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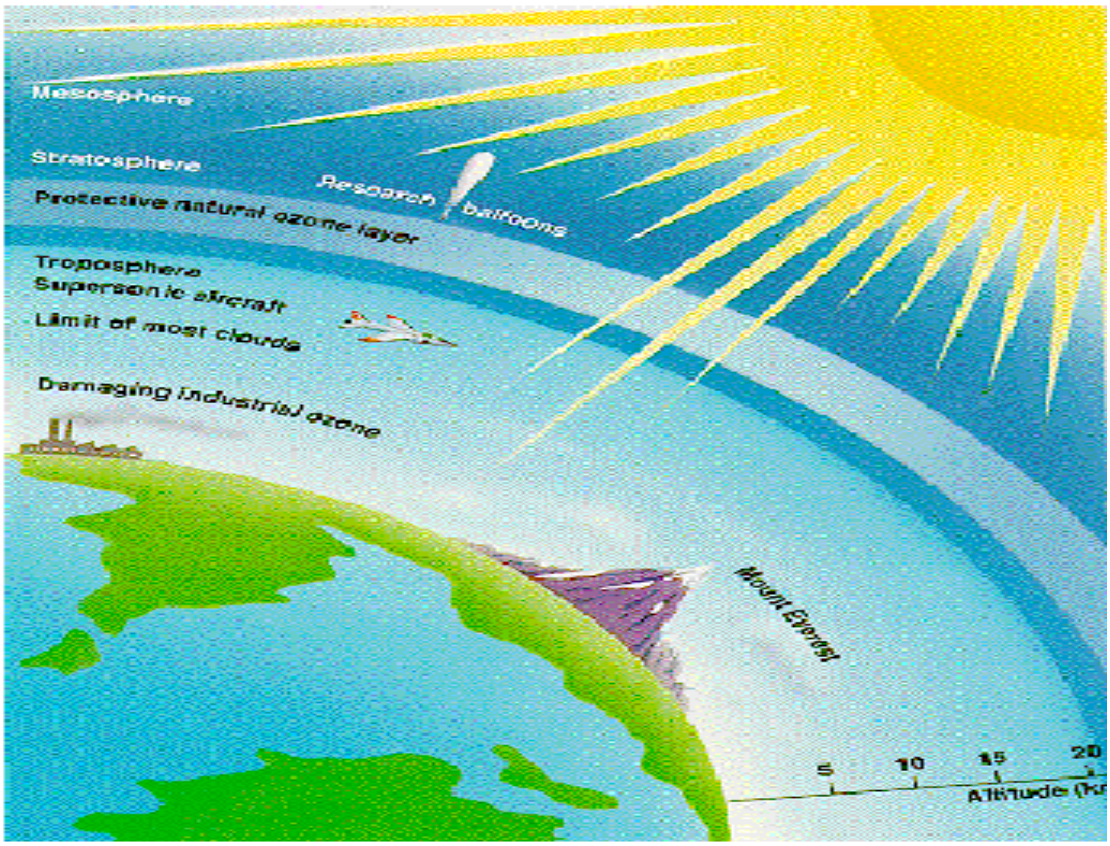
A VIABLE CDM MODEL FOR SOLAR WATER HEATERS



Prepared for

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by

SVK-CDM Technologies Private Limited

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PREFACE

Solar Water Heaters (SWH) replace fossil fuels for water heating. Thus they help reduce Greenhouse Gas (GHG) emissions. Therefore, use of this appliance, in principle, qualifies as a CDM project. However a single solar water heater system is a very small unit to generate sufficient Certified Emission Reductions (CERs) to be pursued as a CDM project. Therefore several units need to be bundled and / or implemented as a programme, using an appropriate methodology and monitoring and verification protocol, in order to have a financially viable CDM project.

In this report, an attempt has been made to bundle the SWH financed by Bank of Maharashtra (BOM) in the past few years, and likely generation of CERs has been estimated. Viability and profitability of the CDM project has been examined at higher level of installations. Further, it has been also examined if such a CDM project could be developed under the recently approved Programme of Activities (POA) approach. We may add here that we also examined the viability of Solar Home System (SHS) for developing a CDM project on the lines similar to SWH. It was noted that given the current CER prices, a SHS based CDM project could be viable only with installations 100,000 and above.

The report first lists important issues involved in developing SWH as a viable CDM project. It then elaborates on applicable CDM project cycle, host country (India) project approval criteria including sustainability requirements, additionality criteria, applicable methodology, baseline, CER calculations, M&V protocol, and stakeholder's requirements for it to be eligible as a CDM project.

The cooperation, guidance and assistance rendered by Dr. Jyoti Painuly of UNEP Risoe Centre, Bank of Maharashtra and other institutions in carrying out this study are gratefully acknowledged.

Date: 10th September 2008

Sunil V. Kulkarni
Director, *SVK-CDM Technologies*

Place: Thane, India

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Abbreviations

Notations	epresentation
CDM	Clean development mechanism
CER	Certified emissions reduction
CH_4	Methane
CO	Carbon monoxide
CO_2	Carbon dioxide
DNA	Designated national authority
DOE	Designated operational entity
EB	Executive board
GHG	Green house gas
IREDA	Indian renewable energy development agency limited
KWh	Kilo watt hour
LPD	Liters per day
LPG	Liquefied petroleum gas
M&P	Modalities and procedure
M&V	Monitoring and Verification
MNRE	Ministry of New and Renewable Energy
MOEF	Ministry of Environment and Forests
N_2O	Nitrous oxide
NGOs	Non governmental organizations
NOX	Oxides of nitrogen
ODA	Official development assistance
PDD	Project design document
PP	Project participant
R&D	Research and development
SHS	Solar home system
SOX	Oxides of Sulphur
SWH	Solar water heater
tCO_2	Tonnes of CO_2
UNFCCC	United nation framework convention on climate change

A VIABLE CDM MODEL FOR SOLAR WATER HEATERS

Executive Summary

Background

It is a well known fact that solar water Heaters (SWH) replace fossil fuels and they do not represent business as usual scenario. Therefore use of this appliance can qualify to be considered as Clean Development Mechanism (CDM) project. However a single solar water heater is a very small unit to be able to generate sufficient Certified Emission Reductions (CERs) to pursue it as a CDM project. Even if the project is considered at the level of local venders or at the level of a company engaged in manufacturing SWH, the CERs still remain very small. The study examines the size of the project from the perspective of its viability as a CDM project and also explores other related issues such as additionality requirement, selection of methodology, baseline calculations, approach for stakeholders' comments, potential bundlers, monitoring & verification, and required policy interventions.

The Approach

Bank of Maharashtra (BOM), a commercial bank in India engaged in financing Solar Water Heaters (SWH), was considered as the base for the study. The CERs were calculated considering Electricity and LPG as the baseline. For the purpose of sensitivity analysis, various price bands for CERs (between US$ 15-25/CER) were considered. The analysis was carried out with bundling of SWH at BOM level, and at the Association of Banks (AOB) / Ministry level (in which case SWH financed by several banks are bundled). Recently approved Programme of Activities (PoA) approach was also considered in the analysis.

Results

A) Development of the CDM project with bundling at the BOM level

The case study of BOM with 8613 SWH installations already in place was examined to determine the viability of the CDM project. A price of US$ 15 per CER was considered for the analysis. The results are included in Table 1.

Table 1: Bundling at the BOM level (In US$)

Particulars	Year 1	Year 2	Year 3	Year 4[1]
Gross Income(8613 Systems)	89,762	89,762	89,762	89,762
Up front CDM project Expenses	100,000	Nil	Nil	Nil
One time M&V Instrument cost	10,000	Nil	Nil	Nil
Recurring Expenses	35,000	35,000	35,000	35,000
Profit after tax/(Loss)	**(55,238)**	**35,595**	**35,595**	**35,595**
Project IRR	**30%**			
NPV (at 5% discount rate)	**157,007**			

It can be observed from the above that the bundled CDM project at an individual bank (BOM in this case) level can be considered viable even with 8600 installations. But

[1] A life span of 10 years was considered for SWH. The cash flow follows the same pattern after fourth year.

considering various assumptions including on transaction costs, CER price etc., the project would be attractive and sustainable if the number of installations is more, say 25,000.

B) Development of the CDM project with bundling at the Association of Banks (AOB) or Ministry level

The case of **25000** installations at the AOB level was examined. Price of US$ 15 per CER was considered for the financial analysis. The results are given in Table 2.

Table 2: Bundling at the AOB level (In US$)

Particulars	Year 1	Year 2	Year 3	Year 4
Gross Income(25000 Systems)	260,542	260,542	260,542	260,542
Up front Expenses	100,000	Nil	Nil	Nil
One time M&V Instrument cost	25,000	Nil	Nil	Nil
Recurring Expenses	35,000	35,000	35,000	35,000
Profit after tax/(Loss)	**65,352**	**146,602**	**146,602**	**146,602**
IRR	**117%**			
NPV (at 5% discount rate)	**959,072**			

It can be observed from the above that AOB / Ministry of Renewable Energy Sources (MNRE) level CDM project would have more **surplus cash flow** every year. Though the CDM project at AOB/MNRE is **viable and sustainable**, it still may not be the most profitable option, since the subsequent installation cannot be added unless the installations are bundled once again. The bundling costs, registration costs etc. are then incurred again.

C) Development of the CDM project by Association of Banks (AOB) / MNRE with PoA approach-

With **PoA** approach for the above project, the viability of the project improves further since a PoA-CDM project **need not incur** expenses for adding subsequent **similar** installations, making the PoA CDM project **most** attractive option**.** The results in this case with 25000 installations are same as given in Table 2. However, for the systems subsequently installed, profit increases due to additional savings on registration costs and some transaction costs. A PoA CDM project does not require registration when additional installations are added, and transactions costs are saved as it does not have to go through all the steps of a CDM project again.

The AOB/MNRE PoA CDM project would have a **surplus cash flow** every year, for subsequent installations, when compared to the bundling approach. This is because, in case of bundling, a part of cash generated out of the CDM project would be required to be used for meeting the up front cost of bringing in **subsequent installations** under a new CDM project. Thus, the CDM project at AOB/MNRE with PoA would be the most **sustainable and profitable.**

Conclusion and Recommendations

The analysis clearly indicated that:

1) The CDM project with bundling at an individual bank level with about 8600 installations, though cash surplus, would **generate** the cash just to meet its own sustainability. But it is a very small project.
2) Bundling of installations by various banks, through an entity such as Association of Banks, would be a viable and sustainable CDM project due to benefits arising out of scale of economy.
3) The profitability **of the CDM project** would **improve** further if the **PoA approach** is considered for developing the project. This is on account of reduced upfront costs that needs to be incurred for subsequent SWH installations.

Methodology

- **Research**
  Detailed examination of published material, seminar proceedings, and events at various CDM related meetings and forums.

- **Preparation of a Concept Paper**
  Compilation of a Concept Paper for discussion with various stakeholders and identification of key issues affecting development of SWH/SHS based CDM projects

- **Consultations with stakeholders (in India)**
  Meetings and discussions with various stakeholders – PIN/PDD consultants and Bank Of Maharashtra, among others – to ascertain their perception of risk in undertaking CDM project and their views in the Indian context.

A VIABLE CDM MODEL FOR SOLAR WATER HEATERS

1. Current Concerns

It is a well known fact that solar water Heaters (SWH) replace fossil fuels and they do not represent business as usual scenario. Therefore use of these appliances can qualify to be considered as Clean Development Mechanism (CDM) projects. However a single solar water heater system is very small unit to be able to generate sufficient Certified Emission Reductions (CERs) to pursue it as a CDM project. Even if the project is considered at the level of local venders or at the level of a company engaged in manufacturing these appliances, the CERs still remain very small. The study examines the size of the project from the perspective of its viability as a CDM project and also explores all other related issues such as additionality requirement, selection of methodology, baseline calculations, approach for stakeholders' comments, potential bundlers, monitoring & verification, and required policy interventions.

The CDM executive board meetings reports **EB-32** (20-22 June 2007) and **EB-33** (25-27 July 2007) has made it possible to register CDM projects as **Program of Activities (PoA)** also, which is particularly useful when it is either difficult or not possible to pursue a potential CDM project as a normal CDM project activity. The study also examines various **issues** involved in pursuing SWH as CDM project under the Program of Activities (PoA). The PoA, as the name suggests, registers a program of activities, which can, in principle, cover a bank's program providing loan for a particular product or a range of products, which help reduce GHG emissions. Thus, these developments offer a good opportunity to pursue SWH as CDM project under Program of Activities (PoA).

2. Objective of the Study

The objective of the study is "Development of a Viable Model to Pursue Solar Water Heaters as Clean development Mechanism (CDM) Project"

3. Project Description

Bank of Maharashtra has provided finance to the tune of Rs. 273.9 million to **8613** clients for purchasing and installation of **solar water heaters** during 2003 to 2006 period, which is expected to rise in future. The bank has 97 approved suppliers for SWH (Flat plate collector type and evacuated tube collector type solar water heaters). Solar water heating systems use solar energy to provide hot water without fuel cost or pollution and with minimal operation and maintenance expenses. Solar energy is the most readily available source of energy. It is also one of the important sources of renewable energy, as it is non-polluting and helps in reducing the greenhouse gas emissions. Compared to the conventional energy sources, solar energy offers clean and renewable energy.

In the proposed CDM project, fossil fuels like LPG, and coal (major sources of energy for generating electricity) are replaced by solar energy through use of SWH, thus avoiding greenhouse gas emissions.

4. Clean development Mechanism (CDM) Project Cycle

The various steps involved in the clean development Mechanism (CDM) project cycle are as shown in the figure 1.

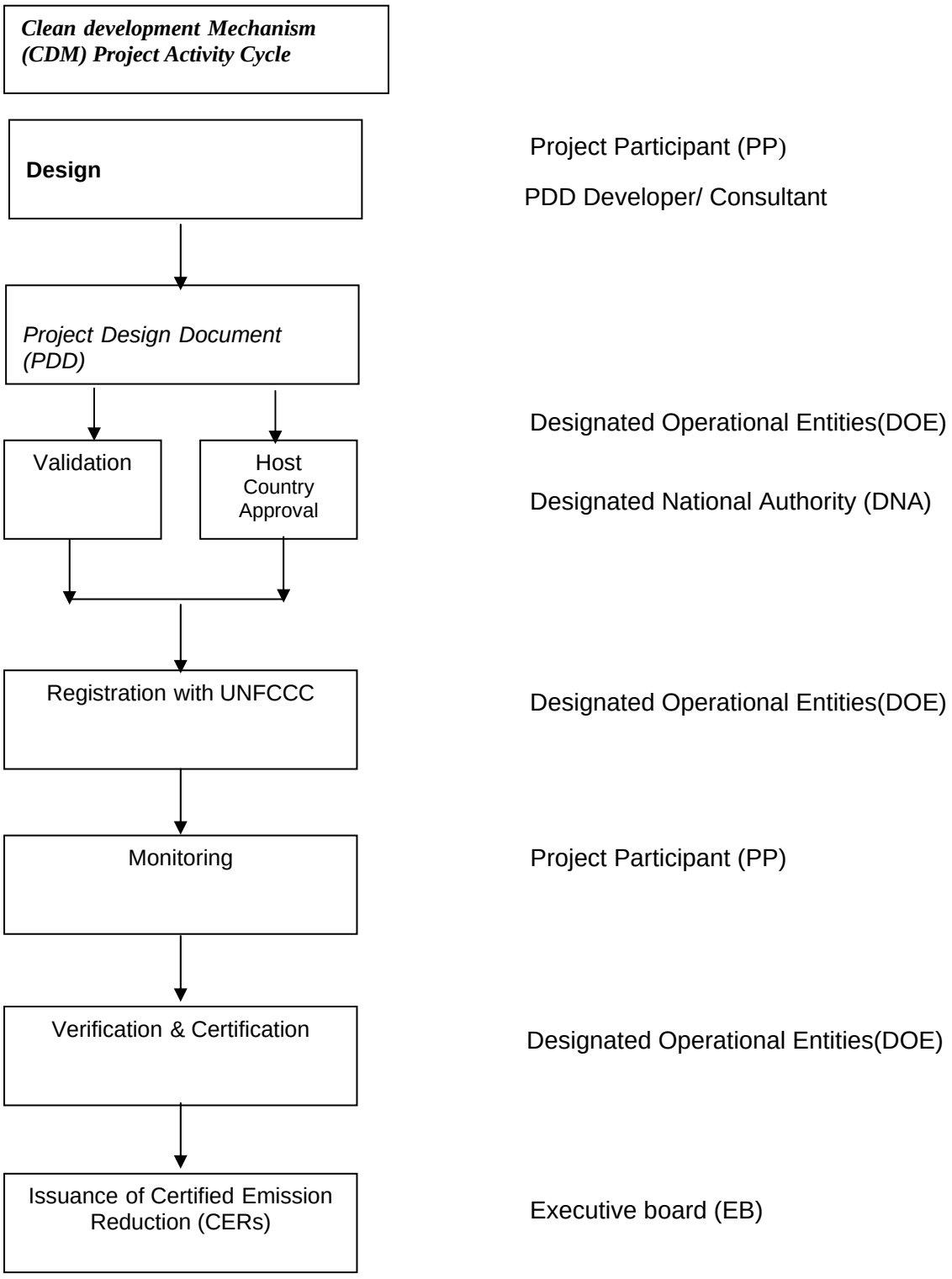

Figure 1: The CDM Project Cycle

5. Issues in the PDD Development

1. Additionality: Project additionality needs to be proven to satisfy UNFCCC guidelines. (http://cdm.unfccc.int/methodologies/PAmethodologies/AdditionalityTools/Additionality tool.PDF)

2. Sustainability: Project sustainability needs be proven as per Designated National Authority (DNA), Ministry of Environment and Forests (MOEF) guidelines.

3. Methodology Selection: The project is planned to be developed as a small-scale CDM project; therefore applicable methodology needs to be chosen.

4. Baseline Scenario: Baseline that reflects business-as-usual scenario (existing practice), needs be identified for the project.

5. Claiming the CERs: The CERs can be claimed only from the date of project registration. The project bundler needs to be identified and a structure for CERs distribution needs to be worked out.

6. Pursuing SWH as CDM project under Program of Activities (PoA)

6. Eligibility Criteria / Priorities of the Host country

a. Sustainability Criteria

The sustainable development criteria of the host country (India) are fulfilled by the project as follows;

Social well-being: The use of solar water heaters generates business opportunities. Maintenance and monitoring of the systems also creates employment opportunities. SWH can provide an affordable heat source where other fuels are not available or are not attractive.

Economic well being: Solar water heaters use solar radiation as a source of energy, which is a renewable source available free of cost. The activity results in savings in fuel costs by avoiding use of wood, LPG and electricity. The reduced use of LPG saves foreign exchange also, thus contributing positively to the economy of the country.

Environmental well-being: Due to the project activity GHG emissions are reduced. The activity also results in the reduction of other pollutants such as CO (Carbon Monoxide), SOx, and NOx (Sulphur Oxides and Nitrogen Oxides), emitted due to use of fossil fuels.

Technological well-being: Water heating accounts for a substantial portion of energy use in many residential, commercial, institutional, and federal facilities. Nationwide, approximately 18% of energy use in residential buildings and 4% in commercial buildings is for water heating. Solar water heating system, which uses the sun's energy rather than electricity or gas to heat water, can efficiently provide up to 80% of the hot water needs without fuel cost or pollution. Thus the technology employed in the project activity leads to improved performance and reduction in fuel consumption.

Thus this project activity fulfils the sustainability criteria of host country.

b. Additionality criteria:

The project should establish the following additionality in order to qualify for consideration as a CDM project activity by the host country:

Emission Additionality: The project leads to real, measurable and long term GHG reduction. The additional green house gas reductions are to be calculated with reference to baseline.

Installation of solar water heaters by domestic and commercial sector will reduce the use of fossil fuels, and hence, GHG emissions. The project leads to real, measurable and long term GHG mitigation. Project lifetime is considered as 10 years.

Financial Additionality: The procurement of CERs should not be from Official Development Assistance (ODA).

No ODA flow to the project is envisaged. Therefore, the project satisfies the financial additionality.

As both the additionalities are satisfied by the project, the project fulfils the additionality criteria of the host country.

7. UNFCCC Requirements for the project

a. Additionality of the project activity

The proposed project activity is additional (using Attachment A to Appendix B of the simplified M & P for small–scale Clean development Mechanism (CDM) project activities) because the project activity would not have occurred anyway due to the following barriers:

(i) **Investment barrier**

The cost of installation of solar water heaters is higher than the prevailing practice for water heating, i.e. the use of wood (rural area), LPG, and electricity (urban area) for water heating. But the project activity uses solar radiation and reduces the corresponding GHG emissions. There is some leakage due to GHG emissions resulting from manufacturing and transportation of the SWH but these are minor and project activity overall results in reduction of GHG emissions.

(ii) **Technological barrier**

Less advanced technological alternative to the project activity is to continue with wood, coal, electricity or LPG, which involves lower risk as performance certainty is very high since this is a well established practice. Market share of proposed technology (SWH) is very low compared to use of wood, LPG or electricity, which are well accepted fuels in India and are available at lower prices. The activity mostly depends on the availability of the sunlight but adequate intensity of solar radiation is not assured throughout the year. Unavailability of sunlight can be a hindrance in operation of SWH, and hence the activity is risky compared to the prevailing practice. This risk is high in rainy season.

(iii) **Barrier due to prevailing practice**

Prevailing practice or existing regulatory or policy requirement would have led to implementation of a technology with higher emissions.

Prevailing practice is the use of wood, coal, electricity and LPG for heating water. Shifting from this to solar water heater requires investment and initiative to change the trend. Solar water heater is new technology as the majority of people use electricity, wood, coal, and LPG for water heating. Thus the project activity is not the baseline scenario and the estimated emission reductions would not occur in the absence of the project activity.

Barriers due to technological acceptance, risk of availability of sunlight, prevailing practices and regulatory circumstances would have continuation of electric heaters, wood, coal, LPG for meeting demand, which emits higher GHG emissions.

The proposed project activity is additional due to these barriers.

b. Size of the project activity:

The CDM project activity is a small-scale project as the generation capacity of the system i.e. the solar water heater system involved in the project activity is less than the limit of 15 MW* for Type I project activities as per the “Annex II- simplified modalities and procedures for small- scale clean development mechanism project activities”.

Note: The total MW for CDM project with 8613 and 25,000 installations works out to **2.83 MW** and **8.21 MW** respectively. The calculations are based on 330 days of operation per year. SWH would replace electricity by 960 KWh/year/system and LPG by 825,000 kcal/year/system.

c. Methodology Identification:

The following two activities (using several appliances) can be bundled in the project:

1. SWH Replacing LPG and Electricity (generated mostly through coal Combustion).

The use of wood is most used form of source of energy for water heating in rural areas where as the use of electricity and LPG is most prevalent in urban and semi urban areas. Solar water heating systems are popular in urban and semi urban areas and hence replacement of electricity and LPG (and not coal and wood) by SWH is considered as base line for calculation of emission reduction.

The project is a small-scale clean development Mechanism (CDM) project. Referring to the UNFCCC guidelines, as per Appendix B to the simplified modalities & procedures (M&P) for small-scale clean development Mechanism (CDM) project activities, type & category for this project are:

1. SWH Replacing LPG and Electricity (generated mostly through coal combustion)

Type: Type I: Renewable Energy Projects
Category: I.C: Thermal energy for the user

As per UNFCCC guidelines, both of these methodologies are permitted to be used together.

8.0 Pursuing SWH Project as a Program of Activities POA:

8.1 What is CDM Program of Activities?

A CDM Program of Activities (PoA) is "a voluntary coordinated action by a private or public entity which coordinates and implements any policy/measure or stated goal (i.e. incentive schemes and voluntary programmes), which leads to GHG emission reductions or increase net greenhouse gas removals by sinks that are additional to any that would occur in the absence of the PoA, via an unlimited number of CDM program activities (CPAs)".[2] Examples could include a program to implement an energy efficiency standard, a demand side management (DSM) program, or a concerted effort to switch industrial facilities from fossil fuel to natural gas.

A PoA must be additional to what would have occurred in its absence. In order to show its additionality a PoA must demonstrate in the absence of the CDM (i) the proposed voluntary measure /standard would not be implemented, or (ii) the mandatory policy/regulation /standard would not be enforced as envisaged, or (iii) that the PoA will lead to a greater level of enforcement of the existing mandatory policy /regulation/standard. This demonstrates the additionality of the PoA as a whole.[3] The additionality of the individual CPAs can be shown using the approved tool for the demonstration of additionality.

A CDM program of activities is identical to a traditional stand-alone CDM project in the sense that both must comply with all the procedures and modalities of the CDM, resulting in real emission reductions: each project activity in a program must have a direct, real and measurable impact on emission reductions. A CDM program of activities, however, is different from a stand-alone CDM project in the following ways:

Multiplicity of GHG reducing activities: The program is a deliberate effort that results in a multitude of GHG reducing activities occurring over time in multiple sites. The sites could be located within one city or region, one country or several, as long as each involved country submits a Letter of Approval.

Managing entity: The program is coordinated or managed by one entity, which can be private or public, which does not necessarily achieve the reductions but promotes others to do so. The entity must identify measures to ensure that all project activities under its program are neither registered as single CDM project activities nor are part of another registered program. The coordinating entity is responsible for making any arrangements for the distribution of CERs and for communicating with the Executive Board of the CDM.

CPAs: A program is implemented via an unlimited number of CDM project activities (CPAs). A CPA is a single, or a set of interrelated measure(s), to reduce GHG emissions applied in either a single or many locations of the same type, within a predefined area. All CPAs in a program must apply one approved baseline and monitoring methodology. At registration, the program must define the type of information, which is to be provided for each CPA to ensure that the CPA is eligible under the program and that the resulting emission reductions are real and measurable. As with all other project activities, the

[2] Annex 1 to the Annotated Agenda for EB 32

[3] Annex 2 to the Annotated Agenda for EB32

crediting period of a CPA is either a maximum of seven years, which may be renewed at most two times, or a maximum of 10 years with no option of renewal

Duration: The GHG reducing activities do not necessarily occur at the same time. A program can have duration of up to **28 years**. Although all actions respond to the same program, they can occur either simultaneously, or throughout the duration of the program. The managing entity can add a CPA to the program at any time by submitting a CPA design document (CPA-DD).

Monitoring & verification: The total volume of emission reductions to be achieved by a program may not be known at the time of registration. Each CPA shall be monitored according to the monitoring methodology, which has been approved for that type of project activity. In cases where there are many small GHG reductions, statistically sound sampling may be proposed in the monitoring methodology submitted for approval. For purposes of verification, the DOE may also use sampling techniques as long as they ensure the accuracy of the emission reductions.

In order to capture the differences between traditional stand-alone projects and programs, the EB may soon have new forms for submission of a program:

Program of Activities: Design Document (PoA-DD) for the submission and registration of a program;

Program Activity Design Document (CPA-DD): for the addition of every CPA to the registered program.

The additional information on PoA could be obtained from the links in Table 3.

Table 3: Links for information on PoA

Sr. No.	About	Link
1.	POA Procedure	http://cdm.unfccc.int/Reference/Procedures/index.html
2.	Eligibility of activities under the CDM	http://cdm.unfccc.int/Reference/Guidclarif/EB33_para30_Eligibility_activities.pdf
3.	Determination of Occurrence of De-bundling	Guidance for determining the occurrence of de-bundling under a programme of activities (PoA) (version 01)
4.	Guidance for Registration	Guidance on the registration of a programme of activities as a single project activity (version 02)
5	Methodologies for Small Scale POA	http://cdm.unfccc.int/EB/index.html

Methodologies have also been made available by UNFCCC for PoA. Small-scale methodologies have been revised to accommodate PoA. The details have been made in EB-33 (25 - 27 July 2007). The link is given in above table.

Referring to this recent development and all the above documents listed in above table, it has been concluded that it is far more convenient and productive to pursue SWH as PoA for registering SWH as CDM projects. **Basic difference in normal CDM project and CDM through PoA is that PoA provides all futuristic benefits as they come, one does not have to commit and follow as in case of normal CDM project.** Further, local regulations and local issues do not affect additionality adversely in case of CDM through PoA. However documentation requirement is more in case of PoA, which is not a constraint, only the documentation work quantum goes up.

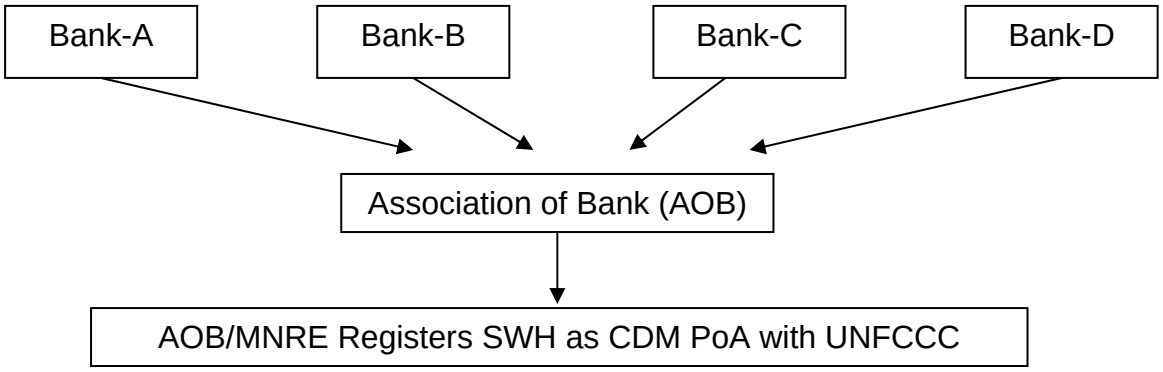

Figure 2: Schematic to pursue SWH as a CDM Project under PoA

Pursuing SWH as a CDM PoA will involve pledging of CERs by the like-minded Banks to join together, which can be through Association of Bank (AOB)/MNRE–AOB/MNRE will then register SWH as CDM PoA with UNFCCC **once** only. Thereafter all the banks will be submitting details of the SWH installed through them and AOB/MNRE will compile them together and intermittently submit the details to UNFCCC. **By this way re-registration of same types of projects will be avoided and overall CDM transaction cost will be low.** Figure 2 above illustrates the possible mechanism for SWH as a CDM project under PoA.

Therefore it is strongly recommended to pursue SWH as PoA

8.2 How the SWH project could be implemented under PoA?

Steps to be followed by Association of Banks (AOB)/MNRE to pursue for CDM project under POA-

Step 1- Enter into Strategic Arrangement* between AOB and participating banks for authorising AOB to exploit the CDM potential of SWH under their respective portfolio;

Step 2- AOB to decide the cut off date for consideration of CDM project at first level, say by March 31, 2008.

Step 3- AOB to collect portfolio data from participating Banks, in a prescribed format;

Step 4- AOB, with the help of external consultant, develop PIN, PCN, PDD etc for CDM project under POA arrangement;

Step 5- Host Country Approval from DNA for the CDM Project;

Step 6- Registration of CDM project as POA with CDM Executive Board;

Step 7- Repeat the above exercise for subsequent years without going into PIN, PDD stage, subject to methodology/Monitoring and verification procedure remaining the same.

* The strategic arrangement between the AOB and Participating banks must address the **basic issues** such as:

1. Roles and responsibilities of each participant;
2. The rules for selection of consultant for PDD, Monitoring and verification Agencies;
3. Arrangements for funds for initial expenses to be met for Registration of CDM project;
4. Utilisation of Funds for further development of SWH market in India.

The best way to address these issues would be that AOB enters into Memorandum of Understanding (MOU) with all participating banks before undertaking the CDM project. The MOU should address all the above issues and agreement should be reached to this effect.

9. Justification of the choice of the project type & category

9.1 Solar Water Heater:

Paragraph 1 of "Type AMS. I.C. Thermal Energy for the user (Version 09: 23 December 2006)" of appendix B to the simplified M&P for small-scale Clean development Mechanism (CDM) project activities states that "This category comprises renewable energy technologies that supply individual households or users with thermal energy that displaces fossil fuels. Examples include solar thermal water heaters and dryers, solar cookers, energy derived from renewable biomass for water heating, space heating, or drying, and other technologies that provide thermal energy that displaces fossil fuel. Biomass-based co generating systems that produce heat and electricity for use on-site are included in this category."

In this project, solar energy (trapped by sun) displaces LPG, electricity (generated by coal, a fossil fuel). Thus, this project activity uses renewable energy to produce thermal energy thereby displacing fossil fuel. Therefore this project falls under category AMS-I.C.

10. Monitoring and Verification

10.1 Solar Water Heater

Monitoring methodology and plan as per Paragraph 11 of "Type AMS. I. C. Thermal energy for the user (Version 09:23 December 2006)" of Appendix B of the Simplified M&P for Small-Scale Clean development Mechanism (CDM) Project Activities, states that:

"11. Monitoring shall consist of:

(C) If the emissions reduction per system is less than 5 tCO_2 a year:

(i) Recording annually the number of systems operating (evidence of continuing operation, such as on-going rental/lease payments could be a substitute); and

(ii) Estimating the annual hours of operation of an average system, if necessary using survey methods. Annual hours of operation can be estimated from total output and output per hour if an accurate value of output per hour is available."

In this project activity for monitoring the Solar Water Heater, guideline suggested in paragraph 11 in subhead (c) of "Type AMS. I. C. Thermal energy for the user (Version 09:23 December 2006)" of Appendix B) and for Solar Home System, guideline suggested in paragraph 14 in subhead (a & b) of "Type AMS. I. A. Electricity generation by the user (Version 09:23 December 2006)" of Appendix B of the Simplified Modalities &Procedures for Small-Scale Clean development Mechanism (CDM) Project Activities will be followed.

10.2 Description of the Monitoring Plan:

In this project activity, as per paragraph 11 of "Type AMS. I.C. Thermal energy for the user (Version 09: 23 December 2006)" for Solar water Heater, and as per paragraph 14 of "type AMS.I.A. Electricity generation by the user (Version 09: 23 December 2006)" for Solar home system energy generated due to trapping of solar radiation (a renewable energy source) is quantified.

As the emission reduction per system is less than 5 tCO_2 per year (5984 CERs for total 8613 installations or @ 0.7(5984/8613) tonnes of CERs per installation per year), monitoring will involve:

i) Recording of total number of systems in operation.
ii) Survey to estimate annual hours of operation of systems.

Recording of total number of systems in operation-

As per guidelines, an annual check of all systems or a **sample** thereof to ensure that they are still operating (Other evidence of continuing operation, such as on-going rental/lease payments could be a substitute) could be used for determining the total number of systems in operation. A sample survey of 5% of total systems could be carried out to determine the number of operating systems. In addition to this, the **repayment track record** of all the loans extended by the banks would also be acceptable criteria for establishing the total number of systems in operation. This could be justified since 1) Banks have a system in place to select vendors, based on their track record indicating very less failures on technical grounds. 2) Normally the borrower (SWH user in this case) does not default on loan unless the equipment is not providing the expected service. 3) All the listed suppliers do have a comprehensive O&M service network that addresses the technical faults.

It may be mentioned here sample survey of 5% of total systems would be the main criteria for establishing the total number of systems in operation. The repayment track record could be used only as **substitute** wherever required. The tenure of loan from Indian banks for SWH varies between 3-5 years where as the selected contract period is

10 years. As such the repayment track record can not be used for balance life of installations after the loan repayment.

Survey to estimate annual hours of operation of systems

The number of hours of operation could be estimated by survey for select installations of SWH (5% of total installations). For accurate measurement, flow meter may also be used for **sample** installations. The normal flow meter required for measuring the flow of hot water is available at US$ 10. The **users** of SWH do not require these instruments (since they are convinced about the utility of SWH) and hence, they would **not** be willing to pay additional charges for the same. As such, the CDM project developer has to provide for the cost of meters as a part of M&V expenditure (one time expenditure) and should form the part of profitability estimates. These costs are one time costs and can easily be absorbed as a part of the up front cost of development of CDM project.

For measurement of all the parameters and maintenance of records due care needs be taken to prepare elaborated formats for data collection (methodology has been described for measurement and collection of each of the parameter).

11. Approach to take stakeholders comments

Following stakeholders are identified for this project activity and their comments will be considered in designing of Project Concept Note (PCN) and Project Design Document (PDD).

List of stakeholders identified:

1. Banks involved in granting loans for SWH and SHS
2. Vendors dealing with manufacture / supply of SWH and SHS, and their dealers
3. Users of SWH and SHS
4. Ministry of New and Renewable Energy
5. Relevant NGOs
6. Research institutions involved in Research & Development in solar energy
7. Other experts

Set of questions to be sent to stakeholders:

The proposed CDM project is expected to be taken up by either the individual bank or by AOB/MNRE. The proceeds from such a CDM project activity is proposed to be used for further creating awareness about positive impact on environment that would be created by use of SWH. Thus the Corporate Social Responsibility would be the main driver for undertaking the CDM project.

As per UNFCC guidelines, PDD is expected to address the concerns of all likely stakeholders and it is also expected to receive their comments. It would therefore be essential to understand the views of these stakeholders on the social, environmental, technological and economical aspects before undertaking CDM project. Further, the PDD should also address issues such as owner of CER/VER revenues, impact of solar energy

through solar heaters on overall environmental situation in India & environment near the user, business as usual scenario and/or otherwise and so on.

Following is the set of questions to be sent to stakeholders for understanding their views. The questions are representative and not exhaustive.

1. Would the harvesting of solar energy be able to improve the environmental situation in India?
2. How does this project activity affect you (positively or negatively) or on your environment?
3. Would you recommend other companies / authorities or families to use solar energy for water heating or to fulfill own electricity need?
4. Do you think "the project activity "will contribute to foreign exchange saving?
5. Do you think "the project activity "will contribute in saving fossil fuels?
6. Do you think, "The project activity "will contribute to Sustainable Development in India?
7. Do you think your organization would be willing to undertake CDM project for meeting social responsibility?
8. Any additional comments on the project activity and suggestions to improve Sustainable Development through this project?

12. Project Lifetime

The average life of SWH is considered to be 10-15 years. As such a project life of 10-15 years can be considered for assessing economical viability of development of CDM project. However, it would be worthwhile to consider project life of 10 years to assess the revenues from CDM project on realistic basis.

13. Issue regarding ownership of Certified Emission Reduction (CER)

The bank, which provides fund to carry out the CDM project, will be the **owner** of CERs and it will submit the project to the board to get benefit of CERs. With PoA approach, even the Bank of Maharashtra, in its own capacity can develop the CDM project. However, the Association of Banks (AOB)/MNRE can also be a party to undertake the CDM project, provided all participating banks with SWH programme, agree to come together under AOB umbrella and hand over rights of CDM exploitation to AOB.

14. Financing details of the SWH Project

SWH Programme is fully financed by The Bank of Maharashtra in this case and by individual participating banks in case of PoA. The CDM project may be developed by BOM on its own or by AOB as contribution from all participating banks implementing the SWH projects.

15. Viability of CDM project

The SWH-CDM project may be carried out by BOM, Association of Banks or by MNRE.

To assess the **viability** of CDM project, it would be essential to estimate the likely revenues, up front and recurring cost of developing the CDM project before arriving at profitability analysis.

Likely revenues from CDM project-BOM case Study

Table 4 below gives an idea about **revenue** generation, based on number of Customers/Installations for BOM.

The key data and assumptions are:
1) There are total 8613 customers/installations of SWH with BOM.
2).The total installations with 4/6 banks in India implementing SWH programme are estimated about 25, 000.
3) BOM as well as other banks/AOB/MNRE would like to add subsequent installations under CDM activity provided that the cash flow from initial CDM activity would pay for subsequent registration and other recurring expenses.
4) The average consumption of hot water is @100 liters/day for 330 days a year.
5) The temperature of water is raised from 25 ^{o}C to 50 ^{o}C (applicable for Maharashtra state where BOM has maximum installations).
6) 75% of total users were using electrical heaters and 25% were using LPG to meet their hot water requirement and now use SWH for their hot water requirement.
7) The average price of US$ 15 per CER is considered.
8) The CERs are also calculated for 15,000 and 25,000 installations. These numbers represent likely scenario of AOB/MNRE clubbing the installations of 4 to 6 banks involved in financing SWH either as bundling or PoA CDM project.
9) The CER revenue would be taxable and we have provided for tax at the rate of 35%.

Table 4: Revenue generation for the SWH CDM project (In US$)

Sr.	No. Costumers/Installations	CERs / year	Gross Revenue/ year
1	8613	5984	89762
2	15000	10422	156325
3	25000	17369	260542

UP front cost and recurring cost-

The up front cost of developing CDM project is estimated at **US$ 100,000 or Rs. 4 Mn**. The one time M&V related instrument cost is estimated at **US$ 10,000** (1000 flow meters @ US$ 10 each). The cost would go up to US$ 15000 and US$ 25, 000 for 15,000 and 25,000 installations respectively.

The recurring cost per year would be **US$ 35,000** or **Rs.1.4 Mn** comprising **US$ 25,000** for of monitoring and verification expenses **(**estimated based on the prevailing M&V cost quotations for similar small scale CDM projects) and US$ 10,000 for meeting general and administration expenses.

Cash flow and profitability Estimates for; A) Bundling at one bank level, B) Bundling at AOB/MNRE level and C) At AOB / MNRE level under PoA are given below.

A) Bundling of the SWH CDM project at BOM level (with 8613 installations)

The cash flow estimates follow the same pattern (except in the first year), and given here Table 5 and 6) only until fourth year. Complete 10 year cash flow statement is given in Annex A.

Table 5: Bundling at the BOM level (In US$)

Particulars	Year 1	Year 2	Year 3	Year 4
Gross Income(8613 Systems)	89,762	89,762	89,762	89,762
Up front CDM project Expenses	100,000	Nil	Nil	Nil
One time M&V Instrument cost	10,000	Nil	Nil	Nil
Recurring Expenses	35,000	35,000	35,000	35,000
Profit after tax/(Loss)	**(55,238)**	**35,595**	**35,595**	**35,595**
Project IRR	**30%**			
NPV (at 5% discount rate)	**157 007**			

It can be observed from Table 5 that the bundled CDM project at an individual bank level (BOM) with 8613 installations is viable, and can be considered as a **sustainable** CDM project. This is however a very small project. The project may be attractive and sustainable if the total number of installations under consideration at the time of registration itself is higher. We take 25000 installations, which means engaging more than one bank. In this case the project needs to be bundled at "**Association of Banks**" or at **MNRE** level.

B) Bundling of the SWH CDM project at AOB/MNRE level (with 25,000 installations)

The cash flow and profitability estimates for a project with AOB/MNRE with 25,000 installations are given in Table 6.

Table 6: Bundling at the AOB level **(In US$)**

Particulars	Year 1	Year 2	Year 3	Year 4
Gross Income(25000 Systems)	260,542	260,542	260,542	260,542
Up front Expenses	100,000	Nil	Nil	Nil
One time M&V Instrument cost	25,000	Nil	Nil	Nil
Recurring Expenses	35,000	35,000	35,000	35,000
Profit after tax/(Loss)	**65,352**	**146,602**	**146,602**	**146,602**
IRR	**117%**			
NPV (at 5% discount rate)	**959,072**			

It can be observed from Table 6 that AOB/MNRE CDM project will have a reasonable **surplus cash flow** every year. The surplus cash can be used for creating awareness about SWH in rural and semi urban areas. However, a part of cash generated out of the CDM project will still be needed to meet the up front cost of bringing in subsequent installations under the project. Though the CDM project at AOB/MNRE is **viable and sustainable**, it still can not be considered as the most profitable option.

C) SWH CDM project at AOB/MNRE level under PoA

If **PoA** approach is considered for the above CDM project, then the project saves on transaction cost since a PoA-CDM project **need not incur** expenses for adding t **similar** installations subsequently, making the PoA CDM project most attractive**.**

The cash flow and profitability estimates for the project with AOB/MNRE with 25,000 installations are given in Table 7.

Table 7: SWH CDM project at AOB / MNRE level under PoA (In US$)

Particulars	Year 1	Year 2	Year 3	Year 4
Gross Income(25000 Systems)	260,542	260,542	260,542	260,542
Up front Expenses	100,000	Nil	Nil	Nil*
One time M&V Instrument cost	25,000	Nil	Nil	Nil
Recurring Expenses	35,000	35,000	35,000	35,000
Profit after tax/(Loss)	**65,352**	**146,602**	**146,602**	**146,602**
IRR	**117%***			
NPV (at 5% discount rate)	**959,072***			

Note-* CDM project under PoA need **not** make provision for registering subsequently installed systems and therefore the IRR and NPV would be higher than these figures for the subsequent installations.

It can be observed from the above that AOB/MNRE PoA CDM project will have a **surplus cash flow** every year. The surplus cash can be used for creating awareness about SWH in rural and semi urban areas. Further, unlike bundling, the CDM project is not required to meet the up front cost of bringing in subsequent installations under the project. Therefore, the CDM project at AOB/MNRE with PoA would be the **most** profitable **and sustainable** option. The IRR and NPV of the subsequent installations will be still higher due to savings on transaction cost.

Financing of expenses to be incurred on development of a CDM Project

It is expected that individual bank or Association of banks, though willing to explore and develop the CDM project, given the **perceived** risk of rejection of the project, will look for some external assistance for developing it for the first time.

As the project is expected to have a good demonstrative value, the UNEP or any other multilateral Institution may consider funding the CDM project development subject to AOB/MNRE agreeing to use the proceeds to propagate the use of SWH in semi urban and rural areas.

16. Indicative Certified Emission Reduction (CER) price and likely Revenues

Current CER price is $12 per CER. Considering the time span of about one year for development of a PoA project, we can expect the price to vary; we have considered it $ 15 per CER. However, considering the longer crediting period and ever changing demand

supply scenarios, it may be worthwhile to consider a price band. A price band of US$ 15-25 was taken to calculate the revenues from the proposed CDM project.

The revenue generation per year for the proposed BOM PoA project for the total size of installations at 8613(current numbers), 15000 and 25,000, and CER price band of US$ 15-25 per CER is given in Table 8.

Table 8: Revenue generation for the SWH CDM project under PoA (US$)

Number of Installations	CERs	US$ 15/CER	US$ 20/CER	US$ 25/CER
8613	5984	89762	119683	149603
15000	10422	156325	208434	260542
25000	17369	260542	347490	434237

It can be observed from Table 8 that the viability of CDM project improves and size may be acceptable with rise in prices of CER and number of installations.

17. Crediting period

As per CDM guidelines, 2 crediting periods are possible, 1) 7 years period with 2 subsequent revisions and 2) Fixed crediting period of 10 years.
We select the second option; fixed crediting period of 10 years for the proposed CDM project.

Why fixed period 10 years and why not 7 years with 2 revisions?

As per guidelines, the contract period for CDM project could be for 7 years with an option of revising it for 2 times. However, it also means that new base line guidelines would be applicable after 7 years and AOB/MNRE would be required to undergo through the PIN/PDD and registration formalities once again. This also means that the income stream arising out of CDM project can be estimated for initial period of 7 years only. A part of the income arising out of CDM project is expected to be used for undertaking awareness programme for SWH/SHS in rural and semi urban areas. A **known cash flow is preferable** for the AOB/MNRE to design the awareness programmes. We therefore suggest using fixed crediting period of 10 years.

18. Benefits to the PoA project owner

With 25,000 installations and total CERs of 17071 tCO_2 per year under the PoA-CDM project, the gross expected revenue (for 10 years), is expected to be **US$ 2,560,600** with US$ 15 per CER . However with CER price at US$ 25, the revenue would increase substantially to **US$ 4,267,660**.

Table 9 below illustrates the analysis for the proposed PoA- CDM project over a time span of **10 years**, under different CER prices.

Table 9: Cash flow and profitability under different CER prices for the SWH CDM project under PoA (In US$)

Particulars	$15/CER	$20/CER	$25/CER
Gross revenue (25000 systems)	**2,605,420**	**3,473,900**	**4,342,370**

Up front cost of project development	110,000	110,000	110,000
One time M&V Instrument cost	25,000	25,000	25,000
Recurring expenses for M&V @ US$ 25,000 per year	250,000	250,000	250,000
Admin cost @ US$10,000/year	100,000	100,000	100,000
Profit after tax	1,466,020	2,030,530	2,595,040
Project IRR	**117%**	**162%**	**208%**
NPV (at 5 % discount rate)	**959,072**	**1,374,213**	**1,789,354**

It can be concluded from Table 10 that the proposed CDM project with PoA approach is **beneficial** to the CER owner with project IRR ranging from **117%** to **208%** and NPV from US$ **959,072 to 1,789,354.**

19. Policy interventions

a) We envisage a policy intervention that makes banks owner of the CERs. It will need to be ensured that that the loan agreements by the banks can include the rights of banks for exploiting CDM benefits, if any. This would make the banks absolute owners for CDM benefits.
b) We envisage that in case MNRE decides to undertake the CDM project, it may have to take some clearances at Government of India level.

20. Conclusion and Recommendations

The proposed CDM project for SWH meets with UNFCC guidelines and also meets with host country requirements.

The financial analysis clearly indicated that-

1) The CDM project with bundling at an Individual bank level with about 8600 installations will generate small cash and can be considered viable. But it is a very small project.

2) The CDM project at individual bank level, though cash surplus, will **generate** the cash just to meet its own sustainability. It may not be able to contribute to overall objective of creating sufficient cash flow to generate additional resources to create awareness for bringing in additional installations.

3) Bundling of installations by various banks through an entity such as Association of Banks, would be a **viable** and **sustainable** CDM project due to benefits arising out of scale of economy.

4) The profitability **of the CDM project** would further **improve** if the **PoA approach** is considered for developing the CDM project. This is on account of reduced up front costs that otherwise needs to be incurred for subsequent SWH installations.

ANNEX A

Bundling of the CDM project at BOM Level For 8613 installations

Table 10: Detailed Cash Flow and Profitability Statement for the entire CDM crediting period of 10 years

(In US$)

Particulars	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10
ross Income	89,762	89,762	89,762	89,762	89,762	89,762	89,762	89,762	89,762	89,762
p front CDM project Expenses	100,000*	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
ne time M&V Instrument cost	10,000	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Recurring Expenses	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000
Net rofit/(Loss)	**(55,238)**	**35,595**	**35,595**	**35,595**	**35,595**	**35,595**	**35,595**	**35,595**	**35,595**	**35,595**
IRR	**30%**									
NPV	**159,007**									

ANNEX B

Bundling of CDM project at AOB/MNRE level for 25,000 installations

Table 11: Detailed Cash Flow and Profitability Statement for the entire CDM crediting period of 10 years **(In US$)**

Particulars	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10
ross Income	**260,542**	**260,542**	**260,542**	**260,542**	**260,542**	**260,542**	**260,542**	**260,542**	**260,542**	**260,542**
p front CDM project Expenses	100,000*	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
ne time M&V Instrument cost	25,000	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Recurring Expenses	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000
Profit after tax/(Loss)	**65,352**	**146,602**	**146,602**	**146,602**	**146,602**	**146,602**	**146,602**	**146,602**	**146,602**	**146,602**
IRR	**117%**									
NPV	**959,072**									

ANNEX C

CDM project at AOB/MNRE level under PoA

Table 12: Detailed Cash Flow and Profitability Statement for the entire CDM crediting period of 10 years

(In US$)

Particulars	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10
ross Income	260,542	260,542	260,542	260,542	260,542	260,542	260,542	260,542	260,542	260,542
p front CDM project Expenses	100,000	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
ne time M&V trument cost	25,000	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Recurring Expenses	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000
Profit/ after tax(Loss)	**65,352**	**146,602**	**146,602**	**146,602**	**146,602**	**146,602**	**146,602**	**146,602**	**146,602**	**146,602**
IRR	**117%***									
NPV	**959,072***									

Note: The IRR and NPV would be higher for subsequent installations due to savings on transaction costs for additional installations under the CDM project.