TOWARDS A STREAMLINED CDM PROCESS FOR SOLAR HOME SYSTEMS [1]

J. W. Martens*, F.D.J. Nieuwenhout*, S. L. Kaufman**, J. Green***,
*Energy research Centre of the Netherlands, **Sunrise Technologies Consulting, *** IT Power

ECN, P.O. Box 37154, 1030 AD, Amsterdam, The Netherlands

ABSTRACT: Solar home systems are an excellent fit for the Clean Development Mechanism under the Kyoto Protocol because they directly displace greenhouse gas emissions while contributing to sustainable rural development. Selling emission reduction credits under the CDM could provide additional revenues for SHSs. However, high transaction costs related to CDM procedures might prevent SHSs from benefiting from CDM revenues. This paper explores how standardised baselines and streamlined monitoring and verification procedures could assist in reducing those transaction costs.

Keywords: Developing countries - 1: Solar Home Systems - 2: Clean Development Mechanism - 3

1. THE CLEAN DEVELOPMENT MECHANISM AND THE KYOTO PROTOCOL

The United Nations Convention on Climate Change was opened for signature in 1992 at the Rio Earth Summit with its main objective being to curb climate change by reducing the world's greenhouse gas (GHG) emissions. In Japan in 1997, the "Kyoto Protocol" was adopted. The Kyoto Protocol is an important step towards making the ideas established in the Convention operational, by giving industrialised countries quantitative emission reduction targets for the period 2008 - 2012. After the successful Bonn meeting in July 2001 it is expected that the Protocol could enter into force as early as 2002, 10 years after the Earth Summit in Rio de Janeiro.

1.1 The Clean Development Mechanism

The Clean Development Mechanism is one of the three flexible mechanisms defined under the Kyoto Protocol. The three instruments are: Emissions Trading (ET), Joint Implementation (JI), and the Clean Development Mechanism (CDM). These mechanisms enable trading emission reductions between countries in order to help countries achieve their emission reductions at a lower cost. The CDM has been set up to allow industrialised countries to achieve part of their emission reduction target in developing countries, provided that the emission reducing activities contribute to sustainable development in the host country. Public or private parties from industrialised countries will be able to invest in projects leading to emission reductions in developing countries. CDM funding must be additional to existing development assistance. The CDM is expected to lead to greater investment flows to developing countries for projects that might not have been feasible without this extra source of funding, such as projects involving solar photovoltaic (PV) installations.

2. GREENHOUSE GAS SAVINGS FROM SHS IN DEVELOPING COUNTRIES

2.1 Solar Home Systems

Solar home systems (SHSs) use solar energy to generate electricity for individual rural homes that are not connected to an electric grid. They are an excellent fit for the CDM because they directly displace GHG emissions while contributing to sustainable rural development. While the quantity of CO_2 emissions abatement is quite small per household, the rate of displacement per kWh in off-grid household applications is high.

Although a relatively mature technology, SHS activities still face major barriers, which limit the development of the rural, off-grid SHS market. These barriers include lack of consumer financing available to ease the burden of high upfront PV system costs, lack of available PV products in developing countries, lack of qualified service technicians in rural areas, low awareness about SHSs among those without systems, and the need for improved management skills within the businesses participating in the SHS marketplace. These barriers are often compounded by market distortions caused by subsidies for grid-electricity and conventional fuels as well as high import taxes on PV modules.

Additional climate change revenues increase the profitability of SHS companies in the developing countries and could assist in developing the SHS market.

2.2 The case for off-grid projects under the CDM

Figure 1 shows the average CO_2 savings per kWh for three different types of applications: PV could respectively replace grid electricity, stand-alone diesel power or household fuels used for lighting. If PV generated electricity is used to replace grid electricity in developing countries, it saves on average 0.56 $kgCO_2/kWh$, by replacing conventional sources of electricity generation.

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[1] This paper is based on the study "Streamlining CDM Procedures for SHSs", by the same authors and financed by the Shell Foundation and Novem [2,4,5]. The authors are grateful to all who provided their feedback in interviews and at workshops during this study. Additional feedback is always welcome (martens@ecn.nl).

Figure 1 clearly shows that PV used in off-grid applications displaces much more carbon than in grid-connected applications. On average, two times more carbon is abated if off-grid diesel generation is replaced and nine times more if household fuels are replaced.

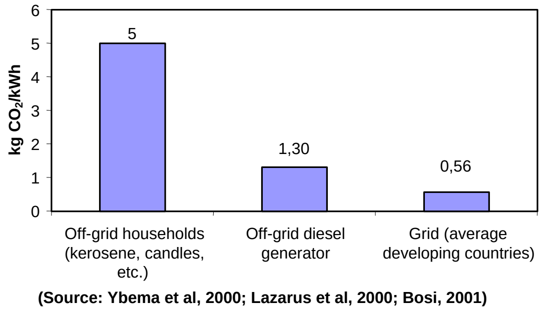

Figure 1: CO_2 savings of PV in developing countries.

2.2 Barriers for solar projects under the Kyoto Protocol mechanisms

Given the potential complexity of rules and administrative procedures currently being proposed for the CDM, many observers have expressed concern that transaction costs could make small project participation very difficult. For example, a study by PriceWaterhouseCoopers [3] found that transaction costs could amount to a substantial percentage of, or even exceed, Certified Emission Reduction (CER) values for small renewable energy projects. Other studies have reached similar conclusions. If not specifically addressed, the CDM could mostly favour large-scale urban and industrial projects and leave out opportunities for advancing clean energy for rural development. This might particularly be relevant in least developed countries where solar and other renewable energy applications have the potential to play an important role in rural electrification.

2.3 Fast tracking procedures for small projects

To make CDM participation viable for small-scale renewable energy projects, the Bonn Agreement (Decision 5/CP.6) has special provisions, called “fast-tracking” procedures, for small projects. The Bonn Agreement stresses the development and adoption of simplified CDM modalities and procedures for qualifying small-scale projects as part of the work plan of the CDM Executive Board, which is likely to be installed during COP7 in November 2001. A committee or panel of experts to assist the Executive Board in developing fast track procedures will likely be assembled in 2002. The Bonn agreement specifies that qualifying small-scale project activities will be defined as:

- renewable energy project activities with a maximum output capacity equivalent of up to 15 MW;
- energy efficiency improvement project activities which reduce energy consumption by up to the equivalent of 15 GWh per year;
- other project activities that both reduce anthropogenic emissions by sources and directly emit less than 15 kt CO_2 per year.

Fast-tracking procedures will potentially include standardised baselines and streamlined monitoring and verification (M&V). Section 3 and 4 expand on how standardised baselines and M&V procedures for SHS projects could be used.

3. STANDARDISED BASELINES FOR SHS PROJECTS

Baseline emissions are the emissions that would occur in the absence of the CDM project. In order to estimate baseline emissions, or “the project baseline”, detailed background information is required. A baseline can be project specific or be standardised. With standardised baselines, the same baseline is used for calculating the emission reductions of multiple projects.

3.1 Standardising baselines

Baseline standardisation has long been recognised as an attractive option to make CDM or JI related emissions measurements more cost-effective and transparent, with greater certainty for investors [1]. The following arguments all apply to SHS projects and provide the rationale for developing standardised baselines:

- Reducing investor uncertainty - SHS markets serving poor rural people in less developed counties are generally perceived as high-risk operations. Risk reduction for SHS businesses is considered an important policy objective to stimulate SHS market development. Given the high level of uncertainty in the market, standardised baselines could stimulate SHS-CDM project development by providing potential investors with a degree of certainty about the number of CERs that can be generated by a project.
- Improving transparency - Measuring CO2 reductions is a complex undertaking. While CO2 reductions can be measured through household questionnaires, current practices use a multitude of methods to estimate CO2 savings, some more reliable than others [4, 5]. Standardisation of such measuring practices would relieve SHS companies from a complex task and increase reliability of the available data on GHG reductions from SHSs.
- Reducing transaction costs - High transactions costs and low per-installation carbon abatement could make it quite difficult for off-grid renewable energy projects to derive value from participating in the CDM. Standardised baselines can significantly help to reduce CDM-related transaction costs.

3. 2 Reference source for a SHS baseline

The “reference case” is the energy supply scenario used to define the baseline situation for calculating the GHG emissions that would be expected in the absence of SHS installations.

Domestic fuels such as kerosene and candles are considered to be a fairly accurate basis for estimating CO_2 abatement and are preferred as a reference case over grid electricity or off-grid diesel generators. SHSs are not typically installed in areas where grid-extension is likely and do not replace the grid where it already exists. Grid electricity would therefore not be the appropriate reference source for SHSs. While SHS installations do sometimes replace individual home generators, this is much less common than their replacing kerosene lamps, candles, and car battery charging. Furthermore, SHS installations almost never replace diesel mini-grid systems. In addition, the amount of electrical capacity that generators provide to households far exceeds that of typical a SHS. Domestic fuel baselines have also almost always been used as the baseline in other climate related SHS activities, such as GEF and AIJ projects.

Eight case studies carried out as part of this study found that carbon abatement from SHS activities varies within and between countries [4,5]. While that analysis provides a basis for estimating global average CO_2 abatement, considerably more data would be required to calculate standard baselines or carbon abatement values at the country or even at the regional level. Waiting until that data becomes available might unnecessarily delay the implementation of SHS projects under the CDM.

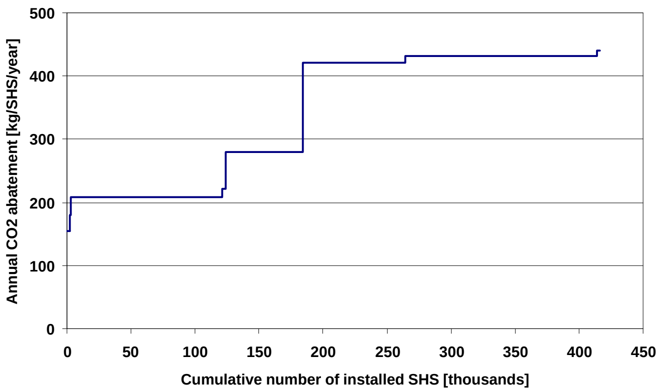

Figure 2: Specific CO_2 emission reduction for case studies. Annual CO2 abatement in kg per solar home system per year against the cumulative numbers installed in the different countries of the case studies.

In order to facilitate SHS projects under the CDM and to overcome the lack of data, a standard global abatement value would be simplest and may be just as accurate as national values. Furthermore, if system performance assumptions are accepted upfront, a standard abatement value would minimize CDM transaction costs since the mere counting of systems deployed would suffice to estimate emission reductions. However, a single global value or formula will underestimate the reductions resulting from use of some systems and overestimate reductions from others. Therefore, it will always still be possible to determine system performance in individual projects, trading greater costs for greater accuracy at the project level.

During a previous analysis of 8 case studies, it was found that roughly 250kg CO_2 per average system of 44Wp per year would represent a conservative but reasonable global value [4]. Figure 2 shows that 70% of the analysed emission reductions were actually higher than 250kg.

3.3 Credit basis: kWh, Wp or SHS?

To produce an appropriate formula for crediting SHS installations with carbon abatement credits, it is important to first determine whether credit should be allocated on a kWh, Wp, or system basis. There is general consensus among SHS stakeholders that kWhs are not a good measure for standardisation as this is difficult to measure, the relation between generated kWhs and used energy services is complex due to losses in the battery, and kWhs are generally not monitored. The project team therefore considered crediting per system and crediting per Wp.

The available empirical data to determine the best option are limited. One study based on household surveys in Kenya shows an increase in CO_2 savings with increasing system sizes. This relationship appears fairly linear, but the increase in CO_2 savings is not directly proportional to module size.

The evidence seems to suggest that the mere introduction of a SHS in a household will have an impact on kerosene savings, but system size is also an important parameter. This notion has been incorporated into our final proposal for the annual CO_2 reduction calculation formula:

75 kg CO_2 for every SHS plus 4 kg CO_2 per Wp.

4. STREAMLINING MONITORING AND VERIFCATION PROCEDURES

Formally, CDM procedures require that CERs can only be issued to projects after they have demonstrated how much CO_2 they save. To prove CO_2 savings, projects will have to monitor the project emissions and compare them to the baseline. The emissions savings reported by the project need to be verified by an independent third party (called an Operating Entity) before the emissions reductions are certified.

Since SHS installations are often widely disbursed in sparsely populated and difficult to reach areas, monitoring and verification (M&V) costs could make CDM participation prohibitive if each household with a system is visited. More simple and efficient M&V procedures are therefore required. There are three variables that need to be monitored and verified in order to correctly establish emission reductions from SHSs:

- Number of systems deployed (sold or installed);
- Number of systems operational in the field;
- Estimated fuel savings per available system.

Since we propose the use of standardised baselines, projects would not have to monitor the estimated fuel savings as this would be determined by the standardised baseline.

The most obvious way to streamline the monitoring process would be to make use of existing documents and procedures. Discussions with SHS companies revealed that most SHS companies have their administrative records checked by local accountants or auditors, including data most relevant to verifying systems sales and installations. With little extra action, these existing independently verified records can be used for CDM verification.

Some SHS companies provide service contracts to their customers and keep maintenance records for their systems. Information from such maintenance records could be used to monitor the number of systems operating in the field. If such maintenance records are not available, sample household surveys would be required. Their costs could be minimised if monitoring and verification could be combined, enabling a single trip to be made.

Under a standardised baseline regime, monitoring of kerosene savings could be done by the UNFCCC. This would provide the basis needed to update and increase the accuracy of the standard baselines. To reduce costs, an independent research team comprised of local researchers (where possible) could conduct random sample surveys of SHS-using homes. Certain information about kerosene use before SHS installations could be retrieved via baseline questionnaires from a sample of customers asked during the installation of their systems.

5. COST IMPACTS & CONCLUDING REMARKS

In this paper, a standardised global baseline and streamlined M&V procedures for SHS have been suggested with the aim of reducing transaction costs for SHS project participation in the CDM. In another analysis, we have attempted to assess the impact of these suggestions on the transaction costs. Although that analysis only provides a rough estimate, it indicates that the proposed measures have a significant impact. They could cut overall transaction costs in half and reduce project development costs to a third of what they otherwise might have been.

Still, the transaction costs analysis indicates that SHSs will face an uphill battle; large scale projects will be required to cover transaction costs and a minimum CER price of around US$10 (current market prices are US$5/tonne CO_2 or lower) will probably be needed to make SHS CDM participation worthwhile. With such a value for CERs the CDM may contribute to approximtely 3-5% of the cost of a SHS.

Over time, as experience is gained with implementing the CDM procedures, transaction costs will likely go down, enabling more SHS projects to enter the CDM. Investors will then be financially rewarded for their contribution to protecting the global climate by providing solar energy to rural households.

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* see www.ecn.nl/unit_bs/kyoto/mechanism/cdmshs.html