  
RET           Renewable Energy Technologies

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