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Feasibility of CDM funding for household and community level projects

With examples from Caucasus and Central Asia

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Summary

An analysis of the current situation of household and community based projects under the Clean Development Mechanism (CDM) reveals that CDM funding has hardly been accessible to such projects. At the same time, they can significantly contribute to the achievement of the sustainable development goal defined in the CDM, particularly through improvements of energy supply for poor households. This is also of great importance to improve the living conditions of women.

We identify projects types with potential for CDM funding and give hints for the development of such projects under the CDM. Most important points to analyse are cost effectiveness of the promoted technology and baseline emissions of the traditional, replaced technology. Moreover, CDM is only applicable to household based projects if a massive dissemination of mature technologies is put into practise.

A high potential is found for projects delivering renewable thermal energy directly to households, based on decentralized sources, mainly biogas, waste biomass and thermal solar power. Also projects providing electric energy for lighting have good potential to achieve funding under the CDM, particularly photovoltaic lamps. As for energy efficiency, the highest potential is found for projects based on efficient cook stoves or efficient lighting by using CFL bulbs. Other technologies with moderate potential for CDM funding are solar cookers, efficient or renewable-energy based irrigation and home insulation; the latter particularly in the region of Caucasus and Central Asia, which is focused on in this study. In any case, factual potential of CDM funding depends on the specific circumstances in the project area; country-specific analysis will always be needed.

Based on an analysis of constraints in the current CDM rules, we propose substantial improvements in terms of funding conditions and methodological requirements for such projects.

1 Introduction

Poor communities in developing and emerging countries have hardly been able to access funding via the Clean Development Mechanism (CDM) for climate change mitigation measures. At the same time, many low-income communities have limited access to sustainable energy which restricts their opportunities for economic development and education.

In this study, we analyze the potential of CDM as a funding mechanism for household and community based projects (further on called **HH projects**). We provide practical guidelines on CDM for institutions working with HH projects. At the same time, we make suggestions how CDM should be improved to be more accessible for household and community based projects.

The study covers household and community based projects in general; for practical examples, we focus on the Caucasus and Central Asia region (further on called **CCA region**), which is the target area of the work of WECF.

Definition of HH projects

We define HH projects as projects that reduce emissions caused directly by households and communities in activities of their daily life and where these households and communities are actively involved in implementing the project.

Typically such HH projects bundle a huge number of small units, e.g. by distributing energy efficient facilities or disseminating clean technologies. HH projects can consist in providing clean and efficient energy services where no service existed before, thus providing clean development, or in replacing old and inefficient technologies. Therefore HH projects have high potential to improve the livelihoods of poor households and communities.

CDM as a funding source for HH projects - general aspects

HH projects in developing countries are traditionally often funded by official development aid, mostly through NGOs or governmental development agencies. Funding is mostly provided in the form of non-reimbursable grants with only partial contribution of beneficiaries and implementing entities to project funding. This implies a low financial risk for project implementation which is particularly needed for implementing pilot projects.

CDM funding is different because it is success based – carbon credits can only be obtained after a project has proven to be operational. This implies an important limitation of CDM funding for many potential projects. But at the same time, CDM is an opportunity for upscaling viable projects, providing sustainable and continuous revenues by carbon credits without dependence on grant funding.

In sum, CDM is an opportunity for large projects based on technologies that have proven to be successful. CDM is hardly suitable for pilot projects.

2 CDM for household and community based projects

2.1 The CDM Mechanism

The Clean Development Mechanism (CDM) is one of the mechanisms defined in the Kyoto protocol to reduce emissions on a global level[1]. It allows projects in Non-Annex 1 countries (developing and emerging countries without binding emission reduction targets) to generate carbon credits called CERs (Certified Emission Reductions). CERs are traded on international carbon markets; main buyers are Annex 1 countries or companies participating in the European Emission Trading Scheme (EU-ETS).

CDM projects can be organized in a bilateral way (an investor from Annex-1 country invests with the purpose to obtain CERs) or in a unilateral way (a project developer from Non-Annex 1 country sets up a project to sell CERs to any potential buyer). The objectives of the CDM also include fostering technology transfer and sustainable development in Non-Annex 1 countries.

In order to obtain CERs, a project must pass the CDM project cycle consisting in:

1. PIN/project concept: Development of the project idea which is often presented in the form of a PIN (Project Idea Note). A PIN is not officially required as CDM document.
2. PDD: Preparation of the official project documentation in a standardized form (called PDD – Project Design Document), making use of approved CDM methodologies. Main parts of the PDD are the development of the baseline scenario, the demonstration of additionality and the description of the monitoring plan.
3. Validation: Detailed check of the PDD by an UN-approved, independent auditor called DOE (designated operating entity).
4. Host country approval: Approval of the project by the CDM authority of the host country, called DNA (Designated National Authority).
5. Registration: Registration of the project by the EB (Executive Board of the UNFCCC – United Nations Framework Convention on Climate Change), upon approval of the validation report prepared by the DOE.
6. Monitoring: Recording of emission reductions achieved after registration according to the monitoring plan.
7. Verification: Detailed check of the monitoring report by a DOE.
8. Issuance: Reception of CERs issued by the EB upon approval of the verification report prepared by the DOE.

Verification and issuance are repeated several times during the crediting period, which can be chosen as fixed (duration 10 years) or renewable (up to three times 7 years, with obligation to re-asses the baseline after 7 and 14 years). The rhythm of verifications is defined by the project owner; it is mostly conducted annually.

For so-called small scale projects (<15MW for electricity production, <60GWh of savings for electricity efficiency project, <180MGW of savings for thermal energy efficiency projects and <60,000 tons of CO_2 savings per year for methane reduction projects), standardized and

[1] See http://cdm.unfccc.int

simplified methodologies may be used and the same DOE may be contracted for validation and verification (in large scale projects, different DOEs must be chosen).

The costs of the CDM project cycle are high: Hiring a DOE for validation costs at least 15,000 EUR; hiring a DOE for verification again costs some 10-15,000 EUR per verification. Contracting a consultant for PDD preparation and management of the project cycle can cost some 30,000 – 100,000 EUR, depending on the complexity of the project. It is however possible to prepare a PDD and mange the project cycle without external consultants.

HH project have very good chances to obtain the Gold Standard label, which certifies high social and environmental standards[2]. Gold Standard CERs can be sold at premium prices.

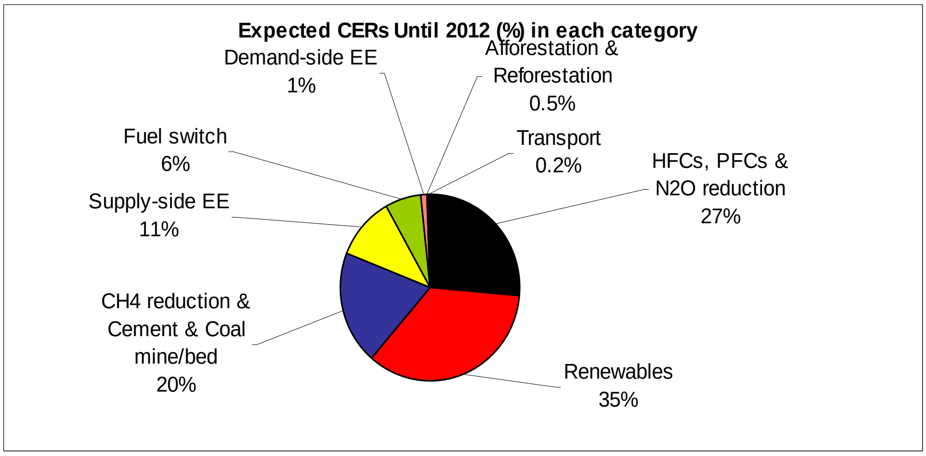
Recently, the programmatic CDM was launched as a CDM mechanism allowing for projects with a flexible size and crediting period. After registrating a framework project (PoA – Programme of Activities), an unlimited number of project activities can be added to this PoA, called CPAs (CDM programme activities). The crediting period of each CPA starts at the time it is added to the PoA. A detailed validation for each CPA is not necessary anymore.

Besides the CDM, a variety of so-called VER standards exist, permitting the generation of carbon credits besides the context of the Kyoto protocol. VERs (Verified Emission Reductions) are traded on the voluntary market, e.g. as voluntary offsets of for the purpose of marketing. VER prices are considerably lower than CER prices, in the range of 3-8 EUR/ton CO_2. The most demanding VER standard is the VER Gold Standard (the Gold Standard also exists for CDM projects).

2.2 Current situation of the CDM

As a market based mechanism, CDM has mainly supported large scale projects in emerging countries (see table 1) that are reducing greenhouse gases with a higher global warming potential than CO_2 such as HFCs (employed in refrigerators and chillers), N_2O and CH_4.

Until 2010, the CDM generated carbon credits corresponding to 300 millions of tons of CO_2, equal to the 50% of the annual emissions of the United Kingdom. Only four countries account for more than 90% of all issued emission reductions (table 2).



Expected CERs by project categories until 2012[3]

[2] See: http://www.cdmgoldstandard.org/

[3] Based on http://cdmpipeline.org/

Top countries by issued CERs	MCERs	Share	Accumulated Share
China	153	46%	46%
India	72	22%	68%
South Korea	44	13%	81%
Brazil	35	10%	91%

Table 1: Countries with most CER issued[3]

Within the countries of the CCA region, there are 13 registered CDM project (until April 2010); another 42 projects are at validation stage. Still no CERs have been issued to projects in these countries. Most frequent project types here are hydropower, land fill gas management and leak reduction in natural gas distribution. No HH projects have been proposed until now.

Country	State of CDM projects	Categories of CDM projects
Armenia	4 registered, 6 in validation	mainly hydropower, also cement production and biogas flaring
Azerbaijan	6 in validation	efficient power plants on oil and natural gas, natural gas flaring, hydropower
Georgia	2 registered, 4 in validation	hydropower, landfill gas, gas distribution
Kazachstan	specific situation - CDM not possible	
Kyrgyzstan	1 in validation	landfill gas
Tajikistan	2 in validation	hydropower and afforestation
Turkmenistan	still no national CDM authority established	
Uzbekistan	7 registered, 9 in validation	N_2O abatement, gas distribution, landfill gas and hydropower

Table 2: CDM projects in Caucasus and Central Asia[3]

2.3 Existing household and community level CDM projects

Table 4 summarizes HH projects in the CDM pipeline as of January 2010. HH projects only represent 1.17% of all CDM projects; more than half of them in the area of energy efficiency, mostly replacing inefficient light bulbs. The success of HH projects in the CDM project cycle is very low. Only two projects achieved issuance of CERs until now, i.e. the Bagepalli household biogas project in India[4] and a solar cooker project in Indonesia[5]. Out of 20 registered HH project, seven have been registered more than four years ago without achieving issuance of CERs.

The situation is different for PoAs: Here HH projects represent 58% of all projects in pipeline, even the first PoA ever registered was a HH project (distribution of CFL bulbs in Mexico[6]). It is too early to tell about the success of these projects in the CDM cycle, but apparently

[4] http://cdm.unfccc.int/Projects/DB/DNV-CUK1131002343.1

[5] http://cdm.unfccc.int/Projects/DB/TUEV-SUED1135345789.43

[6] http://cdm.unfccc.int/ProgrammeOfActivities/registered.html

programmatic CDM has much more potential to stimulate HH projects than the conventional CDM. However, with only 36 projects in pipeline world wide and just three registered PoAs[6] until April 2010, the impact of programmatic CDM of the reduction of greenhouse gases is not yet significant.

Project type	CDM	PoA
CFL bulbs	25	4
Household biogas	8	6
Efficient stoves	7	4
Solar water heaters	3	4
Photovoltaic	5	1
Efficient room heating	5	-
Solar cookers	5	-
Efficient refrigerators	2	-
Solar water desinfection	2	-
Composting	-	1
Irrigation	-	1
Total	**62**	**21**
% of all CDM projects in pipeline	1.17%	58.33%
Registered projects	20	2
% of all registered CDM projects	1.04%	67%
Projects with issued CERs	2	-
% of all CDM projects with issued	0.33%	-
Total issued CERs	13,000	-
% Total of all issued CERs	0.004%	-

Table 3: Summary of existing household and community based CDM projects in pipeline[3]

It must be noted that transaction costs are much higher for PoA than for conventional CDM (see next section), which limits the accessibility for local, independent project proponents and often implies the need for grant funding to pay transaction costs. ODA funding seems to be involved in the majority of PoAs in pipeline.

2.4 Constraints in current CDM for household and community level projects

Based on atmosfair's experiences with project screening, we identify four major constraints for HH projects under the CDM:

- Carbon credits only obtained ex-post
- High transaction costs
- Complicated and bureaucratic procedures
- General design of the CDM

Need for upfront funding

Projects funding through the CDM is obtained by selling carbon credits (CERs); these credits are obtained ex-post, after proving that the project has been operating and thereby reducing GHG emissions. HH projects have very limited access to lending and therefore generally require upfront funding; this represents a significant barrier for such projects under the CDM.

High transaction costs

The transaction costs of CDM are quite independent from the project volume. For HH projects which are typically small projects, the percentage of the project budget that has to be spent for transaction costs is much higher than for larger projects; it can reach 50% of the possible benefits of CDM.

Complicated and bureaucratic procedures

The CDM project cycle is a bureaucratic and time-consuming process; it is a challenge particularly to HH projects where availability of exact data can be limited and financial resources for contracting expensive consultants are missing. Also host country approval can be difficult to obtain in countries without efficient administrative structures.

General design of the CDM

CDM is designed as a market based mechanism which works best for large projects in emerging countries. HH projects consist in many small units; they are also often located in poor developing countries with bad infrastructure. These facts make it difficult to apply the highly formalized and bureaucratic steps of the project cycle, e.g. regarding complicated monitoring. An efficient stove project in Nigeria[7] encountered serious difficulties to find a DOE willing to work in the country considered as dangerous.

2.5 The role of women

In rural areas of most Non-Annex 1 countries, women are key actors in managing the difficulties in everyday's life. Frequently, labour migration of men further contributes to this effect. Village people hardly see opportunities for development in their own region. At the same time, women's perspectives and their roles are not adequately reflected in hierarchic village power structures, religious institutions, nor in state policies and many international projects. Such structures can put barriers to positive developments in villages. Also international aid programmes sometimes contribute to a passive mentality by accustoming people to free supplies of goods and modern technologies.

HH projects offer the chance of people - particularly women - becoming their own sustainable energy managers, based on their own needs and their skills. HH projects can be particularly benefiting for women, by decrease their time and work-load, liberating time e.g. for educational activities and improving health conditions with activities like floor insulation and reduced indoor pollution.

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[7] http://cdm.unfccc.int/Projects/DB/RWTUV1245685309.5

Within the CDM project cycle, the local stakeholder consultation is a crucial step to assure a project design that is in line with the stakeholder's needs. In the current CDM rules, the local stakeholder consultation is a formality without stringent requirements. The importance of the local stakeholder consultation is highly recognized in the Gold Standard rules (see chapter 3.4) with detailed requirements for the organization of the local stakeholder meeting, including explanations on the participation of women.

3 Evaluation of potential CDM projects at the household and community level

Based on many years of experience with the screening of possible HH CDM projects, we present some guidelines to select project ideas with potential for CDM funding. The following criteria are important since they guarantee that significant, sustainable and measurable reductions of GHG emissions are achieved at the household level:

Technology

- The technology/activity should provide renewable energy, energy efficiency (or composting in tropical climates).
- There should be a standardization of the technology/activity disseminating similar installations of similar facilities.
- Facilities should be durable (lifetime minimum 5 years).
- The technology should be mature for mass production (if produced centrally).
- Infrastructure for dissemination to many households should be available.

CO_2 reduction and significance of CDM funding

- The project should lead to greenhouse gas reduction by saving fossil fuels or non renewable biomass; or by avoiding methane.
- The financial contribution of carbon credits to project funding should be high, i.e. the cost per energy unit should be low and the CO_2 reduction per energy unit high (i.e. combination of cheap technology and high baseline).
- CDM funding should play a crucial role for project funding (additionality).
- Infrastructure for monitoring of CO_2 reductions should be available (e.g. through centralized data bases used by micro credits systems).

Implementation and financing

- There should be an experienced and committed institution capable to implement and coordinate the project.
- There should be possibilities to secure funding for the project (apart from CDM funding).
- There should be a considerable contribution of beneficiaries to project funding (in cash or in kind).
- CDM is particularly suitable for combination with micro credit funding (see 3.3).

3.1 Technologies with CDM potential

Based on five years of atmosfair's experience with screening potential projects, we provide a general list of technologies for HH projects that can be suitable for CDM funding (table 4). The list is not complete but covers the most important potential project types. Technologies in italics are mentioned here but not discussed below because they are not typical HH projects. Solar cookers are not included since –after years of experience- the potential of implementing large and successful projects seems to be quite low.

We also give a rough qualitative estimate of specific costs of different technologies, i.e. cost per unit of energy produced or saved. The potential contribution of CDM funding to energy generating projects must be seen in relation to the specific cost of a technology, since CDM funding does not depend on the technology but only on the CO_2 reduction achieved by saving fossil-fuel based energy. Moreover, possible CDM funding depends on the baseline scenario, mainly the replaced baseline fuel (see next section).

Thermal renewable energy	Solar water heaters – moderate cost -	Biogas for cooking – cheap in tropical climate, expensive in cold climate	Biomass briquettes - cheap
Electric renewable energy	Photovoltaic lamps (if replacing kerosene lamps) – moderate cost -	*Micro biomass gasifiers* *–moderate cost-*	*Pico/micro hydro power* *- cheap-*
Mechanic renewable energy	Irrigation based on solar or wind energy - moderate-expensive -		
Efficient use of electric energy	Efficient light bulbs - cheap -	*Efficient refrigerators* *- expensive-*	
Efficient use of thermal energy	Efficient stoves for cooking or heating - cheap -	Home insulation - cheap -	
Efficient use of mechanical energy	Efficient diesel pumps for irrigation - cheap -		
Methane reduction	Composting of organic waste - moderate cost -		

Table 4: Suitable technologies for household and community based projects under the CDM

3.2 Potential of CO_2 reduction according to different baseline scenarios (basically baseline fuels)

For assessing the potential of greenhouse gas reduction, it is crucial to analyze the specific baseline fuels that are to be replaced or reduced by a potential CDM project. Therefore, we first provide details on possible CO_2-savings for different baseline fuels. Methane reduction is explained subsequently.

1. Firewood

For CDM projects reducing the use of firewood, two approved small scale methodologies exist, AMS-I.E[8] (renewable energy facilities) and AMSII.G[8] (energy efficient facilities). Examples for corresponding projects are efficient stoves or solar water heaters in regions where traditional cooking and water heating occurs on wood stoves.

The baseline emissions do not only depend on the quantity of firewood used in traditional facilities, but also on the fraction of non-renewable firewood (or non renewable biomass broadly speaking). Where, for example, firewood stems from managed plantations and is harvested in a sustainable way, it is deemed renewable. In such case, no CERs can be generated by saving firewood. Where firewood collection leads to desertification, e.g. in the Sahel zone, its consumption is probably highly unsustainable, allowing for a high CER generation.

The CDM methodologies require to derive the fraction of non-renewable biomass by comparing areas of sustainable biomass production, like forests under a sustainable management, with areas that lack a sustainable management.

Examples of the CCA region:

In Caucasus and Central Asia, we mostly assume intermediate conditions – regrowth is often fairly good but sustainable management hardly occurs.

In Georgia, regrowth is higher in the humid western and slower in arid south-eastern parts (e.g. South Kakheti). However, management is highly unsustainable in the whole country since concessions for timber exploitation are auctioned to private companies even though no systematic inventories exist (Georgian Times, October 30 2009). The area covered with forests remained relatively stable during the last years[9], but all experts interviewed state that severe degradation is occurring in the forests. Protected areas cover ~10% of the country's forest area[10]. Most Central Asian countries have very limited forest resources since the main ecosystem consists in natural grass lands. Generally, the few existing forests are not managed sustainably.

We preliminarily assume that a share of 75% non-renewable biomass could be shown for most countries of the CCA region; however, detailed studies will be needed.

Methodologies AMS-1.E and AMS-II.G offer default values to calculate CO_2 emissions that can be claimed per ton of non-renewable firewood saved, leading to a value of 1.0725t CO_2/t firewood saved. (This value is derived from a hypothetical use of kerosene as alternative fossil fuel for applications where currently firewood is used; if LPG is more common, 0.945 t CO_2/t firewood has to be used).

Where dung is used, there is a good chance to argue for so called "suppressed demand", i.e. to assume that dung would be replaced by firewood as soon as available and therefore calculate emissions reductions as if the energy delivered by dung would be delivered by firewood.

Charcoal is even less efficient as firewood since large amounts of wood are consumed to produce charcoal. Therefore, the replacement of charcoal allows for even higher emission

[8] See: http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html

[9] See: http://rainforests.mongabay.com/deforestation/2000/Georgia.htm

[10] See: http://www.ceeweb.org/5th_bidi_in_eu/assessment/Georgia.pdf

reductions. A wood-to-charcoal factor of 6 can be used to estimate the wood input per kg of charcoal. The calorific value of charcoal is only around two times higher in comparison to wood.

2. Natural gas, LPG and Kerosene

If gas is the baseline fuel for thermal applications, the CO_2 emissions can be approximated[11] by 200g CO_2/kWh_{therm} or 2kg CO_2/m^3. In the case of LPG, the value is ~220gCO_2/kWh or 2.5 kg CO_2/kg and for kerosene 220-250g CO_2/kWh or ~2.5kg CO_2/kg.

3. Coal

Emission factors for coal vary according to the type of coal used. UNEP provides default values according to different regions[12]. In the example of the CCA region, the default value is 1.73 kg CO_2 per kg coal. For other countries, the factor ranges from 1.4 to 2.4 kgCO_2 per kg coal. If detailed national data are available, higher emissions factors can be claimed.

4. Electricity

National grids: The national grid factor depends on the mix of sources of electricity generation. It is generally lower in countries with a large share of hydropower. Coal-based electricity leads to the highest emissions, whilst electricity from gas is relatively "clean".

There are several ways to determine the emission factor; based on an "operating margin" (based on all power plants serving the grid excluding "low cost/must run" plants) and a "build margin" (based on the most recently built power plants)[13].

As examples, we indicate emission factors for countries of the CCA region (based on existing CDM projects):

Armenia	0.54 kg CO_2/kWh (Source: Jradzor Small Hydroelectric CDM project[14])
Azerbaidjan	0.53 kg CO_2/kWh
Georgia	0.4 kg CO_2/kWh
Kyrgyztan	0.1 kg CO_2/kWh (estimation, no reliable sources available)
Uzbekistan	0.62 kg CO_2/kWh
Tadjikistan	No reliable source available

Table 5: Grid Emission factors for the Caucasus and Central Asia region

5. Off-grid facilities

The default value for decentralized grids where a diesel generator would be the baseline scenario is generally 0.8kgCO_2/kWh (AMS-I.D)[15].

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[11] Calculated using http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_2_Ch2_Stationary_Combustion.pdf

[12] See: http://www.unep.fr/energy/information/tools/ghg/pdf/GHG_Indicator.pdf

[13] See "Tool to calculate the emission factor for an electricity system", http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html

[14] See: http://cdm.unfccc.int/UserManagement/FileStorage/TJ3Y9WX6SFKLVG0C4M817HEB5NOQPZ

[15] See: http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html

6. Methane reduction

Methane is a powerful greenhouse gas; it is 21 times more harmful than CO_2. Methane generation occurs where organic waste decays under anaerobic conditions, i.e. with no or limited availability of oxygen. Carbon credits for methane reduction can be claimed additionally to credits resulting from CO_2 reduction. Composting projects have a potential of obtaining carbon credits by reducing methane, if disposal of organic waste on large landfill is avoided. In this case, the calculation of methane reduction due to decaying biomass is sophisticated[16]; CERs are obtained at the rhythm of hypothetical decay of the biomass used, i.e. CERs generated by avoiding the decay of biomass in a certain year are partly obtained in subsequent years, depending on the velocity of decay which depends on climatic conditions (see also 4.8). In hot and wet climates, decay is faster. In a composting project in tropical climate, where organic waste is prevented from being thrown on a large landfill where waste piles are over 5m high, approximately 0.5 CERs are generated annually if one ton of organic waste is composted annually.

HH projects generating energy based on waste biomass (biogas from manure or briquetting of biomass) generally have less potential of methane reduction, because in the baseline scenario, conditions tend to be rather aerobic, e.g. if manure is spread on fields. Significant methane reduction occurs where in the baseline scenario, manure is disposed into open lagoons[17] or waste biomass is disposed on large waste piles[15].

3.3 Combining CDM and microcredit

Microcredits focus on disadvantaged and low income households with no access to conventional bank credits and financial services. Microcredits are commonly used for financing income generating activities. To substitute unavailable traditional collateral, microfinance institutions (MFIs) use unconventional lending methods:

- very small loans (25-1500 US$)
- soft criteria for lending (e.g. based on personal relations and social control)
- group lending and liability
- frequent repayment (weekly, monthly)
- gradually increasing loan sizes

There are several advantages of combining micro credit funding with CDM funding for HH projects consisting in many small units:

- The need of upfront funding which is a typical barrier for poor households can be resolved by micro credits.

[16] See “Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site”, http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html

[17] E.g. AMS-III.D (Methane recovery in animal manure management systems, http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html) which refers to http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol4.html

- A regional MFI network with its knowledge on local social structures, people's habits, market situation and probably technology dissemination can act as the CDM project coordinator or implementing entity in the case of PoAs.
- CDM monitoring can be integrated into financial monitoring of redemptions.
- Carbon funding can be channelled to end users in the form of lowered interest rates or reduces prices for CO_2-saving facilities.
- The capitalization of a micro credit fund can be leveraged by expected CER revenues; also CER buyers can provide upfront funding to capitalize a micro credit fund.

There is a considerable difference between the typical pay back time of micro credits (<2 years) and crediting periods of CDM projects (10-21 years). After end users have repaid their micro credits, a part of CER revenues could be channelled to them as incentives to collaborate in CDM monitoring; another possibility is to use parts of CERs revenues a continuous extension of the micro credit system.

3.4 Potential of obtaining the Gold Standard label

Generally all HH projects have a high potential of receiving the Gold Standard label. Only projects producing renewable energy or reducing energy consumption on the demand-side are eligible to the Gold Standard. Of the technologies presented here, only composting is currently not eligible to the Gold Standard (but there are possibilities that the Gold Standard includes it into its scope in the future).

The Gold Standard puts special emphasis on the stakeholder consultation; all stakeholders must be given the opportunity to express their opinion on the project. Expected effects on the following social and environmental criteria must be assessed in a so-called sustainability matrix:

Category Environment

- Air quality
- Water quality and quantity
- Soil condition
- Other pollutants
- Biodiversity

Category Social Development

- Quality of employment
- Livelihood of poor
- Access to affordable and clean energy service
- Human and institutional capacity

Category economic and technological development

- Quantitative employment and income generation
- Balance of payments and investment
- Technology transfer and technological self-reliance

Each indicator must be given a score, with “–“ indicating negative impacts compared to the baseline (which can be neutralized by mitigation measures that need to be defined), “0” indicating neutral impacts, and “+” indicating positive impacts. For each category, scores have to be added up. To be eligible under the Gold Standard, the total scoring for at least two of the three categories must be positive, the third one being neutral. All indicators that have not been scored neutral (i.e indicators that have either a negative or positive impact on the project’s sustainability) must be monitored. (This implies an unintended incentive for project developers not to include too many positive scores in order to simplify monitoring).

4 Description of project ideas for HH projects

In this chapter we describe possible projects based on the technologies with high CDM potential. Where plausible, examples are given for the CCA region.

4.1 Solar water heaters

Technology

Low-tech Solar Water Heater in Georgia (source: Rostom Gamisonia)

Solar water heaters (further on called **SWHs)** are a simple and effective way to substitute traditional fuels for water heating by making use of solar radiation. They can be applied by households for showering or pre-heating of water for other applications such as cooking or washing. The technology is particularly suitable in regions with high solar radiation and relatively cold climate – conditions that characterize e.g. the CCA region.

SWHs vary in technology and price. Sophisticated SWHs e.g. using vacuum technology achieve higher efficiencies but are relatively expensive, in the range of 1000 EUR for a 2m^2 SWH suitable for an average HH. Simple SWHs can be much cheaper.

In the example of Georgia, cheap low-tech Solar Water Heaters (SWHs) with 2m^2 collector area and a 100l tank are promoted by the Rural Communities Development Agency (RCDA), run by Rostom Gamisonia[18]. The promoted model has been jointly developed by WECF, the German solar company Solar Partner Süd[18], and the French university IUT Annecy[18]. Water is running through a black flat plate which is heated by the sun. The heat from the plate is transferred to the water. To protect the SWH from freezing, anti freeze is added to the water in the collector and a heat exchanger is used.

The promoted model is based on locally available materials and can be produced by households themselves upon instruction; also production in small factories is thinkable, in quantities of 100s or 1000s (information by Rostom Gamisonia). The price for materials is around 120 EUR (for 2m^2). Traditionally, in Georgia, water is heated by gas in urban areas and by firewood in most rural areas (simply putting a pot on the stove).

CO_2 reduction and significance of CDM funding

The applicable CDM methodologies are small scale methodology AMS-1.C, “Thermal energy for the user”, in the case of fossil fuel replacement, or AMS-I.E[19], “Switch from Non-Renewable Biomass for Thermal Applications by the User”, in the case of firewood replacement. The baseline emissions are calculated by estimating the amount of gas or firewood that would be needed to produce the hot water utilized from the solar collector. If the use of the SWH leads to a greater consumption of hot water than used before, the baseline will refer to the amount of firewood or gas needed to heat this greater quantity of water (concept of depressed demand).

If assuming a consumption per household of 100l of 45° hot water, during 200 days of the year, emission reductions are calculated as follows (making reference to section 3.2):

- If gas is the baseline fuel, approx. 2000kWh$_{therm}$ or 200m^3 of gas would be needed for the service, corresponding to approx. 0.4t CO_2/year.
- If firewood is the baseline fuel, for heating water on a traditional stove (common in rural areas in Georgia), emission reductions depend on the share of “non renewable biomass”. If assuming 1kg CO_2/kg firewood and a stove efficiency half of the gas boiler efficiency, 4000kWh or 1t of firewood would be needed for the energy service described above, resulting in approx. 0.5-1t CO_2/year, depending on the share of non-renewable biomass.
- If coal is the baseline fuel and used under equal conditions as firewood in the example above, emissions would sum to approx. 0.8-1t CO_2/year.
- The situation is different where electric water heating is the baseline and at the same time, electricity is mainly produced from fossil fuels. Depending on the grid factor, CER generation can be up to 1.5t CO_2/year. Under such circumstances, also commercial SWHs can receive significant funding through the CDM.

The contribution of CDM to the implementation cost per low tech SWH, assuming a CER price of 12 EUR/CER, is summarized in table 7.

[18] www.rcda.ge/En/about.html, www.**solar-partner**-sued.de, www.iut-acy.univ-savoie.fr

[19] For both methodologies see: http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html

Baseline fuel	**Emission Reduction**	**CER revenues per year and SWH**	**CER revenues in 10 years (NPV[20], 10% discount rate)**
Gas	0.4t CO_2/year	4.8 EUR	31.2 EUR
Firewood	0.5-1t CO_2/year,	6-12 EUR	37-74 EUR
Coal	0.8-1t CO_2/year.	9.6-12	59-74
Electricity	*Up to 1.5t CO_2/year.*	*up to 18 EUR*	*up to 111 EUR*

Table 6: Estimate of the financial contribution of CDM to Solar Water Heater projects

The contribution of CDM funding is high in comparison to the price of 120 EUR for a low-tech SWH. For commercial and rather expensive SWHs, the contribution of CDM is only attractive where in the baseline case, water is heated by fossil-fuel based electricity. Otherwise, it would only be in the range of a few percent.

If CDM funding is considered right from the beginning of the project, the demonstration of additionality should not present a problem where low-tech SWHs are implemented.

For the monitoring of CO_2 reductions, all SWHs should be recorded in a database. Average annual CO_2 savings per SWH should be determined during validation phase through a survey of a representative sample of SWHs where quantity and temperature of hot water used are recorded. During monitoring, it must then only be shown that SWHs are functional and in use, possibly by sampling. If combined with a micro credit system, the payment of instalments can be used for cross-checking, assuming that a customer who pays also makes use of his SWH.

Implementation of a potential project

Qualified instruction would be needed in case of construction by beneficiaries themselves. Also if industrially produced SWHs are implemented, qualified workforce is required for adequate installation. A network of para-engineers would have to be set up.

Implementation could best be financed through a micro credit network offering financial and also technical support to the households. Households will only pay instalments if their SWH is functional. Therefore, the combination with a micro credit system can also reduce the risk of technical failure.

Dissemination of more than 5,000 SWHs will require a large network for promotion, delivery, capacity building and monitoring. A lower number of installations would not justify the effort of CDM approval. The disseminated SWHs must be technically mature and easy to use. Damages e.g. due to freezing should be avoided without excessive need for technical support after installation. A high rate of failures will directly lead to highly reduced CER generation.

Since CER generation will be based on consumption of hot water, financial planning must be based on realistic estimates of the quantities of hot water that are a) produced by SWHs and b) really used by households. Therefore, the quality of the baseline survey is decisive.

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[20] Net Present Value, see http://en.wikipedia.org/wiki/Net_present_value

Necessary steps would consist in:

- Conduct a baseline survey leading to a statistically sound estimate of
  a) type and amount of fuel consumption for traditional water heating and
  b) average annual amount of hot water that households will use from SWHs after their installation (based on a pilot sample).
- Create infrastructure for producing and disseminating some 10,000 SWHs to households, install them in a standardized way and make sure they keep working for at least some 10 years.
- Integrate CDM funding into the financing structure, at best in the form of partial upfront funding contributing to capitalize a micro credit fund.
- Start the CDM registration procedure.
- Set up a system to register all households that have obtained SWHs under the project, allowing to find these households afterwards, if necessary.

Examples of registered CDM projects

Project can be viewed by typing the reference number into the "project search" mask at http://cdm.unfccc.int/Projects/index.html

Ref. 79	Kuyasa low-cost urban housing energy upgrade project, Khayelitsha (Cape Town; South Africa)	South Africa

4.2 Biomass briquettes for cooking

Technology

There is a potential for producing biomass briquettes or pellets where large agricultural or timber facilities accumulate high amounts of suitable biomass with high calorific value such as sunflower shells or saw dust. By converting biomass into briquettes or pellets, it can be stored and transported and conditions of combustion are improved. For the evaluation of the viability of producing biomass briquettes, the cost of energy required for compacting biomass is an important factor.

Waste biomass can be regarded as renewable energy and can replace firewood or coal used for cooking and heating by households. For a potential CDM project, the consumption of biomass briquettes would be in the centre of the project since emission reductions depend on the fuel that is replaced by briquettes or pellets.

CO_2 reduction and significance of CDM funding

The applicable CDM methodology is the small scale methodology AMS-1.C[21], "thermal energy for the user". Where decaying biomass leads to methane production in the baseline scenario, a combination is possible with AMS-III.E[21] "Avoidance of methane production from decay of biomass through controlled combustion, gasification or mechanical/thermal treatment".

[21] See: http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html

For calculations of profitability, the cost of briquette production is decisive since the resulting price of briquettes should be lower than the price of alternative fuels (firewood, coal, gas or electricity):

- A 45kW press with an output of 900kg/h costs around 150,000 EUR (smaller machines with 150kg/h output are available at around 20,000 EUR)[22]. Electricity consumption of the large machine is around 40kWh per ton of briquettes (small machines are less efficient). At a cost of 0.10EUR/kWh, electricity costs per ton of briquettes/pellets are around 5 EUR. For pellet production, energy consumption is around 25% higher.
- For an economically sustainable production of briquettes, these must be sold at prices of around 25 EUR/ton. (At a price of 20 EUR/ton, the NPV becomes positive at a discount rate of 10%, a 10 years time horizon and 3000 hours of annual operation. But this does not include costs of dissemination and project preparation).

The result indicates that projects are viable in countries with moderate and high prices for firewood. E.g. in Georgia, a firewood price of some 50EUR/ton can be regarded as a conservative estimate, indicating good chances of achieving financial viability. In countries where firewood is very cheap, e.g. Bolivia, where only 15EUR/ton of firewood are common, biomass briquettes can hardly compete with firewood.

To asses the contribution of CDM funding to project costs, it is most sensible to compare CER revenues with the price of the produced briquettes (reference to chapter 3.2 is made):

- If coal is replaced (emission factor of 1.73t CO_2/ton assumed), and 12 EUR are assumed as CER price, CDM would contribute some 10EUR per ton of briquettes produced. (1 ton of briquettes could possibly replace 500kg of coal, assuming a 50% lower calorific value).
- If firewood is the replaced baseline fuel (1tCO_2/ton assumed), CDM contributes 5-10 EUR per ton of briquettes, depending on the share of non-renewable biomass.
- Additional emission reductions might be achieved in specific cases by methane reduction (see 3.2).

CDM could thus help to reduce the price of briquettes/pellets significantly:

Replaced fuel	CER revenues per ton of briquettes
Firewood	5-10 EUR
Coal	10

Table 7: Estimate of the financial contribution of CDM to biomass briquetting project

The contribution of CDM funding is very significant if the price of briquettes is in the range of 25 EUR; therefore the demonstration of additionality should not be a problem.

For the monitoring of CO_2 reductions, sales of briquettes must be monitored. (Average CO_2 savings per ton of briquettes should be determined during validation phase through a survey

[22] Information from Marco Wagner, http://www.projects-online.de/

of traditional fuels used in the target area). During the monitoring phase, only quantities of briquettes sold in defined target areas would have to be monitored, in combination with spot checks to confirm the replacement of the baseline fuel for cooking.

Implementation of a potential project

Centrally available biomass is a precondition for project planning. Depending on the circumstances, a briquetting machine could be run by a cooperative. The entire chain of sales of briquettes must be integrated into the project management.

It has to be assured that there is no significant competing use of the waste biomass, such as energetic use or use as fertilizer. It can also be a challenge to supervise the entire chain of sales. The initial investment to implement briquetting machines is high. CDM is only reasonable if more than 5000tons of briquettes are produced and sold annually.

The following steps would have to be taken:

- Identify places where suitable waste biomass is centrally available; assess technical feasibility of briquette production.
- Assess market potential of biomass briquettes.
- Conduct a baseline survey leading to a statistically sound estimate of emission reductions per ton of briquettes, according to the replaced cooking fuel(s).
- Start the CDM registration procedure.
- Set up a system to monitor sales and final use of briquettes.
- Integrate CDM funding into the financing structure, e.g. as partial upfront funding for the implementation of the briquetting plant or as subsidy for reduced briquette prices.

4.3 Biogas for cooking

Technology

Construction of a Biogas plant in India. (source: Bagepalli Biogas Programme)

Biogas plants at the household level can provide biogas for cooking and thereby replace firewood or coal. Generally at least two or three cows are needed per family to feed a biogas plant. Cattle must at least partially be held in a stable so that manure is centrally available.

Biogas production is hampered by cold temperatures, therefore, in colder climates, biogas plants must be much larger (10-30m^3 digester volume per household instead of 8-20m^3 for hot climates[23]) which leads to higher prices. In the tropics, low-tech systems at the household level cost between 200 and 400 EUR. In the CCA region, the price for biogas plants is relatively high, in the range of 1500-4000 EUR. In cold climates, biogas plants are often equipped with heaters based on e.g. electricity.

CO_2 reduction and significance of CDM funding

The applicable CDM methodologies are small scale methodologies AMS-1.C "thermal energy for the user", in case fossil fuels are replaced, and AMS I.-E. "Switch from Non-Renewable Biomass for Thermal Applications by the User" in case of firewood replacement[24]. At the household level, methane reduction can only be claimed if clearly anaerobic conditions occur in manure storage, e.g. liquid storage in tanks or lagoons (see 3.2).

Without methane recovery, CO_2 reduction only occurs through the replacement of the cooking fuel, which can be fire wood, coal, LPG or kerosene.

In order to estimate of emission reductions according to the different baseline fuels, we assume a load factor of the biogas plant of 75% (e.g. use for cooking during approx. 270 days/year); for emissions factors, we use values given in section 3.2.

- Fire wood: We assume annual firewood consumption of 4t per household (source), which is a typical value for simple and inefficient stoves[25]. Depending on a share of non renewable biomass of 50-100%, emissions result from 1.5-3t CO_2/a
- Coal: At an assumed annual consumption of 1.5-2t, emissions are ~3t CO_2/a
- LPG: We assume an annual consumption of 200kg, resulting in CO_2 emissions of approximately 0.5t CO_2/a
- Kerosene: If Kerosene is the baseline fuel, and assuming a consumption of 1 litre per household per day[26], resulting emission reductions are ~1t CO_2/a.

The contribution of CDM to the implementation cost per biogas unit, assuming a CER price of 12 EUR/CER, is summarized in table 9:

Baseline fuel	**Emission Reduction**	**CER revenues per year and biogas plant**	**CER revenues in 10 years (NPV, 10% discount rate)**
LPG	0.5t CO_2/year	6 EUR	37 EUR
Kerosene	1t CO_2/a	12 EUR	74 EUR
Firewood	1.5 – 3t CO_2/year	18-36 EUR	110 - 221 EUR
Coal	3t CO_2/year	36 EUR	221 EUR

Table 8: Estimate of the financial contribution of CDM to biogas projects for households

[23] Confusion is possible with volume indications; in India, normally the gas generation potential is indicated, versus in most other countries, the digester volume is given

[24] See: http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html

[25] For examples, see ftp://ftp.fao.org/docrep/fao/009/j8227e/j8227e00.pdf

[26] See energy equivalent calculation of Bagepalli Biogas Programme, http://cdm.unfccc.int/Projects/DB/DNV-CUK1131002343.1/iProcess/DNV-CUK1193051404.74/view

CDM is an attractive funding option where cheap biogas plants are installed in the tropics (at prices below 500 EUR). In temperate climates, CDM should not always be a viable option.

Implementation of a potential project

The implementation of a HH project based on biogas would be equivalent to the procedure described for SWHs. A specific constraint is the high cost of biogas plants in cold climates. Here, CDM will probably only be viable if carbon-intensive baseline fuels such as coal are replaced. It is also important to assess the potential of installing biogas plants. In Georgia, e.g., there is a limited potential, because of the limited number of household possessing cattle in the country. It might be difficult to identify the required number of ~5,000 potential biogas plants users.

Examples of registered CDM projects

Project can be viewed by typing the reference number into the "project search" mask at http://cdm.unfccc.int/Projects/index.html

Ref. 2221	Hubei Eco-Farming Biogas Project Phase I	China
Ref. 121	Bagepalli CDM Biogas Programme (5500 units of 2 m3)	India
Ref. 2591	Biogas CDM Project of Bagepalli Coolie Sangha	India
Ref. 136	Biogas Sector Partnership Nepal (6500 units) Activity-1	Nepal

4.4 Solar cooking

Solar cookers generate heat by concentrating sunlight and can thereby provide energy for cooking. Most common types are simple and cheap box cookers as well as well as rather expensive parabolic cookers. The latter work much faster.

Massive distribution of solar cookers has rarely proven to be sustainable, mainly due to the need of changing cooking habits, since solar cookers can only be used during hours of sunshine. In terms of CDM, solar cooking is very similar to cooking with biogas. We do therefore give a detailed description here.

Examples of registered CDM projects

Project can be viewed by typing the reference number into the "project search" mask at http://cdm.unfccc.int/Projects/index.html

CDM2750	2307	Federal Intertrade Pengyang Solar Cooker Project	China
CDM3294	2311	Federal Intertrade Hong-Ru River Solar Cooker Project	China
CDM3631	2924	Ningxia Federal Solar Cooker Project	China
CDM2753		Federal Intertrade Yulin Solar Cooker Project	China
CDM0256	414	Solar steam for cooking and other applications	India
CDM0159	218	CDM Solar Cooker Project Aceh 1	Indonesia

4.5 Photovoltaic lamps (replacing kerosene lamps)

Technology

Photovoltaic lamp (source: d-light)

Photovoltaic lamps (PV lamps) generally consist in a small solar panel and a low-energy-consumption lamp with a battery. Also systems with centralized recharging stations are in use[27]. They can provide light to poor households without grid connection or with a very unstable electricity service. All over the world, the common source of light in such households are kerosene lamps.

Most PV lamp sets available on the market cost around 50EUR which is expensive for poor households.

Another issue is durability since many models have a life time of less than three years.

The example of the d.light project in India[28] is an attempt to overcome these difficulties. The project sells high quality LED lamps connected to solar panels that replace the traditional kerosene based lamps. These lamps are produced in large quantities in China; the low price is only possible due to an envisioned production of millions of lamps. The life time of these lamps surpasses five years.

CO_2 reduction and significance of CDM funding

The applicable methodology is AMS I.A[29] ("Electricity generation by the user "). The basis for claiming carbon credits is the comparison of how much kerosene would be needed to receive the same level of lighting (lumen output).

The average reduction per light output (lumen) is ~ 2.5 kg of CO_2 per year. For example, a typical PV lamp, with an output of 55 Lumen (see picture) replaces 54 litres of Kerosene per year (if used 3.5 hours a day) and thus avoids 0.14 t of CO_2 per year. At a supposed CER price of 12 EUR, the discounted CER value corresponds to approx. 10 EUR or 50% of a lamp's value, allowing for a significant reduction of prices. The financial contribution of CDM is high enough to demonstrate additionality. Monitoring requires to track the number of solar lamps in use by using sampling methods.

Baseline	**Emission Reduction per lamp**	**CER revenues per year**	**CER revenues in 10 years (NPV, 10% discount rate)**
Kerosene	**0.14t CO_2/year**	1.68 EUR	6.37 EUR

Table 9: Estimate of the financial contribution of CDM to photovoltaic lamp projects

27 www.sunlabob.com

28 See: http://cdm.unfccc.int/Projects/DB/TUEV-SUED1245158196.62/view

29 http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html

Implementation of a potential project

Since a huge number of lamps is needed to make the project viable, a system of retailers has to be established. Micro credit financing seems not to be a priority option since the reduced price of lamps could be affordable to households even in poor countries.

Given high CDM transaction costs, a PV lamp project would need to embrace at least 70,000 PV lamps (of the 55 lumen model) to reduce around 10.000t of CO_2 per year. Even if households acquire e.g. 3 lamps each, 24,000 households would need to participate.

The battery is a critical part of PV lamps. Batteries based on lead are cheapest; however, a recycling system for used batteries must be in place to avoid pollution. The establishment of such a recycling system should be arranged together with the establishment of the network of retailers.

The steps to take would be equivalent to the steps described for SWHs.

Examples of registered CDM projects

Project can be viewed by typing the reference number into the "project search" mask at http://cdm.unfccc.int/Projects/index.html

Ref. 2279	Rural Education for Development Society (REDS) CDM Photovoltaic Lighting Project	India
Ref. 2699	D.light Rural Lighting Project	India
Ref. 182	Photovoltaic kits to light up rural households (7,7 MW)	Morocco

4.6 Irrigation

There is a considerable potential of reducing emissions caused by traditional, inefficient diesel pumps applied for irrigation, particularly in India. Projects can replace diesel pumps by photovoltaic pumps or wind pumps. These technologies are relatively efficient if applied for pumping since energy can be stored in the form of lifted water; thereby inefficient storage of electric energy in batteries is avoided. However, both technologies still require high upfront investments. In mountainous areas, hydraulic rams are another option for renewable pumping services.

Also the improvement of the efficiency of diesel pumps has potential for CDM funding if applied within a large, standardized program.

Detailed calculations are not presented in this study since the global potential of community based irrigation projects is relatively low.

4.7 CFL bulbs

Technology

CFL bulbs are available from a large number of producers. They can produce the same lighting output as incandescent bulbs whilst only consuming 15-30% of the electricity.

There are considerable differences in prices and qualities. High quality is also reflected in a higher life time which is crucial for CDM projects since credits can theoretically be obtained during 10 years for each CFL bulb. Typically, the lifetime of a high quality CFL bulb is at least 8,000 hours, i.e. 8 times that of incandescent lamps. Assuming an average usage time of 3.5 hours per day, a high quality CFL bulb can have a life time of more than 6 years. The cost of CFL bulbs is in the range of 3 EUR/unit.

CO_2 reduction and significance of CDM funding

This type of project works in countries with a relatively high grid emission factor (i.e. rather in Armenia than in Kyrgyztan, see above). If the grid factor is above ~0.7kg CO_2/kWh, a project could probably be funded 100% by selling carbon credits.

There are two SSC-methodologies which can be used, AMS II.C[30] ("Demand-side energy efficiency activities for specific technologies") and AMS II.J.[30] ("Demand-side activities for efficient lighting technologies"). The latter is more conservative but less restrictive in monitoring since a default value of 3.5 hours of use per day may be applied. AMS II.J is thus easier to use than AMS II.C., which requires continuous measurement of daily lighting usage of CFL bulbs in a project sample group.

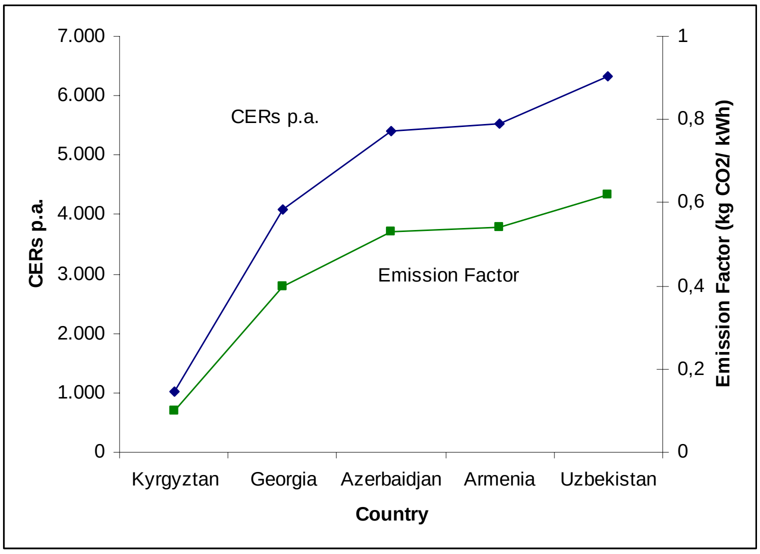
When applying methodology AMS II.J., CFL bulb projects must ensure that CFL bulbs are either directly installed, or at least a minimal price is charged, or a maximum of six lamps per household are distributed. These limitations are set to avoid leakage. In order to calculate the emission reductions per light bulb, the energy savings per CFL bulb are multiplied by the grid emission factor. For a 20 Watt CFLs bulb replacing an incandescent bulbs with a rated power of 100 Watt, the annual energy savings are 80 Watt x 3.5 hours/day x 365 days = 102 kWh/ year. The methodology requires the use of conservative adjustment factors for lamp failure rates and grid losses. As a result, for a crediting period of 5 years, 465 kWh of energy savings could be claimed, i.e. 93 kWh per year. If taking Georgia as an example (emission factor of the grid 0.4 kg CO_2/kWh), emission reductions per household are 93 kWh * 0.4 = 37 kg CO_2/year. CER revenues directly depend on the grid factor in the corresponding country (see figure below).

Assuming a CER price of 12EUR, the discounted CER revenue over 5 years covers more than 50% of the price of a CFL light bulb.

Baseline	Emission Reduction	CER revenues per year	CER revenues in 5 years (NPV, 10% discount rate)
Electricity Grid Georgia	0.037 t CO_2/year	0.45 EUR	1.69 EUR

Table 10: Estimate of the contribution of CDM to CFL bulb projects

[30] http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html



Correlation between Grid Emission Factor and CER Output for CFL projects (100,000 20 Watt CFLs bulbs replacing 100 Watt incandescent light bulbs)

Monitoring includes recording of lamp distribution data, i.e. the number, date and types of CFLs distributed, the number and power of the replaced devices and contact data of the users to identify the beneficiaries of the CFL project. The failure rate of CFL bulbs must be demonstrated by statistically sound samples every 3 years. The monitoring methodology also requires that replaced incandescent bulbs are destroyed and not used in other households.

Implementation of a potential project

To achieve emission reductions of 10,000 t per year, taking the example from Georgia described above, more than 60,000 households would need to participate. It might be easiest to distribute CFL bulbs for free to households handing in a functional incandescent bulb in exchange (this is done in a PoA in Mexico[31]). Thus no retailers would be needed but brigades of agents visiting households directly or distributing CFLs at centralized distribution points. Upfront funding managed by the coordinating entity will be needed to set up such structures.

It is important to set up a recycling system for used CFL bulbs since these contain mercury.

The steps to take would be equivalent to the steps described for SWHs.

Examples of registered CDM projects

Project can be viewed by typing the reference number into the "project search" mask at http://cdm.unfccc.int/Projects/index.html

Ref. 1754	Visakhapatnam (India) OSRAM CFL distribution CDM Project	India
Ref. 2457	Yamunanagar & Sonipat (India) OSRAM CFL distribution CDM Project	India
Ref. 2709	Chhattisgarh Lighting Improvement Project (CLIP) in Rajnandgoan Circle, Chhattisgarh	India
Ref. 2476	Pune (India) OSRAM CFL distribution CDM Project	India
Ref. 2535	CUIDEMOS Mexico (Campana De Uso Intelegente De Energia Mexico) - Smart Use of Energy Mexico	Mexico

[31] See: http://cdm.unfccc.int/ProgrammeOfActivities/poa_db/17BH6AJX524TYQUZF8KGCWV3OIPSE9/view

4.8 Efficient stoves for cooking or heating

Technology

Efficient cook stove Save80 (Source: DARE Nigeria)

There are many examples of efficient stove projects in many parts of the world. Biomass supply for cooking and also heating represents a significant expenditure for many poor households; at the same time, unsustainably firewood harvesting leads to desertification and inefficient stoves cause respiratory diseases.

The principle of efficient stoves consists in a rather complete combustion of firewood and channelling of the heat to the pot; in the case of room heating, it is important that only a small fraction of the heat is released to the air through the chimney.

Efficient stoves need to be tested to demonstrate that their efficiency is clearly better than the efficiency of traditional stoves. If applied for CDM projects, it should be assured that all disseminated stoves (or types of stoves) have a similar efficiency. Moreover, they should have a lifetime of at least 5 years. Stoves must be adapted to the cooking (and heating) habits of the target group. If a stove is used both for heating and cooking, its efficiency in summer time when no heating is required should not be too low.

Prices and qualities of efficient stoves on the market are very different. In Africa, they range from mud stoves with nearly no material costs to stoves imported from Germany that cost around 100EUR (60EUR if subsidized by CDM), called Save80[32]. Experience shows that consumers who pay high prices for firewood (e.g. in towns in the north of Nigeria) are ready to pay high prices for high quality stoves that guarantee for high firewood savings.

In Georgia and Kyrgyzstan, stoves for heating and cooking are produced in pilot projects that reduce fuel consumption by some 50%, at a price of 80-200EUR.

CO_2 reduction and significance of CDM funding

As explained in chapter 3.2, CO_2 savings depend on the avoided consumption of non-renewable biomass. It is important to evaluate if the efficient stove completely replaces the traditional system or if only a partial replacement is achieved (which can happen in the case of mobile cooking stoves). The methodology for efficient stoves (AMS-II.G) offers default values for traditional cooking systems, 10% for three stone fires and comparable systems

[32] see http://cdm.unfccc.int/Projects/DB/RWTUV1245685309.5/view

without grate and chimney, and 20% for other traditional systems. In the case of stoves for cooking and heating, the efficiency of the traditional system should be evaluated by surveys. In areas where efficient stoves have been disseminated by former projects, those will have to be included in the baseline scenario.

If taking Georgia as an example: An efficient stove for cooking and heating is reported to achieve an efficiency of 75%, in comparison to 37.5% for a traditional stove. This would lead to savings of 50% of firewood. If yearly firewood consumption is estimated as 4 tons per family[33], this would result in annual savings of 2tons. If 75% of non-renewable biomass is assumed, 1.5 CERs would be generated by stove per year. At a price of 12 EUR/CER, the discounted value of CER revenues per stove is 110EUR, in the same range as the price for a stove.

If the baseline is charcoal, even higher savings can be achieved.

Baseline fuel	Emission reduction per stove	CER revenues per year and stove	CER revenues in 10 years (NPV, 10% discount rate)
Firewood (cook stove in Africa)[34]	1-3 t CO_2/year	12-36 EUR	74-221 EUR
Charcoal (cook stove in Africa)[30]	2-5 t CO_2/year	24- 60 EUR	147-367 EUR
Firewood (combined stove in Georgia)[30]	1.5 t CO_2/year	18 EUR	111 EUR EUR

Table 11: Estimate of the contribution of CDM to efficient stove projects

If a complete replacement of traditional stoves is plausible, monitoring only consists in tracking the number of stoves in operation together with an evaluation of the efficiency of stoves in use by sampling. A central database should be established where stoves are recorded; allowing for random samples for verifications.

Monitoring should be combined with a structure providing technical support to assure that a high efficiency of stoves is maintained (otherwise the number of CERs will get reduced).

Implementation of a potential project

Depending on the baseline fuel and stove efficiencies, a number of at least 5,000 efficient stoves will be needed to justify CDM. A network of retailers must be implemented who sell or install efficient stoves. Also if industrially produced stoves implemented, qualified workforce is required for adequate installation and technical support during the project's lifetime. Implementation could best be financed through a micro credit network offering financial and also technical support to the households. Households will only pay instalments if their stove is functional. Therefore, the combination with a micro credit system can also reduce the risk of technical failure.

The steps to take would be equivalent to the steps described for SWHs.

[33] Value reported as typical for Georgia. In Africa, firewood consumption lies in the same range – see footnote 24

[34] A share of non renewable biomass of 75% is assumed

Examples of registered CDM projects

Project can be viewed by typing the reference number into the "project search" mask at http://cdm.unfccc.int/Projects/index.html

Ref. 2711	Efficient Fuel Wood Stoves for Nigeria	Nigeria
Ref. 2969	CDM LUSAKA SUSTAINABLE ENERGY PROJECT 1	Zambia

4.9 Home insulation

Technology

There is a huge potential for saving CO_2 emissions by better insulation of buildings especially in the CCA region – which contains most Non-Anex 1 countries with cold winters. In Central Asia, some 80% of household energy is used for room heating. The potential of energy saving through simple and affordable measures can easily reach 50%.The largest energy saving potential is generally found in the replacement of old windows. However, a detailed energy audit will necessary to define the best strategy for energy savings in each specific case. However, it is very complicated to define baseline and monitoring plans in large CDM projects. It would work best in the case of standardized homes such as the refugee settlements in Georgia (IDPs). Other options are projects dealing with very large public buildings such as schools or hospitals.

CO_2 reduction and significance of CDM funding

There is an applicable small scale methodology, AMS.II.E[35], "Energy efficiency and fuel switching measures for buildings". Emission reductions depend on the fuel used for heating; coal reduction offers the highest potential for emission reductions. Due to the diversity of possible measures and related costs, no quantified costs are given here. But potential CDM funding can be very significant where baseline emissions are high and energy standards low.

If due to the insulation measure, the mean indoor temperature gets higher due to suppressed demand before project implementation, the baseline would be the amount of fuel needed to reach this higher temperature, as long as it stays within reasonable limits, e.g. 19°C.

Implementation of potential projects

As mentioned above, implementation in many small units is most feasible if standardized measures are applied to standardized buildings. Since the investment is required when starting the project and later there is a pay-back through energy savings, financing would best be managed by microfinance. CDM funding could be combined with a micro-financing structure.

Examples of existing CDM projects

Project can be viewed by typing the reference number into the "project search" mask at http://cdm.unfccc.int/Projects/index.html

Ref. 79	Kuyasa low-cost urban housing energy upgrade project, Khayelitsha (Cape Town; South Africa)	South Africa

[35] http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html

4.10 Composting of organic waste

Technology

The anaerobic decomposition of organic waste from households generates methane which is an important source of green house gases. Anaerobic conditions occur on large landfills or informal dump sites, where waste is mounted up to large piles which persist for several years. Accordingly, composting projects are more feasible in an urban context, since in rural areas, organic waste is rarely deposited in landfills. Moreover, methane generation is higher in wet tropical climate where decay rates are significantly higher.

Composting of organic waste is an aerobic process, if done properly. The waste has to be left in small piles or in boxes; in case of forming large piles, blowers must be used to introduce oxygen.

An example for a community based composting project is the Indonesian KIPRAH project[36], where several waste recycling facilities that serve some 1,000 households each are implemented and run by neighbourhood organizations. In these facilities, waste is collected, separated and recycled, deposited or composted. For CDM projects, such a centralized composting is much more suitable than household level composting.

CO_2 reduction and significance of CDM funding

CDM small scale methodology AMS-III.F[37] (Avoidance of methane emissions through controlled biological treatment of biomass) is applicable for composting projects. Achievable emissions reductions depend on the conditions of waste decay in absence of the project. Methane generation is highest if waste is dumped to unmanaged waste disposals with a depth of >5m. If waste is burned, only methane generation before burning occurred can be accounted for.

For the calculation of emission reductions, a first order decay model[38] has to be applied which simulated the decomposition of waste in absence of the project. CERs are only issued in the rhythm of simulated waste decay, i.e. for a ton of organic waste avoided in year x, CERs are obtained during several years depending on how fast the decay would have taken place. If the quantity of waste composted annually is constant over the project's duration, CER revenues will increase over the years. Potential CER revenues are highly dependent on the climate (see table 12).

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[36] http://cdm.unfccc.int/UserManagement/FileStorage/3CEHJR07WGKNQY84MOVBPFTX2DZ6I5

[37] http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html

[38] "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site (see: http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html)

CER generation for project example:		Coverage (HHs): 20,000 Ton organic waste/HH*a: 0.5 % of waste brought to final dumpsite: 50% Tons of organic waste treated annually: 5,000 Depth of waste piles at dumpsite: >5m		
year	**Tropical wet**	**Temperate wet**	**Tropical dry**	**Temperate dry**
year 1	1246	638	308	220
year 2	2082	1169	591	427
year 3	2642	1610	851	623
year 4	3017	1977	1090	807
year 5	3268	2281	1309	980
year 6	3437	2534	1510	1143
year 7	3550	2745	1695	1296
year 8	3626	2920	1865	1441
year 9	3677	3065	2021	1577
year 10	3711	3186	2164	1706

Table 12: Potential CER of a composting project under different climates[39]

Project costs can hardly be generalized. In the project example from Indonesia, implementation costs ~30,000 EUR per composting facility covering 1,000 households; operating costs are in the range of 5,000 EUR/year. CDM can just cover some 50% of annual operating costs.

Implementation of a potential project

In tropical wet climates and where the baseline consists in landfills, a project must comprise some 100,000 household to justify CDM.

For composting, organic waste must be separated from non-organic waste which can be done at the household level or ex-post in waste recycling facilities. Ex-post separation is more labour-intensive but waste separation at the household level has hardly been implemented in CDM countries. Apart from CDM funding, financial sustainability depends on revenues from service fees paid by households, income from selling recycled materials and compost. CDM upfront funding could be used to cover a part of the initial investment. In the Indonesian project example, hardware is funded by local government whilst CDM is used for funding community empowerment and operating costs.

Capacity building and permanent monitoring of communities shows to be critical for the project in Indonesia.

In the CCA region, the potential of using CDM funding for composting projects is small since the climate is temperate and dry, leading to low decay of biomass and therefore reduced CER generation.

The steps to take would be equivalent to the steps described for SWHs.

[39] According to the tool mentioned in the footnote just above, tropical wet climate is defined by precipitation > 1000mm, temperate wet climate is defined by an evapo-transpiration lower than precipitation.

5 Proposal to improve the accessibility of the CDM for household and community level projects

Based on experiences with developing HH CDM projects, we suggest changes of the CDM rules, in order to improve the accessibility for HH projects. WECF and atmosfair have already presented these suggestions in several occasions to UNFCCC institutions[40].

1. A funding mechanism for household and community level projects

This mechanism should:

- Provide grants for CDM project development and transaction costs, e.g. validation
- Grant upfront funding for project implementation as a soft loan to be returned by Certified Emission Reductions (CERs)
- Buy CERs from such projects at fixed and high prices

2. Simplified approval procedures for household and community level projects

Requirements for project registration should be highly simplified, by:

- Implementation of a specialized UNFCCC working group
- Establishment of specialized Designated Operational Entities (DOEs) to guarantee faster and cheaper validation procedures
- Establishment of extremely simplified methodologies for household and community level projects, e.g. by defining standardized sectoral baselines and skipping additionality demonstration.

The barriers for HH projects have not been directly discussed in the EB until now; however, since 2006, there has been a discussion on the regional distribution of CDM projects, aiming at increasing the share of CDM in Africa, least developed countries and small island developing countries (EB 26, 35, 46, 50, e.g. annex 54 of EB 50). In this context, several measures have been discussed which could help to overcome some of the barriers for HH projects. Some of the ideas have already been put into practice such as the abortion of the registration fee and some capacity building measures. It is also probable that the assessment of additionality will be substantially simplified for very small HH projects (<5MW of renewable energy production or <20GWh of energy savings)[41].

Some progress has also been achieved in terms of simplifying methodologies, particularly in the case of methodologies for efficient stoves (AMS-II.G) and for the dissemination of CFL bulbs (AMS-II.J), where default values are introduced for traditional stove efficiency and for average hours of daily use of light bulbs. However, still no considerable improvement has been achieved in terms of project funding and transaction costs. A funding mechanism as

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[40] http://unfccc.int/resource/docs/2009/awg7/eng/misc03.pdf, https://cdm.unfccc.int/public_inputs/2009/appl_meth/index.html, http://cdm.unfccc.int/Panels/ssc_wg/workshop/091026/agenda.pdf, www.inforse.org/doc/SEN65.pdf, www.wecf.de/english/articles/2009/12/CDM-eventWECF.php

[41] http://cdm.unfccc.int/Panels/ssc_wg/meetings/025/ssc_025_an14.pdf, http://unfccc.int/files/meetings/cop_15/application/pdf/cmp5_cdm_auv.pdf

suggested above has been discussed in the context of regional distribution but with no success so far.

The programmatic CDM is an important step towards improved conditions for HH projects. However, transaction costs are currently higher than in conventional CDM and registration procedures are more complicated.

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