THE CLEAN DEVELOPMENT MECHANISM AS A POTENTIAL SOURCE OF FUNDING FOR SOLAR COOKING PROJECTS

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ABSTRACT

The Clean Development Mechanism (CDM) was initially expected to provide an innovative source of funding for renewable energy projects, including projects promoting small-scale technologies such as solar cookers. With the CDM´s complexities, uncertainties and related transaction costs, it has been challenging for small scale projects, in particular those that involve many individual users to benefit from the CDM.

This paper analyses the current state of the CDM as it relates to solar cooking projects including a review of the CDM project cycle, appropriate baseline and monitoring methodologies, CDM transaction costs vs. benefits of certified emissions reductions (CERs), and a look at relevant projects already submitted to the CDM process.

The paper concludes by presenting various recommendations and ¨best practices¨ for moving a solar cooking project through the CDM process, while maximizing its success and minimizing transaction costs.

Keywords: CDM, Kyoto Protocol, solar cooking, certified emissions reductions, transaction costs.

1. INTRODUCTION

When the Clean Development Mechanism (CDM) was initially formulated in 1997 as part of the Kyoto Protocol, it was expected to provide an innovative and significant source of funding for sustainable renewable energy projects, including projects promoting small-scale technologies such as solar cookers.

The first few years of the CDM, however, have seen that because of fairly high transaction costs, and the many uncertainties and complexities in the design of the CDM, it has been challenging to use the CDM for small scale projects, and in particular those that involve many individual users. Most projects that have come through the CDM process have been either electricity generation projects, or large scale projects that reduce non CO_2 emissions such as methane or HFC´s and provide a much higher volume of credits. Many people have already dismissed the CDM as a realistic source of funding for projects at a community level, such as solar cooking projects.

Now that the Kyoto Protocol has entered into force (2005), and the CDM is fully operational, it is an ideal point to review the potential of the CDM as a potential source funding for solar cooking projects. This paper intends to carry out a realistic analysis of the current operation of the CDM and carbon markets as they relate to projects whose goal is to promote and disseminate solar cooking technologies.

Included in the analysis is:

- an overview of the steps involved in the development of a CDM project, i.e. the CDM project cycle,
- a review of baseline and monitoring methodologies that are available for these types of projects, and the key issues surrounding these methodologies,
- an analysis of the transaction costs of submitting a CDM project for registration, including costs for project design documents, validation, registration, monitoring and verification, for projects of various sizes,
- a look at the current prices of carbon credits and how they can vary according to project types, risk, and timing,
- a brief look at other sources of potential carbon funding from, for example, the ¨voluntary¨ sector.

2. BACKGROUND

The Clean Development Mechanism or CDM was established in 1997 as part of the Kyoto protocol as one of three mechanisms designed to provide more options or ¨flexibility¨ to industrialized countries (known as Annex 1 countries) in meeting their greenhouse gas emission reduction commitments. The other two mechanisms are Joint Implementation and Emissions Trading[1].

The CDM is unique among the three in that it was designed to help contribute to sustainable development in developing countries, in addition to assisting Annex 1 countries in meeting their Kyoto commitments. A key requirement of a CDM project is that it brings about real, measurable, and long-term greenhouse gas (GHG) reductions, that are *additional* to any those that would occur in the absence of the project activity, and for this reason stringent methodologies need to be followed in order to that a project meets this requirement.

In essence, a CDM Project is an activity that occurs in a developing country, and reduces greenhouse gas emissions. These emissions reductions are verified and then certified as ¨Certified Emissions Reductions¨ or CER´s and the CER´s are generally sold to a company or country in an Annex 1 country to help them meet their Kyoto emissions reductions targets. Each CDM Project requires the approval of the host country, as it is the host country that assesses and approves a project's contribution to sustainable development. Projects usually include the participation of a company or organization from an Annex 1 country, but this is not essential.

A set of of preliminary rules and procedures for the CDM are contained in the Marrakech Accords that were agreed to at Marrakech[2] in 2001, and are designed around these basic requirements that were laid out in the Kyoto Protocol. Further details and clarifications of these rules and procedures are provided on an ongoing basis by the CDM Executive Board, which is the governing body of the CDM.

While CDM projects could theoretically be initiated in the year 2000, and a number of projects did begin at that time, the first actual registration of a CDM project occurred in November 2004, and the Kyoto Protocol itself only came into force on the 16 of February 2005.

Since that time there has been a flurry of activity – many new methodologies have been approved, hundreds of projects are now in the CDM pipeline and CER´s have begun to be issued and transferred to various project participants.

As of April 18, 2006, there were 161 CDM projects registered and an estimated 340,000,000 CER´s expected to be generated by these projects by the end of 2012. The number of CER´s issued by that date was 4,550,000.[3] Of these projects, 62 (or 38.5%) are considered small-scale projects.

3. THE CDM AND SOLAR COOKING PROJECTS

Of these registered projects, only one (as of April 2006) is a solar cooking project - the Aceh Solar Cooker Project in Indonesia, promoted by Dieter Seifert in cooperation with Klimaschutz. This project was registered in February of this year and will generate an estimated 3,500 tCO_2e reductions per year.

There is at least one other solar cooking project in the project pipeline, a Solar Community Kitchens Project in India, in which GTZ is the main proponent and the German government the main buyer of carbon credits. Several biogas cooking projects, which are very similar in nature to solar cooking projects at least in the design and monitoring of a CDM project, have also been registered.

3.1 Relevant CDM Project Types and Categories

3.1.1 Small Scale Category

Because of the complexities and significant transaction costs of the process of developing and registering a CDM project, a special category has been defined for Small Scale Projects, for which transaction costs are somewhat reduced and some elements of the project design are simplified.

To be included in the small scale category, a renewable energy project needs to have a total maximum installed capacity that is less than 15 MW. As it would be very rare for a solar cooking project to have an installed capacity that is greater than 15 MW, (this would imply 25,000 cookers, assuming a nominal power per unit of 600kW) they will almost invariably fall within the small-scale category. For this reason this paper will refer primarily to the simplified procedures and methodologies that are available for small scale project activities.

[1] For further details on the Kyoto Protocol, the Kyoto Mechanisms, and the CDM, please refer the UNFCCC´s website, at www.unfccc.int

[2] During the seveth Conference of the Parties or COP7 that took place in Marrakech.

[3] Each CER represents a reduction of one tonne of CO_2 equivalent.

3.1.2 Project Bundling

Another potential means of reducing transaction costs for small projects is through bundling together various projects of the same type and category and submitting them as a single project bundle. Small scale projects can be bundled as long as the total size of the bundle does not exceed the defined maximum size for a small scale project. Thus, several solar cooking projects with a total capacity less than 15 MW (or less than 25,000 cookers using the nominal unit power given above) could be bundled together to save on transaction costs and to simplify the procedure for individual projects. Some agencies, e.g. IT Power, are now exploring the possibility of creating *Bundling Organizations* that would bring together individual projects into project bundles and would manage the CDM process for these individual projects, even potentially selling the CER´s.[4] They have estimated that for some types of projects, bundling can potentially reduce transaction costs by up to 50%. Because of the relatively small size of solar cooking projects, the creation of a Project Bundling Organization specifically for solar cooking projects could be an interesting option to explore.

3.1.3 The Gold Standard

The Gold Standard has been set up by the World Wildlife Foundation (WWF) as a best practice benchmark for CDM projects in an attempt to create a standard that promotes projects that have minimum environmental impact, truly contribute to sustainable development, and would not have occurred without the CDM. Buyers of CER´s from Gold Standard projects can expect to pay higher than market prices for the CERs, given that the credits are generated by high-quality CDM projects. Solar Cooking projects could be ideal candidates for the Gold Standard given that they promote the use of renewable energy and bring so many environmental and health benefits to the local community.[5]

3.2 CDM Project Cycle[6]

The following is a brief description of the steps that are essential in order to register a CDM project, so that CER´s can be generated:

[4] See for example: ¨A Guide to Bundling Small-Scale Projects¨, by the IT Power Group, available at www.cdmpool.com . This website is meant to be a forum for experiences related to Project bundling and bundling organaizations.

[5] For further information on the Gold Standard, see http://www.cdmgoldstandard.org/

[6] Further details on the CDM Project Cycle and relevant reference documents are provided on the UNFCCC´s website, at http://cdm.unfccc.int/Projects

3.2.1 Project Design Document

Each CDM Project (or project bundle) needs to be described in a Project Design Document, commonly known as a PDD, whose content and format are prescribed by the UNFCCC. This is the key document for a CDM Project. The PDD for small scale projects is somewhat simpler than for larger scale projects,[7] but the main headings are essentially the same:

A. General description of project activity
B. Baseline methodology
C. Duration of the project activity / Crediting period
D. Monitoring methodology and plan
E. Calculation of GHG emission reductions by sources
F. Environmental impacts
G. Stakeholders comments

Sections B, D, and E are the most complicated and detailed sections of the PDD and need to be written according to an *Approved Baseline and Monitoring Methodology*, a methodology that provides instructions for the following: demonstrating that the project is *additional*, and is not the *baseline scenario*[8], determining the baseline scenario, estimating the GHG emissions of the baseline and project scenarios and emissions reductions, and for monitoring these emissions reductions.

If an appropriate *Approved Methodology* is not available for a specific project, project developers need to develop a *New Methodology* and submit it for approval, a process that may take up to one year. Fortunately there are currently 19 Approved Methodologies specifically for small scale projects. One of these, methodology AMS.I.C *Thermal energy for the user* has been used in all of the solar cooking and biogas PDD´s that are currently publicly available, and is currently the most relevant *approved* methodology for these types of projects. The application of this methodology will be discussed further in section 3.3.

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Because of the complexities of baseline and monitoring methodologies, most project developers turn to international consultants to develop the PDD´s for their projects. However, as more and more PDD´s become publicly available and the rules become clear, it will become easier for project developers to write their own PDD´s using previous projects as examples.

3.2.2 Host Country Approval

[7] The most recent version of the Project Design Document for small scale projects as well as guidelines for filling it in , can be found at www.cdm.unfccc.int/Projects/Documents

[8] The *baseline scenario* is the scenario that would have most likely occurred if the project activity had not been initiated. It is the reference scenario from which emissions reductions are calculated.

Once a PDD has been completed it is generally submitted to the *Designated National Authority* (DNA) of the country in which the project is located. The DNA is the organization that has the authority to approve a CDM project in its country. Each host country sets their own approval process, including the criteria or procedures through which they evaluate a project's contribution to sustainable development. Given the numerous sustainable development benefits of solar cooking projects, host country approval in itself should not be difficult; however significant delays are still to be found in the approval processes of some countries.

3.2.3 Validation

The completed PDD then needs to be *validated* by a certified third party organization known as a *Designated Operational Entity* or *DOE*. Validation is the process of independent evaluation of a project activity against the requirements of the CDM, and includes a site visit and interviews with the project developers as well as local authorities at the project location. In most cases, a DOE is a private company that specialized in certification or auditing and the majority are based in Europe. A list of authorized DOE´s and their areas of expertise is available on the UNFCCC website.

3.2.4 Registration

Once a project has been successfully validated, and has been approved by the host country, the DOE submits a request for registration of the project activity. Generally a project is registered (4) weeks after this request has been received by the EB, unless there is sufficient reason for an appeal process.

3.2.4 Certification and Verification

Once a project has been registered, has been operating for at least one year, and emissions reductions have begun to accrue, these emissions need to be *verified* and *certified*, again by a DOE. *Certification* is the written assurance by the DOE that, during a specified time period, a project activity achieved a specific quantity of reductions in GHG emissions. It is important to note, especially for estimating total CER´s, that there are two possible choices for crediting periods, either a single period of 10 years, or a renewable crediting period of 7 years, which can be renewed a maximum of two times, for a total crediting period of 21 years.

3.2.5 Issuance

As a final step, the *Certified Emissions Reductions* are issued by the Executive Board and are transferred to the holding account of the project participant.

3.3 Methodological Issues for Solar Cooking Projects

As mentioned above, the approved methodology *AMS.1.C. Thermal Energy for the User* is at this point the most relevant *approved* methodology for solar cooker projects. This methodology is designed for ¨*renewable energy technologies that supply individual households or users with thermal energy that displaces fossil fuels*¨ and specifically cites solar cookers as an example, along with solar dryers, and water heaters, among others. However, because AMS.1.C is limited to projects that displace fossil fuels, a new draft methodology *AMS.1.E*[9], has been proposed to deal with cases in which non-renewable biomass is displaced by such technologies. These two methodologies will are discussed below.

3.3.1 Baseline Methodologies

The determination of the baseline depends on the fuel or fuels displaced through the introduction of the renewable energy technologies, in this case, solar cookers. The current active version of methodology *AMS.I.C* only identifies two possible baseline categories, either fossil fuels, or electricity. However, previous versions of this methodology also included the category of ¨non-renewable¨ biomass as a possible baseline fuel and as such it was applied (in the Aceh project, for example) in cases where the baseline was a non-renewable source of biomass, for example fuel wood. This category was deleted from the methodology in November 2005 because of the lack of a clear definition of non-renewable biomass and a procedure for addressing potential *leakage*[10] arising from such projects.[11]

For all three categories, in *AMS.1.C*, the baseline emissions are calculated by multiplying the fuel

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[9] A revised draft version of this methodology was proposed by the Small Scale Working Group at its meeting in March. This methodology is expected to be assessed for approval at the EB meeting in early May 2006.

[10] *Leakage* in this case refers to the impact of a project on the use of non-renewable biomass outside the project boundary, that is, if a specific CDM project reduces the use of non-renewable biomass for within its project, how much of this displaced biomass (if any) may then be used be other actors that are not part of the project and therefore lead to increased emissions outside of the project boundary.

[11] A public call for inputs on procedures to address 'leakage' from small-scale CDM biomass project activities and their effect on carbon pools was opened until March 21, and the EB and small scale working group assessed these inputs and used them in the most recent draft of AMS.1.C. (available at http://cdm.unf....).

consumption of the technologies that would have been used in the absence of the project activity, by a CO_2 emission coefficient. In the case of fossil fuels, eg. kerosene, default IPCC[12] coefficients are generally used, usually provided in tonnes CO_2/MJ. In project activities where solar cookers displace electric stoves, an emission coefficient for the displaced electricity (in tonnes CO_2/MWh) needs to be calculated. This coefficient is calculated according to another small-scale methodology, *AMS.I.D*, depending on the source of electricity, for example, if it is from a grid or an isolated diesel generator. Total baseline emissions for a project activity are therefore the sum of all baseline emissions for each technology/displaced fuel combination.

The draft methodology, *AMS.I.E., Switch from Non-Renewable Biomass for Thermal Applications by the Use* was designed for projects involving technologies such as solar cookers or biogas stoves that bring about a switch from non-renewable biomass to renewable sources of energy[13] This methodology assumes that the baseline scenario would be the consumption of the type of fossil fuel that is generally used in the local community, e.g. LPG or kerosene. It does not include a calculation of baseline emissions but provides a formula for directly calculating emissions reductions[14].

Through this methodology emissions reductions in a given year (ER_y) are calculated by multiplying the total quantity of non-renewable biomass that is substituted in the year B_y by the net calorific value of this biomass $NCV_{biomass,}$ and an emissions factor for that biomass:

$$ER_y = B_y \times NCV_{biomass} \times EF_{non\text{-}renewable\ biomass}$$

The draft methodology also provides two options for determining B_y . The option most appropriate to solar cooking projects is simply to multiply the number of units (e.g. solar cookers) by the estimated average annual consumption of biomass per cooker, which is determined either through historical data or through a survey of local usage patterns.

The default net calorific value provided for non-renewable biomass is 15 MJ/kg, though if locally measured values are available they could be used instead. The emissions factor EF for non-renewable biomass is determined by calculating a ratio of the efficiency of biomass stoves over fossil fuel stoves, multiplied by the CO_2 emission factor of the fossil fuel in question.

As mentioned previously, this methodology also provides a procedure for dealing with leakage. When using this methodology it either has to be demonstrated and justified that the project will not lead to leakage, or otherwise a method for calculating this leakage needs to be provided. The two areas of *leakage* that have to be addressed are : (1) the potential use of the non-renewable biomass displaced by the project by other users outside of the project, and (2) the potential use of the non-renewable biomass saved by the project activity for justifying other CDM projects.

Furthermore, the EB recently approved a definition of ¨renewable biomass¨ [15] that concludes stating that where none of these conditions apply the biomass is considered to be non-renewable. Since renewable biomass is considered to be CO_2 neutral, in order to for cooking projects that displace biomass to obtain CER´s, they will also have to demonstrate that the displaced biomass is not *renewable* according to this approved definition.

3.3.2 Monitoring Methodologies

Once the project is in operation, emissions reductions need to be monitored before they are verified and CER´s can be issued. A monitoring plan needs to be described in the PDD and generally is carried out on a yearly basis.

If the methodology AMS.I.C. is used it specifies the following procedures for monitoring technologies for which the emissions reduction per system is less than 5 tonnes of CO2 a year, which would be the case for most solar cookers:

> (i) Recording annually the number of systems operating (evidence of continuing operation, such as on-going rental/lease payments could be a substitute); and
>
> (ii) Estimating the annual hours of operation of an average system, if necessary using survey methods. Annual hours of operation can be estimated from total output, and output per hour if an accurate value of output per hour is available.

As an example of project monitoring, the Aceh Project in Indonesia uses a system of control cards on which each user records the operating hours of their solar cooker. Hours are then counterchecked for plausibility based on hours of sunshine. Also, if a user is not using the device it is passed on to another family.

For the use of the methodology *AMS.1.E* the monitoring plan needs to include the following: (1) an annual check of all units, or a representative sample, to ensure that the

[12] Internacional Panel on Climate Change

[14] Note that this methodology is still in draft form and contains a number of inconsistencies,

[15] Available athttp://cdm.unfccc.int/EB/Meetings/023/eb23_repan18.pdf

units are still operating or have been replaced by an equivalent unit, (2) the confirmation of the displacement or substitution of the non-renewable biomass at each location, and (3) compliance with the conditions demonstrating the non-existence of leakage or its calculation, if it exists.

3.4 CDM Transaction Costs

The transaction costs for a small scale CDM project will vary depending on factors such as the size of the project, its location, whether or not the PDD can be developed in-house or locally, and whether there is a regional DOE available for validation and certification. Monitoring costs can be significant for projects with many individual users, so a simple and low-cost monitoring plan is recommended where possible in order to keep transaction costs reasonable, most likely using a representative sample of solar cookers, as opposed to all units involved.

The following table gives an idea of the range of transaction costs in US$ (for a small scale project) that need to be considered before developing a CDM project:

TABLE 1 – CDM TRANSACTION COSTS

Transaction	**Cost to CDM Project**
PDD Preparation	0 – 15,000
Validation	$ 4,000 – 15,000
Registration Fee	0.10 per CER up to 15,000 annually 0.20 per CER for those beyond 15,000. *No registration fee if total CERs for crediting period < 15,000*
Monitoring	Up to 5% of operational costs
Verification and certification	$ 4,000 – 10,000 per visit
Risk mitigation	1 – 3 % annual value of CER
Adaptation Fund of the UNFCCC	2% of CERs generated annually

Thus, upfront costs for project design, validation and registration, range from a minimum of $4000 for a very small project whose PDD is prepared at no additional cost, up to a potential $31,500 if annual CER´s are expected to be about 15,000. Annual costs will vary depending on quantity of CER´s and the ease of monitoring. Note that these costs do not include any legal costs for setting up carbon contracts, nor administrative costs.

3.5 Carbon Prices

Now that the CDM is fully operational, with CER´s being issued, and even a Compliance Mechanism in place that will set penalties for countries who do not meet their targets, the market for CER´s is getting stronger. The majority of buyers are still in Europe where large companies are obligated to comply with the commitments set out in their National Allocation Plans.
The prices that buyers pay for CERs vary substantially depending on the stage that a project is at, the quantity of credits, the perceived risks and the conditions of the contract, ie. who takes on the risk. According to the CDM /JI Monitor [16], a recent purchase of already issued CER´s closed at about 20 euros per CER. However, purchases in which the project is at a much earlier stage in the project cycle, and the buyer takes on much of the risk, prices are still in the 5 euro range. The majority of purchases are currently closing at 7 and 20 euros and involve contracts in which the buyer promises to buy all the CER´s that the project delivers, with a number of preconditions.

3.6 Cost/Benefit Analysis

Before beginning to develop a CDM project it is crucial to carefully and realistically analyse the costs and benefits of the CDM for the specific project, based on the expected number of CER´s, expected price of CER´s and the transaction costs as estimated in the previous table. Project sizes or project bundles could be potentially designed to maximize the value of the CER´s and minimize transaction costs. Projects that meet the Gold Standard can generally get a somewhat higher price, currently at about 15 euros, but one needs to keep in mind that there is an additional $2000 registration fee for certifying under the Gold Standard.

It is also worthwhile looking at potential voluntary markets, for example purchasers who buy carbon credits in order to make their events (e.g conferences, sports events, etc.) carbon neutral without going through the CDM process[17]. For these buyers, CDM-specific transaction costs would not apply, although there would still be some costs such as for verifying emissions reductions and broker commissions.

[16] CDM/JI Monitor, March 6,2006.www.pointcarbon.com

[17] See for example, Klimabalance: at www.500ppm.com

4. CONCLUSION

The Clean Development Mechanism is definitely operational and is one means for providing additional funding for solar cooking projects. The market is getting stronger, the Kyoto Protocol is a reality and prices for Certified Emissions Reductions are increasing. There is at least one solar cooker project already registered that can be as a model, an approved methodology for projects displacing fossil fuels or electric stoves, and another soon to be approved, for the displacement of non-renewable biomass. There is even a mechanism for allowing for project bundling. In other words, practically everything is in place for developing solar cooking projects under the CDM.

On the other hand, because transaction costs are still significant and the registration procedures remain complicated, it is important before setting up a program that takes advantage of CDM funding to carefully analyse the costs and benefits of the CDM, as well as the effects of project size or project bundling, and to review all available options, such as obtaining the Gold Standard certification or selling in the voluntary market. One option for facilitating and simplifying this process would be to set up some form of bundling/carbon finance organization specifically for solar cooker projects that could streamline the process of registering projects, optimizing the sizes of projects or project bundles and arranging the sales of carbon credits.