CLEAN DEVELOPMENT MECHANISM
SMALL-SCALE PROGRAMME OF ACTIVITIES DESIGN DOCUMENT FORM
(CDM-SSC-PoA-DD) Version 01

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NOTE:

(i) This form is for the submission of a CDM PoA whose CPAs apply a small scale approved methodology.

(ii) At the time of requesting registration this form must be accompanied by a CDM-SSC-CPA-DD form that has been specified for the proposed PoA, as well as by one completed CDM-SSC-CPA-DD (using a real case).

SECTION A. General description of small-scale programme of activities (PoA)

A.1 Title of the small-scale programme of activities (PoA):

>>
Southern African Solar Electrical Energy Programme (SASEE)

Version 1.0, 03/08/2011 – Draft CPA-DD for Validation
Version 2.0, 14/11/2011 – Revised CPA-DD at Validation

A.2. Description of the small-scale programme of activities (PoA):

>> The following information shall be included here:

1. General operating and implementing framework of PoA

This small scale programme of activities (hereafter referred to as the "PoA") is a programme for the installation of solar photovoltaic electrical systems that utilise incoming solar radiation for the production of electrical energy for household and industrial use. The programme is geographically located in 8 Southern African countries. These are: Botswana, Lesotho, Mozambique, Namibia, South Africa, Swaziland, Zambia and Zimbabwe (hereafter referred to as "the Countries"). The PoA is an initiative undertaken by EcoMetrix Solar Ventures (hereafter referred as "EcoMetrix"). The PoA will be coordinated and managed by EcoMetrix.

2. Policy/measure or stated goal of the PoA

The stated objective of this programme is to reduce reliance on fossil fuel based electricity and thus to reduce the associated CO_2 emissions in Southern Africa by displacing electricity produced by coal or other carbon-intensive fossil fuels through the use of solar photovoltaic technology.

In addition the PoA will contribute to activities aimed at growing and strengthening the solar industry in the Countries. Whilst the Countries involved in this PoA are well known to have little to no oil or natural gas reserves, they do have well developed coal reserves and considerably undeveloped, but promising solar resources. Programmes such as this are necessary to move away from the current dependence on the most prevalent fossil fuel resources and encourage the uptake of the prevalent/abundant renewable resources. The abundance of solar irradiation in Southern Africa and the potential for solar photovoltaic electricity generation is illustrated below in *Figure 1*.

The growth of the renewable energy resources is a key priority of Southern African States and specifically South Africa. In the latest Integrated Resource Plan (IRP2010), the South African Department of Energy allocates 17.8GW of new generation capacity additions to the national grid to renewables by 2030 under the policy adjusted scenario. Of this, 300MW have been allocated per year from 2012 to 2015 specifically for photovoltaic solar electricity generation development. The conclusion of the report goes on to state that a solar PV programme should be pursued including decentralised generation[1]. This policy outlook clearly supports the objective of the PoA.

[1] IRP2010, Department of Energy, Government Gazette, 06 May 2011, pg. 22.

http://www.doe-irp.co.za/content/IRP2010_promulgated.pdf

The programme also supports the sustainable development of the Host non-Annex I parties in the following way:

- *Economic*: The programme encourages the use of photovoltaic technology, thereby stimulating the local photovoltaic industries. In addition, the use of photovoltaic equipment reduces demand on the constrained electricity supplies thereby frees up more electrical capacity for economic activities.
- *Social*: The programme makes an indirect contribution to social development in that it aims to stimulate the local photovoltaic industries and requires participants in the industry to adhere to stringent standards and up-skill workers to the nationally required standard. As the industry grows many people will need to be trained to install PV panels and provide the necessary maintenance in order to meet demand for the product. In addition, it may become commercially viable to produce PV panels locally in which case new jobs will be created in a new PV panel manufacturing industry.

Environmental: The programme aims to reduce the demand on the national grid at a domestic level and thus the use of fossil-fuel fired electricity. As a result the CO_2 emissions per household or facility enrolled in the programme should decrease and contribute towards achieving emission reduction targets.

Chronology of events

The following activities were undertaken in the development of this PoA:

25 November 2010	– Initial CDM meeting
28 January 2011	– Completed CDM Feasibility Study
16 February 2011	– PDD Development begins
11 July 2011	– DOE Contracted
03 August 2011	– Validation Start (GSC)
16 September 2011	– First Store (Strubensvallei Builders Warehouse)

3. Confirmation that the proposed PoA is a voluntary action by the coordinating/managing entity.

The PoA is a voluntary action, not required by law, undertaken by EcoMetrix Solar Ventures (EcoMetrix) who is the coordinating/managing entity for the PoA.

A.3. Coordinating/managing entity and participants of SSC-POA:

>> The following information shall be included here:

1. Coordinating or managing entity of the PoA as the entity which communicates with the Board

Ecometrix Solar Ventures will be the coordinating/managing entity of the PoA and will be responsible for ensuring that all solar photovoltaic equipment is installed under the correct CDM specifications as detailed by the programme; as well as implementing and effectively executing the monitoring plan.

2. Project participants being registered in relation to the PoA. Project participants may or may not be involved in one of the CPAs related to the PoA.

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wished to be considered as a project participant (Yes/No)
Ellies Holdings (Pty) Ltd	Private entity	No
EcoMetrix Solar Ventures (Pty) Ltd	Private entity	Yes
Republic of South Africa*	Public entity	No
(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.		

A.4. Technical description of the small-scale programme of activities:

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The technology to be installed under the PoA consists of solar photovoltaic panels which produce electrical energy for either residential or light industrial consumption. The panels may be connected directly to the load when the demand cycle and solar cycle are highly correlated such as in the case of pool pumps. The panels may also be connected to batteries for storage of the electrical energy so as to provide electricity to the consumer at night, or when radiation levels are not high enough to generate electrical power. In this way the daily cyclical nature of solar power is reduced and the availability of the system increased.

The panels can be installed at both grid connected and off-grid locations and used for electrical consumption within the boundary of the residence, industrial or commercial property. The following parameters apply:

- No electricity shall be exported back onto the grid in the case of grid-connected properties.
- The photovoltaic electrical system may be backed up by onsite or mini-grid fossil-fuel generation in the case of off-grid installations.
- The photovoltaic electrical system may include components such as an inverter and batteries for storage of electrical energy.
- The total rated capacity of the installed photovoltaic electrical system will not exceed the maximum load of the installation site.

Any solar photovoltaic panel technology will qualify for inclusion in the programme provided it has been successfully tested under the appropriate standards and has an official peak watt rating under Standard Testing Conditions.[2] This includes but is not limited to wafers made from single crystal silicon, polycrystalline silicon and ribbon silicon as well as advanced thin film technologies.

[2] Standard Testing Conditions ('STC') are defined as 1kW/m^2 of sunlight and a PV cell temperature of 25˚C and an air mass of 1.5kg/m^3. Their output measured under STC is expressed in terms of 'peak watt' nominal capacity.

A.4.1. Location of the programme of activities:

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The PoA is located within the following Southern African countries: Botswana, Lesotho, Mozambique, Namibia, South Africa, Swaziland, Zambia and Zimbabwe.

A.4.1.1. Host Party(ies):

>>
Botswana
Lesotho*
Mozambique*
Namibia
South Africa
Swaziland
Zambia*
Zimbabwe.

* indicates that the Host Country is a Least Developed Country (LDC)[3]

A.4.1.2. Physical/ Geographical boundary:

>> Definition of the boundary for the PoA in terms of a geographical area (e.g., municipality, region within a country, country or several countries) within which all small-scale CDM programme activities (SSC-CPAs) included in the PoA will be implemented, taking into consideration the requirement that all applicable national and/or sectoral policies and regulations of each host country within that chosen boundary;

The boundary of the PoA is defined as the geographical area within which all the implemented small-scale CDM programme activities (SSC-CPAs) included in the PoA will be physically installed. All installations of solar photovoltaic electrical systems which are enrolled in the CPAs under this PoA will be within the borders of the Host Parties listed in A.4.1.1 (listed above).

Each CPA will define the geographical boundary within which it operates and will focus on the installation of systems within the same climatic zone so as to reduce the variation of incoming solar radiation levels and ambient temperature which directly affect the performance of the photovoltaic installations. Multiple CPAs can operate within the same geographic location as the de-bundling checks and monitoring plan will ensure that there is no double counting of installed systems.

A.4.2. Description of a typical small-scale CDM programme activity (CPA):

>>
A typical CPA will consist of an organisation, e.g. a retailer, housing developer or company, who elects to market and/or install solar photovoltaic panels. The solar photovoltaic panels can be installed at many locations to provide electrical energy for residential or light industrial use, within the borders of the Countries. Only those products which have been shown to adhere to the appropriate local, or regional, standards and were installed by contractors who have been appropriately trained will be enrolled and thus be eligible to claim emission reductions.

[3] http://www.un.org/esa/policy/devplan/profile/ldc_list.pdf

Typical examples of such CPAs include, but are not limited to, the following:

- Retailers who offer solar photovoltaic panel systems at reduced rates to incentivise the purchase and installation of these products. The reduced purchase price is directly subsidised by the expected carbon revenue generated from participation in the PoA.
- Housing developers who offer home owners the option of installing solar photovoltaic electrical systems on their roofs.
- Hotel and resort owners/developers who wish to generate their electrical supply from solar photovoltaic systems and reduce their reliance on fossil-fuel fired electricity generation.
- Companies who wish to generate a portion of their electricity requirements from solar photovoltaic panels.

A SSC-CPA may consist of:

1. New installations of solar photovoltaic electrical systems to generate electricity at pre-existing residences, industrial and commercial properties and/or;
2. New installations of solar photovoltaic panels at newly built residences, industrial and commercial properties and/or;
3. Additional installations of solar photovoltaic panels at existing residential, industrial and commercial properties for the generation of electricity for on-site consumption and/or;
4. Replacement of electrical generation equipment at new or existing residential, industrial and commercial properties.

For all types of installations the baseline technology in the absence of solar photovoltaic electrical systems would be either:

- Electricity supplied by the national gird in the case of grid-connected properties or;
- Electricity supplied by a mini-grid generation source utilising fossil fuel in the case of off-grid properties.

A.4.2.1. Technology or measures to be employed by the SSC-CPA:

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Solar Photovoltaic Electrical Systems

A CPA consists of quality rated solar photovoltaic technology, which converts solar radiation into electrical energy. The electricity is then used at the site of generation for residential or light industrial consumption. Such technologies may include, but are not limited to; wafers made from single crystal silicone, polycrystalline silicon and ribbon silicon as well as advanced thin film technologies. The photovoltaic panels must have an official kW(p) rating (determined under STC) from an appropriate national standards body, or in the case where no such institution exists locally; from a recognised international standards body.

Installation

Photovoltaic electrical systems will be installed by contractors with a local presence, which have the necessary qualifications, experience and training for installation. The units to be installed must be compliant with the relevant local or appropriate international standards and requirements for such photovoltaic technologies and the panels should be installed as required by such norms and standards.

A.4.2.2. Eligibility criteria for inclusion of a SSC-CPA in the PoA:

>> Here only a description of criteria for enrolling the CPA shall be described, the criteria for demonstrating additionality of CPA shall be described in section E.5

The eligibility criteria for the inclusion of a SSC-CPA in a PoA are as follows:

1. All the solar photovoltaic electrical systems installed under the SSC-CPA /must be
   i. Rated and approved by the standards generating body as required by local regulations, (or in the absence thereof under appropriate international standards);
   ii. Installed by installers who are appropriately trained and skilled;
   iii. Installed within the borders of the Countries;

2. Collectively all installations must be rated less than 15MW(p)[4] total installed capacity;

3. Photovoltaic electrical systems must be installed as either:
   i. New installations at newly built residences, industrial or commercial properties or;
   ii. New installations at existing residences, industrial or commercial properties or;
   iii. Additional installations which are physically distinct from the existing units[5] or;
   iv. Replacement installations where an independent monitoring of the scrapping of the replaced equipment is implemented.

4. The baseline technology for solar photovoltaic electrical systems installed under the SSC-CPA must be either:
   i. For grid connected installations, the generation of electricity from a fossil-fuel based national/ regional grid or;
   ii. For off-grid/mini-grid locations, the generation of electricity from fossil-fuel intensive generation equipment.

5. Each CPA must implement the baseline and monitoring methodology AMS I.F. '*Renewable electricity generation for captive use and mini-grid.*' Version 2.

6. Each CPA must implement the operational and management plan as detailed in section A.4.4.1.

7. Each CPA must monitor and collect the data specified by the parameters as listed in section A.4.4.2.

8. The coordinating entity will ensure that all CPAs under its PoA are neither registered as an individual CDM project activity nor included in another registered PoA, and that the CPA is subscribed to the PoA;

9. Each CPA shall be uniquely identified and defined by way of the unique identifying numbers attached to each installation. The unique identifying numbers will be the manufacturers serial numbers for the specific panels installed under the CPA ;

[4] This is consistent with the SSC eligibility requirements as detailed in AMS-I.F *Renewable electricity generation for captive use and mini-grid* , version 2 and *The general guidance to SSC CDM methodologies*, version 1.

[5] This is consistent with the requirements as detailed in AMS-I.F *Renewable electricity generation for captive use and mini-grid*, (version 2) section 7.

10. Each CPA must ensure that leakage, additionality, establishment of the baseline scenario, baseline emissions, eligibility and double counting are unambiguously defined;

11. Each SSC-CPA must be approved by the coordinating entity and DOE prior to its incorporation into the PoA;

12. Each SSC-CPA must satisfy the de-bundling rules of the PoA according to '*The Guidelines on Assessment of Debundling for SSC Project Activities*' EB 54, annex 13.

A.4.3. Description of how the anthropogenic emissions of GHG by sources are reduced by a SSC-CPA below those that would have occurred in the absence of the registered PoA (assessment and demonstration of additionality):

>> The following shall be demonstrated here:

(i) The proposed PoA is a voluntary coordinated action;
(ii) If the PoA is implementing a voluntary coordinated action, it would not be implemented in the absence of the PoA;
(iii) If the PoA is implementing a mandatory policy/regulation, this would/is not enforced;
(iv) If mandatory a policy/regulation is enforced, the PoA will lead to a greater level of enforcement of the existing mandatory policy/regulation.

The information presented here shall constitute the demonstration of additionality of the PoA as a whole.

(i) The proposed PoA is a voluntary, coordinated action

The PoA is a voluntary action, coordinated and implemented by the coordinating entity in order to support the objective of developing the use of renewable energy in the country, including solar energy for the generation of electricity and thereby reducing the reliance on fossil-fuel based electricity generation.

There is no mandatory requirement for the installation of such technologies. The solar photovoltaic systems implemented in a typical CPA under the PoA are installed by consumers of electricity generated from fossil-fuel sources, who, voluntarily apply to be included in the PoA.

(ii) If the PoA is implementing a voluntary coordinated action, it would not be implemented in the absence of the PoA

In accordance with Attachment A of Appendix B of the '*Simplified modalities and procedures for small scale CDM project activities*[6]' (version 08) , additionality is demonstrated by showing that the PoA would not have occurred anyway due to the existence of certain barriers. This analysis will identify the barriers that are in place and how they would prevent the implementation of the proposed project activity if the project activity was not registered as a CDM activity.

Cost Barrier

A financially more attractive alternative to installing a solar photovoltaic electrical system is to continue using electricity from the national/regional grid or a mini-grid where electricity is generated from fossil-

[6] Document can be viewed at http://cdm.unfccc.int/methodologies/SSCmethodologies/AppB_SSC_AttachmentA.pdf

fuels. This is due to the high capital investment required to purchase and install a photovoltaic electrical system versus the absence of capital outlay in the case of a pre-existing grid-connection and the sunk-costs associated with the capital investment in fossil-fuelled generation equipment.

Even when evaluating the levelised electricity cost of the project activity and the most financially attractive alternative over the life of the project, the high capital investment required for installing photovoltaic technology effectively negates any savings in standard electricity consumption costs or fuelling a mini-grid. Compounding the problem is the relatively low cost of electricity due to subsidised pricing that is common throughout Southern Africa (see *Figure 2*). Therefore the significantly larger capital investment required to purchase and install a solar photovoltaic electrical system is the primary barrier to investment in photovoltaic technology in Southern Africa.

Cost comparison analysis shall be undertaken at CPA level to illustrate the cost barrier.

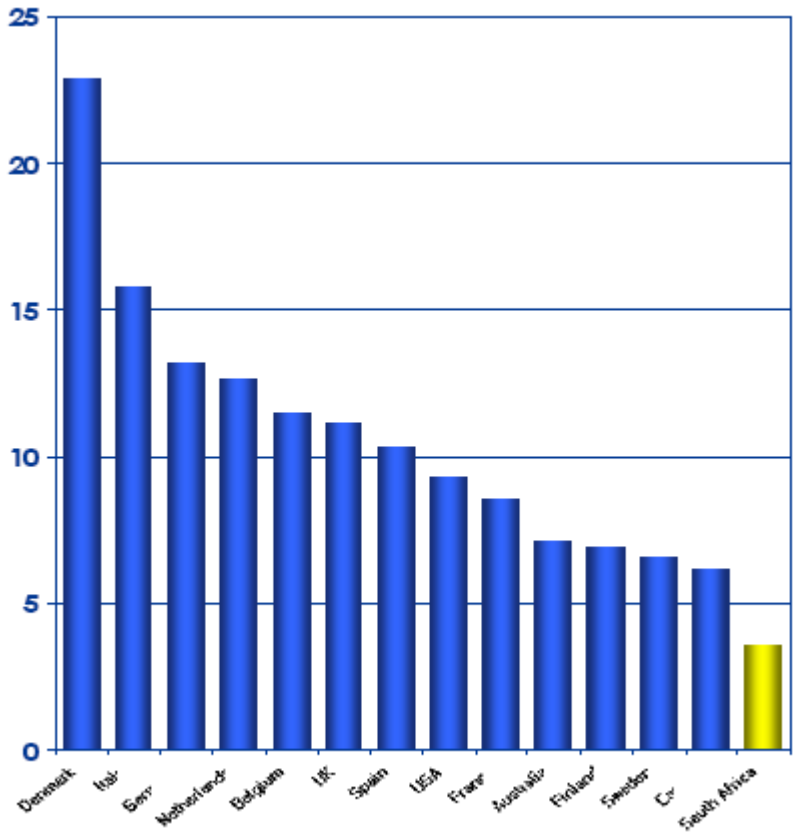


Figure 2: The graph illustrates comparative electricity costs in South Africa versus other countries.[7]

Barriers due to prevailing practice

The prevailing practice in Southern Africa is the use of electricity from the national grid or the use of electricity from onsite (mini-grid) fossil fuel generation equipment. The installation of solar photovoltaic

[7] *Source:* National Response to South Africa's electricity shortage. January 2008. http://www.info.gov.za/otherdocs/2008/nationalresponse_sa_electricity1.pdf

panels to generate electricity for residential or light industrial use is neither widespread across Southern Africa, nor common in any smaller geographically defined areas despite the abundance of the solar radiation resource. This is clearly illustrated in South Africa's National Electrification Programme which aims primarily to connect households to the national grid and does not focus on off-grid photovoltaic electrical system solutions. *Figure 3* shows the number of households newly electrified in South Africa and their source of electricity. In the case of off-grid connections this most commonly refers to photovoltaic domestic systems. The large disparity between the prevailing practice of grid-connection and off-grid systems is very apparent.

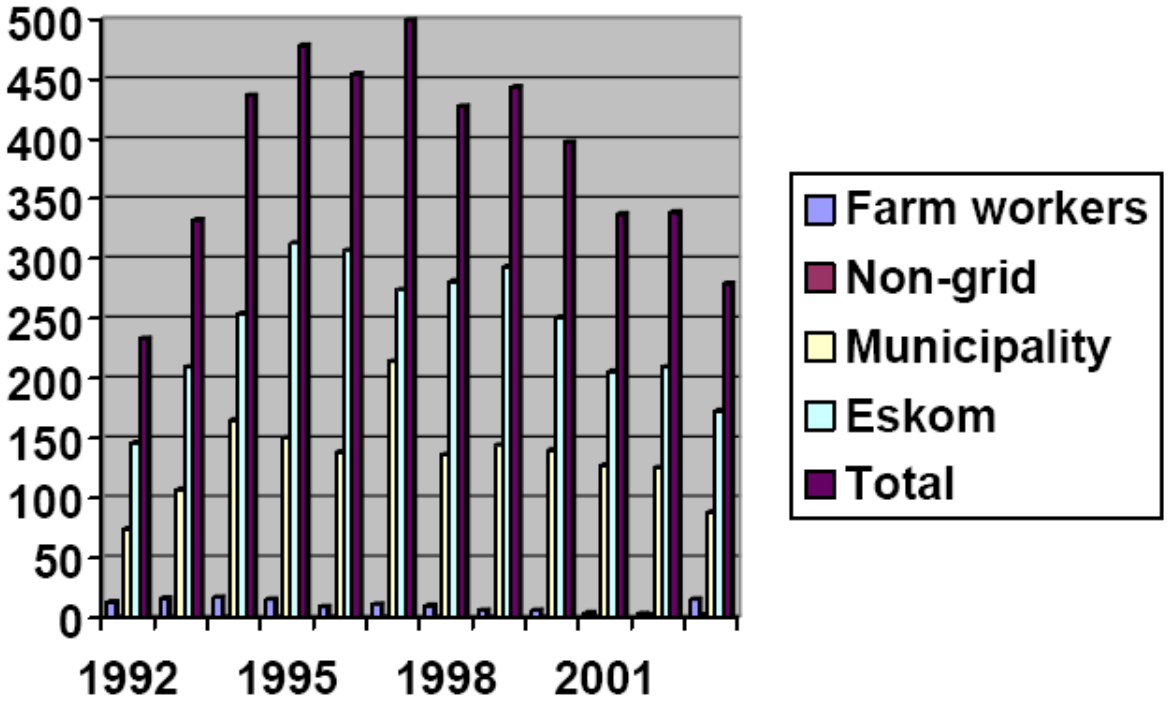


Figure 3: Annual new household electricity connections in South Africa 1992-2003[8]

This programme is the first of its kind in Southern Africa. It aims to increase the uptake of solar photovoltaic electrical technology throughout the host countries and demonstrate to residential and light industrial electricity consumers that they can generate electricity towards their own onsite consumption requirements in a sustainable and reliable manner.

Currently there is a lack of product availability in 'brick & mortar' establishments within Southern Africa and this decreases the prevalence and availability of supply of the systems as well as a typical consumer's access to photovoltaic technology. At present there is little incentive for major retailers to market these products due to the pervasive high risk-low return paradigm, largely attributable to the lack of demand for photovoltaic products because it is prevailing practice to be connected to the national grid or use common fossil-fuel generation sources.

[8] *Source*: Domestic Electricity Provision in the Democratic South Africa pg. 12, D Malzbender & B Kamoto, 2005, Nordic Africa Institute.

http://www.acwr.co.za/pdf_files/01.pdf

There is also much information asymmetry about photovoltaic technologies which results in a lack of consumer awareness and education regarding the performance of photovoltaic products. There is a perception amongst a large group of consumers that photovoltaic systems are inferior technology to that of grid-connection[9]. While in the case of a grid-connection it is the general perception that there are no directly attributable maintenance costs due to all maintenance occurring at the centralised generation sites or being co-ordinated by the relevant generating organisation to the necessary distribution/substation location. This further entrenches the prevailing practice of not installing onsite renewable electrical generation systems where a grid connection is pre-existing (or possible), because consumers perceive such systems to have directly attributable maintenance costs and lack the technical knowledge about the operation and maintenance of a solar photovoltaic system.

There is a general lack of climate change knowledge within the majority of the public and awareness and education around how the installation of solar photovoltaic systems can positively contribute to a reduction in GHG emissions is low. The below figure 4 shows the level of consumer awareness with respect to climate change when asked the question: "How much, if anything, would you say you know about climate change or global warming?" Given this level of awareness and with little incentive to stimulate the investment in photovoltaic systems because of the prevailing practice within Southern Africa, it is a major barrier to the uptake of solar photovoltaic technology.

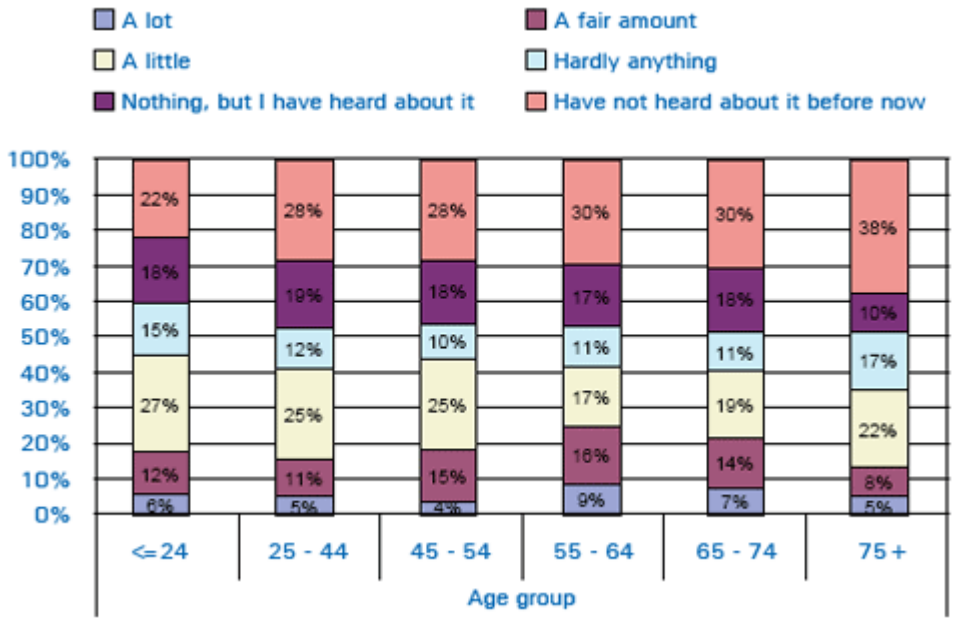


Figure 4: Levels of knowledge about climate change by age group in a sample survey of the South African population.[10]

The registration of the PoA will overcome these barriers in the following ways:

[9] Energy Research Centre 2007, Create Acceptance. Electricity from solar home systems in South Africa: Historical and recent attitudes of stakeholders, pg. 10.

http://www.erc.uct.ac.za/Research/publications/07Prasad%20Electricity%20from%20SHSsl.pdf

[10] *Source*: South African Social Attitudes Survey (SASAS), Human Sciences Research Council, 2008.

1. **Subsidising the capital investment** – The revenue generated from the sale of the emission reductions achieved by the programme will be recycled back into the programme as a subsidy against the significant capital investment required to purchase and install a solar photovoltaic system. This will directly reduce the upfront cost of the photovoltaic panels and thus help to reduce the cost barrier.

2. **Demonstrating the advantages of photovoltaic system installations** – consumers will be properly educated about the advantages of installing a photovoltaic system prior to making the investment decision. In addition, they may elect to have an energy audit conducted on their property as well as to install metering equipment which will record and monitor the electricity savings directly attributable to the photovoltaic system. In this way the programme will demonstrate the reliability of the system and the sustainable nature of onsite photovoltaic electrical generation to overcome the prevailing view that such systems are unreliable and produce few benefits.

3. **Increasing product availability** – By partnering with retailers, housing developers, hotel/resort owners and companies, the programme will promote the increase in supply of photovoltaic electrical generation equipment and stimulate investment in inventory as well as the training of installers and sales representatives with respect to the product. Retailers will stock photovoltaic panel systems in 'brick and mortar' establishments and thus increase the average consumer's access to these products. Participating in the carbon markets will provide the necessary incentive for the above partnerships to be successful as it will mitigate their market risks by the resulting revenue from the sale of emission reductions.

4. **Consumer awareness and education –** the programme will incentivise the training of installers and sales representatives in the benefits of photovoltaic electrical generation, the basics of the technology and the various system options available to consumers. As a result, consumers will be able to obtain reliable information regarding the performance of the product, as well as the operation and maintenance of the system, prior to the investment decision and at the point of sale. In this way information asymmetry is removed. The use of qualified installers will ensure that the installed photovoltaic systems function optimally and also provide the consumer with any additional informational or technical support they may require at installation. Consumers will therefore be able to make an informed investment decision and reap the full benefits of the installed renewable electricity generation systems in line with their expectations. By participating in the programme they will also be aware of the associated GHG reductions resulting from their installation and gain basic insight into the carbon markets, ultimately becoming more aware of the issues around carbon emissions and climate change.

(iii) If the PoA is implementing a mandatory policy/regulation, this would/is not enforced;

There is no mandatory requirement for the installation of solar photovoltaic technology.

(iv) If mandatory a policy/regulation is enforced, the PoA will lead to a greater level of enforcement of the existing mandatory policy/regulation.

There is no mandatory requirement for the installation of solar photovoltaic technology

A.4.4. Operational, management and monitoring plan for the programme of activities (PoA):

A.4.4.1. Operational and management plan:

>> Description of the operational and management arrangements established by the coordinating/managing entity for the implementation of the PoA, including:

(i) A record keeping system for each CPA under the PoA,
(ii) A system/procedure to avoid double accounting e.g. to avoid the case of including a new CPA that has been already registered either as a CDM project activity or as a CPA of another PoA,
(iii) The SSC-CPA included in the PoA is not a de-bundled component of another CDM programme activity (CPA) or CDM project activity.
(iv) The provisions to ensure that those operating the CPA are aware of and have agreed that their activity is being subscribed to the PoA;

(i) A record keeping system for each CPA under the PoA,

The CME will establish and maintain an extensive database for each and every enrolled installation under each CPA wherein the following data will be recorded:

i. Date of installation
ii. Panel manufacturer
iii. Model of panel(s)
iv. Total rated kW(p) generation capacity of panel(s)
v. Number of panels
vi. Unique serial numbers of panels
vii. Installation address
viii. Owners contact details
ix. Signed contract ceding rights to carbon revenue in the case of residential consumers
x. Grid connected or off-grid installation (if off-grid then also the type of fossil-fuel generation producing electricity)
xi. Installers details
xii. Scrapping confirmation where generation equipment is replaced

All the above data parameters will be collected at the time of installation by the installer who will complete the necessary documentation recording the above data parameters. The CPA will record the installations' information in its data collection system which is made available to the CME.

The CME will be responsible for the management of records and data associated with each CPA and all records will be stored for a period of two years after the end of the relevant crediting period. Relevant data capture, verification and storage procedures will be followed in maintaining the data to ensure its accuracy, validity and completeness.

(ii) A system/procedure to avoid double accounting e.g. to avoid the case of including a new CPA that has been already registered either as a CDM project activity or as a CPA of another PoA,

Each CPA shall be uniquely identified and defined by way of the unique manufacturers' serial numbers attached to each panel installation. The addition of any new installations under a CPA will be cross-checked against the database to ensure that there is no double accounting for any installations already enrolled under a participating CPA and therefore that there will be no new CPA's included in the programme that have already been registered under the PoA.

The geographical boundary for the PoA is limited by the borders of the Countries. While it is possible to distinguish each of the CPA's by way of geographical region, there may be more than one CPA registered per region as installations will also be grouped by product type and the entity which is functioning as the CPA. In this way certain CPAs may overlap geographically, however, each individual installation and CPA will still be expressly distinguishable based on the information contained within database to be maintained by the CME. The database will contain the physical location of each installation. Therefore as an additional check, the location of each potential inclusion in a SSC-CPA will be tested against the location of all the products already included in the PoA database.

Prior to registering a new CPA within the proposed PoA, the coordinating entity will check the CDM project database to establish whether a CDM project activity or CPA of another PoA for the installation of SWH has already been registered within the borders of the Countries. This search will cover registered project activities, project activities requesting registration, project activities under review and project activities for which either a review or corrections have been requested.

In an instance where a CPA of another PoA or CDM project activity is already registered in a Country for the installation of these products, the coordinating entity will ensure through cross-checking the database of the other SSC-CPA or CDM project that there is no double counting of the individual photovoltaic system installations included in the SSC-CPAs for this PoA.

(iii) The SSC-CPA included in the PoA is not a de-bundled component of another CDM programme activity (CPA) or CDM project activity.

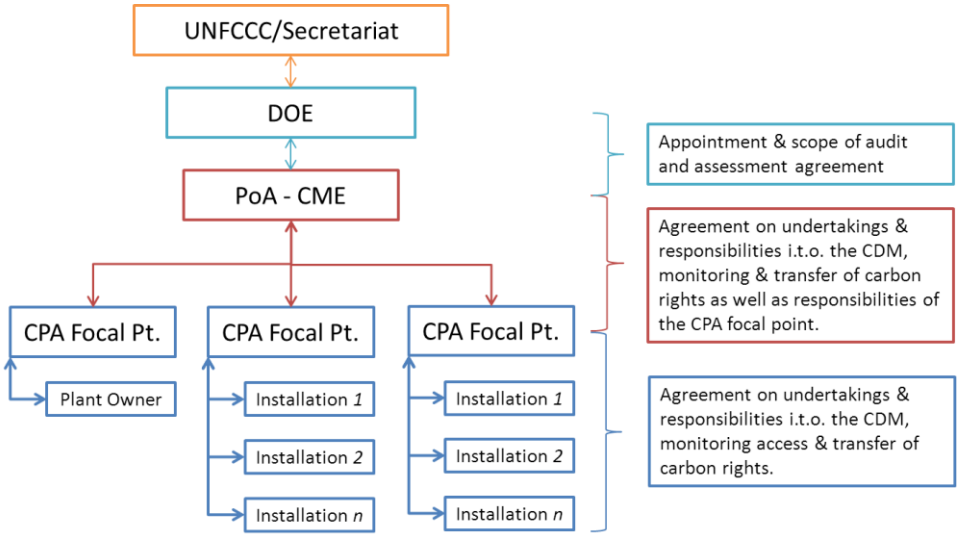
In Accordance with the "*Guidelines on assessment of de-bundling for SSC project activities*" (version 03) section 7[11]. If each of the independent subsystems/measures (e.g. biogas digester, solar home system) included in the CPA of a PoA is no greater than 1% of the small scale thresholds defined by the methodology applied, then that CPA of the PoA is exempted from performing a de-bundling check. The installations under the CPA will be subject to this threshold.

Where no independent subsystems are greater than 1% of the 15MW(p) total installed rated capacity, i.e. 150kW(p), the CPA will be exempt from the debundling check. However in the case of an installation

[11] http://cdm.unfccc.int/Reference/Guidclarif/ssc/methSSC_guid17.pdf

larger than 0.15MW, a de-bundling check will be conducted according to the "*Guidelines on assessment of de-bundling for SSC project activities*"(version 03).

(iv) The provisions to ensure that those operating the CPA are aware of and have agreed that their activity is being subscribed to the PoA



Contractual relations will be established throughout the supply chain to ensure that all parties are aware of the Programme and how they are affected by its CDM registration. The agreements are grouped into 2 types:

- **CPA CDM Undertaking Agreement**: CPA participants agree to adhere to the requirements of the Programme including monitoring requirements;
- **Project Developer CDM Undertaking Agreement**: The project developer or focal point e.g. photovoltaic panel retailer will sign a contract of undertaking wherein the role and responsibility of the project developer in the PoA/CPA is prescribed especially in respect to additionality criteria and monitoring requirements.

A.4.4.2. Monitoring plan:

>> The following information shall be provided here:

(i) Description of the proposed statistically sound sampling method/procedure to be used by DOEs for verification of the amount of reductions of anthropogenic emissions by sources or removals by sinks of greenhouse gases achieved by CPAs under the PoA.

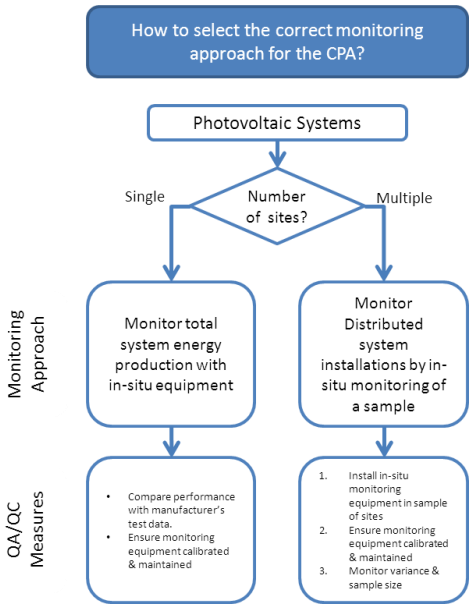
The CME opts for a verification method that does not use statistical sampling. All CPAs will be verified.

(ii) In case the coordinating/managing entity opts for a verification method that does not use sampling but verifies each CPA (whether in groups or not, with different or identical verification periods) a transparent system is to be defined and described that ensures that no double accounting occurs and that the status of verification can be determined anytime for each CPA;

The CME will implement a monitoring protocol that allows the DoE to verify all CPAs. As described previously a database will be established that contains all the CPA specific data required to identify and locate the photovoltaic systems enrolled in the CPA. This data is also used to obtain the data required to implement the monitoring plan as detailed in section A.4.4.2(i) which will use an acceptable sampling method to calculate and verify the emission reductions achieved by the CPA.

A monitoring report will be provided by the coordinating entity to allow the DOE to verify the emission reductions for each monitoring period of each individual CPA. The use of unique identifiers and QA/QC procedures will ensure that double counting is not possible.

The start and end dates of each monitoring period for each individual CPA, together with the emission reductions attributable to that monitoring period will be recorded in the database. Record keeping procedures undertaken by the CME will ensure that the data attributed to a monitoring period can be clearly attributed to an individual CPA and will furthermore prevent double counting of emission reduction data.



In the case where CPA comprises a single installation, the energy produced by the installed equipment should be monitored directly.

Where a CPA consists of multiple installations supplying discrete loads, the programme will use a monitoring approach of stratified random sampling to measure the quantity of fossil-fuel generated electricity that is displaced by the installation of the solar photovoltaic electrical systems. A directly monitored sample of each CPA to verify the emission reductions as a result of the photovoltaic electrical system installations will be monitored using correctly calibrated energy meters on a continuous basis with hourly measurement and daily recording. The target population is all installations enrolled in the PoA and the sample measurements will be the quantity of net electricity displaced per annum by the installed solar photovoltaic electrical system.

A.4.5. Public funding of the programme of activities (PoA):

>>

The proposed PoA will not receive any public funds resulting from official development assistance from Parties included in Annex I to the Convention.

SECTION B. Duration of the programme of activities (PoA)

B.1. Starting date of the programme of activities (PoA):

>>

03 August 2011, the start of validation and Global Stakeholder Consultation.

B.2. Length of the programme of activities (PoA):

>>
28 years

SECTION C. Environmental Analysis

>>

C.1. Please indicate the level at which environmental analysis as per requirements of the CDM modalities and procedures is undertaken. Justify the choice of level at which the environmental analysis is undertaken:

1. Environmental Analysis is done at PoA level ☐
2. Environmental Analysis is done at SSC-CPA level X

As the PoA allows for both small and medium sized installations of PV systems it is inappropriate to conduct an environmental analysis at the PoA level since the capacity of the installed system will determine whether or not a full scale EIA process will be needed.

The CME does note that PV installations are a very low impact technology and are unlikely to have notable environmental impacts. Nonetheless an appropriate environmental analysis should be conducted on a CPA basis in accordance with environmental legislation in the host country.

C.2. Documentation on the analysis of the environmental impacts, including transboundary impacts:

>>
The negative environmental impacts of an individual domestic or light industrial scale solar photovoltaic electrical system and the corresponding CPA are not considered significant.

The positive environmental benefits of the installation of solar photovoltaic electrical systems include:

- Decreased air pollution linked to the use of the fossil fuels;
- Displacement of fossil fuels and GHG emission reductions;
- Decreased dependency on fossil fuels; and
- Decreased demand for electricity grid electricity.

C.3. Please state whether in accordance with the host Party laws/regulations, an environmental impact assessment is required for a typical CPA, included in the programme of activities (PoA),:

>>
No environmental impact assessment is required in any of the Host Countries for this type of project i.e. no EIA is required for a typical CPA, included in the PoA.[12]

SECTION D. Stakeholders' comments

>>

[12] For example in South Africa, in terms of Section 24 of the National Environmental Management Act (1998) and the associated regulations (published in 2006), a formal EIA process is not required when the electricity generation capacity is less than 20MW.

D.1. Please indicate the level at which local stakeholder comments are invited. Justify the choice:

1. Local stakeholder consultation is done at PoA level ☐
2. Local stakeholder consultation is done at SSC-CPA level X

Each CPA operates within a geographically defined region and within any one of the Host Countries. For this reason local stakeholder consultation is done on a CPA level to ensure that the stakeholders within the region that are actually affected by the project activity are adequately informed and consulted.

Note: If local stakeholder comments are invited at the PoA level, include information on how comments by local stakeholders were invited, a summary of the comments received and how due account was taken of any comments received, as applicable.

D.2. Brief description how comments by local stakeholders have been invited and compiled:

>>
Local Stakeholder consultation is performed at CPA level.
Comments received from the Global Stakeholder Consultation period are specific to the CPA and thus have also been included at CPA level.

D.3. Summary of the comments received:

>>
n/a

D.4. Report on how due account was taken of any comments received:

>>
n/a

SECTION E. Application of a baseline and monitoring methodology

This section shall demonstrate the application of the baseline and monitoring methodology to a typical SSC-CPA. The information defines the PoA specific elements that shall be included in preparing the PoA specific form used to define and include a SSC-CPA in this PoA (PoA specific CDM-SSC-CPA-DD).

E.1. Title and reference of the approved SSC baseline and monitoring methodology applied to a SSC-CPA included in the PoA:

>>
NOTE: The approved SSC baseline and monitoring methodology should be approved for use in a PoA by the Board.

The approved SSC simplified baseline and monitoring methodology is AMS-1.F. version 2 *Renewable electricity generation for captive use and mini-grid*, approved at EB 61, is applied to each SSC-CPA included in the PoA.

E.2. Justification of the choice of the methodology and why it is applicable to a SSC-CPA:

>>
NOTE: In the case of CPAs which individually do not exceed the SSC threshold, SSC methodologies may be used once they have first been reviewed and, as needed, revised to account for leakage in the context of a SSC-CPA.

The CPAs included in this PoA comprise the installation of photovoltaic renewable energy generation systems that supply electricity to users i.e. for captive use. The CPA's will displace electricity distributed from the national grid or from a fossil-fuel fired mini-grid, comprising generation units not exceeding a total capacity of 15MW and not connected to the national or regional grid.

The total installed capacity of the renewable energy generation systems installed under a CPA will not exceed 15MW(p)[13] under Standard Testing Conditions[14]. This threshold is applicable to new, additional and replacement installations. The CPA will thus remain below the small-scale eligibility threshold applicable to installed capacity of the project activity (renewable energy generation equipment) for type I projects, as per Annex 21 to EB61 – *General guidelines to SSC CDM Methodologies* (version 17) section 3(a)(iii).

Table 2 in AMS-1.F. version 2 sets out the applicability based on project types for AMS-1.F. The project activities of the SSC CPAs indicate that AMS-1.F is the applicable methodology as they are:

1. Displacing grid electricity consumption (e.g. grid import) and/or captive fossil fuel electricity generation at the user end (excess electricity may be supplied to a grid)
2. Supplying electricity to a mini-grid system where in the baseline all generators use exclusively fuel oil and/or diesel fuel.

The approved SSC methodology AMS-I.F. details specific conditions that apply in the case of using the methodology in a project activity under a programme of activities. Sections 22 & 23 are not applicable to the CPAs since no renewable generation from biomass will occur as a project activity. Section 24 refers to the replacement of equipment, where there is a requirement that the number of scrapped equipment and the number of project activity equipment physically correspond with each other if leakage is not considered. Each CPA included in this PoA will consider leakage of replaced equipment at CPA level and therefore Section 24 is not applicable. .

E.3. Description of the sources and gases included in the SSC-CPA boundary

>>

	Source	Gas	Included?	Justification / Explanation
Baseline	Power plants servicing the national grid and/or a mini-grid comprising fossil-fuel generation equipment not connected to the regional or national grid. I.e. Electricity consumption in	CO_2	Yes	According to AMS-1.F. which refers to AMS-1.D. for grid connected systems and therein the "Tool to calculate the emission factor for an electricity system (version 2.2.1)", only CO2 emissions from electricity generation should be accounted for.

[13] As per section 4(a) & (b) of the General Guidelines to SSC CDM Methodologies (version 17), maximum output is the installed/rated capacity as indicated by the manufacturer of the equipment. Therefore in the case of solar photovoltaic applications the maximum output is referred to in MW(p) as rated by the manufacturer and approved by the appropriate national Standards Body.

[14] Standard Testing Conditions ('STC') are defined as $1kW/m^2$ of sunlight and a PV cell temperature of 25˚ and an air mass of $1.5kg/m^3$. Their output measured under STC is expressed in terms of 'peak watt' nominal capacity.

	residential and/or light industrial properties from a gird-connection or mini-grid.			For mini-grid fossil-fuel generation, prescribed CO_2 emission factors as per AMS-1.F. are used as detailed in table I.F.1.
		CH_4	No	Minor source of emissions
		N_2O	No	Minor source of emissions
Project activity	Solar photovoltaic electrical system: generation of electrical energy onsite at residential or light industrial/commercial properties	CO_2	No	No emissions
		CH_4	No	No emissions
		N_2O	No	No emissions

E.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:

>>

The prevalent source of electrical energy supply in Southern Africa is from a national gird which is predominately fossil-fuelled. In the case where a property is not grid connected, and they can afford to generate their own electricity, fossil-fuelled generation units are the predominant generation source.

For grid-connected properties the baseline scenario is the amount of electricity that is displaced by the renewable energy system. Baseline emissions are therefore calculated as the amount of electricity that is displaced by the renewable energy generating system multiplied by an appropriate country-specific grid emissions factor.

$$\mathbf{BE_y = EG_{BL,y} * GEF_y}$$

Where:

$\mathbf{BE_y}$ = Baseline emissions in year *y* (tCO_2)

$\mathbf{EG_{BL,y}}$ = Quantity of net electricity displaced as a result of the renewable electrical generation system in year *y* (MWh)

$\mathbf{GEF_y}$ = Grid Emission Factor as calculated per the procedures provided in AMS-I.D. (tCO_2/MWh)

For off grid properties the baseline scenario is the annual electricity displaced that is generated by the renewable energy system. This represents the amount of electrical energy that the photovoltaic system displaces from direct combustion of fossil-fuels for electricity generation. Baseline emissions are calculated as the annual electricity generated by the photovoltaic unit multiplied by an emissions factor for the relevant fossil-fuel combusting generation unit used in the baseline scenario.

$$\mathbf{BE_y = EG_{BL,y} * EF_y}$$

Where:

BE_y	=	Baseline emissions in year y (tCO_2)
$EG_{BL,y}$	=	Quantity of annual electricity generated by the renewable energy system in year y (MWh)
EF_y	=	Fossil-fuel combustion generation emission factor (tCO_2/MWh)

Where the off-grid (mini-grid) baseline scenario is the use of diesel or heavy oil fuelled generation equipment for electricity production, the emission factors as stipulated in AMS-I.F for a modern diesel generating unit of the relevant capacity operating at optimal load shall be used in the baseline calculation.

The relevant baseline emission factor will be determined ex-ante at CPA level.

E.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the SSC-CPA being included as registered PoA (assessment and demonstration of additionality of SSC-CPA): >>

Reduction of CO_2 – In the baseline scenario, the production of electricity from fossil-fuels, both at grid-connected locations and off-grid (mini-grid) locations, results in emissions of CO_2. This is the most likely alternative that will occur in the absence of a CDM project activity that stimulates the uptake of solar photovoltaic electrical systems for electricity generation. By installing photovoltaic electrical systems at domestic and light industrial properties for captive use or a mini-grid, GHG emissions from electricity production are reduced linearly with the amount of electricity that is displaced by the project activity.

E.5.1. Assessment and demonstration of additionality for a typical SSC-CPA:

>> Here the PPs shall demonstrate, using the procedure provided in the baseline and monitoring methodology applied, additionality of a typical CPA.

Where a CPA is limited to an installed capacity of 5MW(p) or less the *'Guidelines for demonstrating additionality of Microscale Project Activities'* (version 03) EB63, Annex 23 shall be applied by the CPA.

Where a CPA has an installed capacity of greater than 5MW(p) but less than 15MW(p), the CPA shall demonstrate that barriers exist to the uptake of the solar photovoltaic technology advocated by the CPA. The CPA shall demonstrate that a cost barrier exists using the latest market information available and the following formula for Levelised Cost of Energy Analysis[15]:

$$LCoE = \frac{\sum_{t=1}^{n} \frac{I_t + M_t + F_t}{(1+r)^t}}{\sum_{t=1}^{n} \frac{E_t}{(1+r)^t}}$$

Where:

$LCoE$	= Levelised Cost of Energy (aka Levelised Energy Cost)
I_t	= Investment expenditures in year *t*
M_t	= Ops and maintenance expenditures in year *t*
F_t	= Fuel expenditures in year *t*

[15] http://en.wikipedia.org/w/index.php?title=Levelised_energy_cost&direction=next&oldid=365220846

E_t = Energy generation in year *t*
r = Discount rate
t = year
n = Life of system

In order to demonstrate additionality of the CPA it shall be shown that an investment barrier[16] exists by substantiating:

$$LCoE_{baseline} \leq LCoE_{project}$$

If this cannot be demonstrated, the existence of at least one other barrier, e.g. prevailing practice or access to finance, must be substantiated.
The barriers identified for each CPA are the same as the barriers identified in section A.4.3 for the PoA as a whole. Faced with this cost barrier and without the assistance of the PoA to overcome this and the other identified barriers, residential or industrial properties in Southern Africa will not install solar photovoltaic electrical systems and the prevailing practice of using grid electricity or diesel-fuel generation will continue.

Therefore a typical CPA will not be carried out in the normal course of business and each CPA is considered to be additional. The additionality of each CPA will be further demonstrated within each SSC-CPA-DD by a cost analysis over the life of the project activity where the specifics of each CPA can be adequately addressed.

Where a CPA has an installed capacity of greater than 15MW(p), this activity is not eligible under this PoA.

E.5.2. Key criteria and data for assessing additionality of a SSC-CPA:

>> Here the PPs shall provide the key criteria for assessing additionality of a CPA when proposed to be included in the registered PoA. The criteria shall be based on additionality assessment undertaken in E.5.1 above. The project participants shall justify the choice of criteria based on analysis in above section.
It shall be demonstrated how these criteria would be applied to assess the additionality of a typical CPA at the time of inclusion.

Additionality criteria for inclusion of each CPA in the PoA

a) Demonstrate the cost barriers to the project activity by performing a cost analysis as detailed in section E5.1, OR if not enough information is available to perform the LCoE analysis;
b) Conduct a prevailing practice barrier analysis to assess that the project activity is prevented from occurring in the normal course of business by at least one of the barriers due to prevailing practice listed below:
    i. Information asymmetry among the target consumer base about the product, specifically with regards to the reliability and capability of photovoltaic systems;

[16] An investment barrier is defined as "a financially more viable alternative to the project activity would have led to higher emissions" EB35, Annex 34.

ii. Lack of product availability in 'brick & mortar' establishments;
iii. Perception that there are no directly attributable maintenance costs to grid-connection;
iv. Lack of technical knowledge about the operation and maintenance of a solar photovoltaic electrical system;
v. Little incentive for major retailers to market and promote the product due to high-risk/low return paradigm surrounding the photovoltaic product market ;
vi. Lack of climate change knowledge and education around the benefits of photovoltaic electrical systems and their contribution to reducing GHG emissions.

Where a CPA is limited to an installed capacity of 5MWe or less (i.e. 21,333m^2 of aperture area in the SWH case) the '*Guidelines for demonstrating additionality of Microscale Project Activities'* (version 03) EB63, Annex 23) shall be applied by the CPA whereby a project activity is additional if any of the following apply:

a) The geographic location of the project is in one of the Least Developed Countries or Small Island States or in a special underdeveloped zone of host country identified by the Government before 28 May 2010;
b) The project is an off grid activity supplying energy to households/communities;
c) The project is designed for distributed energy generation (not connected to a national or regional grid) with both of the following conditions satisfied:
    a. Each of the independent subsystems in the project activity is smaller than or equal to 1500kW electrical installed capacity;
    b. End users of the sub systems or measures are households/communities/SMEs.
d) The project activity employs specific renewable energy technologies/measures recommended by the host country DNA and approved by the Board to be additional in the host country.

NOTE: Information provided here shall be incorporated into the PoA specific CDM-SSC-CPA-DD that shall be included in documentation submitted by project participants at registration of PoA.

E.6. Estimation of Emission reductions of a CPA:

E.6.1. Explanation of methodological choices, provided in the approved baseline and monitoring methodology applied, selected for a typical SSC-CPA:

>>

A CPA is eligible as a small scale project activity according to AMS-I.F. Renewable electricity generation for captive use and mini-grid.

Quantity of Net Electricity Displaced

The CPA will implement the sampling procedures as described in the monitoring plan to determine the quantity of net electricity that is displaced by the project activity. AMS-I.F requires continuous monitoring, hourly measurement and monthly recording of this data parameter and this will be done using energy meters to directly measure the quantity of net electricity displaced for a sample of the photovoltaic electrical installations.

Baseline Emission Factors

For grid connected properties the baseline and monitoring methodology of AMS-I.F. (Version 2) refers to AMS-1.D. According to section 12(a) the Emission Factor of an electricity system can be calculated in a

transparent and conservative manner using a combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the "*Tool to calculate the emission factor for an electricity system (version 2.2.1)*". This tool will be applied to grid connected installations within a typical CPA. The equations used to determine the emission reductions are discussed in section E.6.2.

The *"Tool to calculate the emission factor for an electricity system (version 2.2.1)"* is applicable to a grid-connected project activity where the CM emission factor of the baseline grid electricity system is calculated for grid power plants only, or, an option, it can include off-grid power plants. The relevant electricity systems to the CPAs are not located partially or totally in an Annex I country and therefore the *"Tool to calculate the emission factor for an electricity system (version 2.2.1)"* is applicable.

For off-grid (mini-grid) connected properties where the generators use diesel or heavy oil fuel, the baseline and monitoring methodology of AMS-I.F. (Version 2) specifies a table of standardized emission factors for modern diesel generating units of the relevant capacity operating at optimal load. Emission factors for each installation under a CPA will be calculated using the appropriate parameters within the Table I.F.I. in AMS-I.F.

For a mini-grid system not using diesel or heavy oil fuel the baseline emission factor shall be determined as per the weighted average emissions for the current generation mix following the procedure provided in AMS-I.D which refers to the "*Tool to calculate the Emission Factor for an electricity system (version 2.2.1)*".

Each CPA will calculate and document the appropriate baseline emission factors as detailed above and will implement the sample method in the monitoring plan to determine the quantity of net electricity displaced.

E.6.2. Equations, including fixed parametric values, to be used for calculation of emission reductions of a SSC-CPA:

>>

The first step in calculating the emission reductions of a CPA will be to define which installations are connected to the national gird and which installations are off-grid (mini-grid). This information will be readily available as it is included in the data recorded by the CME for each installation under a CPA. Once this has been established the following procedure will be used to calculate the emission reductions of the respective installations:

Grid Connected Emission Factor Calculation

Where the installation is grid-connected, the Grid Emission Factor will be calculated as per the "*Tool to calculate the Emission Factor for an electricity system (version 2.2.1)*." The combined margin (CM) is calculated to determine the CO2 emission factor for the displacement of electricity generated by power plants in an electricity system. The CM is the result of a weighted average of two emission factors pertaining to the electricity system: the "operating margin" (OM) and the "build margin" (BM). The OM is the emission factor that refers to the group of existing power plants whose current electricity generation would be affected by the proposed CDM project activity. The BM is the emission factor that refers to the group of prospective power plants whose construction and future operation would be affected by the proposed CDM project activity.

The tool prescribes a step-based approach to calculate the CM:

Step 1: Identify the relevant electricity systems
A project electricity system is defined by the spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity i.e. the photovoltaic system installations and that can be dispatched without significant transmission constraints.

None of the project electricity systems for any of the Host Countries are located in an Annex-I country. The geographical extent of the project electricity system will be documented transparently and all grid power plants/units connected to the system will be identified.

Electricity transfers from connected electricity systems to the project electricity system are defined as electricity imports and electricity transfers to connected electricity systems are defined as electricity exports. Where electricity imports and/or exports exist, these will be identified and electricity exports will not be subtracted from electricity generation data used for calculating and monitoring the electricity emission factors.

Step 2: Choose whether to include off-grid power plants in the project electricity system (optional)
This programme selects option I to calculate the operating margin and build margin emission factor whereby only grid power plants are included in the calculation. This is because the applicable methodology AMS-I.F provides for specific emission factor calculations where the installation is off-grid (or connected to a mini-grid) and therefore off-grid electrical generation is dealt with separately.

Step 3: Select a method to determine the operating margin (OM)
The calculation of the operating margin emission factor ($EF_{grid,OM,y}$) is based on one of the following methods:

(a) Simple OM; or
(b) Simple adjusted OM; or
(c) Dispatch data analysis OM; or
(d) Average OM.

The below criteria will be considered by each CPA in determining the selection of the method to calculate OM. Each CPA will outline their choice and justification for the method employed in line with the below restrictions.

The simple OM method (Option a) can only be used if low-cost/must-run resources constitute less than 50% of total grid generation in:
1) average of the five most recent years, or
2) based on long-term averages for hydroelectricity production.

The dispatch data analysis (Option c) cannot be used if off-grid power plants are included in the project electricity system as per Step 2 above; however, this will not be a constraint as off-grid power generation is specifically excluded from the grid-connected baseline scenario according to AMS-I.F. Dispatch data analysis will therefore not be used as the method to calculate OM by a CPA.

The simple adjusted OM method (Option b) could be used, but detailed data is needed for this method and is not available for all of the Host Countries. Therefore this method is excluded and will not be selected by a CPA.

The average OM (Option d) method should only be used if the data for simple OM is not available. This method should therefore be used in the case where the Host country does not have the data available to use the simple OM method.

For the simple OM, the simple adjusted OM and the average OM, the emissions factor can be calculated using either *ex ante* or *ex post* data vintages. An ex-ante approach will be adopted for all CPAs included in the PoA. The emission factor is determined once at the validation stage and thus no monitoring and recalculation of the emissions factor during the crediting period will be required.
For grid power plants a 3-year generation-weighted average, based on the most recent data available at the time of inclusion of the CPA will be used.

Step 4: Calculate the operating margin emission factor according to the selected method
Only the simple OM or average OM method may be used by a CPA. The two methods are outlined below:

(a)Simple OM

The simple OM emission factor is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation (tCO_2/MWh) of all generating power plants serving the system, not including low-cost/must-run power plants/units. The simple OM may be calculated:

Option A: Based on the net electricity generation and a CO_2 emission factor of each power unit[17] or
Option B: Based on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system.

Option B can only be used if:
a) The necessary data for Option A is not available; and
b) Only nuclear and renewable power generation are considered as low-cost/must-run power sources and the quantity of electricity supplied to the grid by these sources is known; and
c) Off-grid power plants are not included in the calculation

Option A - Calculation based on average efficiency and electricity generation of each plant

Under this option, the simple OM emission factor is calculated based on the net electricity generation of each power unit and an emission factor for each power unit, as follows:

$$EF_{grid,OMsimple,y} = \frac{\sum_{m} EG_{m,y} \cdot EF_{EL,m,y}}{\sum_{m} EG_{m,y}}$$

Where:
$\mathbf{EF_{grid,OMsimple,y}}$ = Simple operating margin CO_2 emission factor in year *y* (tCO_2/MWh)

[17] Power units should be considered if some of the power units at the site of the power plant are low-cost/must-run units and some are not. Power plants can be considered if all power units at the site of the power plant belong to the group of low-cost/must-run units or if all power units at the site of the power plant do not belong to the group of low-cost/must-run units.

$\mathbf{EG_{m,y}}$	=	Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
$\mathbf{EF_{EL,m,y}}$	=	CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
m	=	All power units serving the grid in year *y* except low-cost / must-run power units
y	=	The relevant year as per the data vintage chosen in Step 3

Determination of $\mathbf{EF_{EL,m,y}}$

The emission factor of each power unit m should be determined as follows:

• Option A1. If for a power unit m data on fuel consumption and electricity generation is available, the emission factor ($EF_{EL,m,y}$) should be determined as follows:

$$EF_{EL,m,y} = \frac{\sum_i FC_{i,m,y} \cdot NCV_{i,y} \cdot EF_{CO2,i,y}}{EG_{m,y}}$$

Where:

$\mathbf{EF_{EL,m,y}}$	=	CO_2 emission factor of power unit m in year y (tCO_2/MWh)
$\mathbf{FC_{i,m,y}}$	=	Amount of fossil fuel type *i* consumed by power unit *m* in year *y* (Mass or volume unit)
$\mathbf{NCV_{i,y}}$	=	Net calorific value (energy content) of fossil fuel type *i* in year *y* (GJ/mass or volume unit)
$\mathbf{EF_{CO2,i,y}}$	=	CO_2 emission factor of fossil fuel type *i* in year *y* (tCO_2/GJ)
$\mathbf{EG_{m,y}}$	=	Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
m	=	All power units serving the grid in year *y* except low-cost/must-run power units
i	=	All fossil fuel types combusted in power unit m in year *y*
y	=	The relevant year as per the data vintage chosen in Step 3

• Option A2. If for a power unit m only data on electricity generation and the fuel types used is available, the emission factor should be determined based on the CO2 emission factor of the fuel type used and the efficiency of the power unit, as follows:

$$EF_{EL,m,y} = \frac{EF_{CO2,m,i,y} \cdot 3.6}{\eta_{m,y}}$$

Where:

$\mathbf{EF_{EL,m,y}}$	=	CO2 emission factor of power unit *m* in year *y* (tCO2/MWh)
$\mathbf{EF_{CO2,m,i,y}}$	=	Average CO2 emission factor of fuel type *i* used in power unit *m* in year *y* (tCO_2/GJ)
$\mathbf{\eta_{m,y}}$	=	Average net energy conversion efficiency of power unit m in year *y* (ratio)
m	=	All power units serving the grid in year *y* except low-cost/must-run power units
y	=	The relevant year as per the data vintage chosen in Step 3

Where several fuel types are used in the power unit, use the fuel type with the lowest CO_2 emission factor for $EF_{CO2,m,i,y}$.

• Option A3. If for a power unit *m* only data on electricity generation is available, an emission factor of 0 tCO_2/MWh can be assumed as a simple and conservative approach.

Determination of $\mathbf{EG_{m,y}}$

For grid power plants, $EG_{m,y}$ should be determined as per the provisions in the monitoring tables.

Option B - Calculation based on total fuel consumption and electricity generation of the system.

Under this option, the simple OM emission factor is calculated based on the net electricity supplied to the grid by all power plants serving the system, not including low-cost/must-run power plants/units, and based on the fuel type(s) and total fuel consumption of the project electricity system, as follows:

$$EF_{grid,OMsimple,y} = \frac{\sum_i \left(FC_{i,y} \times NCV_{i,y} \times EF_{CO2,i,y}\right)}{EG_y}$$

Where:

$\mathbf{EF_{grid,OMsimple,y}}$	=	Simple operating margin CO_2 emission factor in year *y* (tCO_2/MWh)
$\mathbf{F_{Ci,y}}$	=	Amount of fossil fuel type *i* consumed in the project electricity system in year *y* (mass or volume unit)
$\mathbf{NCV_{i,y}}$	=	Net calorific value (energy content) of fossil fuel type *i* in year *y* (GJ/mass or volume unit)
$\mathbf{EF_{CO2,i,y}}$	=	CO2 emission factor of fossil fuel type i in year y (tCO2/GJ)
$\mathbf{EF_{CO2,i,y}}$	=	Net electricity generated and delivered to the grid by all power sources serving the system, not including low-cost/must-run power plants/units, in year *y* (MWh)
i	=	All fossil fuel types combusted in power sources in the project electricity system in year *y*
y	=	The relevant year as per the data vintage chosen in Step 3

For this approach (simple OM) to calculate the operating margin, the subscript m refers to the power plants/units delivering electricity to the grid, not including low-cost/must-run power plants/units, and including electricity imports to the grid. Electricity imports should be treated as one power plant m.

(d) Average OM

The average OM emission factor ($EF_{grid,OM\text{-}ave,y}$) is calculated as the average emission rate of all power plants serving the grid, using the methodological guidance as described under (a) above for the simple OM, but including in all equations also low-cost/must-run power plants.

Option B should only be used if the necessary data for Option A is not available.

Step 5: Calculate the build margin emission factor

The vintage of data used by the CPAs will be that as classified under **Option 1** where:

- For the first crediting period, the build margin emission factor is calculated *ex ante* based on the most recent information available on units already built for sample group *m*. Most recent refers to the time at which the CPA is submitted for inclusion under the PoA. For the second crediting period, the build margin emission factor will be updated based on the most recent information

available on units already built at the time of submission of the request for renewal of the crediting period to the DOE. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used. This option does not require monitoring the emission factor during the crediting period.

The sample group of power units *m* used to calculate the build margin should be determined as below:

a) Identify the set of five power units that have started to supply electricity to the grid most recently ($SET_{5\text{-units}}$), excluding power units registered as CDM project activities. Determine their annual electricity generation ($AEG_{SET\text{-}5\text{-}units}$ in MWh); ;

b) Determine the annual electricity generation of the CPA electricity system (excluding power units registered as CDM project activities). Identify the set of power units that stared to supply electricity to the grid most recently and that comprise 20% of the AEG_{total} (excluding power units registered as CDM project activities) Determine their annual electricity generation ($AEG_{SET\geq 20\%}$ in MWh).

c) From the $SET_{5\text{-units}}$ and $SET_{\geq 20\%}$ select the set of power units that comprises the larger annual electricity generation (SET_{sample})

CPAs should then identify the date when the power units in the SET_{sample} started to supply electricity to the grid. If none of the power units in SETsample started to supply electricity to the grid more than 10 years ago, then use SET_{sample} to calculate the BM.

Otherwise:

d) Exclude from the SET_{sample} the power units which started to supply electricity to the grid more than 10 years ago. Include that set the power units registered as CDM project activity (if any) starting with power units that started to supply electricity to the grid most recently, until the electricity generation set comprises 20% of the annual electricity generation of the project electricity system. Determine for the resulting set ($SET_{sample\text{-}CDM}$) the annual electricity generation ($AEG_{SET\text{-}sample\text{-}CDM}$ in MWh).

If the annual electricity generation of that set comprises at least 20% of the annual electricity generation of the project electricity system i.e. $AEG_{SET\text{-}sample\text{-}CDM} \geq 0.2 \times AEG_{total}$, then the CPA should use the sample group $SET_{sample\text{-}CDM}$ to calculate the BM;

Otherwise:

e) Include in the sample group $SET_{sample\text{-}CDM}$ the power units that started to supply electricity to the grid more than 10 years ago until the electricity generation of the new set comprises 20% of the annual electricity generation of the project electricity system (if 20% falls on part of the generation of a unit, the generation of that unit should be funny included in the calculation).

f) The sample group of power units *m* used to calculate the BM is the resulting set. ($SET_{sample\text{-}CDM>10yrs}$)

Capacity additions from retrofits of power plants should not be included in the calculation of the build margin emission factor.

The build margin emissions factor is the generation-weighted average emission factor (tCO_2/MWh) of all power units *m* during the most recent year *y* for which power generation data is available, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_{m} EG_{m,y} \times EF_{EL,m,y}}{\sum_{m} EG_{m,y}}$$

Where:

$\mathbf{EF_{grid,BM,y}}$	=	Build margin CO_2 emission factor in year *y* (tCO_2/MWh)
$\mathbf{EG_{m,y}}$	=	Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
$\mathbf{EF_{EL,m,y}}$	=	CO_2 emission factor of power unit m in year *y* (tCO_2/MWh)
m	=	Power units included in the build margin
y	=	Most recent historical year for which power generation data is available

The CO_2 emission factor of each power unit *m* ($EF_{EL,m,y}$) should be determined as per the guidance in Step 4 (a) for the simple OM, using options A1, A2 or A3, using for *y* the most recent historical year for which power generation data is available, and using for *m* the power units included in the build margin.

Step 6: Calculate the combined margin (CM) emissions factor

The combined margin (CM) emission factor is calculated based on one of the following methods:

Option A - Weighted Average CM
Option B - Simplified CM

Option A should be used as the preferred option.
Except where the CPA:

a) Is located in a Least Developed Country (LDC) i.e. Lesotho, Mozambique or Zambia, or;
b) In a country with less than 10 registered CDM projects at the date that the CPA is submitted for inclusion in the PoA or;
c) Where the CPA cannot meet the data requirements of *Step 5* above.

Option A – The weighted average CM

The combined margin emission factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM}$$

Where:

$\mathbf{EF_{grid,BM,y}}$	=	Build margin CO_2 emission factor in year *y* (tCO_2/MWh)
$\mathbf{EF_{grid,OM,y}}$	=	Operating margin CO_2 emission factor in year *y* (tCO_2/MWh)
$\mathbf{w_{OM}}$	=	Weighting of operating margin emissions factor (%)
$\mathbf{w_{BM}}$	=	Weighting of build margin emissions factor (%)

The following default values should be used for w_{OM} and w_{BM}:

• Wind and solar power generation project activities: w_{OM} = 0.75 and w_{BM} = 0.25 (owing to their intermittent and non-dispatchable nature) for the first crediting period and for subsequent crediting periods;

Option B – The simplified CM
The combined margine emission factor is calculated as follows:

Using the equation as specified under Option A
Where:
$\mathbf{w_{OM}}$ = **0**

w_{BM} = 1

If the simplified CM is used, the OM emission factor $EF_{grid,OM,y}$ must be calculated using the average OM (option (d) in step 3)

Baseline Emissions
Baseline emissions for the photovoltaic electrical system are the product of the amount of electricity displaced with the electricity produced by the renewable generating installation and an emission factor.

$$\mathbf{BE_y = EG_{BL,y} * EF_{CO2,y}}$$

Where:

$\mathbf{BE_y}$	=	Baseline Emissions in year *y* (tCO_2)
$\mathbf{EG_{BL,y}}$	=	Quantity of net electricity displaced as a result of the implementation of the CDM project activity in a *y* (MWh)
$\mathbf{EF_{CO2,y}}$	=	Emission Factor (tCO_2/MWh)

1. Determine the amount of electricity displaced with the electricity produced by the photovoltaic electrical system ($\mathbf{EG_{BL,y}}$).
2. Identify the country-specific grid emission factor or fossil-fuelled generation emission factor as appropriate and calculated in accordance with the methods described in the above section ($\mathbf{EF_{CO2,y}}$).
3. Calculate the baseline by multiplying the electricity displaced by the PV installation by the relevant emission factor for the baseline generation fuel type ($\mathbf{BE_y}$).

Project Leakage
1. Where equipment has been replaced, a check that there is documentation proving that the original equipment has been scrapped and is no longer in use will be performed.
2. If the equipment is still in use then the emission reductions from the associated installation as calculated above will be considered as leakage ($\mathbf{LE_y}$).
3. Where no energy generation equipment is transferred from another activity, leakage does not have to be considered.

Project Emissions

$$\mathbf{PE_y = 0}$$

The project is a renewable energy project but is not:
a) A geothermal project or;
b) A hydro project

Therefore the programme does not have any associated project emissions according to AMS-I.F.

Emission Reductions

$$\mathbf{ER_y = BE_y - PE_y - LE_y}$$

Where:

$\mathbf{ER_y}$	=	Emission reductions in year y (tCO_2/y)
$\mathbf{BE_y}$	=	Baseline emissions in year y (tCO_2/y)

$\mathbf{PE_y}$ = Project emissions in year y (tCO_2/y)
$\mathbf{Le_y}$ = Leakage emissions in year y (tCO_2/y)

E.6.3. Data and parameters that are to be reported in CDM-SSC-CPA-DD form:

Data / Parameter:	**$EF_{CO2,y}$**
Data unit:	tCO_2/kWh
Description:	Emission Factor as determined according to AMS-I.F.
Source of data used:	The grid emission factor will be determined by each CPA according to AMS-I.F using the most appropriate local data sources.
Value applied:	
Justification of the choice of data or description of measurement methods and procedures actually applied :	For a Grid-Connected baseline – procedures as detailed in AMS-I.D. and the "Tool to calculate the emission factor for an electricity system (version 2.2.1)" will be used to calculate the Grid Emission Factor. For a non-grid (mini-grid) connected baseline – If the generation fuel is diesel or fuel oil, the emission factors as specified in Table I.F.1. in AMS-I.F. will be used applying the most appropriate EF for the generation equipment's load factor and capacity. If the generation fuel is not diesel or fuel oil, the mini-grid emission factor will determined by each CPA according to AMS-I.D as stipulated in AMS-I.F.
Any comment:	This is the Emission Factor to be applied in the case of grid-connected properties or non-grid (mini-grid) connected properties.

E.7. Application of the monitoring methodology and description of the monitoring plan:

D.7.1. Data and parameters to be monitored by each CPA:

Data / Parameter:	**$EG_{BL,y}$**
Data unit:	kWh
Description:	Daily electrical energy displaced by the installed photovoltaic electrical system.
Source of data to be used:	Direct, physical measurements as recorded by metering equipment.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	In this section the project participants shall provide description of equipment used for measurement, if applicable, and its accuracy class.
QA/QC procedures to be applied:	See section E.7.2
Any comment:	

E.7.2.Description of the monitoring plan for a CPA:

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Monitoring Approach

The PoA uses a monitoring approach of stratified random sampling to measure the quantity of fossil-fuel generated electricity that is displaced by the installation of the solar photovoltaic electrical systems. A directly monitored sample of each CPA to verify the emission reductions as a result of the photovoltaic electrical system installations will be monitored using correctly calibrated energy meters on a continuous basis with hourly measurement and daily recording.

The target population is all installations enrolled in the CPA and the sample measurements will be the quantity of net electricity displaced per annum by the installed solar photovoltaic electrical systems within the CPA.

Sample Frame

The sampling frame will include a complete list of installations in the CPA as well as the information needed to implement the monitoring plan which is listed in section A.4.4.1 as part of the operational and management plan record keeping requirements for a CPA. The necessary information to implement the monitoring metering equipment will thus be available from each CPA via this data source as well as from the primary database maintained by the CME.

Sampling Precision

The sample size for each CPA population will be determined so as to achieve a 90% confidence interval with 10 per cent error margin for the collected data, with a minimum sample size of 50. The actual size of the sample will be determined for each CPA individually to achieve the above precision target and will be justified accordingly based on the specific characteristics of the particular CPA population. The expected co-variance of the population will be estimated ex-ante for each CPA (and their associated strata) but is expected to be low. The expected co-variance of the CPA will be adjusted ex-post the first monitoring and verification cycle, based on the actual co-variance observed in the sample from the CPA.

Where CPAs overlay each other geographically, the sample data from the first CPA established in the area may be used to verify the emission reductions of any secondary CPAs in addition to further sampling within the overlaying CPA. The size of the sample in this case will be determined according to the variance in the measured electricity produced by the installations in the original CPA sample. Therefore, if the original CPA sample represents a statistically acceptable proxy for the electricity generated by the photovoltaic electrical system within that climatic zone, a smaller sample will be selected for any secondary CPAs within the same climatic zone to verify the emission reductions.

Stratified Random Sampling

Each CPA's sample will be stratified into an appropriate number of strata based on the primary grouping variable which is the rated kW(p) output capacity of the systems. Each photovoltaic panel system installed will ONLY be assigned to one strata as classified by the rated performance of the system. This will be documented by the CME to ensure that each stratum is mutually exclusive from the other strata and that the strata are collectively exhaustive with no CPA population element excluded. As a further check, the CME will ensure that each panel serial number within a CPA is assigned to a corresponding sample stratum. The sampled installations will be drawn at random from the sample frame which will include a complete list of installations in the target population as well as the information needed to implement the metering.

Sample Method
The quantity of electricity displaced will be directly physically measured and monitored by installing an appropriately certified and calibrated energy meter at the boundary of the sample photovoltaic electrical system installations. The CPA will determine the specifics of the metering equipment used but it will be the responsibility of the CME to ensure it is certified to national or IEC standards and calibrated according to the national standards and reference points or IEC standards. The meters will be recalibrated at appropriate intervals according to the manufacturer specifications at a minimum of every 3 years and the CME will be responsible for observing that this has occurred.

The complete list of installations in the sample frame and their geographic and rated capacity details will be used to implement the meters at randomly selected installations and to allocate installations into their appropriate stratum within a CPA.

The meter will constantly measure the electrical output of the system and record the total quantity of electricity used on a daily basis over the monitoring period. This data will then be transmitted remotely to the central database of the CME or collected from the installation sample sites for calculation of the emission reductions of the CPA. The electricity produced from the photovoltaic electrical system represents the electricity displaced by the installation that would have been generated by a fossil fuel source in the baseline scenario. Therefore the CPA emission reductions can be verified by directly monitoring a sample of the photovoltaic system installations within the CPA and the electrical energy used from them.

Procedures for administering data collection & minimizing non-sampling errors.
Installers who are contracted to install the photovoltaic electrical systems by a CPA will be trained in completing all the necessary data parameters required to be collected at installation. In addition, random checks will be carried out to verify that the information collected at installation is accurate. These checks will be detailed by each CPA but may include:

i. contacting the home-owner to check the system is installed at the specified location,
ii. random site visits to the specified location to check the system is installed properly and in operation,
iii. random site visits to verify the size of the installation and the rated capacity of the system
iv. contacting the home-owner or a random site inspection to confirm the baseline electricity supply scenario.

These checks will minimize any non-sampling measurement errors.

Quality Assurance
In order to ensure the quality of the emission reductions claimed during any monitoring period a sample based survey is conducted to allow the verifier to benchmark the parameters used for random sample selection and sample stratification as well as those which could affect the performance of the installed photovoltaic electrical system.

Parameter	Unit	Frequency	QA/QC procedure
Unique Identifier	Barcode/Serial Number	Once-off	Initially recorded at installation, verified annually by sample-based survey
Location	Physical Address	Annual	Initially recorded at installation, verified annually by sample-based survey

Manufacturer of Panel	Manufacturer Name	Annual	Initially recorded at installation, verified annually by sample-based survey
Rated Output Capacity	kW(p)	Once-off	Initially determined by 3rd party according to national/international standard
Days in Operation	Number of days	Annual	Verified annually by sample-based survey

Data Management

The coordinating entity will maintain a database containing information that can be attributed to each individual CPA and the PoA as a whole. The information maintained will include:

i. A list of installations participating in each CPA including name, address and contact details
ii. The unique identifying manufacturer's serial number;
iii. The specifications of the panels including manufacturer, size and KW(p) rating.
iv. Name, contact details and registration particulars for each installer responsible for the installation of the photovoltaic panels included in the CPA;
v. Records of all visits made to installations in respect to the programme and activities of the CME;
vi. Proof in the form of the necessary certification that equipment enrolled in the programme has been certified by the appropriate body;
vii. Results of monitoring activities from monitoring sample
viii. Signed contract ceding rights to carbon revenue in the case of residential consumers
ix. Record of pre-existing electricity generation source i.e. baseline scenario
x. Documented proof of scrapped equipment in the case of replaced fossil-fuelled generation equipment.

The data included in the database will be sourced from documents completed by installers, manufacturers / agents, intermediaries and end-users as well as CME management and monitoring activities. These data will be reviewed to ensure completeness, validity and accuracy. No units will be included in the PoA unless all required documentation has been completed correctly.

For each monitoring period the coordinating entity will produce a monitoring report for the DOE to verify the information related to the emission reductions contained in the CPA. PoA record keeping procedures will prevent double counting across CPAs. These procedures will include cross checking of unique identifiers on enrolled equipment throughout the database to ensure that the equipment has not been included more than once in the database.

Verification of each CPA will occur at the end of each monitoring period. Appropriate record keeping procedures will be implemented to ensure that each monitoring period data set can be transparently attributed to its corresponding CPA, preventing any occurrences of double counting. An audit of the project data base will be able to determine the current status of each CPA – the duration of previous monitoring periods, the households and sample groups delivering monitoring data, and current verification activities.

Monitoring of the Scrapping of Replaced Equipment

Where the installation replaces electrical generating equipment, the installer will certify that the baseline equipment has been scrapped. This shall be done for all installations of this kind and the record of such will be maintained by the CME.

E.8 Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies)

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The baseline study and monitoring methodology were completed on the 20th of July 2011 by:

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Annex 1

CONTACT INFORMATION ON COORDINATING/MANAGING ENTITY and PARTICIPANTS IN THE PROGRAMME of ACTIVITIES

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

Annex 3

BASELINE INFORMATION

Annex 4

MONITORING INFORMATION

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