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

CONTENTS

Annexes

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):

SASSA Low Pressure Solar Water Heater Programme
Version 2
17/08/2010

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

Africa has one of the highest levels of solar radiation in the world. Due to high solar radiation in South Africa the concept of heating water with the sun is logical. The small-scale programme of activities (hereafter referred to PoA) of the Solar Academy of Sub Saharan Africa (Pty) Ltd (hereafter referred to SASSA) is a programme for the installation of low pressure solar water heaters (SWHs) in low income households throughout South Africa.

Traditionally electric geysers have been used in South-Africa to heat water for domestic hot water purposes. Due to the historically low cost of electricity, alternatives have not been considered. Additional reasons for low market penetration are relatively high upfront costs and a lack of consumer awareness. SWHs will help to reduce the electric water heating load. SWH offers also a great opportunity for households outside the national grid system. Suppressed demand for energy services refers to a state where current levels of access to energy services are inadequate because of income or infrastructure constraints. This state does not accurately reflect the real demand for energy services by energy poor households. The SWH rollout will eliminate part of the suppressed demand by decreasing the cost of energy services, thus increasing access to energy services whilst allowing energy poverty to decline.

The objective of the PoA is to install South African Bureau of Standards (SABS) approved non-pressure (also called low-pressure) storage tank and vacuum tube solar collectors of SASSA to low income households free of charge. The municipalities and households will not have to pay anything towards this project. This opportunity is only available while Eskom and carbon finance, subsidies can be sourced and by the supplier sourcing high volumes of equipment at reduced prices.

This project is a voluntary initiative coordinated by SASSA. SASSA will market, supply and install the SWHs.

The project fulfils the national sustainable development criteria determined by the Department of Minerals and Energy of South Africa and contributes to sustainable development as follows[1]:

Economic Dimension

Load shedding is one of the major problems in South Africa. Current electricity supply is not enough to meet projected future demand and it is hindering the fast growing economy of the country. The proposed PoA will reduce electric water heating loads and help South Africa to correct the energy mix, with a

[1] Sustainable development criteria for approval of clean development mechanism projects by the designated national authority of the CDM, 2004, Department of mineral and energy, p. 3, available under: http://www.dme.gov.za/dna/pdfs/sustainable_criteria.pdf

greater focus on renewable energy. Further the project will create local job opportunities during the installation period as well as maintenance of the SWHs. It is estimated that a minimum of 1 employee is needed for installation and maintenance work per 660 installations over the lifetime of the PoA. The PoA is expected to create a minimum of 300 jobs of which approximately 1/3 will be permanent.

Environmental dimension

The program will contribute towards to sustainable low carbon economy by making use of renewable energy and reducing electricity consumption and thereby reduces the amount of greenhouse gases (GHGs) produced by fossil fuel combustion at the national electricity grid. Furthermore SASSA will start Trees for Life Initiative in the communities where the SWHs are installed. This will lead to further job generation and social upliftment. It is estimated that over 100 000 trees are plated under this initiative over the duration of the programme.

Social dimension

Through the programme, jobs will be created in the solar sector, with training provided for technicians to install and maintain the SWH systems. Hence the project will lead to skills and know-how development. Further the provision of solar water heaters free of charge will result in improved service delivery to residents and a major social upliftment. Further SASSA will implement an Educational Program in the target communities to increase the awareness and understanding of the residents of climate change, energy efficiency and SWH. Further a community based business programme will offer training on SWHs, installation, maintenance and replacement. This training programme will increase local entrepreneurs understanding of the opportunities within the SWH business.

Policy/measure or stated goal of the PoA

The stated initiative of this programme is to supply, install, and finance solar water heaters to provide hot water services for low income households in South Africa and to reduce GHG emissions through the avoidance of electricity used for the purposes of heating water.

SASSA will install a SABS approved non-pressure (also called low-pressure) storage tank and vacuum tube solar collectors to low income households under this PoA. The SWH systems will have to comply with the SABS Standard Specification for SWH systems SANS[2] 6211-1:2003, SANS 151-2009 and SANS 1307:2003 (including the Thermal Performance Testing, Storage Water Heaters and Mechanical Qualification Testing) and will be installed in accordance with the SABS Code of Practice for Installation[3].

[2] SANS stands for South African National Standard
[3] Please note that the SANS test numbers are subject to changes if reviews occur.

SASSA is the coordinating entity and will ensure that all participating installers/ subcontractors and SWH systems meet the specified standards of the programme, thereby ensuring that the quality of both the systems and the installations is not compromised.

The general operating and implementing framework of the PoA is presented in the diagram below:

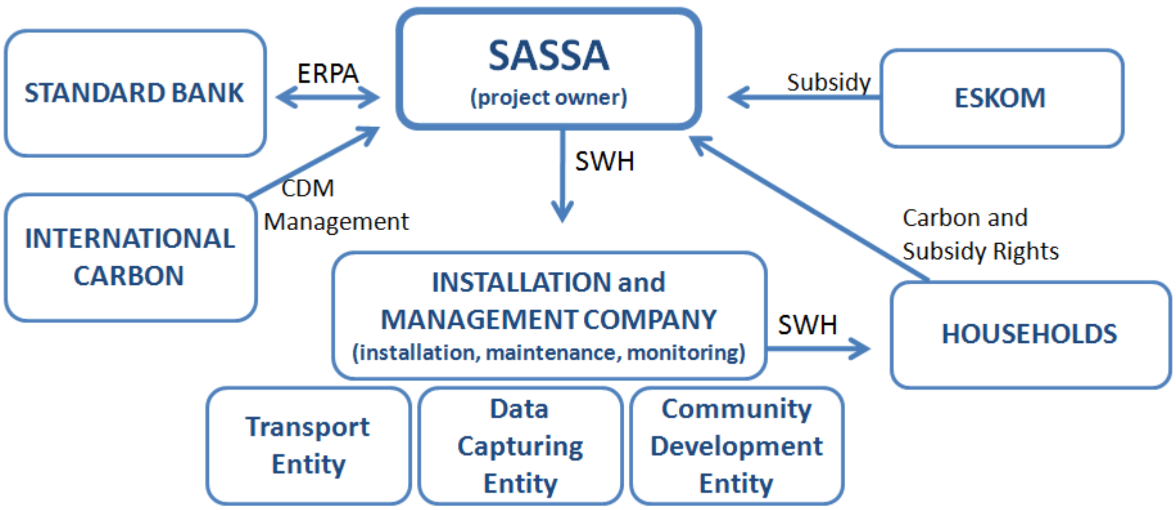


Diagram 1. Operating and implementing framework of the SASSA SWH Programme:

Voluntary Action

The PoA is a voluntary action taken by the Solar Academy of Sub Saharan Africa (Pty) Ltd to supply, install, and finance solar water heaters to provide hot water services for low income households in South Africa. There is no law or regulation in South Africa that would require the installation of SWHs in residential buildings. The SWHs will be installed at no cost for the household. This offer is only available while Eskom subsidies and Carbon Funding can be sourced. Please see section A.4.3. for more detailed information.

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

The coordinating and managing entity of the PoA is the South African private entity Solar Academy of Sub Saharan Africa (Pty) Ltd.

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 wishes to be considered as project participant (Yes/No)
Republic of South Africa	Solar Academy of Sub Saharan Africa (Pty) Ltd	No
United Kingdom of Great Britain and Northern Ireland	Standard Bank Plc	No
United Kingdom of Great Britain and Northern Ireland	International Carbon Pty	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:

A.4.1. Location of the programme of activities:

The PoA is located within the geographical boundaries of South Africa.

A.4.1.1. Host Party (ies):

Republic of South Africa

A.4.1.2. Physical/ Geographical boundary:

The boundary of the PoA is defined as the geographical area within which all the implemented the small-scale Clean Development Mechanism programme activities (SSC-CPAs) included in the PoA will occur. All SWH's in the CPAs included in the PoA will be installed within the borders of the Republic of South Africa. Therefore, the boundary of the PoA is defined as the Republic of South Africa.

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

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

A typical CPA consists of a group of SWH. The total number of installed square meters of collectors of each individual CPA will remain below the small-scale threshold of 64,000 m^2 applicable to solar energy projects, as per Appendix B of the Simplified modalities and procedures for small-scale clean development mechanism project. Hence the maximum number of the installations in each CPA is determined by the collector area of the SWHs installed.

The SWHs installed under this PoA will typically be 110 litre storage tank low pressure SWHs with a collector area of 0,9 m^2 and hence each CPA will have maximum of 59 000 units.

Each CPA consists of SABS tested SWH systems, which converts solar radiation into thermal energy for the heating of water. The SWHs that will be installed under this PoA may either be manufactured locally by SASSA or manufactured internationally and imported to South Africa and distributed by SASSA.

All the major apparatus of the SWHs participating in the CPA shall comply with the SABS Standard Specification for SWH systems SANS 6211-1:2003, SANS 151-2009 and SANS 1307:2003[4] to ensure that the SWHs installed are able to withstand local climatic and water quality conditions. All SWH are installed by South African companies that have the necessary qualifications, experience and training for the installation of SWH. All SWHs installed under this programme will be low pressure vacuumed tube SWHs. The installation will not have an electric backup element.

The figure 1 below shows a typical low pressure vacuum tube collector SWH system. The technology of the small-scale project activity installed is Solar Water Heating (SWH) technology comprising:

1. solar collectors/absorbers (evacuated tube collectors);
2. insulated hot water storage tanks;
3. pipe work;
4. support structures.

[4] Please note that the SANS test numbers are subject to changes if revised.

The solar collector and storage water tank is connected together, water tank on the top and collector panel on the bottom (integral). It relies on the natural circulation of waters between the collector and the water tank. As water in the vacuum tubes is heated, it rises naturally into the tank, while cool water in the tank flows down to the bottom of the vacuum tubes, causing circulation throughout the system. It is a simple and safe solution to heat water with energy from the sun.

Figure 1. Low pressure vacuum tube collector SWH system

Worldwide SWH technology is well-established in terms of technological development. Standard specifications have been available since 1980, to support the wider adoption of the technology. In countries where SWH systems have been installed, they have been shown to have effective operating lifetimes in excess of ten years. There is a small local, South African, production capacity which serves the small existing market mainly in high income household. By the end of 2009 less than 5 000 SWH has been installed in South Africa under the Eskom programme[5]. This capacity can be scaled up significantly to supply a bigger market.

The project activity will stimulate the increase in local content (manufacture, supply, installation and maintenance) of solar water heating systems. The technology requires re-skilling and training of employees as well as plumbers and installation contractors to supply, install and maintain the technology.

[5] Eskom Distribution 2010, Solar Water Heating Programme, Monthly Status Report March 2010

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

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

No	Criteria
1	The CPA to be included in SWHs PoA shall meet the applicability requirements of the CDM methodology AMS.I.C- Thermal energy production with or without electricity, version 17.
2	The CPA to be included in SWHs PoA shall meet SSC additionality, leakage and debundling rules, relevant to PoAs.
3	All installation shall take place in residential buildings within the geographical boundaries of South Africa.
4	All the SWH under the SSC-CPA are comply with all relevant SABS/SANS Standard Specification for SWH systems.
5	All SWH under the SSC-CPA are low pressure (also called as non pressurised) systems without an electric backup system.
6	Each CPAs shall be uniquely identified and defined by way of the unique identifying numbers (serial numbers) attached to each SWH to, ensure that all CPAs under its PoA are neither registered as an individual CDM project activity nor included in another registered PoA .
7	All households joining the programme shall cede the rights to the subsidy and carbon to the coordinating entity.
8	All households joining the programme shall have electricity and water connection.
9	All residences joining the programme shall have a proof of identity (ID).
10	Each SSC-CPA must be approved by the coordinating entity and DOE prior to its incorporation into the PoA.

The coordinating entity, SASSA, 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.

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):

In accordance with paragraph 28 of the “Simplified modalities and procedures for small scale CDM project activities”, the small-scale project activity must demonstrate at least one of the barriers listed in Attachment A to Appendix B of the Simplified modalities and procedures, due to which the project activity would not have occurred in any case. In this respect, the following barriers have been identified for the PoA:

Investment Barriers

There is a lack of an investment framework for SWHs in South Africa. In 2007 the South African government launched through Eskom (national power utility) a once-of subsidy to homeowners to support the installation of Solar Water Heaters (SWH). The funding is a SWH subsidy, paid by Eskom based on the technical performance of the SWH. Further the Department of Energy of South Africa announced in late 2009 an ambitious target to roll out one-million SWHs by 2014 - an endeavour that would see an unprecedented growth in the SWH market, from manufacture, supply and installation, and also creating jobs as part of this program. However, by the end of 2009 less than 5,000 SWHs had been installed under the Eskom program[6].

The high upfront costs create a significant barrier for SWH. According to Eskom the average the cost of an installed SWH is between ZAR 12 000 and 35 000[7], whereas electric geysers cost typically maximum half of the price. Even though the payback period through the electricity savings for SWHs is relatively short, typically between 3 to 5 years, the high upfront costs are a barrier for most South African households. The 1.2 million households in South Africa that belong to the high income segment could possibly afford to finance a SWH. However, the pure success of the Eskom subsidy program clearly shows that even with a subsidy the households prefer an electric geyser. Furthermore, as a large share of South African households spend their income on basic needs, it is very unlikely that they could afford a technology with high upfront costs.

Local authorities in South Africa do not have access to funding or finance to embark on energy infrastructure investments of the scale contemplated under this programme. Further the duties of a municipality do not include hot water services. These reasons contribute to the fact that over 5 million households in South Africa are without a prober water heating system.

Under this programme the low pressure SWHs will be funded by SASSA and hence the installation is at no cost for the resident, who will also benefit from the programme through energy savings. This offer is only available while Eskom subsidies and Carbon Funding can be sourced.

Technological Barriers

The availability of the required skills for the development of solar water heating; the low penetration and the uncertainty in the market for SWHs prevents the development of the required skills. Furthermore there is not enough skilled labour for the installation and maintenance of the SWHs.

SASSA will train the local contractors to undertake the installations and maintenance of the solar water systems.

Other Barriers

The lack of awareness of SWHs and energy efficiency benefits, especially in the poor segment households, hinders the uptake of SWHs. People are not aware of the advantages of SWHs and how much water heating contributes to electricity bill in general. Further the knowledge on the Eskom subsidy and subsidy requirements is limited. As part of the programme SASSA will implement an educational program in the targeted communities. The programme will increase the knowledge of the residences on climate change, energy efficiency and the usage of SWH technology. Further a community based Small and Medium Entrepreneur Environment Broad Based Black Economic Empowerment (SMEE BBBEE) will be implemented. Under this programme local people will be trained on SWH related issues such as

[6] Eskom Distribution 2010, Solar Water Heating Programme, Monthly Status Report March 2010

7 Please see point 25 under http://www.eskomdsm.co.za/?q=Solar_water_heating_FAQs

installation, maintenance, and replacement to build local entrepreneurs knowledge on possibilities in the SWH market.

The above analysis shows that without the PoA SWH faces clear barriers which the continuation of current practice, with heating water with electricity, does not face.

The coordinating entity, SASSA, will perform a number of crucial tasks which are currently not well performed by the existing SWH industry, to overcome the above mentioned barriers. These include:

1. Marketing, supply, installation and maintenance of the SWHs;
2. Training the installers to provide households with a quality installation and maintenance service;
3. Organize and provide the funding for the installation of the SWHs on behalf of the households;
4. The educational communication and awareness campaigns in order to intensify the demand for solar water heating and to guarantee the proper functioning of the SWH.

The costs of the above mentioned management tasks are considerable, the only revenue to SASSA is the Eskom subsidy, which is not sufficient to cover all associated costs, and hence, the coordinating entity needs Carbon Credits to fund the shortfall, and to ensure that the tasks to overcome the above indentified barriers are met.

The PoA is a voluntary action, coordinated and implemented by the coordinating entity to supply, install, and finance solar water heaters to provide hot water services for low income households in South Africa and to reduce GHG emissions through the avoidance of electricity used for the purposes of heating water.

The project will contribute towards to the 10 TWh renewable energy target set in the White Paper on Renewable Energy by the Department of Minerals and Energy, published in November 2003[8], as well as the Governments ambitious target announced in late 2009, to roll out one-million SWHs by 2014. However, both targets have been set out without any mandatory requirements and hence there is no regulation for the installation of SWH in South Africa. The SWH implemented within the PoA are installed and included in the PoA voluntarily by SASSA and the consumers.

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

A.4.4.1. Operational and management plan:

The following operational and management arrangements have been established by the managing entity for the implementation of the PoA, including:

[8] *Available at: http://www.dme.gov.za/pdfs/energy/renewable/white_paper_renewable_energy.pdf*

1. A record keeping system for each CPA under the PoA

A database will be set up by the coordinating entity for the PoA. It will include the following information for each SWH installed in a SSC-CPA:

1. Site Details: street address and GPS coordinates, ERF number (i.e. 23 digit national property number)
2. Residence details: first name, surname, ID number and contact details
3. Installer Details: installation date, installer name, company and contact details
4. Installation Details: Serial Number, SWH type, size and collector area
5. CPA unit identification number
6. Confirmation that the dwelling has electricity and water connection
7. Residence Agreement to cede subsidy and carbon rights to SASSA

The database to be used is a SQL database that is hosted in a secure hosted environment. The server is hosted by a Data Company. All information is imputed from the residential agreement form into the data base either directly via the web interface or by database synchronisation with a third party database (this may vary in each CPA or municipality). The ERF number, which is a 23 digit national identification number for each property, is used to locate each SWH in a Geographical Information System (GIS) tool to enable spatial integration. ESRI ArcMap desktop product will be used to view the spatial data. The ESRI ArcMap (spatial view) can be used to identify candidate installations, as well as inform relevant parities when the status of the installation changes (e.g. finalized installation or failure). The information can be easily drawn from the database and utilized for reporting. Data will be archived for two years once the 10 year crediting period has lapsed. Relevant data capture, verification and storage procedures will be followed in maintaining the data to ensure its accuracy, validity and completeness.

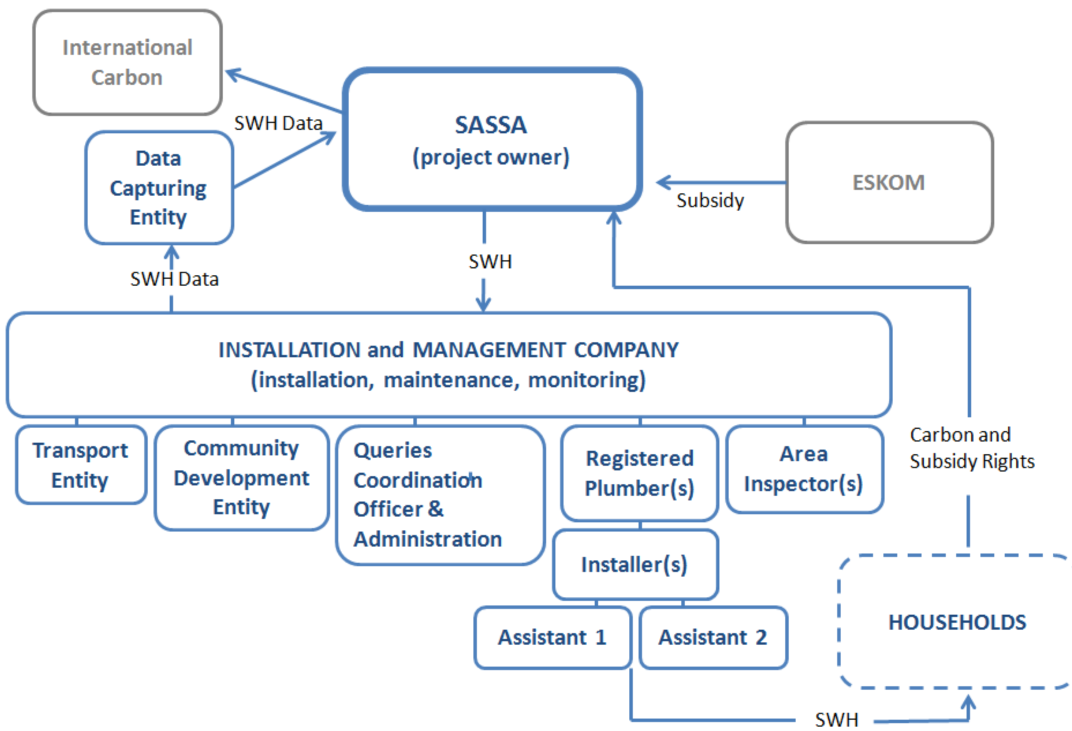
2. A system/procedure to avoid double accounting

The database ensures that all SWHs in a CPA are uniquely defined and are included in one CPA only, thereby avoiding double counting of emissions reductions generated by the CPA.

For each installation an installation sheet is compiled (including the information identified above in points 1-6) which is the proof that the SWH has been installed. The installation sheet is attached to the residential agreement. The installer will submit copies of all installation sheet and residence agreements to coordinating entity SASSA, which will ensure that the data capturing entity will input the information in an electric form (data capturing software – described above). The coordinating entity has a unique identifying number (serial number) which matches to the unique identifier physically attached to the SWH and can only be used once. With help of the series number and ERF-number each SWH can be linked to specific property and view in spatially in the database. The ERF number is a 23 digit property number, individual for each property in South Africa.

An area inspector will visit the household to ensure that the installation is done in accordance to the SABS and manufacturing SWH guidelines. After the inspection SASSA will pay the installer and apply for the Eskom subsidy. Eskom is invoiced weekly for payment. The serial number and the data capturing software ensure that applications for participation in the programme cannot be submitted twice for the same SWH. The diagram 2 below shows the management structure.

Diagram 2. Management structure of the PoA



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

In Accordance with paragraph 9, Annex 32 "Guidelines on assessment of de-bundling for SSC project activities" of the EB 36, if each of the independent subsystems/measures (e.g. 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 or PoA is exempted from performing de-bundling check i.e. considered as not being a de-bundled component of a large scale activity.

According to "Appendix B of the Simplified modalities and procedures for small-scale clean development mechanism project" small-scale threshold for solar energy projects is 64,000 m^2. Under this PoA the most typical installation is likely to be the 110-litre SWH, which has an absorber area of 1.08 m^2. The maximum collector area for SASSA SWHs is 1.8 m^2 (200 litre SWH), and in general the maximum collector area for 300 litre storage tank SWHs is 4 m^2 which is less than 0.007 % of the small scale threshold.

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

The coordinating entity is responsible for identifying, implementing, registering and managing all CPAs to be included in the proposed PoA and hence is given that the coordinating entity for the CPA is aware of the PoA and has agreed that the CPA be included in the PoA. Legally binding agreements will be signed by all residents installing a SWH under the PoA making them aware that they are participating in the SASSA programme and that their SWH will be included in a CPA and that the coordinating entity is the legal owner of the Certified Emission Reductions (CER's) from the installed SWH.

A.4.4.2. Monitoring plan:

The coordinating entity (SASSA) will implement a system that will allow the DOE to verify the emission reductions for each individual CPA and to consolidate the CPA's to determine the emission reductions for the PoA as a whole. The coordinating entity will establish a database for the PoA that contains sufficient data, specific to each CPA and SWH, to allow the DOE to calculate the emission reductions for each individual CPA. The information maintained will include:

- Location of the SWH systems registered (address, GPS coordinates and ERF number);
- Name and ID of the SWH system /property owner;
- Installation date of the SWH system;
- Details of the SWH installer
- Technical specifications of the SWH system (inc. type, size/volume, collector area);
- Unique identification number of the SWH (serial number);
- The dates when system stops operation and restarts operation;
- The reason for any system problems;
- Data from the sample group indicating the proportion of SWHs that were operating during the monitoring period;
- Data from the sample group indicating the number of systems operating
- Real–time measurement data for a sample group (i.e. annual solar irradiation, ambient temperature, inlet and outlet water temperature, waterfowl)
- Crediting Period of the CPA;
- Monitoring Period.

The SASSA Measurement and Verification (M&V) Plan for the low pressure solar water heating systems will guide the monitoring of each CPA. The M&V plan has three measurement and verification levels that are applied to ensure the operation of the SWH's and to calculate the ex-post emission reductions. These levels are: 1) real-time measurement (done in 1/10000 of the SWHs), 2) inspection of operationally (done in 1/100 of the SWHs), and 3) simulation approach to determine energy provide for each SWH passed on level 1 and 2 measurements.

Each installation is inspected within a few days after the installation to ensure correct installation and operation of the system. Each household will get an introduction and an operation manual for the SWH. The manual indicates a phone number for queries and complains. In case of a failure of a SWH the household will contact identified installers via given phone number. The installer will record the problem, the solution as well as how long the installation was out of operation. Complains are recorded in the data management system. During the operation of the SWHs constant random inspections are done to record and guarantee the operation of the systems (level 2 of M&V plan). For this purpose every one out of 100 (1/100) of the installations are inspected for accuracy and quality. The database will annually allocate the 1 in 100 sites for inspection by an automated random number generator, which will be set to never select the same site for inspection over the 10 year period. Therefore 10 percent of all the installations will be inspected over the 10 year monitoring period. The on-site inspections will be done by local subcontractor.

Furthermore one in ten thousand (1/10 000) installations will be measured and monitored real time to perform comprehensive measurement data. These measurements are used to adjust the SABS energy output estimates.The data at each of the metered sites is recorded every 5 minutes and integrated daily. Each metered site (1:10,000) is selected based on: 1) geographical location, namely there must be at least 1 metered site within 50 km[9] from any simulated site, and 2) Statistical representation, no more than 10,000 sites may be referenced to one metered site. In each area in which installations will take place the first installation will be a metered installation determined by random selection.

A monitoring report is produced for each monitoring period in order to verify the information related to the emission reductions contained in each CPA. Appropriate record keeping procedures will be implemented to ensure that each monitoring period data set can be transparently attributed to its corresponding CPA and SWH, preventing any occurrences of double counting.

For more details please see section E.7.2 and annex 4.

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

No public funding from parties included in Annex I is involved in this programme.

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

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

June 23, 2010

Based on the definition of a starting date of a PoA the starting date is determined to be 23rd of June 2010, which is the signing of the Venture Management Agreement between AES (the installation and management company in NMBM) and SASSA. In October 2009 Eskom announced that the SWH subsidy is also applicable for low pressure system (previously only applicable for high pressure systems). To apply for the subsidy the SWHs need to be tested and approved by SABS. The SASSA 110 litre low pressure SWH approval where received between August 2009 and July 2010. On the 16th of March 2010 SASSA signed a MoU with International Carbon to develop the project under the CDM approach in

[9] The rationale for the selection of the 50 km radius is based on measurements from three (3) weather stations near Nelson Mandela Bay, namely Addo [33° 34'E; 25° 42' S; Altitude 85m], Jansenville [32° 59'E; 25° 36' S; Altitude 60m] and East London [33° 01'E; 27° 49' S; Altitude 155m]. Between these three sites the maximum variance in annual average global radiation is 2 %, between Addo and Jansenville, which are in 115 km distance from each other. Eberhard Anton, A 1990, "A solar Radiation Data Handbook for Southern Africa", p 62 – 69.

order to source Carbon finance. In March 2010 SASSA also applied for the Eskom subsidy, and finally in the agreement between Eskom and SASSA was signed on 19th of July 2010. The first municipality to support the nationwide programme was Nelson Mandela Bay Municipality (NMBM). A MoU between SASSA and NMBM was signed on the 6th of April 2010. The three parties SASSA, International Carbon and Standard Bank agreed on the basic terms for the commercialization of the potential CERs. A Carbon Term Sheet was signed between the project participants on the 11th of May 2010.

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 a procedure is undertaken. Justify the choice of level at which the environmental analysis is undertaken:

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

Environmental analysis is undertaken at the PoA level, since the impacts of all CPAs will be similar.

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

There are no significant anticipated negative impacts on the environment and/or on people through this programme. The project reduces the consumption of non-renewable natural resources, such as fossil fuels and further reduces the GHG emission as well as of airborne particulates (ash) and pollutant gases which cause air quality problems. The installations will take place in existing infrastructure i.e. residential buildings. Hence, the environmental effects gained from the project implementation are of a positive nature.

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),:

The National Environmental Management Act 107 of 1998, effective from 1 July 2006, governs environmental impact assessments (EIA) and does not require an EIA or any other assessment (i.e. basic assessment, scoping report) for this type of activities and hence an EIA is not required for the measures undertaken under this programme.

More information on the national EIA law and process available at
http://www.eiatoolkit.ewt.org.za/process/what.html

SECTION D. Stakeholders' comments

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

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

Comments from local stakeholders where invited via a national news paper, local radio and through personal invites, which where send to the key stakeholders. The key stakeholders where identified to be the metro mayors, municipal managers and the Designated National Authority. Altogether 17 personal invites where send out. The news paper advert was placed on May 2 in Sunday Times inviting people to a public participation meeting, and to submit comments and queries via phone and email. The public participation meeting was held on May 7 in Nelson Mandela Bay. Two meetings took place at 2 pm and 4 pm. Comments were invited until the May 10, 2010.

D.3. Summary of the comments received:

The table 1 below summarizes the comments and queries received and the answers given:

Table 1. Summary of public participation queries.

No	Date	Means of Communication	Concern / Comment	Answer
1	2010/03/05	Phone	Person querying involved in CDM and would like to know more about the process and how this project is going to be run if no profit is made?	Profit is made from carbon credits. Furthermore the project will help SASSA to create more local production capacity. In longer term increased production will lead to decreased production costs .It was stated that the product will be at no cost to residents due to the sourcing of subsidies and carbon funding. SASSA still makes a marginal profit on the supply of the product (e*mail*).
2	2010/03/05	Phone	Requires more information about the project and the quantity and quality of the heaters.	This programme will start first installations in NMBM. However, the concept is to spread the programme to other parts of the country as well. There could be as many as 3 million units needed in South Africa. Any supplier with the right technology, quality, approvals from SABS and price can possibly join. *(call)*
3	2010/03/05	Phone	When will the project commence in Gauteng?	The roll out is expected to start in August 2010 in Gauteng (*call).*

4	2010/04/05	Phone	Manufactures a similar product and would like to get involved.	The workshop will not be marketing of any product but to explain the concept of the program At this stage SASSA products are used (SASSA is the managing entity). However, if the products fulfil the given SABS criteria cooperation with SASSA is possible. *(call)*
5	2010/04/05	Phone	Would like to get involved with financial benefit.	Discussion on the involvement possibilities and the non profit/ at non cost aspect of the project. *(call)*
6	2010/04/05	Phone	Will there be a conference near Johannesburg?	Not planned at this stage, but possible. If so separate announcement will be given. *(call)*
7	2010/04/05	Phone	Will there be a conference near KZN?	Not planned at this stage, but possible. If so separate announcement will be given. *(call)*
8	2010/07/05	Phone	Will there be a conference near Johannesburg?	Not planned at this stage, but possible. If so separate announcement will be given. *(call)*
9	2010/07/05	Phone	Has a portable product that might be compatible with the solar water heater.	Discussion on the technical aspect of the project. *(call)*
10	2010/05/03	Email	Advert on Masiqhame Instant Hot-Water Heaters	Noted
11	2010/05/03	Email	Can other companies interested be involved in the rollout, or are installations done by Tasol?	SASSA will used and a number of companies to undertake installation work. Depending on the potential services offered, it is possible for other companies to get involved. More information required to give more specific answer.*(email)*
12	2010/05/03	Email	Registered Plumber Contractor with resides in Dinwiddie, Germisto and would like to join the programme	The Ekurhuleni roll out is anticipated to start in August 2010. The installations are also community inclusive, with the intend of job creations and skills development. Details are kept on out files, and SASSA will contact at later stage to discuss the Ekurhuleni installation requirements *(email)*.

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

Most of the comments and questions received where around how to join the programme as plumber or SWH supplier. The participation requirements (right technology, registered plumbers etc.) where specified and the interested where asked to keep in contact with SASSA in order to join the programme.

SECTION E. Application of a baseline and monitoring methodology

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

From Appendix B of the "Simplified modalities and procedures for small scale CDM projects", the following methodology applies to the project activity:

Project Type: Type I – Renewable energy projects
Project Category: AMS-I.C. -Thermal Energy Production with or without electricity, Version 17

The "Tool to calculate the emission factor for an electricity system, Version 2" has also been applied in combination with the methodology AMS-I.D.

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

AMS.I.C version 17 is applicable to a SSC-CPA since a SSC-CPA meets all the requirements set out in the methodology:

- The CPAs included in this PoA comprise renewable energy technologies that supply users with thermal energy that displaces fossil fuel based gird energy.
- The methodology comprises technologies such as solar thermal water heaters.
- A SSC-CPA individually does not exceed the applicable SSC threshold which is 64 000 m^2 i.e. the CPAs are below the 64,000 m^2 threshold.[10]

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

As defined in AMS.I.C, the project boundary is the physical, geographical site of the renewable energy generation including the residential facility consuming the thermal energy produced. Hence the boundary for a SSC-CPA comprises the physical site of each SWH within the CPA as well as the South African grid system, as the SWH replaces grid electricity. Each CPA (CPA no) and SWH (serial no) can be indentified based on unique identification number.

The GHG reduced through the CPAs under this PoA is CO_2. The reduction takes place through the avoidance of fossil fuels (predominantly coal) used in the production of electricity to heat water, in the absence of the CPAs.

[10] Appendix B of the Simplified modalities and procedures for small-scale clean development mechanism project activities – A. General guidance - version 2 - http://cdm.unfccc.int/methodologies/SSCmethodologies/AppB_SSC_gnal_guid.pdf 'For thermal applications of solar energy projects, 'maximum output' shall be calculated using a conversion factor of 700 Wth/m^2 of aperture area of glazed flat plate or evacuated tubular collector i.e. eligibility limit in terms of aperture area is 64000 m^2 of the collector.'

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

With respect to AMS-I.C Version 17, the baseline for the displacement of electricity shall be calculated as per the procedures detailed in AMS-I.D (paragraph 17). This further state that the baseline emissions are the product of electrical energy baseline expressed in kWh produced by the renewable generating unit multiplied by an emission factor and refers further to "Tool to calculate the emission factor for an electricity system". The section E.6.2 shows the equations used to calculate the baseline.

South Africa has one of the most favourable conditions for harvesting the energy from the sun. Most areas in the country have more than 2 500 hours of sunshine per year, and the solar-radiation levels range between 4.5 and 6.5kWh/m^2 per day. Regardless of the favourable climate conditions and subsidy program (see section E.5.) only a few SWHs are in the market. The current total installed capacity in households is 330 000 m^2, which means that less than 3 % of the households in South Africa heats water with a SWH. The 3 % estimation is very conservative, as it is calculated with a 1 m^2 collector are, which is typical for 110 litre SWH. It is most likely that the installed SWHs are in high income households, which typically use 200-300 litre SWHs which have significantly bigger collector area (up to 4 m^2).[11,12]

In South Africa, hot water is predominantly heated by electric water heating systems. The domestic sector uses about 13 % from the total electricity consumption in the country and about 40 % of it is used for water heating. There are approximately 11 million households in the country of which the high and middle income households use electric geysers to heat water. More than 76 % of these income groups have an electric geyser. In the low income and poor segment households the penetration level of electric geysers is 21 %. In this income group there are over five million households that have an electricity connection, but cannot afford a geyser. These households heat up the water with kettles and stoves that use electricity or paraffin.[10,13]

Suppressed demand for energy services refers to a state where current levels of access to energy services, before any CDM intervention, are inadequate because of income or infrastructure constraints, thus not reflecting real demand for energy services by energy poor households. The paragraph 46 of the CDM Modalities and Procedures state that "the baseline may include a scenario where future anthropogenic emissions by sources are projected to rise above current levels, due to the specific circumstances of the host Party." Hence the baseline refers to a situation that would be occur, if suppressed demand did not exist.

This programme will install SWHs in the low income and poor segment households, which do not have a proper water heating system. These households heat water with electric or paraffin stoves, or electric kettles. The reason for this is that in poor communities households demand less service because they cannot afford to buy more i.e. the demand is suppressed due to income constrains or lack of access to funds. The warm water service is not installed as a component of low cost housing delivery in South Africa. The National Housing Code determines the minimum requirement to be a metered single standpipe[14].

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[11] O.D Dintchev 2004, Evaluation of Domestic Solar Water Heaters – Domestic Use of Energy Conference 2004.

[12] Department of Energy Website 1 May 2010: http://www.dme.gov.za/energy/renew_solar.stm.

[13] N. Magubabe 2009, Speaking Notes of the Acting Director-General of Department of Energy Ms Nelisiwe Magubabe, Johannesburg 5 November 2009.

[14] The Department of Human Settlements 2009, The National Housing Code – Technical and General Guidelines.

As demonstrated above, in South Africa water is predominantly heated by electric water heating systems (medium and high income household). If the low income households could afford a prober water heating system, the most likely future scenario would be installation of an electric geyser. The suppressed demand and the increasing and preferred electricity use for water heating in low income housing can be confirmed from the following studies "NMBM Solar Water Heater Pilot Project - Social Contribution, 2009" and "Social Research Study for Kuyasa 2003". Hence the baseline for this programme is determined to be electric water heating.

This programme will eliminate part, of the suppressed demand by decreasing the cost of energy services and thus increasing access to energy services whilst allowing energy poverty to decline in a carbon neutral way. The table 2 presents the key parameters for the baseline determination.

Table 2. The salient project parameters[15].

Parameter	Unit	Value
Size	litre	110
SABS Test No	-	09S097 b
Energy Output per day (Q)	MJ	13.692
Energy Output per day (Q)	kWh	3.803333
SABS test period	h	6
Power Rating of a SWH	kW	0.633889
Absorber Area	m^2	1.08

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):

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

The barriers for individual CPAs are identical to the PoA. In accordance with the "Attachment A to Appendix B" of the simplified modalities and procedures, and the "Non-binding best practice examples to demonstrate additionality for SSC project activities" (EB 35, annex 34) following barriers have been identified for the CPAs:

Investment Barriers

The high upfront costs create a significant barrier for SWHs. According to Eskom the average the cost of an installed SWH is between ZAR 12 000 and 35 000[16], whereas electric geysers cost approximately half of the price. Even though the payback period through the electricity savings for SWHs is relatively short, typically between 3 to 5 years, the high upfront costs are a barrier for most South African households.

[15] Please note that the size, SABS test number, and output may vary, if different SWHs/upgrades are applied. However, this will be indicated in the CPA-DDs, if relevant.

[16] Please see point 25 under http://www.eskomdsm.co.za/?q=Solar_water_heating_FAQs

The 1.2 million households in South Africa that belong to the high income segment could possibly afford to finance a SWH. However, the poor success of the Eskom subsidy program clearly shows that even with the subsidy the households still prefer an electric geyser.

There are over 5 million households in South Africa that belong to the low income segment. These households spend their income on basic needs; and it is therefore very unlikely that the households would afford a technology with high upfront capital costs. The individual CPAs under this programme will target these households. The low pressure SWHs will be funded by SASSA resulting in no cost for the resident, who will also benefit from the programme also trough electricity savings. This offer is only available while Eskom subsidies and carbon finance can be sourced.

The table 3 below shows the most important key data for the investment comparison analysis of the two different scenarios (CPA with and without carbon) with the maximum 59 000 installations. The table clearly shows the shortfall between cost and income (subsidy), without carbon funding and the difference in the Internal Rate of Return. The detail financial analysis is shown in appendixes V and VI.

Item	***ZAR With CERs***	***ZAR Without CERs***
Cost per SWH		
Production Cost	2508	2508
Installation Cost	1523.04	1523.04
Maintenance, Monitoring and Management	518.70	518.70
Total	4549.74	4549.74
Revenue		
Subsidy per SWH	4240	4240
CER Price	105	105
Other Variable		
CPI	5.1 %	5.1 %
VAT	14 %	14 %
Exchange Rate (EUR-ZAR)	10.5	10.5
Finance Cost	2.5 %	2.5 %
IRR	6.15 %	- 6.45 %

Table 3. Key data for the investment comparison analysis with and without carbon revenue.

Technological Barriers

The availability of the required skills for the development of solar water heating; the low penetration and the uncertainty in the market for SWHs prevents the development of the required skills. There is also not enough skilled labour for the installation and maintenance of the SWHs. SASSA will train the local contractors to undertake the installations and maintenance of the solar water systems.

Other Barriers: Lack of Awareness

The lack of awareness of SWHs and energy efficiency benefits, especially in the poor segment households, hinders the uptake of SWHs. People are not aware of the advantages of SWHs and how much water heating contributes to electricity bills in general. Further the knowledge on the Eskom subsidy and subsidy requirements is limited. As part of the programme SASSA will implement an educational program in the targeted communities and further it will apply the Eskom subsidy on behalf of the households. SASSA will establish a community training centre to educate people on climate change, energy efficiency and SWH themes.

Simplified Additionality

In the 54th CDM Executive Board meeting a new "Guideline for demonstrating additionality of renewable energy projects = < 5 MW and energy efficiency projects with energy savings < =20GWH per year" was given (annex15). According these guideline renewable energy projects up to 5 MW are additional, if the independent subsystem/measure (e.g. SWH) in the project activity is smaller than or equal to 2 250 kW thermal installed capacity and the end users of the subsystem or measure are households/communities/SMEs.

The SWHs installed under this programme have an installed capacity of 0.634 kW for the detailed calculation) and all installations are done in households. Hence, the CPAs can apply the simplified additionality rule, if it fulfils the 5 MW requirements i.e. all CPAs with maximum 31 550 SWHs are automatically additional based on the new guideline. Please see appendix III for detail calculations.

The above analysis shows that without the PoA SWH face specific barriers, which the continuation of the current practice (i.e. heating water with electricity), does not face.

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

Each CPA, that is funded and implemented by SASSA or its affiliate agencies, is additional as per the additionality demonstration for the entire PoA (section E.5.1.). The PoA faces financial and technical barriers as well as barriers due to lack of awareness and thus has no intention to implement the CPA without the additional carbon revenue. However, the additionality of each CPA using one of the above arguments is discussed in the CPA-DD B.3.

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:

The CPAs under this PoA will apply the small scale methodology AMS-I.C. "Thermal energy production with or without electricity", version 17. With respect to AMS-I.C Version 17, the baseline for displacement of electricity shall be calculated as per the procedures detailed in AMS-I.D. AMS-I.D determines that the baseline emissions are the product of electrical energy baseline expressed in kWh produced by the renewable generating unit multiplied by an emission factor, and refers further to the "Tool to calculate the emission factor for an electricity system". The equations used to determine the emission reduction is discussed in E.6.2.

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

Baseline Emissions

The paragraph 17 of AMS-I.C applicable for displacement electricity from a grid refer to AMS-I.D, which determines that the baseline emissions are the product of electrical energy baseline expressed in kWh produced by the renewable generating unit multiplied by an emission factor:

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

Where,

BE_y = Baseline Emissions in year *y*, tCO_2e;

$EG_{BL,y}$ = Energy baseline in year *y*, kWh;

EF_{CO2} = CO_2 Emission factor, tCO_2/kWh.

The Emission Factor is calculated according to the “Tool to calculate the emission factor for an electricity system”. The Energy Baseline is the energy output determined by SABS test[17], which has been calculated as follows:

$Q = \alpha_1 H + \alpha_2 (T_a - T_c) + \alpha_3$

Where,

Q = Energy output in MJ

H = The energy input i.e. irradiation in MJ per m^2

T_a = The ambient air temperature and

T_c = Incoming cold water temperature

$\alpha_1, \alpha_2, \alpha_3$ = Specific coefficients determined in the SABS test

The determination of $Q_{i,y}$ complies with the SANS 6211-1: 2003 test[18] for the solar absorption efficiency of a domestic solar water heating system.

The energy output described above bases on the assumption that 110 litre warm water is used per day in the household. In sizing of a solar water heater 50 litres per person daily consumption is used as basis. Typically additional 50 litres is included for dishwashing and miscellaneous (e.g. a four person household typically gets a 250 litre SWH).[19] 50 litres per person is also the recommended basic water consumption to cover basic human. In poor households, due to lack of prober water supply (“suppressed demand

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[17] The SABS test results determine also the level of Eskom subsidy.
[18] South African National Standard as published by the South African Bureau of Standards (www.sabs.co.za)
[19] http://www.pacinst.org/reports/basic_water_needs/basic_water_needs.pdf

situation"), hot water consumption is less, typically approximately 25 litres. The low income households in South Africa have in average more than 4 people. Hence, the daily water consumption can be estimated to be approximately 110 litres per household.[20] When heating 110 litres of water from 20 Celsius degrees to 55 Celsius degrees 16 MJ energy is required. (The cold water inlet temperatures in South Africa vary from 14 to 24 Celsius degrees, being in average at 20 Celsius degrees and hot water outlet temperatures from 50 to 65 is Celsius degrees[21]). Hence, the SABS test gives rather conservative energy output, compared to the approach where the required energy would be calculated trough water inlet and outlet temperatures and the water flow. Please see appendix III for detailed calculation. Furthermore is should be noted that neither the efficiencies of baseline water heating systems nor transmission and distribution losses have been taken in consideration, which makes the baseline determination conservative.

Grid Factor

The grid emission factor is calculated according to the "Tool to calculate the emission factor for an electricity system". In South Africa Eskom dominates the electricity supply market and only a few municipal and private generators exists. The Eskom power plants public information exists until 2008, and the private generators information is available only partly until 2005. It is considered to be acceptable that Eskom represents the electricity production industry in South Africa, as it produces over 96 % of electricity in South Africa. Only less than 4 % comes from private and municipal generators. [22]

In South Africa the grid system is a nation wide grid system, and fuel consumption as well as net electricity generation data is available for all Eskom systems. Hence, the simple operating margin has been selected (option A, equation 1 of the tool). The method is applicable as the low-cost/must-run resources constitute less than 50% of total grid generation in South Africa (please see annex). Hence, the operating margin has been calculated *ex-ante* based on 3-year generation-weighted average on the most recent publicly available data. As the newest power plants which built over 10 years ago the build margin is calculated based on the five power plants built most recently (option A, equation 13 of the tool). Finally, the combined margin, i.e. grid emission factor, is calculated applying equation 14 of the tool. The data is presented in annex 3, and the detail calculation is presented in the appendix III.

The power plant data has been obtained from Eskom Websites under General Power Plant Data (2005,2006/7,2007/8) available under:
http://www.eskom.co.za/live/content.php?Item_ID=4226&Revision=en/3.

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[20] Water consumption patterns, available at: http://www.unep.org/dewa/africa/publications/aeo-1/149.htm and http://www.pacinst.org/reports/basic_water_needs/basic_water_needs.pdf
[21] D. Breakspear 1998, Residential Water Heating Systems, p. 242; Eskom 2009, The Energy Efficiency Series – Towards Energy Efficient Mining Sector, p 8; R. Rankin 2008, An Investigation into the Energy Saving and Economic Viability of the Heat Pump Water Heaters applied in the Residential Sector – a Comparison with Solar Water Heating System, p 4
[22] Electricity supply statistics of South Africa, 2005 (the latest one), page 6, 14. Available under: http://www.nersa.org.za/documents/ArchivedESSDocuments.aspx

Project Emissions

According AMS.I.C the project emissions consist of CO_2 emissions from onsite fossil fuel consumption. As this PoA does not include an electric backup system, there are no emissions related to the project activity. The managing entity could not identify any other emission sources associated with the project implementation. Hence the project emissions in year y is zero ($PE_y = 0$) under this programme.

Leakage

According AMS.I.C. leakage shall be considered if the SWH is transferred from another activity, or the PoA includes replacement of existing equipment. The PoA takes place in poor income households that currently lack proper water heating equipment, and hence heat up water with electric kettles and electric and kerosene stoves. Hence the SWH is rather seen as a new installation opposite to the replacement of existing equipment (see section E.4 for suppressed demand argumentation). The baseline water heating systems will be further used for cooking. Leakage ($LE,_y$) is considered to be zero under this programme.

Emission Reductions

$ER_y = BE_y – PE_y - LE_y$

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

Data / Parameter:	**EF_{grid}**
Data unit:	tCO2e/MWh
Description:	The emission factor for the electricity system.
Source of data used:	Calculated
Value applied:	0.9798 tCO_2e/MWh
Justification of the choice of data or description of measurement methods and procedures actually applied :	The factor is calculated according to the guidance given in the Tool to calculate the emission factor for an electricity system, Version 02.
Any comment:	Please see annex III and appendix III for more detailed information.

Data / Parameter:	Q
Data unit:	TJ
Description:	Daily solar energy output by the SWH i in the day
Source of data used:	SABS test results
Value applied:	
Justification of the choice of data or description of measurement methods and procedures actually applied :	The solar water heater system analysis is based on SANS 6211-1:2003. The SABS test determines the energy output of the SWH. The SABS test result is used for ex-ante calculation. For ex-post calculation the SABS test is adjusted based on the real-time measurements.

Any comment:	Note that the test result is adjusted only if lower values are measured.

Data / Parameter:	$\mathbf{N_{estimate}}$
Data unit:	Units
Description:	Estimated number of units installed under the CPA
Source of data used:	Estimated based on size of absorber area
Value applied:	59 000 (maximum)
Justification of the choice of data or description of measurement methods and procedures actually applied :	During the Design Document development, it shall be estimated, how many SWHs will be included in this CPA, based on the collector area. Based on the SSC limits the maximum total collector are of each CPA shall be 64 000 m^2, giving 59 000 SWHs with a 1.08 absorber area of the collector.
Any comment:	

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

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

Data / Parameter:	**N**
Data unit:	--
Description:	Number of SWH operating in the year
Source of data to be used:	Site visits: visual and technical checks, as well as failure reporting
Value of data applied for the purpose of calculating expected emission reductions in section B.5	100 %
Description of measurement methods and procedures to be applied:	1 in 100 randomly selected sites will be inspected, the installation will be checked for data capture accuracy and if system functionality. The database will annually allocate the 1 in 100 sites for inspection by an automated random number generator, which will be set to never select the same site for inspection over the 10 year period. Therefore 10 percent of all the installations will be inspected over the 10 year monitoring period. Furthermore all reported failures will be recoded into the data capturing system.
QA/QC procedures to be applied:	
Any comment:	100% applied for ex-ante. For ex-post will be reduced based on the results of the sample and reported failures.

Data / Parameter:	$\mathbf{Q_{,y}}$
Data unit:	MWh
Description:	Solar energy output by the SWH in the year *y*, MWh
Source of data to be used:	Calculation

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:	The calculation bases on the SABS test results, which is adjusted with the real-time measurement results.
QA/QC procedures to be applied:	Sample group (1/10 000) and confirmation of the applied irradiation and average temperature values with university / weather station data.
Any comment:	

Data / Parameter:	$\mathbf{H_{year}}$
Data unit:	MJ/m^2 or TJ/m^2
Description:	Annual average irradiation
Source of data to be used:	Measured on-site
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:	One (1) in ten thousand (10,000) installations will be measured and monitored real time so as to perform comprehensive measurement and verification. The data at each of the metered sites is recorded every 5 minutes and integrated daily. Pyranometer is used to determine the solar irradiation.
QA/QC procedures to be applied:	The measured irradiation is cross-checked with irradiation figures from local universities and weather stations, if available. The equipment is calibrated according manufacturers recommendation.
Any comment:	Used to adjust the energy output determined in the SABS test.

Data / Parameter:	$\mathbf{Ta,_{year}}$
Data unit:	Celsius or Kelvin
Description:	The average annual ambient air temperature
Source of data to be used:	Measured on-site
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:	One (1) in ten thousand (10,000) installations will be measured and monitored real time so as to perform comprehensive measurement and verification. The data at each of the metered sites is recorded every 5 minutes and integrated daily. Each measured site will have one ambient temperature probe, which is measured with a transducers.

QA/QC procedures to be applied:	The measured temperature is cross-checked with irradiation figures from local universities or weather stations, if available. The equipment is calibrated according manufacturers recommendation.
Any comment:	Used to adjust the energy output determined in the SABS test.

Data / Parameter:	$Q_{on-site}$
Data unit:	MWh
Description:	Solar energy output by the SWH in the year *y*, MWh
Source of data to be used:	Measured on-site
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:	One (1) in ten thousand (10,000) installations will be measured and monitored real time so as to perform comprehensive measurement and verification of the amount of energy displaced. These SWHs are measured for irradiation, ambient air temperature, for water inlet and outlet temperature and water flow. The data at each of the metered sites is recorded every 5 minutes and integrated daily.
QA/QC procedures to be applied:	The measured SWHs are used to adjust the energy output determined in the SABS test.
Any comment:	

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

The methodology AMS-I.C. “Thermal energy production with or without electricity”, Version 17 determines that, if the emission reduction per system is less than 5 tonnes CO_2 per year, monitoring shall consist of:

i) the number of systems operating, and
ii) estimating the annual hours of operation of the average system.

The estimation of the operation hours is not appropriate as the SWH receives solar radiation constantly during the day and the energy used for water heating is relative to the amount of irradiation and average ambient temperature. Hence, annual average irradiation and ambient average temperature are metered in 1/10 000 of the installations, or more based on the maximum distance of 50 km of each SWH to the measurement point. The rationale for 50 km maximum distance is that within 50 km the weather patterns are very similar and hence the variation is minimal (see section A.4.4.2). Furthermore water flow and inlet and outlet temperatures are measured. This data is used to adjust the energy output determined in the SABS for the specific SWH (calibrated simulation approach). This is done in a way that each SWH is liked in the data base to the nearest measurement point (maximum distance 50 km). In case the measured daily energy output is less than 13.692 MJ (SABS test result), the daily energy output of all the SWHs linked to that specific measurement point are reduced accordingly. No adjustments are done if measurement results giver higher daily energy outputs. This is a conservative approach. The data at each of the metered sites is recorded every 5 minutes and integrated daily. At midnight every day, the simulation is executed on each household/SWH based on the daily measured values. As a cross check measure the measurement results are compared to measurements from universities or weather stations.

To confirm the number of operating systems 1 % of the installations in each CPA are sampled for functionality, as well as to check the data capture accuracy. The database will annually allocate the 1 in 100 sites for inspection by an automated random number generator, which will be set to never select the same site for inspection over the 10 years period. Therefore 10 percent of all the installations will be inspected over the 10 years monitoring period. The results are used to adjust the ex-post emission reduction calculation (i.e. % of SWHs operational). Please see Annex 4 for more details on sample size.

To reach optimal operation levels each installation is inspected within a few days after the installation to ensure correct installation and operation of the system. Each household will get an introduction and an operation manual for the SWH. The manual indicates a phone number for queries and complains. In case of a failure of a SWH the household will contact identified installers via given phone number. The installer will record the problem, the solution as well as how long the installation was out of operation in the data management system. The programme has a 10 year maintenance period under which all SWHs are inspected every 3 years and cleaned from water calcification and the seals are replaced.

Hence, the monitoring plan and the ex-post emission reduction calculations are based on following data:

1. Confirmation of operation of the systems, through a technical inspection (1 % of the sample) as well as recorded system failures (continues data capturing)
2. SABS test result
3. Real-time measurements: annual average solar radiation, annual average ambient temperature, inlet and outlet water temperature and water flow (1/10000 measurement group)

The SASSA Monitoring and Verification Plan determines the detail measures for sampling and measurement, as well as calibration of the measurement equipment. The pyranometer, the ambient temperature probe and the cold-water temperature probe will at all times have a valid calibration certificate. The calibration expiry period will be programmed into the on-line database and monitoring system which will warn the relevant responsible person that the calibration expiry period is approaching. One month prior to the expiry period a new works order will be issued and the relevant instrumentation will be replaced with a calibrated unit and the removed item either recalibrated for future use or disposed of.

SASSA will subcontract a specialised company for record keeping and maintaining of the data. The following data is recorded in the database for monitoring purposes from each CPA:

- Unique identification the SWH (series number and ERF number);
- Installation date of the SWH system;
- System specifications including size, collector area and SABS test results;
- Number of systems operating based on the sample group;
- System problems: the reason for any system problems and dates when system stops operation and restarts operation;
- Real-time measurement results: daily solar irradiation, daily ambient air temperature, daily water flow and inlet and outlet temperatures (for sample group).

The database to be used is a SQL database that is hosted in a secure hosted environment. The information can be easily drawn from the database and utilized for reporting. Data will be archived for two years once the 10 year crediting period has lapsed. Relevant data capture, verification and storage procedures will be followed in maintaining the data to ensure its accuracy, validity and completeness. Please see section A.4.4.1 for more details on the data capturing.

The sampling and maintenance will be undertaken by the service provider, with inputs provided by the local municipality for customer/household.

International Carbon will assist the coordinating entity to produce a monitoring report for each monitoring period in order to verify the information related to the emission reductions contained in the CPA.

The PoA record keeping procedures will prevent double counting across CPAs (each SWH with in each CPA can be uniquely identified and spatially placed based on the serial number and ERF-number).

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)

The baseline study and monitoring methodology were completed on 17/08/2010 by:

Organizations	International Caron
Address	97 Ashley Road
Postal Zip/city	Walton-on-Thames, London, KT12 1HH
Country	United Kingdom
Represented by:	Laura Lahti
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Email	laura.lahti@intlcarbon.com

Annex 1

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

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Organization:	International Carbon
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding from Annex I countries has been received for this PoA.

Annex 3

BASELINE INFORMATION

Data for Grid Emission Factor Calculation

The below s show the data used for Emission Factor determination. The calculation is presented in Appendix III.

Table 3 Power Plant Data

plant name and type	year of comissioning	total capacity (MW)	low cost/ must run plants	build margin plant	fuel type	emission factor [tCO2/MJ]	NCV [MJ/t]
Arnot	1971/09/21	1 980			Coal	0.0000895	19186
Duvha	1980/01/18	3 450			Coal	0.0000895	19186
Hendrina	1970/05/12	1 895			Coal	0.0000895	19186
Kendal	1988/10/01	3 840		X	Coal	0.0000895	19186
Kriel	1976/05/06	2 850			Coal	0.0000895	19186
Lethabo	1985/12/22	3 558		X	Coal	0.0000895	19186
Matimba	1987/12/04	3 690		X	Coal	0.0000895	19186
Majuba	1996/04/01	3 843		X	Coal	0.0000895	19186
Matla	1979/09/29	3 450			Coal	0.0000895	19186
Tutuka	1985/06/01	3 510			Coal	0.0000895	19186
Koeberg	1984/07/21	1 800	X		Nuclear	0	0
Acacia	1976/05/13	171			Gas/Kerosine	0.0000708	42400
Port Rex	1976/09/30	171			Gas/Kerosine	0.0000708	42400
Peaking							
Simunye							
Komati							
Colley Wobbles	1900/01/01	42	X		Hydro	0	0
First Falls	1900/02/01	6	X		Hydro	0	0
Gariep	1971/09/08	360	X		Hydro	0	0
Ncora	1900/03/01	2	X		Hydro	0	0
Second Falls	1900/04/01	11	X		Hydro	0	0
Van Der Kloof	1977/01/01	240	X		Hydro	0	0
Drakensberg	1981/06/17	1 000			Pump Storage	0	0
Palmiet	1988/04/18	400		X	Pump Storage	0	0
Camden (re-inst	1966/12/21	1 600			Coal	0.0000895	19186
Grootvlei	1969/06/30	1 200			Coal	0.0000895	19186
Komati	1969/06/30	1 000			Coal	0.0000895	19186
Total							
TOTAL with out low cost/must run							

Table 4. Power Production and Emission Date

Plant name and type	*Net Energy Production (MWh)*			*Fuel Consumption (tonne)*			Emissions (t CO2e)		
	2005	2006/7	2007/8	2005	2006/7	2007/8	2005	2006/7	2007/8
Arnot	11 495 036	15 938 102	11 905 060	5 456 640	8 063 020	6 210 700	9 369 853	13 845 391	10 664 685
Duvha	24 479 488	31 550 562	23 622 732	11 765 290	15 915 147	12 425 531	20 202 732	27 328 647	21 336 463
Hendrina	12 410 151	16 083 288	13 756 351	6 883 375	8 746 546	7 794 220	11 819 767	15 019 105	13 383 821
Kendal	26 461 793	34 164 855	26 517 420	15 161 339	20 115 835	15 986 131	26 034 248	34 541 846	27 450 537
Kriel	20 510 202	22 468 695	17 762 398	10 518 778	11 722 579	9 059 934	18 062 288	20 129 391	15 557 238
Lethabo	22 498 940	32 052 833	25 701 723	15 602 785	22 792 396	18 314 572	26 792 275	39 137 894	31 448 812
Matimba	28 401 085	34 983 880	29 021 742	9 369 375	18 075 673	14 862 323	16 088 594	31 038 588	25 520 793
Majuba	17 620 119	22 828 565	23 680 971	14 338 444	11 834 508	12 853 342	24 621 216	20 321 590	22 071 078
Matla	23 782 480	30 864 194	24 549 833	12 929 861	16 867 123	13 795 309	22 202 472	28 963 330	23 688 573
Tutuka	16 500 638	23 389 829	20 980 242	8 599 359	11 654 556	10 627 575	14 766 364	20 012 586	18 249 109
Koeberg	0			0					
Acacia	47 848			13 641			40 949		
Port Rex	30 094			8 579			25 755		
Peaking									
Simunye									
Komati									
Colley Wobbles	0			0			-		
First Falls	0			0			-		
Gariep	402 432			0			-		
Ncora	0			0			-		
Second Falls	0			0			-		
Van Der Kloof	322 928			0			-		
Drakensberg	1 818 463			0			-		
Palmiet	796 020			0			-		
Camden (re-instated 2005-06)	756 540	2 815 982	5 171 057	390 000	257 000	3 218 873	669 687	441 307	5 527 278
Grootvlei	0	0	237 138	0		130 747.70	-	-	224 513
Komati	0	0		0			-		
Total	208 334 257	267 140 785	222 906 667				190 696 201	250 779 674	215 122 902
TOTAL with out low cost/must run	***204 994 414***	***267 140 785***	***222 906 667***				***190 696 201***	***250 779 674***	***215 122 902***

Table 5. Grid Emission Factor

Operating Margin		
Average Emissions	***218 866 259***	
Average Energy Production	***231 680 622***	
EF OM	***0.9447***	***t CO2/MWh***
Build Margin		
Emissions	106 491 220	t CO2
Energy production	104 921 856	MWh
EF BM	***1.0150***	***t CO2/MWh***
Combined Margin		
Grid Emission Factor	***0.9798***	***t CO2/MWh***

The power plant data is taken from Eskom Website for General Power Plant Data, available under: http://www.eskom.co.za/live/content.php?Item_ID=4226&Revision=en/3. The NCV for coal has been sourced from Eskom annual report 2008 (page 216) available at http://www.eskom.co.za/annreport08/ and the NCV value for Kerosine from IPCC 2006. Eskom letter confirming the coal quality (low grade bituminous coal) has been submitted to the DOE. The fact that Acacia and Port Rex are gas turbine stations, which are powered by kerosene as their primary fuel can be confirmed under: http://www.eskom.co.za/content/GX%200001GenPlantMixRev7.doc. The emission factors applied are from 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2, Energy.

Annex 4

MONITORING INFORMATION

Annual Check of Representative Sample to Ensure Operation of the SWHs

To confirm the number of operating systems 1 % of the installations in each CPA are sampled for functionality, as well as to check the data capture accuracy. The database will annually allocate the 1 in 100 sites for inspection by an automated random number generator, which will be set to never select the same site for inspection over the 10 years period. Therefore 10 percent of all the installations will be inspected over the 10 years monitoring period. The results are used to adjust the ex-post emission reduction calculation (i.e. % of SWHs operational).

Depending from the CPA size the sample size can be up to 590 installations per year, which is very likely to give an answer in sufficient confidentiality level. According the “General guidelines for sampling and surveys for SSC project activities”, the sample size shall be determined with minimum 90% confidence interval and 10% maximum error margin. This implies to determine the sample size with 90% probability of falling in the range of ± 10% of the true population value (often denoted as 90/10 precision) and can be calculated based on a normal / Gaussian distribution.

To estimate the sample size (n), of the SWHs installed and operating under the program in the households with a maximum10% margin of error at desired confidence level of 90%, the optimal sample size n of the SWHs is given by:

$$1.645 \frac{\sigma}{\sqrt{n}} \leq 0.1$$

And the sample size n is:

$$n \geq \frac{(1.645)^2}{(0.1)^2} \sigma^2 \approx 270.6\sigma^2$$

The value 1.645 denotes the abscissa of the normal curve that cuts off an area of 0.1 at the tails to give the desired confidence level of 0.9, and can be obtained from normal distribution tables.

Since the maximum value of σ^2 is ¼, the sample size n=65 should suffice. However, to gain meaningful data for the mean and the standard deviation a more conservative sample group between 100 and 200 is often selected[23]. As 1 % of the installations (which is likely to be between 350-590 SWHs per CPA) will be checked annually for operation, the 90/10 precision is well fulfilled with the 1 % sample size.

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[23] Please see also AM0046 / Version 02 for sample size discussion.