Analysis of financing models for small hydropower plants on the basis of case studies

Feasibility of CDM as a financing model
Case study Ethiopia

August 2006
# TABLE OF CONTENTS

## 1 INTRODUCTION .................................................................................................................. 4

## 2 EXECUTIVE SUMMARY ....................................................................................................... 5

## 3 ASSESSMENT OF THE ENERGY SECTOR IN ETHIOPIA .................................................. 6

### 3.1 CURRENT ELECTRICITY SUPPLY STRUCTURE ............................................................... 6

### 3.2 FUTURE DEVELOPMENT OF THE ELECTRICITY SECTOR .......................................... 7

#### 3.2.1 Investment climate and plans ..................................................................................... 7

#### 3.2.2 Governmental strategy for the electricity sector ......................................................... 8

## 4 EFFECTS OF KYOTO RATIFICATION FOR THE ENERGY SECTOR IN ETHIOPIA .......... 10

### 4.1 THE CLEAN DEVELOPMENT MECHANISM (CDM) ...................................................... 10

### 4.2 PREREQUISITES FOR ETHIOPIA TO HOST CDM PROJECTS .......................................... 11

#### 4.2.1 Institutional requirements ......................................................................................... 11

#### 4.2.2 Procedural issues ..................................................................................................... 12

### 4.3 IMPLICATIONS OF CDM FOR THE ETHIOPIAN ENERGY SECTOR ................................ 12

#### 4.3.1 Implication of the CDM for renewable energy generation ....................................... 12

#### 4.3.2 Existing Methodologies for estimating CO2 reduction potential ............................... 14

#### 4.3.3 Estimation of Emissions Baseline for grid connected energy generation in Ethiopia ... 17

### 4.4 DESCRIPTION OF CDM PROJECT PROCEDURE .......................................................... 19

#### 4.4.1 General CDM project cycle ...................................................................................... 19

#### 4.4.2 Assessments and documentation required for a Project Design Document (PDD) ... 21

#### 4.4.3 Additional requirements of the Austrian Ji/CDM Programme .................................. 22

### 4.5 RECOMMENDED CDM PORTFOLIO STRUCTURES FOR ETHIOPIA (SUCH AS PROJECT BUNDLING) .......................................... 23

#### 4.5.1 Small-scale projects ................................................................................................. 23

#### 4.5.2 Project bundling ...................................................................................................... 24

## 5 SPECIFIC SITE STUDY BONORA MINI-HPP .................................................................... 26

### 5.1 SUMMARY OF RESULTS FROM EXISTING FEASIBILITY STUDY ................................ 26

#### 5.1.1 Technical design ...................................................................................................... 27

#### 5.1.2 Financial Analysis .................................................................................................. 27

### 5.2 IMPACT OF CDM ON FINANCIAL VIABILITY OF THE PROJECT ................................. 28

#### 5.2.1 Estimation of CDM Baseline ................................................................................... 28

#### 5.2.2 Estimation of CDM transaction costs ...................................................................... 29

#### 5.2.3 Impact of CDM revenues on Financial Analysis ..................................................... 29

## 6 SPECIFIC SITE STUDY AWETU MHPP .............................................................................. 31

### 6.1 SUMMARY OF RESULTS FROM EXISTING FEASIBILITY STUDIES ............................. 31

#### 6.1.1 Technical design .................................................................................................... 32

#### 6.1.2 Financial Analysis .................................................................................................. 32

### 6.2 IMPACT OF CDM ON FINANCIAL VIABILITY OF THE PROJECT .................................. 33

#### 6.2.1 Estimation of CDM Baseline ................................................................................... 33

#### 6.2.2 Estimation of CDM transaction costs ...................................................................... 33

#### 6.2.3 Impact of CDM revenues on Financial Analysis ..................................................... 34

## 7 OUTLOOK/RECOMMENDATIONS FOR THE DEVELOPMENT OF SMALL HYDRO PROJECTS IN ETHIOPIA ....................................................................................... 36

### 7.1 PREREQUISITES FOR HYDROPOWER PROJECTS TO QUALIFY FOR CDM ................ 36

#### 7.1.1 Project eligibility ..................................................................................................... 36

#### 7.1.2 Project types .......................................................................................................... 36

#### 7.1.3 Restrictions for large dam projects ........................................................................ 36

#### 7.1.4 Environmental concerns ....................................................................................... 37

#### 7.1.5 CDM and Official Development Assistance (ODA) .............................................. 37

### 7.2 CRITICAL SUCCESS FACTORS ..................................................................................... 37

### 7.3 POTENTIAL SAVINGS IN CDM TRANSACTION COSTS THROUGH PROJECT POOLING ................................................................. 38

#### 7.3.1 Possible savings in transaction costs ................................................................. 38

#### 7.3.2 Impact on Financial Analysis .............................................................................. 39

### 7.4 RECOMMENDATIONS FOR FURTHER DEVELOPMENT OF THE MHPPs BONORA AND AWETU ................................................................. 40
LIST OF TABLES

Table 1: Registered CDM projects using ACM0002 ................................................................. 15
Table 2: Carbon Emission Factor Ethiopia ............................................................................... 19
Table 3: Technical data - Bonora MHPP .................................................................................. 27
Table 4: Financial data - Bonora MHPP .................................................................................... 27
Table 5: CO₂ emission reductions - Bonora MHPP ................................................................. 28
Table 6: Estimated CDM transaction costs – Bonora MHPP .................................................... 29
Table 7: Expected CDM related cash flows – Bonora MHPP .................................................. 29
Table 8: Technical data - Awetu MHPP ................................................................................... 32
Table 9: Financial data - Awetu MHPP ................................................................................... 32
Table 10: CO₂ emission reductions - Awetu MHPP .............................................................. 33
Table 11: Expected CDM related cash flows – Awetu MHPP .............................................. 34
Table 12: Specific CDM transaction costs ............................................................................... 39

LIST OF FIGURES

Figure 1: Evolution of Electricity Generation by Fuel from 1971 to 2003 in Ethiopia .................... 6
Figure 2: CDM projects per sector ......................................................................................... 13
Figure 3: Annual CERs per sector ......................................................................................... 13
Figure 4: Emissions baseline concept ...................................................................................... 14
Figure 5: Baseline emissions in Ethiopia ................................................................................ 18
Figure 6: Conventional vs. CDM project cycle ....................................................................... 19
Figure 7: CDM project steps .................................................................................................. 20
Figure 8: Location of Bonora MHPP ..................................................................................... 26
Figure 9: Cumulative cash flow - Bonora MHPP .................................................................. 30
Figure 10: Location of Awetu MHPP .................................................................................... 31
Figure 11: Cumulative cash flow - Awetu MHPP .................................................................. 34
1 INTRODUCTION

In the rural areas of least developed countries, due to lack of adequate access to modern energy services, many social and development programmes can not be implemented. In order to address this problem, it is necessary to design a programme, where, among others, the provision of electrical energy supply can be achieved in a sustainable manner.

Many countries in Africa are endowed with hydropower resources. The small hydropower development programmes in Africa face, among others, financial barriers. Removing these barriers requires the design of innovative financing models that bundle together different sources such as public monies, international grants, private investment, Clean Development Mechanism (CDM) of the Kyoto Protocol.

This project aims at determining the feasibility of CDM as a financing option for small hydropower projects and its possible contribution to financial sustainability of such projects. This work will be carried out using the data from actual case studies. Ethiopia is selected as the case study since it has ample hydropower potential and the Government has already adopted the “Ethiopian Water Resources Management Policy” that aims at creating favourable conditions for the development of these abundant hydropower resources.
2 EXECUTIVE SUMMARY

There is a clear commitment from the Government of Ethiopia to expand electricity coverage in rural areas. Furthermore, the country has abundant, cheap, and environmentally friendly hydro resources, whose potential has been estimated at more than 30,000 MW.

To help finance the expansion of the power sector, the government is encouraging private investors to develop and operate hydropower projects. However, the interest of the private sector in making substantial investments in power generation has not yet materialized.

The Clean Development Mechanism (CDM), as defined in the Kyoto Protocol, can play a major role in promoting renewable energy generation in developing countries. Under the CDM, non-Annex I Parties (developing countries) can obtain Certified Emission Reductions (CERs) from emission reducing projects. The CERs can be sold on the carbon market, thus contributing additional revenues to the project. For renewable energy projects the main source of emission reductions results from replacing CO₂ intensive generated electricity by non-CO₂ sources.

Ethiopia acceded to the Kyoto Protocol in April 2005 and therefore is eligible to host CDM projects. Developing a project under the CDM requires a number of steps to be carried out in parallel to the development of the conventional project prior to the construction phase. After project implementation, the actual emission reductions have to be continuously monitored before the resulting certificates (CERs) can be issued by the CDM Executive Board.

In order to assess the effect of CDM on small hydropower plants in Ethiopia, the projects Bonora (1.04 MW installed power, 6,180 MWh annual generation) and Awetu (0.275 MW installed power, 1,828 MWh annual generation) were chosen for detailed assessments. Feasibility studies for these two projects, which were financed by the Austrian Development Cooperation in 2002, were available. The assessments were undertaken considering the replacement of diesel generators through the hydropower plants.

The results showed a significant increase of the project’s financial attractiveness through CDM:

- The Financial IRR for the Bonora MHPP would be increased from 14% to 15%
- Due to its smaller size, the Financial IRR for Awetu MHPP would only be increased from 8.24% to 8.45% which is still below the cost of capital of 10%. Therefore, bundling the two projects under CDM is recommended to decrease the specific transaction costs. Through bundling, the Financial IRR for Awetu MHPP could be further increased to 8.69%.

Following a conservative approach, the income from CERs was only considered for the years 2008 to 2012. Nevertheless, an important factor for pursuing the projects under the CDM is the upward potential of Carbon credits in case the worldwide cap-and-trade regime will be prolonged after 2012, which would allow the projects to generate CERs up to 2028.

In addition, CDM could mitigate other financing barriers for small hydropower projects due to the following effects:

- Revenues through the sale of CERs provide additional income for the project in “hard currency” (EUR or USD) from buyers with excellent credit ratings (e.g. Government of Austria). This can provide the required security for loans in EUR or USD in order to purchase “state of the art” technology from industrialised countries.
- Due to the high environmental and economic standards required for CDM projects, many financing institutions are specifically targeting CDM projects or at least prefer CDM projects over “regular” investment projects. The involvement of internationally reputable organisations in the CDM process (e.g. UNFCCC) improves the risk profile of the project.
3 ASSESSMENT OF THE ENERGY SECTOR IN ETHIOPIA

3.1 Current electricity supply structure

In Ethiopia, the percentage of the population with direct access to electricity is extremely low, currently less than 6%. The majority of the people with access are supplied by the Government-owned Ethiopian Electric Power Corporation (EEPCo).

Within EEPCo, a vertically integrated power utility, the electricity supply is divided into two major systems:
- the Interconnected System (ICS) supplied mainly by hydropower plants
- the Self Contained System (SCS) with a majority of diesel powered generation capacity

Currently, the total installed generation capacity in Ethiopia is about 790 MW, mostly hydro based. Due to the growing demand for electricity, unfavourable hydrologic conditions, and slippage of scheduled commissioning dates of new hydro generation plants, the ICS system in the past few years has frequently faced supply deficits which have led to power rationing. In order to alleviate this problem, EEPCo has now introduced 80 MW diesel fired power plants.

Figure 1: Evolution of Electricity Generation by Fuel from 1971 to 2003 in Ethiopia

![Figure 1: Evolution of Electricity Generation by Fuel from 1971 to 2003 in Ethiopia](source: International Energy Agency – Energy Statistics)

Figure 1 shows Ethiopia’s large dependency on hydro for electricity generation as well as a significant annual increase in electricity generation throughout the last decade. According to recent figures, electricity sales within EEPCo have reached 1.8 TWh. For a country with about 70 million people, this results in a per capital consumption of only about 25 kWh/year. EEPCo has about 800,000 customers, most of them in Addis Ababa (360,000), where the connection rate is only 33%. In other urban areas, the rate is 20-30%. However, 85% of the population lives in rural areas, mostly in towns and villages, where access rates are more modest. Of the 5,000 rural towns, only 160 are connected to the grid, with an estimated 100,000 direct customer connections.

The low level of access to infrastructure services, including to electricity, is a major barrier to economic development and to the provision of social services in towns and rural areas. EEPCo’s limited capacity to speedily connect large new consumers, upon request, is thus constraining
commercial and industrial growth. Further, the poor quality and variability of existing service, characterized by low voltage levels and voltage fluctuations beyond acceptable ranges, frequent breakdowns and delays in restoring supply after a breakdown has occurred, is an ongoing problem.

An electricity proclamation (proclamation no. 86/97) and a revised investment law are in place to facilitate private sector investment in electricity supply. Local investors are allowed to invest in hydro generation (unlimited capacity) and thermal generation (up to 25 MW). Local investors can also engage in the distribution of electricity they generate. Foreign investors in the electricity sector are restricted to hydro generation activities only.

Since the mid 1990s, a major effort has been under way to restructure EEPCo with the prime aim of decentralising and commercialising its activities. Decentralisation will have the benefit of bringing the decision-making apparatus closer to the rural areas. However, whether rural electrification per se would be a concern of EEPCo is open to question, because EEPCo is in essence a purely commercial enterprise. In the past, rural towns or villages were electrified by EEPCo as requests arose and after the necessary feasibility studies, designs and investment programs have been done and decided upon.

Any initiatives for “unconventional” electricity supply (i.e. electricity from small, private supply systems based on solar, wind, and biomass energy conversion plants) are facing various obstacles if no deliberate policy intervention is made. This is a bad omen for about 85% of the Ethiopian population now living in the rural areas. Hence, rural electrification has a prominent role on the development agenda for Ethiopia, which has also an important political dimension. There is an ever-increasing pressure from every Regional State administration to get more and more centres electrified. The pressure is felt both at the policy making level and at the level of EEPCo.

The present policy direction is to get EEPCo to electrify 160 "Woreda" towns by year 2005. Woreda towns are third echelon towns in Regional States (with Regional capitals coming first in the hierarchy, and zonal capitals coming next). There are over 300 of these towns, each with a population ranging from under 2000 to over 5000, awaiting electrification. Not all of these towns would be economically justifiable to electrify. Diesel supplied towns, in particular, would be loss makers, for certain. EEPCo would have to be granted tariff rates high enough to counter any losses that may arise due to the electrification of Woreda towns.

Whether new innovative financing models such as the Clean Development Mechanism (CDM) could support rural and regional electrification initiatives will be looked at in the present study. The focus will be on assessing the opportunities to enhance the feasibility of small hydropower projects through CDM, thus improving sustainable energy generation in Ethiopia.

### 3.2 Future development of the electricity sector

#### 3.2.1 Investment climate and plans

Ethiopia has put together an ambitious plan to expand the electric system to both support the high demand growth and to extend access to the rural population at a very accelerated pace.

EEPCo is currently building two additional large hydropower plants. The first is Tekeze with installed capacity of 300 MW and 962 GWh of energy. The second is Gilgel Gibe II, with installed capacity of 420 MW and 1500 GWh of energy. The hydropower project Gojeb, with 150 MW and 476 GWh of energy is at a preliminary stage of the construction phase. These three projects are scheduled for year 2007, 2008 and 2010 respectively. In addition, there are further hydropower projects in the development pipeline of EEPCo. Despite the significant generation potential and the attractiveness of
some of those projects, hydro plants are capital intensive, and incremental capacity costs range from EUR 800 to EUR 1,300 per installed kW.

The expansion of the power sector will require significant investments. The electric sector expects to invest about ETB 40 billion (EUR 3.6 billion) in the next 4-5 years. About one third of this amount will be assigned to scaling up of energy access among the poor population in rural areas. If EEPCo’s 10 year total capacity expansion program is considered, investments of more than ETB 65 billion (EUR 5.9 billion) will be required. From this amount, generation represents about ETB 51 billion (EUR 4.6 billion), transmission & distribution represent ETB 9 billion (EUR 0.8 billion), while ETB 5 billion (EUR 0.45 billion) are assigned for rural electrification and institutional strengthening.

The expansion plan put forward by EEPCo represents the largest investment program ever undertaken by the utility and would stretch the project management capability of any large corporation. The forecast growth of demand in many years exceeds 20%, a rate unprecedented in recent history. Therefore, there are concerns regarding EEPCo’s financial sustainability in operating an ever-expanding power system. It is assumed that the Government of Ethiopia will have to make significant equity contributions to support EEPCo’s investment in generation, transmission & distribution, specifically for rural electrification, to materialize the capacity expansion program. Furthermore, EEPCo’s debts are currently in the process of restructuring, which should strengthen its balance sheet.

The Worldbank also supports a rural electrification fund for the development of small hydropower plants. Several projects were approved by the fund so far, the implementation of the projects is still pending.

Low tariffs have been an important constraint to carry on the power sector expansion program and to increase access. Current average tariffs in Ethiopia are in the range of EUR 40 to 45 per MWh and have been frozen for about 10 years. A study commissioned by Government of Ethiopia indicates that current tariffs represent only 30-40% of the system long run marginal costs. Recommendations have been clearly spelled out in the same study to increase average tariffs by 10% p.a. in real terms, over a 5 year period, to support EEPCo financial sustainability.

Ethiopia’s government has made commitments to increase tariff level and review current tariff structure to better target subsidies to the poor. However, the average tariff increase and proposed changes in tariff structure still have to be discussed and agreed upon. EEPCo’s financial and economic assessment documents assume a 10% real tariff rate increase every 5 years.

3.2.2 Governmental strategy for the electricity sector

The Government has embraced increasing electricity access (from about 13% today to about 50% by 2012) as an integral part of its strategy for promoting income-generating activities and social services outside major urban centers to improve living standards and reduce poverty. Promoting access to electricity is also part of its strategy to decentralize the delivery of services throughout the country. A multifaceted strategy for increasing access, and for improving the quality of services to EEPCo’s existing consumers, comprises the following:

(a) Development of the country’s substantial hydropower resources through both private and public sector investment for domestic and export markets (Sudan and Djibouti);
(b) Liberalization of power generation, transmission, distribution, and supply in the isolated areas in order to complement EEPCo’s efforts in the interconnected system;
(c) Commercialization and decentralization of EEPCo’s operations in order to improve operating efficiency, and the quality of services to consumers and to unlock resources for investment in systems expansion; and
(d) Strengthening the system of regulation to improve the sector’s commercial and operational efficiency.
(e) Development of the so called Universal Electricity Access Program (UEAP), a major effort to increase electrification among rural towns and villages.

There is a clear commitment from the Government of Ethiopia to expand electricity coverage in rural areas. The percentage of the population with direct access to electricity is about 6%, representing some of the lowest electrification rates in Africa. At the same time, the country has abundant, cheap, and environmentally friendly hydro resources, whose potential has been estimated at more than 30,000 MW. Therefore, accelerated electrification is stated as one of its primary objectives over the next decade in the hope of promoting growth and improving the quality of life of its population, most of which is rural based.

To help finance the expansion of the power sector, the government is encouraging private investors to develop and operate hydropower projects and to sell their production to EEPCo, as a Single Buyer. The Government is also exploring measures for creating an attractive investment environment for the private sector, including setting up a one-stop shop through which investors can obtain all licenses, clearances and permits. However, the interest of the private sector in making substantial investments in power generation has not yet materialized.

The liberalization of the isolated system is intended to spur expansion of access to rural and peri-urban areas. It has arisen from the Government’s realization that, because of capital, management and human resource constraints, EEPCo alone could not feasibly expand access rapidly enough within a reasonable period of time. The Government has therefore adopted a two-track strategy comprising grid-extension by EEPCo and isolated electrification by the private sector, including communities. For the grid-extension track, the key to progress will be success in implementing the commercialization decentralization of EEPCo’s operations.
4 EFFECTS OF KYOTO RATIFICATION FOR THE ENERGY SECTOR IN ETHIOPIA

4.1 The Clean Development Mechanism (CDM)

Under the Clean Development Mechanism, Annex I Parties to the Kyoto Protocol (with a commitment inscribed in Annex B of the Kyoto Protocol) may implement emission-reducing projects in the territory of non-Annex I Parties and use the resulting Certified Emission Reductions (CERs) for the fulfilment of their Kyoto targets. Article 12 of the Kyoto Protocol specifies: “The purpose of the clean development mechanism shall be to assist Parties not included in Annex I in achieving sustainable development and in contributing to the ultimate objective of the Convention, and to assist Parties included in Annex I in achieving compliance with their quantified emission limitation and reduction commitments”. Furthermore, a Party may authorize legal entities to participate, under its responsibility, in actions leading to the generation, transfer or acquisition of CERs.

In a CDM project an Annex I Party, usually a developed country (or an authorised institution), participates in the financing of a climate protection project in a newly industrialising or developing country through the purchase of CERs. The CERs generated in return are (normally) added to the Assigned Amount of the Investor Country.

Prerequisites for CDM projects are that
- the Parties involved participate in the projects voluntarily and explicitly approve them,
- the projects lead to real, measurable and long-term benefits related to the mitigation of climate change and
- the reductions in emissions be additional to any that would occur in the absence of the project activity (“Additionality”).

The CDM is expected inter-alia to
- generate investment in developing countries, especially from the private sector,
- promote the transfer of environmentally safe and sound technologies and know-how,
- bring about positive development effects and further sustainable development in general, and
- get Parties without a Kyoto commitment involved in the climate regime at an early stage.

According to the Marrakesh Accords, an “equitable geographic distribution of clean development mechanism project activities at regional and subregional levels” is to be promoted. Moreover, “public funding for clean development mechanism projects from Parties in Annex I is not to result in the diversion of official development assistance”. Therefore, the development and implementation of CDM projects can not be financed through Official Development Assistance (ODA) funds.

In addition, the Marrakesh Accords explicitly stipulate that “Parties included in Annex I are to refrain from using CERs generated from nuclear facilities to meet their commitments”.

The rulebook for the CDM set forth in the Marrakesh Accords puts a focus on emission-reducing projects. However, also afforestation and reforestation activities can qualify for the CDM under certain conditions.
4.2 Prerequisites for Ethiopia to host CDM projects

In general, the following conditions have to be fulfilled for implementing CDM projects:

- participation in a CDM project activity has to be voluntary,
- Parties participating in the CDM have to designate a National Authority for the CDM, and
- the Host Country has to be a (non-Annex I) Party to the Kyoto Protocol.

4.2.1 Institutional requirements

In accordance with Article 12 of the Kyoto Protocol and the subsequent decision by the Conference of the Parties to the Kyoto Protocol, the modalities and procedures for CDM require that "Parties participating in the CDM shall designate a national authority for the CDM."

The registration of a proposed CDM project activity can only take place once approval letters are obtained from Parties to the Convention that have ratified the Kyoto Protocol. The Letter of Approval (LoA) is issued through each Designated National Authority (DNA) of the participating countries.

DNAs are a fundamental prerequisite for a CDM project, giving approval to their ability to meet sustainable development criteria and granting permission for the project activity to take place within the national territory. The results of a recent UNEP Risoe workshop for Sub-Saharan Africa revealed that delays in implementing CDM projects had generally been due to the:

- Setting of Sustainable Development rules
- Identification of which government department should host the DNA
- Writing of regulations to govern the operation of the DNA

Ethiopia signed the United Nations Framework Convention on Climate Change (UNFCCC) at the Earth Summit held in Rio de Janeiro and later ratified it on April 5th, 1994. Since then Ethiopia has paid great attention to the issues of climate change and various activities have been undertaken including conducting climate change country studies and participating in climate change negotiations. Finally, Ethiopia acceded to the Kyoto Protocol on April 14th, 2005. Although a DNA was nominated in Ethiopia, so far, neither specific procedures for hosting CDM projects nor Sustainable Development rules were established due to lack of resources.

Designated National Authority in Ethiopia:

Environmental Protection Authority (EPA)
P.O.Box 12760
Addis Ababa,
Ethiopia
http://www.epa.gov.et

Mr. Dessalegn Mesfin
Deputy Director General
Phone: (251-1)1646 4607
Fax: (251-1)1646 4676
E-mail: epa_ddg@ethionet.et
4.2.2 Procedural issues

In general, the DNA shall act as a focal point for the CDM project approval process. The activities that the DNA undertakes may differ from country to country, but DNAs are likely to function as “one stop shops” for project developers and others interested in developing CDM projects within a Host Country. The core functions of national CDM authorities are:

(a) issuing Host Country Letters of Approval;
(b) authorizing private and public entities to participate in the CDM;

DNAs could also assume the role of:

(c) ensuring all stakeholders have a clear point of contact that is familiar with national policies and procedures relating to the CDM;
(d) developing rules and procedures for approval of CDM projects, including national sustainable development criteria or principles; and
(e) reporting on national CDM programmes and providing recommendations on changes or additions that should be made to CDM procedures.

Effective and transparent procedures regulating the approval of CDM projects play a major role in attracting potential investors in the CDM. A recent market analysis stated that a supportive CDM approval system in the country hosting the projects figures as the most important factor determining the attractiveness of a CDM investment. Marketing and promoting the CDM is important as it increases awareness of CDM opportunities and attracts investment. However, a potential conflict of interest with the DNAs regulatory role may arise if the one entity is both promoting and approving CDM projects. This problem is particularly acute if the DNA chooses to act as a facilitator in project development. The DNAs assessment of projects in terms of meeting sustainable development criteria and authorizing participation needs to remain impartial and transparent at all times.

Under international law, it is not required that the DNA reviews all aspects of a project. In the system established under the UNFCCC and the Kyoto Protocol, it is the main role of the Designated Operational Entity (DOE) to ensure the project complies with the CDM modalities. DOE acts as independent auditors, validating Project documents and verify that emission reductions of a project actually occur.

Finally, it is the responsibility of the project sponsor to determine financial viability of the project and ensure that other aspects of the project, (such as licenses, technology specifications and environmental impact assessments) conform to national requirements. This does not mean a DNA should not peruse aspects of the project outside its mandate stipulated in the Marrakesh Accords, but rather that it is not necessary that the DNA duplicates procedures. And there is a risk that if a host country requires a comprehensive review of project proposals de novo prior to issuing Letter of Approval, projects transaction costs and administration costs of the DNA would increase significantly.

4.3 Implications of CDM for the Ethiopian energy sector

4.3.1 Implication of the CDM for renewable energy generation

The Clean Development Mechanism can play a major role in promoting renewable energy generation in developing countries. For renewable energy projects the main benefit of the CDM results from replacing CO₂ intensive generated electricity by non-CO₂ sources.

Based on CDM statistics published by the UNEP Risoe Centre in May 2006, renewable energy projects (such as Biomass, Hydro and Wind) represent more than 50% of the CDM projects which are currently developed worldwide (see Figure 2).
Figure 2: CDM projects per sector

<table>
<thead>
<tr>
<th>Number (% of CDM projects in each sector)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biomass energy</td>
</tr>
<tr>
<td>Hydro</td>
</tr>
<tr>
<td>EE Industry</td>
</tr>
<tr>
<td>Wind</td>
</tr>
<tr>
<td>Agriculture</td>
</tr>
<tr>
<td>Landfill gas</td>
</tr>
<tr>
<td>Fossil fuel switch</td>
</tr>
<tr>
<td>Biogas</td>
</tr>
<tr>
<td>Cement</td>
</tr>
<tr>
<td>HFCs</td>
</tr>
<tr>
<td>Fugitive</td>
</tr>
<tr>
<td>Solar</td>
</tr>
<tr>
<td>Geothermal</td>
</tr>
<tr>
<td>EE Households</td>
</tr>
<tr>
<td>N2O</td>
</tr>
<tr>
<td>Energy distrib.</td>
</tr>
</tbody>
</table>

However, the CERs generated annually by renewable energy projects represent only about 15% of total CERs as shown in Figure 3. This is due to the fact that:
- CDM projects in the renewable energy sector are usually rather small (below 100 MW)
- Renewable energy projects usually reduce CO2, which has the lowest Global Warming Potential (GWP) out of the six Greenhouse Gases (GHGs).

Figure 3: Annual CERs per sector

For renewable energy generation, the amount of CERs generated by a CDM project depends largely on the CO2 intensity of the generation which will be displaced due to the CDM project activity. The displacement can occur either directly (e.g. hydropower plant replaces diesel generator) or indirectly through displacement of a certain generation mix in a power grid.
Displacement of generation mix:
In case the generation mix has a high Carbon Emission Factor (t CO₂/MWh), the reduction potential due to additional renewable energy sources being connected to the grid is also high.

On the other hand, if there are no carbon intensive generation sources in the grid which would be displaced, (e.g. marginal plants constitute mainly renewable capacity), the resulting emission reductions from a new renewable energy source supplying to the grid will be low.

4.3.2 Existing Methodologies for estimating CO2 reduction potential
To be able to determine the volume of carbon credits that could be generated by a particular CDM project, a hypothetical emission scenario has to be established. This shows the volume of emissions which would have occurred in the absence of that project and is called Business-As-Usual or BAU. The emission level of this hypothetical scenario is called the project’s baseline.

The baseline so established is compared with the actual levels of GHG emissions. As shown in Figure 4, the difference between the two, expressed in metric tons of carbon dioxide equivalent, is the mitigation effect of the project which will be recognized as a reduction in the form of carbon credits. Thus, the baseline is a very important tool to determine the volume of carbon credits and is the subject of close scrutiny under the Kyoto regime. Although not discussed in depth here, the establishment of an acceptable baseline is highly technical and is the subject of various methodologies and scrutiny. The justification of a particular baseline is a critical step in obtaining approval of the proposed CDM project.

Project participants who want to undertake a CDM project activity shall either:
• use a methodology previously approved by the Executive Board, or
• propose a new methodology to the CDM Executive Board for consideration and approval, if appropriate

In this section, two existing methodologies are described which are relevant for implementing CDM hydropower projects in Ethiopia.
4.3.2.1 Grid connected renewable energy projects

For most grid-connected renewable energy projects, the Approved Consolidated Methodology ACM0002 is appropriate for Baseline determination\(^1\). This methodology applies to electricity capacity additions from:

- Run-of-river hydro power plants and hydro power projects with existing reservoirs where the volume of the reservoir is not increased;
- Wind sources;
- Geothermal sources;
- Solar sources;
- Wave and tidal sources.

However, this methodology is not applicable to project activities that involve switching from fossil fuels to renewable energy at the site of the project activity, since in this case the baseline may be the continued use of fossil fuels at the site. It must be assured that the geographic and system boundaries for the relevant electricity grid can be clearly identified and information on the characteristics of the grid is available. The methodology can also be applied to grid connected electricity generation from landfill gas capture to the extent that it is combined with the approved "Consolidated baseline methodology for landfill gas project activities" (ACM0001).

The baseline methodology ACM0002 shall be used in conjunction with the approved monitoring methodology ACM0002 ("Consolidated monitoring methodology for grid-connected electricity generation from renewable sources").

As of June 2006, out of the 225 projects registered by the CDM executive board, 20 used the ACM0002 for estimating the emission baseline. A summary of these projects is provided in Table 1 below.

<table>
<thead>
<tr>
<th>Registered</th>
<th>Title</th>
<th>Host Parties</th>
<th>Methodology</th>
<th>Reductions p.a.</th>
</tr>
</thead>
<tbody>
<tr>
<td>17 Sep 05</td>
<td>Landfill Gas Extraction and Utilization at the Matuail landfill site, Dhaka, Bangladesh</td>
<td>Bangladesh</td>
<td>ACM0001</td>
<td>80000</td>
</tr>
<tr>
<td>29 Oct 05</td>
<td>Essaouira wind power project</td>
<td>Morocco</td>
<td>ACM0002</td>
<td>156026</td>
</tr>
<tr>
<td>14 Nov 05</td>
<td>Poechos I Hydro Project</td>
<td>Peru</td>
<td>ACM0002</td>
<td>31463</td>
</tr>
<tr>
<td>25 Dec 05</td>
<td>BII NEE STIPA Wind Farm</td>
<td>Mexico</td>
<td>ACM0002</td>
<td>309979</td>
</tr>
<tr>
<td>25 Dec 05</td>
<td>20 MW Kabini Hydro Electric Power Project, SKPCL, India</td>
<td>India</td>
<td>ACM0002</td>
<td>44968</td>
</tr>
<tr>
<td>04 Feb 06</td>
<td>Abanico Hydroelectric Project</td>
<td>Ecuador</td>
<td>ACM0002</td>
<td>156660</td>
</tr>
<tr>
<td>04 Feb 06</td>
<td>Sibimbe Hydroelectric Project</td>
<td>Ecuador</td>
<td>ACM0002</td>
<td>57870</td>
</tr>
<tr>
<td>19 Mar 06</td>
<td>Wigton Wind Farm Project (WWF)</td>
<td>Jamaica</td>
<td>ACM0002</td>
<td>52540</td>
</tr>
<tr>
<td>20 Mar 06</td>
<td>Gangwon Wind Park Project</td>
<td>Republic of Korea</td>
<td>ACM0002</td>
<td>149536</td>
</tr>
<tr>
<td>20 Mar 06</td>
<td>La Higuera Hydroelectric Project, Chile</td>
<td>Chile</td>
<td>ACM0002</td>
<td>477586</td>
</tr>
</tbody>
</table>

\(^1\) Please refer to [http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html](http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html) for further details
Six out of the 20 CDM projects utilising the ACM0002 were hydropower projects.

According to the ACM0002 consolidated methodology, the baseline scenario consists of the electricity that would have been generated by the operation of grid-connected power plants and by the addition of new generation sources.

It is specified that a baseline emission factor \( (E_F_y) \) is to be calculated as a “combined margin” (CM), consisting of the combination of the “operating margin” (OM) and “build margin” (BM) emission factors according to the three steps below. It is requested that calculations for this combined margin be based on data from an official source (where available) and made publicly available.

**Step 1.** Calculate the Operating Margin emission factor(s) \( (E_{FOM,y}) \) based on one the four specified methods:
(a) Simple OM;
(b) Simple adjusted OM, or
(c) Dispatch Data Analysis OM; or
(d) Average OM

Calculations for each of the four methods are elaborated in the ACM0002 document. It is specified that the dispatch data analysis should be the first methodological choice. Project participants may use the other OM calculation methods, but must justify why they did not use the dispatch data analysis.

**Step 2.** Calculate the Build Margin Emission Factor \( (E_{FBM,y}) \) as the generation-weighted average emission factor \( (tCO_2/MWh) \) of a sample of power plant \( m \), as elaborated in the document.

**Step 3.** Calculate the baseline emission factor \( E_F_y \), as the weighted average of the Operating Margin emission factor \( (E_{FOM,y}) \) and the Build Margin emission factor \( (E_{FBM,y}) \):

\[
E_F_y = W_{OM} * E_{FOM,y} + W_{BM} * E_{FBM,y}
\]
where weights, $W_{OM}$ and $W_{BM}$, by default are 50% (i.e. $W_{OM} = W_{BM} = 0.5$), and $EF_{OM,y}$ and $EF_{BM,y}$ are calculated as described in Steps 1 and 2 above and are expressed in tCO$_2$/MWh. Alternative weights can be used, provided that appropriate evidence justifying the alternative weights is presented.

### 4.3.2.2 Isolated renewable energy projects

Non grid connected (isolated) power plants based on renewable energy are mainly small scale projects which are implemented under rural electrification schemes. For this case, the approved small-scale methodology “AMS-I.A. – Electricity generation for the user” would be appropriate for determining the emissions baseline.\(^2\)

The AMS-I.A. can be applied for renewable energy generation units that supply individual households or users with a small amount of electricity. The applicability is limited to households and users that do not have a grid connection. These units include technologies such as solar power, hydropower, wind power, and other technologies that produce electricity all of which is used on-site by the user, such as solar home systems, and wind battery chargers. The renewable generating units may be new or replace existing fossil fuel fired generation. The capacity of these renewable energy generators shall not exceed 15 MW.

If the unit added has both renewable and non-renewable components (e.g. a wind/diesel unit), the eligibility limit of 15MW for a small-scale CDM project activity applies only to the renewable component. If the unit added co-fires [non-] renewable biomass and fossil fuel, the capacity of the entire unit shall not exceed the limit of 15MW.

Project activities adding renewable energy capacity should consider the following cases:

1) Adding new units;
2) Replacing old units for more efficient units.

To qualify as a small scale CDM project activity, the aggregate installed capacity after adding the new units (case 1) or of the more efficient units (case 2) should be lower than 15 MW.

The energy baseline for such projects is the fuel consumption of the technology in use or that would have been used in the absence of the project activity.

The emissions baseline is the energy baseline times the CO2 emission coefficient for the fuel displaced. IPCC default values for emission coefficients may be used. A default value 0.9 kg CO2 equiv./kWh, which is derived from diesel generation units, may be used. A small-scale project proponent may, with adequate justification use a higher emissions factor.

### 4.3.3 Estimation of Emissions Baseline for grid connected energy generation in Ethiopia

So far, no CDM project was developed in Ethiopia which used the baseline methodology ACM0002 for estimating the emission reductions.

However, the Ministry of Housing, Spatial Planning and the Environment of the Government of the Netherlands has estimated the emission baseline in Ethiopia based on a similar methodology, the so-called Hybrid Average Margin baseline method.\(^3\)

This section describes the key factors of the Hybrid Average Margin baseline method. The method is based on a combination of elements from the system-average (as an approximation of the operating margin) and built margin baseline approaches.

\(^2\) Please refer to [http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html](http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html) for further details

\(^3\) J.W. Martens et. al. "Standardised Baselines for Small-scale CDM activities" (2001)
The Hybrid Average Margin method for small-scale projects draws a line between the existing operational power mix (year x, which is the year for which the most recent data are available) and the mix projected for the year 2012.

The starting point for developing the baseline will be to determine the grid mix of currently operational plants connected to the grid in year x. Only those plants that generate electricity as their core activity are included in the baseline. Finally, no corrections for electricity import and/or export are made. The power mix is determined based on total grid mix, but excluding hydro and other zero fuel cost technologies (e.g. wind and solar).

Facilities operated by resources that are obtained at zero costs should be excluded from the baseline, on the basis that these by default will not be displaced by a new CDM project, unless spilled or wasted as a result.

Electricity generation from hydropower sources is specifically relevant for the situation in Ethiopia as shown in Figure 1. Hydro generated electricity is unique in the sense that its resources (water) are obtained at zero costs and that water can also be stored. This storage is important because it means that on a momentarily basis it may be replaced by the small scale CDM project, but it still can be used at another time. Since the marginal costs of hydro are zero, it is very likely that the stored hydropower will be the preferred option over fossil fuel based power plants.

In short, hydropower will never be wasted by an operator and thus never be replaced by small-scale investments as long as there are other alternatives in the system. There is one important exemption to this rule, in which case water in hydropower reservoirs are being ‘spilled’ is when it is used for irrigation. However, the amount of water spilled on irrigation is likely to be determined by irrigation needs and is similar for both baseline and project situation.

Figure 5 illustrates the concept of the Hybrid average margin for Ethiopia graphically. The power mix considered for Ethiopia comprises mainly diesel fired power plants. Moreover, the figure assumes that the parameters of the System Average and Built Margin (BM) baseline are held constant.

**Figure 5: Baseline emissions in Ethiopia**
Table 2: Carbon Emission Factor Ethiopia

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Hybrid Approach</td>
<td>t CO2/MWh</td>
<td>0.920</td>
<td>0.878</td>
<td>0.835</td>
<td>0.792</td>
<td>0.749</td>
<td>0.706</td>
<td>0.663</td>
<td>0.620</td>
<td>0.577</td>
<td>0.535</td>
<td>0.492</td>
<td>0.449</td>
<td>0.406</td>
</tr>
</tbody>
</table>

The main characteristics of the Hybrid Average Margin method are:
For the first year value, a proxy for the operating margin is step by step calculated:
(a) The existing operational power mix at the country level forms the starting point of the methodology. Data for the year \( x \) (year for which the most recent data is available) is collected from the host country.
(b) The weighted average power mix is determined by defining the proportional contribution of generated electric output of each power plant or power plant type in the total power mix.
(c) Per plant (or fuel, if plant type unavailable) the appropriate emissions factor for currently operational technologies is applied. Country specific technology CEFs are used. If these are not available, default CEFs for current technologies (as provided by Öko Institute, 1998) are applied.

For the 2012 baseline value, a proxy for the built margin is step by step calculated:
(d) Data on recently built and likely to be build power plants form the mix for 2012, and information will be collected on their generated output or capacity under construction or planned.
(e) Performance characteristics for the plants to be built will be based on projected levels in 2012.
(f) The final step is to multiply the determined weighted average proportions of the mix in 2012 with the respective defined emissions rates. The baseline for intervening years will be formed by connecting emission rate for the first year (year \( x \)) and 2012 values as shown in Figure 5.

It should be noted again that the Hybrid Average Margin method only represents an approximation of the approved methodology ACM0002 (explained in chapter 4.3.2). Therefore, undertaking a grid connected renewable energy CDM project activity in Ethiopia would require to re-calculate the baseline based on the requirements of the ACM0002.

### 4.4 Description of CDM project procedure

#### 4.4.1 General CDM project cycle

CDM projects require the development of CDM specific documents (such as the Project Design Document) in parallel to the conventional investment project. The various development steps are shown in Figure 6.
The following Figure 7 gives an overview of the general project cycle of a “Normal Scale” CDM project reflecting the international regulations of the Kyoto Protocol and the Marrakesh Accords. The Figure shows that, whereas the project participants are responsible for the project design process, the DOE is the central player driving the validation process as a whole. The CDM Executive Board (EB) may be involved if there are deviations from the methodology that cause the DOE to request guidance from the EB.

It is also important to note the complexity of the process, in that many activities are being carried out in parallel, especially during the review phase by the DOE.

**Figure 7: CDM project steps**

<table>
<thead>
<tr>
<th>Time</th>
<th>Project participants</th>
<th>Designated operational Entity (DOE)</th>
<th>CDM Executive Board (EB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project preparation (Development, Implementation)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preparation of Project Idea Note (PIN)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preparation of Project Design Document (PDD) (incl. Baseline Study, Monitoring Plan, information on environmental impacts, stakeholder comments and public funding)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Submission of PDD to a DOE (possibly including Environmental Assessment)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Submission of draft PDD to the EB in the case of new (Baseline and/or Monitoring) methodology used</td>
<td></td>
<td>Submission of Validation Report to the EB</td>
<td>The EB decides on the approval of the new methodology not later than within 4 months</td>
</tr>
<tr>
<td>Publication of PDD and invitation of stakeholder comments for 30 days</td>
<td></td>
<td>Validation (incl. check of approvals of Parties involved)</td>
<td></td>
</tr>
<tr>
<td>Validation (incl. check of approvals of Parties involved)</td>
<td></td>
<td>Submission of Validation Report to the EB</td>
<td>Request for review by a Party involved or 3 members of the EB</td>
</tr>
<tr>
<td>Submission of Validation Report to the EB</td>
<td></td>
<td>Request for review by a Party involved or 3 members of the EB</td>
<td>Review at the latest at the second meeting and publication of decision</td>
</tr>
<tr>
<td>Registration</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project Operation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preparation of regular Monitoring Reports</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Submission of Monitoring Report to a (different) DOE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Publication of Monitoring Report</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Verification</td>
<td></td>
<td></td>
<td>Review within 30 days and publication of decision</td>
</tr>
<tr>
<td>Publication of Verification Report</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preparation and Publication of Certification Report</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Request for review by a Party involved or three members of the EB</td>
<td></td>
<td></td>
<td>Decision on review at next meeting</td>
</tr>
<tr>
<td>No request for review within 15 days</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Issuance of CERs and transfer of CERs to registry of Investor Country</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
In addition to “Normal Scale” CDM projects, the Marrakesh Accords define “Small Scale” CDM project activities as follows:

- Renewable energy project activities with a maximum output capacity equivalent of up to 15 MW (or an appropriate equivalent);
- Energy efficiency improvement project activities which reduce energy consumption, on the supply and/or demand side, by up to the equivalent of 15 GWh per year;
- Other project activities that both reduce anthropogenic emissions by sources and directly emit less than 15 kilotonnes of carbon dioxide equivalent annually.

In the case of “Small Scale” CDM projects, the high relative transaction costs per emission reduction often prevent project implementation. In order to address this problem, simplified standardised procedures, methodologies and documents, e.g. a special PDD template, have been developed for this project type\(^4\).

4.4.2 Assessments and documentation required for a Project Design Document (PDD)

The PDD is basically a checklist which the project developer must complete, showing the design of the project and how it meets the validation requirements of the CDM. It is the main document that the validator will assess when deciding whether to approve the project, and the document that will be made available during the 30 day public comment period. The PDD is available in Arabic, Chinese, English, French, Russian and Spanish on the UNFCCC website at: [http://cdm.unfccc.int/Reference/Documents](http://cdm.unfccc.int/Reference/Documents). In most cases, the PDD will have documents appended to it that provide supporting evidence and information. But the key information should be reported in the PDD.

The standard PDD template as published by the UNFCCC includes the following chapters:

A. General description of project activity  
B. Application of a baseline methodology  
C. Duration of the project activity / Crediting period  
D. Application of a monitoring methodology and plan  
E. Estimation of GHG emissions by sources  
F. Environmental impacts  
G. Stakeholders’ comments  

Annexes  
Annex 1: Contact information on participants in the project activity  
Annex 2: Information regarding public funding  
Annex 3: Baseline Information  
Annex 4: Monitoring plan

Of all the things that must be done when designing a CDM project and preparing the PDD, the most important tasks for project participants are the following:

**Stakeholder consultation:** The project developer must consult local stakeholders when designing the project and show how “due account” was taken of these comments in the PDD. The report on how the developer has taken stakeholder comments into account is found in section G of the PDD.

\(^4\) Please refer to [http://cdm.unfccc.int/Projects/pac/pac_ssc.html](http://cdm.unfccc.int/Projects/pac/pac_ssc.html) for further details.
Environmental impact assessment: The developer must analyze the project’s environmental impacts and, if necessary, prepare an environmental impact assessment. This must be included in, or appended to, the PDD. Whether or not a full EIA has to be done is decided by the host country. If your national and/or regional environmental regulations require an EIA which includes a public comment period, then this may be another opportunity for you to have input. The assessment of the project’s environmental impacts is found in section F of the PDD.

Estimating the baseline: The baseline predicts the scenario that is most likely in the absence of the CDM project – i.e. what will happen under business as usual - and the likely greenhouse gas emissions that will occur in that scenario. Comparing the baseline to the project provides an estimate of how many emission reductions the project is expected to achieve. Developing a baseline is also critical for deciding whether a CDM project is additional, because testing for additionality involves asking whether the CDM project is the baseline – i.e. whether the project itself is the business as usual outcome. If it is, then it is not additional, because it would have happened anyway (see below for more on additionality). As shown in chapter 4.3.2, standardised baseline methodologies are available for estimating the baseline for grid-connected renewable energy generation projects.

Demonstrating additionality: The question of whether a project is additional is extremely important. It asks if the project would have gone ahead anyway without the CDM and thus whether it results in real reductions in greenhouse gas emissions. Project developers are asked in the PDD for "an explanation of how and why this project is additional and therefore not the baseline scenario" – i.e. the business as usual outcome. Consistent with the standardised baseline methodology, there is also a standardised “Tool for the demonstration and assessment of additionality” available at the UNFCCC website (http://cdm.unfccc.int/Reference/Documents).

Small-scale projects (see chapter 4.4.1) use a different PDD, and use simpler rules and procedures for validation. However, the public participation and environmental assessment requirements of a small-scale project are the same as for a standard project. The small-scale projects PDD and other documentation is available at the following UNFCCC webpage: http://cdm.unfccc.int/Projects/pac/pac_ssc.html.

4.4.3 Additional requirements of the Austrian JI/CDM Programme

The Austrian JI/CDM Programme has developed a specific PDD template which serves as the basis for the project evaluation by the Programme Management. It refers to the PDD form elaborated by the Executive Board (CDM-PDD) and contains supplementary items, especially with regard to environmental, socio-economic and development aspects. This reflects the fact that according to Article 7 para. 6 of the Directive for the Austrian JI/CDM Programme “the objectives and principles of the Austrian Development Policy are taken into account, provided that the project is carried out in a developing country”. The Austrian Project Design Document covers the following main issues:

- General project description;
- Baseline Study; Monitoring Plan;
- Stakeholders’ comments;
- Ecological, socio-economic and development aspects.

Besides the more extensive PDD, the Austrian JI/CDM Programme requires additional documents within a so called “Detailed Proposal” for assessing potential CDM projects:

a. Technical Description of the Project

The detailed technical description of the project shall include the project organisation, time schedule, drawings, etc.
b. Business Plan
A comprehensive Business Plan shall be provided, including:

- describing the market in which the investment will be made, and
- containing the financing concept and a financial model of the project as well as a risk and sensitivity analysis

c. Indicative Offer of Emission Reductions
The indicative offer of emission reductions shall contain:

- an indicative total number of emission reductions offered,
- an indicative delivery schedule and
- an indicative price per emission reduction credit (CER)

According to Article 7 paragraph 5 of the Directive for the Austrian JI/CDM Programme, the purchase of (claims on) emission reduction credits “takes place on the basis of cost-benefit optimisation and is based on the international market price for comparable projects”. In this context the assumptions for the price calculations should be revealed by the Applicant.

Evaluation criteria for CDM projects
The basic intention being to focus on “high value” projects, the complete Proposal is evaluated by the Programme Management with regard to the evidence produced that the proposed project will be capable of generating emission reductions which can be counted towards the Austrian emission reduction commitment. By applying the following evaluation criteria to the Proposals submitted, projects are selected that provide clear evidence of a long-term sustainable project implementation thus guaranteeing the generation of the respective emission reductions:

- **Kyoto-related criteria**: quality of Baseline Study and Monitoring Plan of proposed project;
- **Economic criteria**: financial and economic standing of the Applicant, financial structure and economic viability of proposed project;
- **Technical criteria**: technical capacity of Applicant, technical feasibility of proposed project;
- **Ecological criteria**: environmental impact of proposed project during construction and operation;
- **Socio-economic and development criteria**: socio-economic and development impact of proposed project, especially considering inter alia stakeholder integration, technology and know-how transfer, quality of new jobs created, gender equality and social protection of the workforce.

4.5 Recommended CDM portfolio structures for Ethiopia (such as project bundling)

4.5.1 Small-scale projects
In addition to grid-connected renewable energy projects, many times small-scale off-grid energy projects fit the development needs of developing countries and can be supported through the CDM. They can help to provide much-needed modern energy services and improve living conditions for millions of people in rural communities.

Despite the low prices for CERs and high transaction costs for the development of such projects that have characterised the market to-date, the current pipeline of CDM projects shows that a number of small-scale projects, such as small hydro, are beginning to come on stream with some of the transaction costs reduced through the use of the relevant procedures and modalities developed specifically to “fast-track” projects of this size. However, the majority of CDM investments are
flowing into larger scale projects, whilst projects at the lower end of the small-scale definition, producing very few CERS, are being overlooked for carbon finance.\(^5\)

### 4.5.2 Project bundling

While small-scale projects are generally of a higher quality in terms of their contribution to sustainable development than larger scale projects, these projects face the obstacle of an unfavourable relation between CDM revenues to transaction costs.

One approach to reducing CDM transaction costs is to bundle a number of small-scale projects into a portfolio that can be developed as one larger CDM project. As long as the portfolio is under the limits defined for small-scale projects (see chapter 4.4.1), they can benefit from reduced transaction costs associated with fast tracking procedures and the spreading of costs across several projects.

It would also mean that every small-scale project developer would not necessarily need to accustom him/her selves to the complex modalities of the CDM. However, in practice there have been few examples of successful implementation in developing countries.

For Ethiopia, the most relevant small-scale project category is “Renewable energy project activities with a maximum output capacity equivalent of up to 15 MW”, which is further divided into:

- A. Electricity generation by the user
- B. Mechanical energy for the user/enterprise
- C. Thermal energy for the user
- D. Renewable electricity generation for a grid

In addition to cost reductions in the project cycle through simplifications in the PDD (see chapter 4.4.2), the CDM Executive Board has also proposed that several small-scale project activities may be bundled with opportunities for cost reductions possible at the project design, validation, registration, and monitoring/verification/issuance stages. For example a single PDD could be used for a project bundle and monitoring requirements may be reduced, for example to a sample basis.

Desk studies have shown that bundling can make CDM projects more attractive by increasing internal rates of return by around 1-3\%.\(^6\) This is particularly the case for metered small-scale project bundles, as the monitoring costs can be particularly high, even though monitoring of only a sample of individual systems may be required.

The eligibility of small-scale project bundling is based on three types of requirements:

1. the (bundled) project has to fall under one of the three project categories defined by the CDM Executive Board
2. the (bundled) project must be additional
3. the size of the total bundle should not exceed the limits for small scale CDM project activities

Although it may be possible to reduce some transaction costs, such as for registration, for projects with different baseline methodologies, it is highly recommended to avoid these types of project bundles as very few cases will result in reduced transaction costs, particularly when additional PDDs, separate monitoring plans and reports etc are required.

Finally, project bundling can increase the number of legal requirements and agreements that will have to be fulfilled. This is because the project may include a greater number of project participants than with a normal CDM project.

\(^5\) J. Mariyappan et. al., “A Guide to Bundling small scale CDM Projects”

\(^6\) IT Power and KITE (2002) Bundling Small-scale CDM Projects
Any contracts and agreements will have to be integrated into the overall project structure to ensure the successful implementation and operation of the CDM project and share risks (e.g. for non-delivery of CERs), responsibilities (e.g. for carrying out monitoring of individual projects) and benefits (e.g. for sharing of CERs) to the appropriate parties. The costs and time required to put in place and negotiate these CDM related agreements, such as the carbon contract, will be part of the CDM transaction costs and should be accounted for accordingly.
5 SPECIFIC SITE STUDY BONORA MINI-HPP

5.1 Summary of results from existing feasibility study

The Feasibility Study for the Bonora Mini Hydropower Plant (MHPP) was finalised in September 2002. This project was part of an effort being made by the Government of Ethiopia to make use of the available hydro resources. Based on the Governments Five Years Development Plans, the Austrian Embassy Development Cooperation (AEDC) in collaboration with the Ethiopian Electric Power Corporation (EEPCO) has developed this project.

The Feasibility study was carried out by a Joint Venture of TIWAG-Tiroler Wasserkraft AG, Verbundplan GmbH and Tropics Consulting Engineers Plc. of Ethiopia.

The project is located in the Sidama administrative region, about 400km of road distance to the south of Addis Ababa. The site is located in the immediate vicinity of the town of Daye at an elevation of 1,900 m.a.s.l.

Figure 8: Location of Bonora MHPP
5.1.1 Technical design

Based on the data taken from the Final Report of the Feasibility Study for the Bonora MHPP, the main technical features are summarized in Table 3 as follows:

Table 3: Technical data - Bonora MHPP

<table>
<thead>
<tr>
<th>Project</th>
<th>Bonora MHPP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Location</td>
<td>Daye, Sidama</td>
</tr>
<tr>
<td>Project type</td>
<td>Run of river HPP with daily storage</td>
</tr>
<tr>
<td>Turbines</td>
<td>2 Francis turbines</td>
</tr>
<tr>
<td>Design discharge</td>
<td>1,9 m³/s</td>
</tr>
<tr>
<td>Net head</td>
<td>64 m</td>
</tr>
<tr>
<td>Installed Capacity</td>
<td>1,040 kW</td>
</tr>
<tr>
<td>Firm capacity</td>
<td>1,040 kW</td>
</tr>
<tr>
<td>Average Annual Energy generation</td>
<td>6,180 MWh</td>
</tr>
<tr>
<td>Stream flow</td>
<td></td>
</tr>
<tr>
<td>Catchment Area</td>
<td>438 km²</td>
</tr>
<tr>
<td>Mean River Flow</td>
<td>4.6 m³/s</td>
</tr>
<tr>
<td>50 year flood</td>
<td>73 – 84 m³/s</td>
</tr>
<tr>
<td>Civil structures</td>
<td></td>
</tr>
<tr>
<td>Intake and desilter</td>
<td>1,4 m³/s</td>
</tr>
<tr>
<td>Head race channel</td>
<td>3 km</td>
</tr>
<tr>
<td>Daily storage</td>
<td>8,400 m³</td>
</tr>
<tr>
<td>Penstock</td>
<td>250 m; 1,9 m³/s</td>
</tr>
<tr>
<td>Powerhouse</td>
<td>surface, 15 x 8 x 5,5 m</td>
</tr>
<tr>
<td>Investment costs</td>
<td>1,868,826 EURO</td>
</tr>
</tbody>
</table>

5.1.2 Financial Analysis

The Financial Analysis and Economic Evaluation included in the Feasibility Study were carried out by using the software program COMFAR III Expert, which was developed by UNIDO.

The Computer Model for Feasibility Analysis and Reporting (COMFAR III Expert) is intended as an aid in the analysis of investment projects. The main module of the program accepts financial and economic data, produces financial and economic statements and graphical display and calculates measures of performance.

In the Feasibility Study, the Bonora MHPP project was evaluated under conservative conditions as well as under peak-load conditions. For the purpose of this study, the Financial Analysis under the conservative approach will be shown and will be used as a basis for assessing the effect of CDM.

Table 4: Financial data - Bonora MHPP

<table>
<thead>
<tr>
<th>Construction phase</th>
<th>1 year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production phase</td>
<td>25 years</td>
</tr>
<tr>
<td>Product</td>
<td>Electricity in kWh</td>
</tr>
<tr>
<td>Nominal capacity</td>
<td>6,180 MWh/year</td>
</tr>
<tr>
<td>Local Currency</td>
<td>Ethiopian Birr</td>
</tr>
</tbody>
</table>
Analysis of financing models for small hydropower plants on the basis of case studies in Ethiopia

UNIDO United Nations Industrial Development Organization

<table>
<thead>
<tr>
<th>Foreign Currency</th>
<th>EURO (€)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exchange Rate</td>
<td>1 Euro = 7.8 Birr</td>
</tr>
<tr>
<td>Sales program</td>
<td>0.50 Birr/kWh</td>
</tr>
<tr>
<td>Discount factor</td>
<td>10.0 % according to interest rate of the World Bank</td>
</tr>
<tr>
<td>Escalation rate</td>
<td>2.5 % for operation costs</td>
</tr>
<tr>
<td>Sales revenue</td>
<td>2 % for sales revenue</td>
</tr>
<tr>
<td>Government loan</td>
<td>100%</td>
</tr>
<tr>
<td>Type</td>
<td>Annuity</td>
</tr>
<tr>
<td>Number of repayments</td>
<td>30 (15 years)</td>
</tr>
<tr>
<td>Interest rate</td>
<td>6.5 %</td>
</tr>
<tr>
<td>Depreciation</td>
<td>Linear to zero (A defined percentage of the original asset value)</td>
</tr>
<tr>
<td>Depreciation for Mechanical and Electrical Equipment</td>
<td>20 years</td>
</tr>
<tr>
<td>Depreciation for Civil Works, Structures and Buildings</td>
<td>50 years</td>
</tr>
</tbody>
</table>

Based on the financial data as shown in Table 4 above, the project is financially feasible:

<table>
<thead>
<tr>
<th>Total Investment in EUR per kW of installed capacity</th>
<th>1,797.00 €/kW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Investment in EUR per kWh of annual production</td>
<td>0.30 €/kWh</td>
</tr>
<tr>
<td>Net present Value (NPV)</td>
<td>890,130.00 €</td>
</tr>
<tr>
<td>Financial Internal Rate of Return (FIRR)</td>
<td>14.07 %</td>
</tr>
</tbody>
</table>

5.2 Impact of CDM on financial viability of the project

The potential impact of CDM on the financial viability of the Bonora MHPP will be shown by considering additional project income from the sale of Certified Emission Reductions (CERs) after deducting the CDM transaction costs.

5.2.1 Estimation of CDM Baseline

As indicated in the Feasibility Study for the Bonora MHPP, the installation of diesel generators is a possible alternative option to supply energy to the project region. Considering the Baseline estimations for isolated renewable energy projects as shown in chapter 4.3.2.2, the CO₂ emission reductions resulting from the implementation of the Bonora MHPP project activity can be estimated as follows:

<table>
<thead>
<tr>
<th>Table 5: CO₂ emission reductions - Bonora MHPP</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
</tr>
<tr>
<td>Carbon Emission Factor</td>
</tr>
<tr>
<td>Annual emission reductions</td>
</tr>
<tr>
<td>TOTAL Emission Reductions</td>
</tr>
</tbody>
</table>
5.2.2 Estimation of CDM transaction costs

Implementing a hydropower project under the CDM requires several steps in addition to the conventional project implementation as shown in detail in chapter 4.4. In order to prepare the required documents and studies including the submission to the relevant authorities, the following CDM transaction costs shall be considered:

Table 6: Estimated CDM transaction costs – Bonora MHPP

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost[*) [EUR]</th>
</tr>
</thead>
<tbody>
<tr>
<td>PDD incl. Baseline Study and Monitoring Plan (for a small-scale CDM project in Ethiopia); Detailed Proposal for transfer of credits to a Carbon fund (e.g. Austrian JI/CDM Programme)</td>
<td>40.000</td>
</tr>
<tr>
<td>Validation by a Designated Operational Entity (DOE)</td>
<td>10.000</td>
</tr>
<tr>
<td>Possible “Refund for immaterial services” related to the development of the CDM project, e.g. Baseline Study, Validation, etc. (e.g. refund from the Austrian JI/CDM Programme: up to 50% of the cost incurred, max. EUR 40.000)</td>
<td>- 25.000</td>
</tr>
<tr>
<td>Registration fee (does not have to be paid for CDM project activities with expected average annual emission reduction over the crediting period below 15.000 t CO₂)</td>
<td>--</td>
</tr>
<tr>
<td>TOTAL</td>
<td>25.000</td>
</tr>
</tbody>
</table>

*) Costs were estimated based on recently developed CDM projects

After project implementation, additional annual costs of app. EUR 4.000 shall be considered for monitoring and verification of emission credits (for years 2008 to 2012).

5.2.3 Impact of CDM revenues on Financial Analysis

For assessing the impact of CDM revenues on the financial viability of a hydropower project, all CDM related positive and negative cash-flows will be considered in addition to the calculations performed in the Feasibility Study (see chapter 5.1.2). The CDM related cash-flows are summarised below:

Table 7: Expected CDM related cash flows – Bonora MHPP

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Design Document</td>
<td>-40.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Validation</td>
<td>-10.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Refund of immaterial services</td>
<td>25.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CER revenues*)</td>
<td></td>
<td>55.620</td>
<td>55.620</td>
<td>55.620</td>
<td>55.620</td>
<td>55.620</td>
</tr>
<tr>
<td>Monitoring and Verification</td>
<td></td>
<td>-4.000</td>
<td>-4.000</td>
<td>-4.000</td>
<td>-4.000</td>
<td>-4.000</td>
</tr>
</tbody>
</table>

*) Based on an expected CER price of 10.0 EUR/t CO₂
The additional project revenues through CDM at an assumed CER price of 10,0 EUR/t CO\textsubscript{2} will improve the project results as follows:

- **Net present Value (NPV)**: from 890,130,00 EUR to 1,060,810,00 EUR
- **Financial Internal Rate of Return (FIRR)**: from 14,07 % to 15,04 %

The cumulative project cash flow will be increased as shown in Figure 9.

As shown in chapter 5.1.2, the basic financial analysis of the Bonora MHPP (without considering CDM revenues) indicates a viable project with an expected return above the cost of capital.

Considering the potential additional project income through CDM would even improve the cumulative project cash flow; the additional CER revenues would decrease the payback period from 9 years to app. 8 years and lead to a financial return of app. 15%. Although the CER revenues are limited up to 2012 and relatively high transaction costs have to be considered, the overall effect on the financial feasibility of the Bonora MHPP is considerable.

In case the CERs resulting from the CDM project could be sold at EUR 20, the additional revenues would even improve the FIRR to 16,37%, which is an improvement of 2,3% in absolute terms compared to the original calculation.

Finally, it is important to note that the CER revenues provide additional income for the project in “hard currency” (EUR or USD) from debtors with excellent credit ratings (e.g. Government of Austria). In order to have “state of the art” technology available for hydropower projects, some of the equipment will have to be supplied from industrialised countries. Due to the fact that the revenues from the sale of electricity will be in Ethiopian Birr, only the revenues from CER sale could provide the required security for loans in EUR or USD.
6 SPECIFIC SITE STUDY AWETU MHPP

6.1 Summary of results from existing feasibility studies

The Feasibility Study for the Awetu Mini Hydropower Plant (MHPP) was finalised in June 2002. This project was part of an effort being made by the Government of Ethiopia to make use of the available hydro resources. Based on the Governments Five Years Development Plans, the Austrian Embassy Development Cooperation (AEDC) in collaboration with the Ethiopian Electric Power Corporation (EEPCO) has developed this project.

The Feasibility study was carried out by a Joint Venture of TIWAG-Tiroler Wasserkraft AG, Verbundplan GmbH and Tropics Consulting Engineers Plc. of Ethiopia.

The project is located in the Welega administrative region, about 85km of road distance from Dambi Dolo. The site is located at an elevation of about 1,300 m.a.s.l.

Figure 10: Location of Awetu MHPP
6.1.1 Technical design

Based on the data taken from the Final Report of the Feasibility Study for the Awetu MHPP, the main technical features are summarized in Table 8 as follows:

Table 8: Technical data - Awetu MHPP

<table>
<thead>
<tr>
<th>Project</th>
<th>Awetu MHPP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Location:</td>
<td>Alem Teferi, West Illubour</td>
</tr>
<tr>
<td>Project type:</td>
<td>Run of river HPP with daily storage</td>
</tr>
<tr>
<td>Turbines:</td>
<td>2 Francis turbines</td>
</tr>
<tr>
<td>Design discharge:</td>
<td>0,8 m³/s</td>
</tr>
<tr>
<td>Net head</td>
<td>40 m</td>
</tr>
<tr>
<td>Installed Capacity:</td>
<td>275 kW</td>
</tr>
<tr>
<td>Firm capacity</td>
<td>275 kW</td>
</tr>
<tr>
<td>Average Annual Energy generation</td>
<td>1.828 MWh</td>
</tr>
<tr>
<td>Stream flow:</td>
<td></td>
</tr>
<tr>
<td>Catchment Area:</td>
<td>92 km²</td>
</tr>
<tr>
<td>Mean River Flow:</td>
<td>1,7 m³/s</td>
</tr>
<tr>
<td>50 year flood:</td>
<td>37 – 41 m³/s</td>
</tr>
<tr>
<td>Civil structures:</td>
<td></td>
</tr>
<tr>
<td>Intake and desilter</td>
<td>0,8 m³/s</td>
</tr>
<tr>
<td>Headrace channel</td>
<td>1,3 km</td>
</tr>
<tr>
<td>Daily storage</td>
<td>12.600 m³</td>
</tr>
<tr>
<td>Penstock</td>
<td>140 m; 0,8 m³/s</td>
</tr>
<tr>
<td>Powerhouse</td>
<td>surface, 14 x 8 x 5,5 m</td>
</tr>
<tr>
<td>Investment Costs:</td>
<td>990.340 €</td>
</tr>
</tbody>
</table>

6.1.2 Financial Analysis

The Financial Analysis and Economic Evaluation included in the Feasibility Study were carried out by using the software program COMFAR III Expert, which was developed by UNIDO.

Table 9: Financial data - Awetu MHPP

<table>
<thead>
<tr>
<th>Construction phase</th>
<th>1 year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production phase</td>
<td>25 years</td>
</tr>
<tr>
<td>Product</td>
<td>Electricity in kWh</td>
</tr>
<tr>
<td>Nominal capacity</td>
<td>1.828 MWh/ year</td>
</tr>
<tr>
<td>Local Currency</td>
<td>Ethiopian Birr</td>
</tr>
<tr>
<td>Foreign Currency</td>
<td>EURO (€)</td>
</tr>
<tr>
<td>Exchange Rate</td>
<td>1 Euro = 7,8 Birr</td>
</tr>
<tr>
<td>Sales programme</td>
<td>0,50 Birr/kWh</td>
</tr>
<tr>
<td>Discount factor</td>
<td>10,0 % according to interest rate of the World Bank</td>
</tr>
<tr>
<td>Escalation rate</td>
<td>2,5 % for operation costs</td>
</tr>
<tr>
<td></td>
<td>2 % for sales revenue</td>
</tr>
<tr>
<td>Government loan</td>
<td></td>
</tr>
</tbody>
</table>
Type: Annuity
Number of repayments: 30 (15 years)
Interest rate: 6.5%
Depreciation: Linear to zero (A defined percentage of the original asset value)
Depreciation for Mechanical and Electrical Equipment: 20 years
Depreciation for Civil Works, Structures and Buildings: 50 years

Based on the financial data as shown in Table 9: Financial data - Awetu MHPP above, the project is financially feasible:

- Total Investment in EUR per kW of installed capacity: 3,601.00 €/kW
- Total Investment in EUR per kWh of annual production: 0.54 €/kWh
- Net present Value (NPV): -175,578.00 €
- Financial Internal Rate of Return (FIRR): 8.24%

6.2 Impact of CDM on financial viability of the project

The potential impact of CDM on the financial viability of the Awetu MHPP will be shown by considering additional project income from the sale of Certified Emission Reductions (CERs) after deducting the CDM transaction costs.

6.2.1 Estimation of CDM Baseline

Considering the Baseline estimations for isolated renewable energy projects as shown in chapter 4.3.2.2, the CO₂ emission reductions resulting from the implementation of the Awetu MHPP project activity can be estimated as follows:

<table>
<thead>
<tr>
<th>Year</th>
<th>Carbon Emission Factor t CO₂/MWh</th>
<th>Annual generated energy MWh</th>
<th>Annual emission reductions t CO₂</th>
<th>TOTAL Emission Reductions t CO₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>0.9</td>
<td>1.828</td>
<td>1.645</td>
<td>8.225</td>
</tr>
<tr>
<td>2009</td>
<td>0.9</td>
<td>1.828</td>
<td>1.645</td>
<td>8.225</td>
</tr>
<tr>
<td>2010</td>
<td>0.9</td>
<td>1.828</td>
<td>1.645</td>
<td>8.225</td>
</tr>
<tr>
<td>2011</td>
<td>0.9</td>
<td>1.828</td>
<td>1.645</td>
<td>8.225</td>
</tr>
<tr>
<td>2012</td>
<td>0.9</td>
<td>1.828</td>
<td>1.645</td>
<td>8.225</td>
</tr>
</tbody>
</table>

6.2.2 Estimation of CDM transaction costs

The transaction costs for implementing the Awetu MHPP project under the CDM are expected to be similar to the transaction costs estimated for the Bonora MHPP in chapter 5.2.2, Table 6.

A possible reduction in transaction costs could be achieved by bundling several small scale projects into one CDM project.
6.2.3 Impact of CDM revenues on Financial Analysis

For assessing the impact of CDM revenues on the financial viability of a hydropower project, all CDM related positive and negative cash-flows will be considered in addition to the calculations performed in the Feasibility Study (see chapter 6.1.2). The CDM related cash-flows are summarised below:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Design Document</td>
<td>-40.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Validation</td>
<td>-10.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Refund of immaterial services</td>
<td>25.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monitoring and Verification</td>
<td>-4.000</td>
<td>-4.000</td>
<td>-4.000</td>
<td>-4.000</td>
<td>-4.000</td>
<td></td>
</tr>
</tbody>
</table>

*) Based on an expected CER price of 10,0 EUR/t CO₂

The additional project revenues through CDM at an assumed CER price of 10,0 EUR/t CO₂ will improve the project results as follows:

Net present Value (NPV)  
from - 175.578,00 EUR  
to - 153.383,00 EUR

Financial Internal Rate of Return (FIRR)  
from 8,24 %  
to 8,45 %

The cumulative project cash flow will be increased as shown in Figure 11.

As shown in chapter 6.1.2, the basic financial analysis of the Awetu MHPP (without considering CDM revenues) indicates a non-viable project with an expected return below the cost of capital.
Considering the potential additional project income through CDM improves the cumulative project cash flow; the additional CER revenues would slightly decrease the payback period app. ½ year. Due to the fact that the CER revenues are limited up to 2012 and relatively high transaction costs have to be considered, the overall effect on the financial feasibility of the Awetu MHPP is marginal.

In case the CERs resulting from the CDM project could be sold at EUR 20, the additional revenues would improve the FIRR to 9,05%, which is an improvement of 0,81% in absolute terms compared to the original calculation. Furthermore, the payback period could be decreased about 1 year (12 years instead of 13 years).

Nevertheless, for the Awetu MHPP the revenues from CDM do not seem to be sufficient to make the project financially viable, unless some of the following performance improvements can be achieved:

- Higher electricity tariff
- Sale of CERs beyond 2012 (CERs could be generated up to 2028)
- Price of CERs above EUR 20,00
- Lower CDM transaction costs
7 OUTLOOK/RECOMMENDATIONS FOR THE DEVELOPMENT OF SMALL HYDRO PROJECTS IN ETHIOPIA

7.1 Prerequisites for hydropower projects to qualify for CDM

As described in detail in chapter 4, there are numerous factors determining the eligibility of projects to qualify for CDM. In general, for any CDM project to be undertaken in a certain country, the legal and institutional requirements to host CDM projects in this specific country must be fulfilled. Besides the country related eligibility, there are additional criteria which have to be fulfilled by the individual projects.

7.1.1 Project eligibility

Not all projects are eligible to participate in the JI/CDM mechanisms. The key eligibility requirement for participation is “additionality”. That means, CDM projects must reduce emissions below the business-as-usual scenario (the baseline), and they must therefore be “additional” to what would have happened anyway, i.e. the project would not have taken place without the added value given by carbon credits.

Therefore, it must be shown that CDM revenues will make a significant difference to the project, helping to overcome investment or other barriers, and that there are alternatives to the project that are financially viable. A project may be additional even if it is profitable without CDM, if there are other barriers hindering its development (technological, institutional, etc.). A tool for the assessment of additionality was developed by the UNFCCC for both large and small-scale projects.

Furthermore, determining emissions reductions is inherently difficult, due to the uncertainty surrounding what is likely to happen in a theoretical future scenario. For renewable energy projects such as hydroelectricity, the process depends on the calculation of a carbon emissions factor for the electricity grid to which the project will be connected as shown in chapter 4.3.2.

7.1.2 Project types

All types of hydro projects are currently being developed under the CDM, including projects with dams resulting in additional flooded area, as long as the area inundated is small in relation to the electricity generated by the project. Specifically, the following types of project have been most successful in the carbon market to date:

- Run-of-river projects, e.g. featuring diversions.
- Hydro projects that use existing dams and reservoirs.
- Large scale projects with relatively small flooded area compared to the electricity generation.
- Small-scale hydro projects i.e. less than 15 MW installed capacity.

7.1.3 Restrictions for large dam projects

For new-build hydro projects that involve the construction of new dams and/or reservoirs however there are specific issues to be addressed. Large dams, subject to public debate in recent years, have also been scrutinised heavily under the CDM regulations. The methane emissions from the dams and reservoirs, resulting from the aerobic and anaerobic decomposition of organic materials in the inundated areas must be accounted for.

---

7 International Water Power and Dam Construction Magazine, April 2006
The emission values of greenhouse gas (GHG) emissions, specifically methane, vary widely between large lakes and reservoirs across the globe (based on the World Commission on Dams report). It should be noted however that natural habitats emit methane anyway; therefore it is the net change in methane emissions due to impoundment that should be used for assessment, and not the gross emissions from the reservoir. In general, methane emissions are higher: in tropical climates; where vegetation cover is dense; where the flooded area is large relative to the MW installed capacity (e.g. low topography); and where significant quantities of organic material are washed into the reservoir by rivers and streams.

Based on the third point above, the UNFCCC has developed thresholds and criteria for the eligibility of hydroelectric power plants with reservoirs as CDM project activities. The thresholds are defined in terms of power density (Watts/m²) and clarify whether or not it is possible to use existing methodologies for a specific project and if project emissions from the reservoir are negligible and may be neglected from emissions calculations. Therefore many projects, even with dams, are eligible under the CDM, and should consider carbon finance in their financial planning.

7.1.4 Environmental concerns

Environmental concerns must be at the forefront of CDM project development and each project must meet the sustainable development criteria of the host country. For projects larger than 20MW, the EU requires that the international criteria and guidelines of the World Commission on Dams publication, “Dams and Development. A new framework for decision-making”, have been taken into account during project development if credits are to be sold into the EU Emissions Trading Scheme.

7.1.5 CDM and Official Development Assistance (ODA)

At its Meeting in Marrakesh, Morocco, in 2001 the Conference of the Parties to the UNFCCC agreed on modalities and procedures for CDM. In particular, it was agreed “that public funding for clean development mechanism projects from parties in Annex 1 is not to result in the diversion of official development assistance and is to be separate from and not counted towards the financial obligations of Parties included in Annex I”.

In this connection, the CDM Board, at the time of considering a proposed a CDM project that includes ODA financing, would seek an affirmation (project by project) from the donor that public financing does not result in the diversion of ODA. Moreover, it is the host Party's prerogative to confirm whether a clean development mechanism project activity assists it in achieving sustainable development. Thus, the recipient country will need to approve each project, including the source of financing.

7.2 Critical success factors

Developing a renewable energy project under the CDM is a lengthy and complicated process and involves many different stakeholders. Therefore, it is important to plan the CDM procedure carefully and ensure full coordination with the regular project development activities and communication with all relevant stakeholders.

Based on the experience from the development of CDM projects, several critical success factors are identified in this chapter. These are relevant for renewable energy CDM projects in general and hydropower CDM projects in particular. Considering the success factors before deciding whether to undertake a certain project idea under the CDM can save considerable amount of money and time by not pursuing unreasonable CDM projects.
Procedure related success factors:
- The PDD shall be developed in a logical and consistent manner, possibly following an existing approved methodology for estimating emission reductions.
- Deviations from selected baseline and monitoring methodologies must be justified sufficiently.
- The project must be in compliance with local legal requirements and must include an extensive stakeholder consultation process.
- Developing the PDD requires a finalized Environmental Impact Assessment (EIA) for the proposed project activity; implementation requires construction/operating permits/approvals.
- Project participants must be identified clearly.
- It is important to explain baseline scenarios and project additionality in sufficient detail; baseline information must be supported by evidence and referenced accordingly including a clear definition of the project boundaries; respective risks to the baseline shall be identified/described.
- Clear differentiation between small-scale project activities and large-scale projects is required when conceptualising the CDM project.
- CDM projects require written confirmation that funding will not result in a diversion of official development assistance (ODA).

Project related success factors:
- The expected emission reductions must be large enough to justify the costs of the CDM transaction process (shall be above 20.000 t CO2).
- Eligibility criteria for hydropower projects shall be considered before starting the CDM process:
  - Project type (run-of-river preferred).
  - Project size (small scale projects preferred).
  - Additionality, i.e. CDM must be decisive for investment decision.
- The CDM process must be started early within the project development phase (possibly during the feasibility phase, definitely before the investment decision).
- The approval process can be sped up if a Memorandum of Understanding for the development of CDM projects is existing between the host country and the buyers country.
- The proceeds from CDM shall be considered in the project financing structure; this requires an Emission Reduction Purchase Agreement (ERPA) to be signed prior to the development of the financing concept.
- The conclusion of a Power Purchase Agreement (PPA) shall be pursued in parallel to the ERPA; both PPA and ERPA are important to secure project financing prior to the implementation of the project.

7.3 Potential savings in CDM transaction costs through project pooling

7.3.1 Possible savings in transaction costs

The expected CDM transaction costs for small hydro power plants were listed in chapter 5.2.2 for the Bonora MHPP. The indicated transaction costs of EUR 50.000 are rather low due to the fact that the baseline scenario for this project is the installation of diesel generators which simplifies the preparation of the Baseline Study.

The preparation of CDM documents for grid connected renewable energy projects requires more elaborate project documents and can be expected to increase the transaction costs up to 100% (EUR 80.000 to 100.000).

On the other hand, if several CDM projects of the same type are bundled together as described in chapter 4.5.2, transaction costs can be significantly reduced. If, for example, the CDM projects Bonora and Awetu would be grouped together, the transaction costs would be in the range of a single CDM...
project (approximately EUR 60,000). Furthermore, the small scale methodology which would be applied for these projects would allow project pooling up to 15 MW total installed power. Since the total installed power of Bonora and Awetu is only 1,315 MW, this project bundle could be extended even more, thereby reducing the specific CDM transaction costs.

The relation between CDM transaction costs and expected revenues is an important indicator for CDM project activities. This relation can be calculated for the two project cases and for the combined CDM project bundle as follows:

<table>
<thead>
<tr>
<th>Project</th>
<th>CDM Transaction costs [EUR]</th>
<th>CDM revenues [EUR]</th>
<th>Specific transaction costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bonora MHPP</td>
<td>50,000</td>
<td>278,100</td>
<td>18 %</td>
</tr>
<tr>
<td>Awetu MHPP</td>
<td>50,000</td>
<td>82,250</td>
<td>61 %</td>
</tr>
<tr>
<td>Bonora/Awetu CDM project bundle</td>
<td>60,000</td>
<td>360,350</td>
<td>16,65 %</td>
</tr>
</tbody>
</table>

As indicated in Table 12 above, project pooling is an effective means to reduce CDM transaction costs and should be utilised to a maximum extent.

### 7.3.2 Impact on Financial Analysis

In order to assess the impact of reduced CDM transaction costs on the financial analysis, the total costs have to be distributed on the individual projects. By distributing the CDM costs dependent on the expected CDM revenues, the cost per project would be calculated as follows:

Bonora CDM transaction costs: 60,000 * 278.100 / 360.350 = EUR 46,300
Awetu CDM transaction costs: 60,000 * 82.250 / 360.350 = EUR 13,700

Project bundling reduces the transaction costs for both projects below the originally estimated costs of EUR 50,000 each. This reduction will not have a significant influence on the Bonora MHPP due to its larger size.

On the other hand, the reduction of EUR 36,300 in transaction costs will have a positive impact on the financial return of Awetu MHPP. Furthermore, the costs for monitoring and verification can be halved to EUR 2,000 p.a. (from EUR 4,000) because of bundling. Considering the reduced costs as well as the refund of immaterial services would improve the project result as follows:

- **Net present Value (NPV)**: from - 153,383,00 EUR to - 127,651,00 EUR
- **Financial Internal Rate of Return (FIRR)**: from 8,45 % to 8,69 %

Through bundling, the specific CDM transaction costs for Awetu MHPP could be reduced from 61% to 16,65%. This reduction would justify undertaking Awetu MHPP under CDM which might not have been possible if the project was developed independently.
7.4 Recommendations for further development of the MHPPs Bonora and Awetu

The MHPP projects Bonora and Awetu are currently in the Feasibility Study phase which was financed by the Austrian Development Cooperation. In the Feasibility Studies the following further activities were recommended:

- Detailed project design including preparation of tender documents; review of existing legal requirements in Ethiopia in terms of licenses and permits
- Development of the organisational and institutional framework
- Development as “pilot-projects” within the “Rural Electrification Program” of Ethiopia

Based on the assessments undertaken within this study, CER revenues significantly increase the project’s financial attractiveness by improving key financial indicators. Furthermore, CDM would make the projects more resilient to various risks such as country risk and foreign exchange risk.

The financial benefit of the revenues obtained by selling CERs is significant:

- The Financial IRR for the Bonora MHPP would be increased from 14% to 15%
- Due to its smaller size, the Financial IRR for Awetu MHPP would only be increased from 8,24% to 8,45% which is still below the cost of capital of 10%. Therefore, bundling the two projects under CDM is recommended to decrease the specific transaction costs. Through bundling, the Financial IRR for Awetu MHPP could be further increased to 8,69%.

Following a conservative approach, the income from CERs was only considered for the years 2008 to 2012 because of the uncertainty about a post-Kyoto regime. Nevertheless, an important factor for pursuing the projects under the CDM is the upward potential of Carbon credits in case the worldwide cap-and-trade regime will be prolonged after 2012, which would allow the projects to generate CERs up to 2028.

In addition, MHPP projects usually face serious financing barriers. As a result, the possibility of CER sale under the CDM is an important factor to overcome the investment barriers and reach financial closure due to the following effects:

- The revenues through the sale of Certified Emission Reductions (CERs) provide additional income for the project in “hard currency” (EUR or USD) from buyers with excellent credit ratings (e.g. Government of Austria). In order to have “state of the art” technology available for the MHPP projects, some of the equipment will have to be supplied from industrialised countries. Due to the fact that the revenues from the sale of electricity will be in Ethiopian Birr, only the revenues from CER sale could provide the required security for loans in EUR or USD.
- Due to the high environmental and economic standards required for CDM projects, many financing institutions are specifically targeting CDM projects or at least prefer CDM projects over “regular” investment projects. The involvement of internationally reputable organisations in the CDM process (e.g. UNFCCC) improves the risk profile of the project.

Generally, small and mini hydropower projects are considered a most environmentally friendly source of renewable energy. These types of projects usually can be implemented with minimal damage to the local environment. Many times, significant socio-economic benefits can be achieved if MHPPs form an integral part of rural electrification schemes. Therefore, MHPP projects are highly qualified for an implementation under the CDM; so far, no MHPP project was rejected by the CDM Executive Board. While it is likely that MHPP projects are being registered, it is important to analyse the implementation costs versus the expected benefits thoroughly before implementing a MHPP project under the CDM. The total expected emission reductions shall be above 20,000 t CO2 in order to justify the costs of the CDM transaction process. Furthermore, it is important to utilise any additional benefits out of the CDM status (such as easier access to project financing) in order to improve the CDM cost-benefit relation.
The three most common pitfalls to be kept in mind for CDM MHPP projects are (i) the lack of institutional setup in the host country, (ii) a late start of the CDM process (e.g. after implementation and financing decision) and (iii) project sizes too small to justify the CDM transaction costs (this can be mitigated through project bundling).

It is recommended to support the implementation of the MHPPs Bonora and Awetu by registering the projects under the CDM. Therefore, the following next steps would be required in parallel to the development of the detailed project design and the tender documents:

1. Assessment of current institutional status for hosting CDM projects in Ethiopia, such as CDM procedures and Sustainable Development rules
2. Identification of possible financing sources for MHPPs (e.g. ACP-EC Energy Facility of the European Commission or FINESSE Program of the African Development Bank)
3. Promoting the project among possible investors and/or operators of the plants as well as possible Carbon buyers funds
4. Development of the CDM project Phase I: Preparation of Project Idea Note (PIN); submission to the Ethiopian Authorities (Designated National Authority) and a potential Carbon buyers fund (e.g. Austrian JI/CDM Programme)
Appendix 1: COMFAR III - Project summary sheets