



**PROGRAMME DESIGN DOCUMENT FORM FOR  
SMALL-SCALE CDM PROGRAMMES OF ACTIVITIES (F-CDM-SSC-PoA-DD)  
Version 02.0**

**PROGRAMME OF ACTIVITIES DESIGN DOCUMENT (PoA-DD)**

**PART I. Programme of activities (PoA)**

**SECTION A. General description of PoA**

**A.1. Title of the PoA**

Hot Water Heating Programme for South Africa  
Version 2  
02/05/2012

**A.2. Purpose and general description of the PoA**

The objective of this small scale programme of activities (hereafter referred to as the “PoA”) is to install heat pumps (hereafter referred to as “HP”) and solar water heaters (hereafter referred to as “SWH”) throughout South Africa. The solutions can be installed individually or as a combination of a heat pump and solar geyser (hereafter referred to as “hybrid solution”). The installations can take place in domestic or commercial buildings. The programme will replace exiting electric geysers.

In South Africa, electricity is used to heat water for domestic and industrial hot water purposes. Eskom, as the state-owned electricity supplier, dominates the generation capacity, which is driven mainly by coal (>90%). Since 2008, South Africa is subject to electricity shortfalls. Although new generation capacity is under construction (three new coal power stations being built by Eskom) electricity supplies are still predicted to be tight over the next three to five years. Due to the historically low cost of electricity, alternatives such as HPs and SWHs have not been considered. Additional reasons for low market penetration rates for these include comparatively high upfront costs and a lack of awareness of their environmental and economic benefits.

The main electrical-demand challenge for South Africa is therefore to reduce energy consumption from a sustainable demand side management perspective. This PoA will involve the implementation of HPs and SWHs and will therefore help reduce the electric water heating load. Furthermore it will contribute in achieving a sustainable energy mix for South Africa.

The PoA fulfils the national sustainable development criteria determined by the Department of Minerals and Energy of South Africa and contributes to sustainable development as follows<sup>1</sup>:

**Economic Dimension**

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<sup>1</sup> 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](http://www.dme.gov.za/dna/pdfs/sustainable_criteria.pdf)



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 will help South Africa correct the energy mix, with a greater focus on renewable energy. Furthermore the project will create local job opportunities during the installation period as well as maintenance of the HPs and SWHs during the operational periods.

### **Environmental Dimension**

The programme will contribute towards a sustainable, low-carbon economy by reducing electricity consumption and making use of renewable energy, and thereby reducing the amount of greenhouse gases (hereafter referred to as “GHGs”) produced by fossil fuel combustion at the national electricity grid level.

### **Social Dimension**

Through the programme, job opportunities will be created in the HP and solar sector. Manpower is required for installation, maintenance and monitoring of the programme activity, with training provided for technicians to install and maintain the systems. Hence the project will lead to skills and knowledge development. Furthermore the PoA will lead to reduced electricity bills (cost savings) in the target households and SMEs.

### **Policy/Measure or Stated Goal of the PoA**

This project is a voluntary initiative coordinated by Low E Co. Eskom supports the installation of HPs and SWHs for both domestic and industrial use by providing a subsidy. However, reduction of electricity use or installation of HPs/SWHs is not required by law. The stated goal of the PoA is to install HPs and SWHs in households and industry, thereby displacing carbon intensive electricity from the grid currently used to provide hot water.

All HP and SWH installations under this PoA will comply with the relevant SABS Standard Specifications. These are for residential SWH systems SANS<sup>2</sup> 6211-1:2003, SANS 151-2002<sup>3</sup>, SANS 6210:1992 and SANS 60335-2-21:2000 (including the Thermal Performance Testing, Fixed Electrical Storage Water Heaters, Mechanical Qualification Testing and Safety of Households and Similar Appliances) and for residential HP SANS 151-2002, SANS 181:2004 and SANS 514:2007 (Fixed Electric Storage Water Heaters, Thermostats for Electric Storage water Heaters and Immersion Heaters for Electric Storage Water Heaters).<sup>4</sup> There is currently no component testing and no scope to test custom built units for the commercial and industrial SWHs/HPs.

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<sup>2</sup> SANS stands for South African National Standard

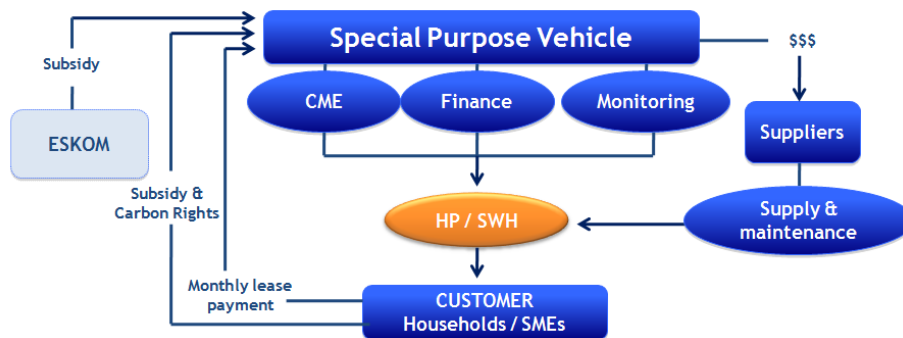
<sup>3</sup> Only applicable for systems with electric back up element.

<sup>4</sup> Please note that the SANS test numbers are subject to changes if reviews occur.

Low E Co is the coordinating entity and will ensure that all participating suppliers and HP/SWH systems meet the specified standards of the programme, thereby ensuring that the quality of both the systems and the installations is not compromised. A special purpose vehicle, Low E Co (hereafter referred to as “SPV”) will be established to operate the programme.

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

*Diagram 1. Implementing framework of the Programme:*



## Voluntary Action

The PoA is a voluntary action taken by Low E Co together with its partners (project developers, suppliers and financiers) to supply, install, and finance HPs and SWHs to provide hot water services for domestic and commercial/industrial purposes within South Africa. Currently there is no law or regulation in South Africa that would require replacement of electric geysers with HPs or SWHs, nor would require reduction of electricity use for water heating. Additional to the carbon funding, the PoA will make use of the Eskom Demand Side Management (hereafter referred to as “DSM”) funds to finance the HPs and SWHs, as long as the subsidy is available. Please see section A.4.3. for more detailed information.

### A.3. CMEs and participants of PoA

The coordinating and managing entity of the PoA is the South African private entity Low E Solutions t/a Low E Co.

Project Participants of the PoA are International Carbon Ltd and I Carbon (Pty) Ltd t/a International Carbon.

**A.4. Party(ies)**

Name of Party involved (host) indicates a host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Republic of South Africa	I Carbon (Pty) Ltd <sup>5</sup>	No
Republic of South Africa	International Carbon Ltd	No
United Kingdom	Low E Solutions (Pty) Ltd <sup>6</sup>	No

**A.5. Physical/ Geographical boundary of the PoA**

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



<sup>5</sup> I Carbon (Pty) Ltd trading as International Carbon.

<sup>6</sup> Low E Solutions (Pty) Ltd trading as Low E Co

The boundary of the PoA is defined as the physical, geographical area within which all the implemented, small-scale, Clean Development Mechanism programme activities (hereafter referred to as “SSC-CPAs”) included in the PoA will occur, including all power plants connected physically to the electricity system (grid) that the project equipment is connected to. All HPs and SWHs in the CPAs included in the PoA will be installed in residential or commercial/industrial buildings within the borders of the Republic of South Africa. Therefore, the boundary of the PoA is defined as the residential or commercial/industrial buildings, the electricity system within the Republic of South Africa.

#### A.6. Technologies/measures

A typical CPA consists of a group of SWHs and/or HPs either in residential and/or commercial/industrial buildings. The aggregate energy savings by a single CPA may not exceed the equivalent of 60,000 MWh per year for electrical end use energy efficiency technologies, and the total number of installed square meters of collectors of each individual CPA will remain below the small-scale threshold of 64,000 m<sup>2</sup> applicable to solar energy projects, as per Appendix B of the Simplified modalities and procedures for small-scale clean development mechanism projects. Hence the maximum number of the installations in each CPA is determined by the total energy savings of the HPs and SWHs and the collector area of the SWHs installed.

##### *Heat Pumps:*

A heat pump is an electrically-powered device that extracts available heat from one area (the heat source i.e. air) and transfers it to another (the heat sink i.e. water) to heat water. The most common type of heat pump is the air-source heat pump (also applied under this programme), which transfers heat between the outside air and water used inside the building.

The working fluid, refrigerant, is pressurized and circulated through the system by a compressor. The low temperature and low pressure refrigerant evaporates when passing the expansion valve, and extracts energy (heat) from the ambient air into the refrigerant. Once it picks up heat it is sent to the compressor, where through high pressure it is compressed into liquid phase (ideal gas law) and circulated to the condenser (also known as heat exchanger). The compressed refrigerant ejects the heat into the environment (i.e. water), after which the liquid refrigerant returns to the expansion valve and the cycle is repeated. The heat pump heats water to temperatures in the region of 60°C.<sup>7</sup> Please see Figure 1.

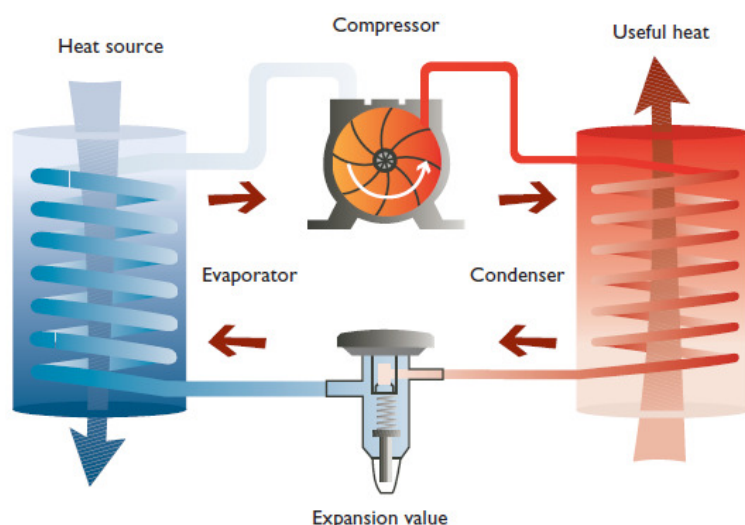


Figure 1. Functionality of a typical heat pump

<sup>7</sup> Eskom 2009, Effective Water Heating, page 1; Rankin and van Eldik 2010, An Investigation into the Energy Savings and Economic viability of Heat Pump Water Heaters applied in the residential sector, page iii.

Two types of heat pumps can be found, namely integrated type and split type. In the first case the entire system is contained in one unit that consists of a storage tank and a heat pump. In the second configuration the tank is separated from the heat pump. Heat pumps are typically mounted on the outside walls of buildings under the eaves or at ground level depending on the configuration of the system.

Electrical energy is used to drive the compressor, a pump to circulate water through the refrigerant-to-water condenser, and a fan power to cycle air through the finned air-to-refrigerant evaporator. HPs typically consume 1 unit of electrical energy for every 2.5 – 3.5 units of heating produced i.e. only 30 – 40 kWh electrical energy is used to produce 100kWh thermal energy.<sup>8</sup> Hence, HPs realise an energy saving of 60 - 70% when compared to conventional electrical water heating systems.

The HPs installed under this PoA will typically be<sup>9</sup>:

<b>Application</b>	<b>Litres</b>	<b>Input power</b>	<b>Heating Capacity</b>
Domestic - 1-5 users	100-300	0.5-0.95 kW	1.5-3.8 kW
Commercial usage	301-500	1.06-1.9 kW	3.8-7.2 kW
Industrial usage	> 500	> 1 kW	> 3 kW

#### *Solar Water Heaters:*

SWH systems convert solar radiation into thermal energy for the heating of water. Both types of SWHs can be installed under this programme active (i.e. a pump to circulate water or heat transfer fluid [hereafter referred to as “HTF”] between the collector and the storage tank) high pressure systems, as well as passive systems. All types, vacuum tube collectors and flat plates as well as high and low pressure systems can be applied. The SWH system can be close-coupled, where the storage tank is horizontally mounted immediately above the solar collectors on the roof, or integrated collector storage, where the tank acts as both storage and solar collector. Both direct and indirect systems can be installed under this programme. The indirect system uses non-toxic antifreeze HTF in the collector, whereas in the direct system water from the main household water supply is circulate between the collector and the storage tank, and the water is heated directly without transfer fluids. The solar collector absorbs solar radiation, converts it into heat, and transfers it to the water or via HTF to water. Heated water is then held in the storage tank and is ready for use. Active SWHs rely on electric pumps, valves and controllers to circulate water, or other heat-transfer fluids through the collectors. The SWH technology typically comprises the following elements<sup>10</sup>:

1. solar collectors/absorbers (non-concentrating flat-plate and evacuated tube collectors);
2. insulated hot water storage tanks (mounted inside the house or externally);
3. insulated pipework;
4. circulating pumps;
5. control valves;
6. vacuum breakers;
7. electrical or gas backup heating;
8. electrical control systems to minimise the auxiliary heating required – including timers;
9. water mixing valve for over-temperature protection;
10. support structures.

<sup>8</sup> Rankin and van Eldik 2010, An Investigation into the Energy Savings and Economic viability of Heat Pump Water Heaters applied in the residential sector, page iv.

<sup>9</sup> Eskom Supplier List (01.09.2011)

<sup>10</sup> The points 4,7 and 8 are not relevant for low pressure systems.

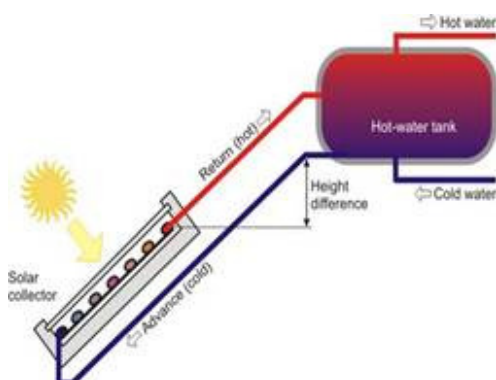


Figure 2. Principle design of a SWH

The SWHs installed under this PoA will be high pressure SWHs. The sizes vary, depending on suppliers and SWH type, typically from 85 litres up to 500 litres. A typical 4 person household is likely to select a 250 litre SWH, whereas commercial/industrial facilities will use 300-500 litre solutions or bigger ones. Both vacuum tube collectors and flat plate systems can be installed under this programme.

The SWHs installed under this PoA will typically be<sup>11</sup>:

No. of Users	Tank Size	Collector Are	Heating Capacity	Back up element <sup>12</sup>
1-2	100-150 l	1.5-2 m <sup>2</sup>	10-20 MJ	2-3 kW
2-3	200 l	2-2.5 m <sup>2</sup>	15-25 MJ	2-3 kW
3-4	250 l	2.5-3 m <sup>2</sup>	20-30MJ	2-3 kW
> 4	300 l	3-3.5 m <sup>2</sup>	25-35MJ	2-3 kW
Commercial usage	300 – 500 l	3-5.5 m <sup>2</sup>	> 30 MJ	> 3 kW
Industrial usage	> 500 l	> 5 m <sup>2</sup>	> 30 MJ	> 3 kW

#### Hybrid Solutions:

A hybrid solution has a solar collector and a HP common coupled to a hot water storage vessel. Thermal energy is harvested during the sunny hours from the sun. The heat pump replaces the electric geyser element and serves as a high efficiency back-up heat source. A hybrid solution can reach over 90 % energy savings.

The HPs and SWHs that will be installed under this PoA may either be manufactured locally or internationally and imported to South Africa and distributed by local suppliers. All the major apparatus of the HPs and SWHs participating in the PoA shall comply with the relevant SABS Standard Specification for HP and SWH systems to ensure that the installations are able to withstand local climatic and water quality conditions. The relevant Standard Specifications are:

- For HP: HP SANS 151-2002, SANS 181:2004 and SANS 514:2007;
- For SWH: SANS 6211-1:2003, SANS 151-2002, SANS 6210:1992 and SANS 60335-2-21:2000.<sup>13</sup>

<sup>11</sup> Eskom Supplier List (07.01.20011)

<sup>12</sup> Please note that electric back up element is not necessary i.e. the customer will decide whether or not to have an electric back up element.

<sup>13</sup> Please note that the SANS test numbers are subject to changes if revised. Furthermore SANS 151 and 60335 are only relevant for high pressure SWHs.



Worldwide both technologies have been well-established in terms of technological development. In countries where SWH and HPs systems have been installed, they have been shown to have effective operating lifetimes in excess of ten years. The Eskom subsidy programme for SWHs was initiated in 2008 and has matured in the last 12 months. The SWH industry is growing and sales volumes are showing steady growth. By March 2010, less than 5,000 SWH had been installed under the Eskom programme<sup>14</sup> and by August 2011 this number had increased to almost 150,000<sup>15</sup>, most installation being low pressure units<sup>16</sup>. The HP market in South Africa is still very small. Since the launch of the Eskom subsidy programme in February 2011, approximately 200 units have been installed under the Eskom programme<sup>17</sup>. This capacity can be scaled up significantly to supply a bigger market.

#### **A.7. Public funding of PoA**

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

### **SECTION B. Demonstration of additionality and development of eligibility criteria**

#### **B.1. Demonstration of additionality for PoA**

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:

##### ***Other Barriers: Financial Resources***

There is a lack of an investment framework for HPs and SWHs in South Africa. In 2007 the South African government launched, through Eskom (national power utility), a once-off subsidy to homeowners to support the installation of SWHs. A subsidy for HPs was launched on 18<sup>th</sup> of February 2011. The funding is a subsidy, paid by Eskom, based on the technical performance of the equipment. The subsidies are part of Eskom’s DSM initiative, which was established after South Africa suffered from major electricity supply interruptions due to insufficient power station capacity in 2007. DSM provides rebates to consumers upon the purchase and installation of SWH and HP systems to reduce demand on the electricity network. However, the Eskom subsidy is not sufficient to cover all cost associated with the installation, maintenance and monitoring of HPs and SWHs over a 10 year period.<sup>18</sup>

The high upfront costs create a significant barrier for HPs and SWHs.<sup>19</sup> According to Eskom the average cost of a household HP is between ZAR 12 000 and ZAR 16 000, and the average cost for installed household SWHs is between ZAR 12 000 and ZAR 35 000<sup>20</sup>. This is two to three times more than typical

<sup>14</sup> Eskom Distribution 2010, Solar Water Heating Programme, Monthly Status Report March 2010

<sup>15</sup> Eskom August 2011, Solar Water Heating Programme, Weekly Administrative Dash Board

<sup>16</sup> It should be noted that since 2011 one SWH PoA from South Africa has been registered under the CDM, and several other SWH PoAs are under validation.

<sup>17</sup> Eskom August 2011, Residential Heat Pump Rebate Programme, page 14-15; Eskom 2011, Heat Pump Claim Form.

<sup>18</sup> Eskom Annual Report 2008

<sup>19</sup> Milton and Kaufman 2005, Solar Water Heating as a Climate Protection Strategy: The Role for Carbon Finance, page 15.

<sup>20</sup> Please see point 25 under [http://www.eskomdsm.co.za/?q=Solar\\_water\\_heating\\_FAQs](http://www.eskomdsm.co.za/?q=Solar_water_heating_FAQs); Eskom 2009, Effective Water Heating, page 5; Eskom Presentation from 2010, Using Heat Pumps for Domestically, Commercial and Industrial Applications to Save Energy, slide 10.

electric geysers cost. The Eskom subsidy for Heat Pumps is between ZAR 3 668 and ZAR 4 320 (depending on the size) and for SWHs between ZAR 3 280 and ZAR 8 969 (depending on the SWH type and size)<sup>21</sup>. For commercial and industrial installations Eskom has three different programmes: Standard Offer, Standard Product and ESCo Model. Under these programmes the following subsidies are paid:

- 0.7 ZAR per kWh saved for SWH;
- 0.42 ZAR per kWh saved for HPs.

The total subsidy is 70 % of the estimated saving over a 3 years.

Even though the payback period facilitated by the electricity savings is relatively short, around 3 years<sup>22</sup>, the high upfront costs are a barrier for most South African households. The poor success of the Eskom subsidy programme clearly shows that even with a subsidy, the households reluctant to invest in HPs and SWHs.

#### ***Other Barriers: Capacity to Absorb New Technologies***

The availability of the required skills and especially the lack of qualified installers have been identified as major constraints in the supply chain of the SWH industry. The low penetration and the uncertainty in the market for SWHs and HPs prevent the development of the required skills. Qualified plumbers can be relied on to install SWHs and HPs professionally, provided that they have received detailed training for specific types of SWHs and HPs by the supplier. However, training can take up to several months depending on the level of skills. Unskilled labour can be used for installations, but well-developed training facilities and intensive on-the-job training is required. The same applies for maintenance. The advantages of mass markets (i.e. labour with experience) have never materialised in South Africa.<sup>23</sup> The programme will lead to training of installation and maintenance teams to undertake the installations and maintenance of the HP and SWH systems.

#### ***Other Barriers: Limited Information***

The lack of awareness of alternative water heating methods and energy efficiency benefits hinder the uptake of HPs and SWHs. People are not aware of the advantages and how much water heating contributes to their electricity bill in general. Furthermore, knowledge of the Eskom subsidy and requirements is limited. As part of the programme, targeted households and industries will be provided with marketing material that provides education on water heating, energy efficiency and the advantages of HP and SWH systems. Furthermore the customers are provided with information on a selection of preferred HP and/or SWH suppliers and their product and price details. This way, the customer does not need to compare the over 1 000 different products that are currently listed under the Eskom website. Hence the programme will increase knowledge on climate change, energy efficiency and the usage of HP and SWH technology.

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

The coordinating entity, together with the suppliers, 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:

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<sup>21</sup> Eskom 2011. Residential Heat Pump Rebate Programme, page 8; and Eskom Letter from April 2011 on SWH Rebates, page 2.

<sup>22</sup> Rankin and & van Eldik 2010, An Investigation into the Energy Savings and Economic viability of Heat Pump Water Heaters applied in the residential sector, page ix.

<sup>23</sup> Holme 2005, Market Survey of Solar Water Heating in South Africa for EDC and CEF, p 24 and 32; Industrial Development Corporation 2010, Presentation on Green Industries & Technology, slide 6.

1. Selection of reliable products;
2. Marketing, supply, installation and maintenance of the HP and SWH systems;
3. Organize and provide the funding for the installation of the HPs and SWHs on behalf of the households/ supplier;
4. The compilation of educational awareness campaigns in order to intensify the demand for HP and SWH products.

The PoA is a voluntary action, coordinated and implemented by the coordinating entity to supply, install, and finance HPs and SWHs to provide hot water services for residential, commercial and industrial buildings 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 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<sup>24</sup>, as well as the Government's 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 that requires replacement of electric geysers with HPs or SWHs in South Africa. The HPs and SWHs installed under the PoA are included in the PoA voluntarily by the coordinating entity and the customers.

## B.2. Eligibility criteria for inclusion of a CPA in the PoA

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

No	Criteria
1	<p>The SWHs to be included in the CPA shall meet the applicability requirements of the CDM methodology AMS.I.C. Thermal energy production with or without electricity, version 19.</p> <p>The HPs to be included in the CPA shall meet the applicability requirements of the CDM methodology AMS.II.C. Demand-side energy efficiency activities for specific technologies, version 13.</p> <p>The CPAs shall apply both methodologies, if both technologies SWHs and HPs are installed within one CPA. However, a CPA may also consist of only SWHs or HPs, in which case only the relevant applicability requirements to the techno in questions shall apply.</p>
2	<p>The Standard for Sampling and Surveys for CDM Project Activities and Programme of Activities shall be applied also for monitoring, and hence a 95/10 confidence/precision is requested as per section B.7.2 of this document.</p>
3	<p>The CPAs to be included in this PoA shall meet either the SSC additionality rules as per Attachment A to Appendix B of the Simplified modalities and procedures or the microscale additionality rules as per the Guidelines for demonstrating additionality of microscale project activities. The CPA-DD shall identify whether SSC or microscale additionality rules are applied as per section B.5. of this document.</p>
4	<p>Each system included under the programme shall fulfill the relevant debundling rules i.e. annual</p>

<sup>24</sup> Available at: [http://www.dme.gov.za/pdfs/energy/renewable/white\\_paper\\_renewable\\_energy.pdf](http://www.dme.gov.za/pdfs/energy/renewable/white_paper_renewable_energy.pdf)



	savings $\leq$ 600 MWh and/or absorber area $\leq$ 640 m <sup>2</sup> as per Section C of this document.
5	Installation shall take place in residential, commercial or industrial buildings within the geographical boundaries of South Africa.
6	The start date of the CPA is determined to be the first signed installation/carbon cession form agreement with the household and/or business under that CPA. The starting date of the CPA cannot be prior the date of 12/02/2012.
7	All the HPs and SWHs under the SSC-CPA shall comply with all relevant SABS/SANS Standard Specification for HP or SWH systems.
8	In order to ensure that all CPAs under this PoA are neither registered as an individual CDM project activity nor included in another registered PoA: <ul style="list-style-type: none"> <li>a. Each CPA shall be uniquely identified and defined by way of the unique identifying numbers (serial numbers) attached to each SWH and HP;</li> <li>b. Each CPA developer/supplier and household will sign an agreement with the CME which; <ul style="list-style-type: none"> <li>1) cedes the carbon to the CME, and 2) clarifies that the installations are not part of another CDM activity.</li> </ul> </li> </ul>
9	All participants joining the programme shall have electricity and water connection, as well as existing electric geyser.
10	All participants joining the programme shall have a proof of identity (ID), or corporate registration certificate.
11	Funding for the CPA may not come from Official Development Aid from Annex I Countries.
12	Each SSC-CPA must be approved by the coordinating entity and Designated Operational Entity (hereafter referred to as “DOE”) prior to its incorporation into the PoA.
13	When installing heat pumps or hybrid solutions the level of the output/service (e.g. water temperature) shall not be significantly smaller (maximum - 10%) or significantly larger (maximum + 50%) than in the baseline situation.

### B.3. Application of methodologies

From Appendix B of the “Simplified modalities and procedures for small scale CDM projects”, the following methodologies apply to the project activity:

**Project Type:** Type I – Renewable energy projects

**Project Category:** AMS-I.C. – Thermal Energy Production with or without electricity, Version 19

**Project Type:** Type II – Energy Efficiency

**Project Category:** AMS-II.C – Demand-side energy efficiency activities for specific technologies, Version 13

Furthermore the following tools are applied:

“Tool to calculate baseline, project and/or leakage emissions from electricity consumption, Version 01”

“Tool to calculate the emission factor for an electricity system, Version 02.2.1”

As per the “General Guidelines to SSC CDM methodologies”, PoAs can apply multiple methodologies without preapproval from the CDM Executive Board if these methodologies have been previously applied, in combination, in a registered project activity. The project with reference no 0079, has applied AMS.IC and AMS-II.C in combination.

The CPAs shall apply both methodologies, if both technologies SWHs and HPs are installed within one CPA. However, a CPA may also consist of only SWHs or HPs, in which case only the relevant applicability requirements to the techno in questions shall apply.

The monitoring methodology and related sampling is explained in detail in section B.7.2 of this document.

**SECTION C. Management system**

A Special Purpose Vehicle, Low E Co, which includes financiers and project developers, has been created to take care of following functions: 1) the CDM coordinating entity, 2) the CDM Cycle management (subcontracted to International Carbon), 3) the supply and maintenance of the HPs and SWHs (via suppliers), 4) the financing facility, and 5) data capturing and monitoring. Figure 3 shows the implementation and management structure of the PoA.

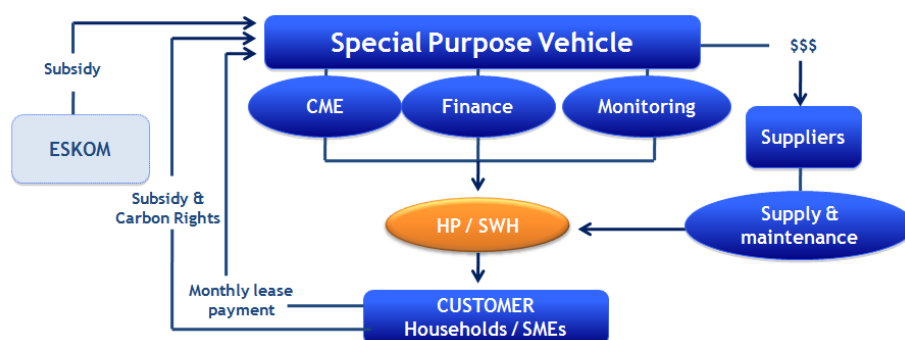


Figure 3. Implementation and management structure of the PoA

The main management tasks for the PoA are identified in the table below:

Step	Task	Description	Reference document (if relevant)
1	Technical development of the PoA/SPV concept and related documents	<ul style="list-style-type: none"> <li>Development of Implementation and Financing Structure</li> <li>Development of Management Structure</li> <li>Development of Maintenance and Monitoring Plan</li> </ul>	<ul style="list-style-type: none"> <li>PoA-DD and CPA-DD template</li> <li>Grid Emission Factor</li> <li>CPA Inclusion Manual</li> <li>Monitoring Manual</li> </ul>
2	Manage PoA CDM registration process	<ul style="list-style-type: none"> <li>Validation and registration of PoA</li> </ul>	<ul style="list-style-type: none"> <li>Contract with DOE</li> <li>Host Country Approval</li> <li>Modalities of Communication (“MoC”) with CDM Executive Board</li> </ul>
3	Inclusion of new CPAs	<ul style="list-style-type: none"> <li>Consistency with CPA Inclusion Criteria</li> </ul>	<ul style="list-style-type: none"> <li>CPA Inclusion Manual</li> </ul>
4	Operation and Management of the PoA	<ul style="list-style-type: none"> <li>Consistency with maintenance and monitoring plans</li> <li>Continuous data capturing</li> </ul>	<ul style="list-style-type: none"> <li>Monitoring Manual</li> </ul>
5	Periodical Verification	<ul style="list-style-type: none"> <li>Review of CPA monitoring data and report</li> <li>Verification of each CPA shall be done by an appointed DOE</li> </ul>	<ul style="list-style-type: none"> <li>CPA Monitoring Reports</li> </ul>
6	Issuance of CERs	<ul style="list-style-type: none"> <li>Allocation of UNFCCC approved CERs</li> </ul>	<ul style="list-style-type: none"> <li>MoC</li> <li>ERPA</li> </ul>

### 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 HP, SWH or hybrid solution installed in a SSC-CPA:

1	Site Details	<ul style="list-style-type: none"><li>▪ Address</li><li>▪ GPS coordinates</li></ul>
2	Residence / Company Details	<ul style="list-style-type: none"><li>▪ First name and surname / Company name</li><li>▪ ID number / Company registration number</li><li>▪ Contact details</li></ul>
3	Installer Details	<ul style="list-style-type: none"><li>▪ Installation date</li><li>▪ Installer name</li><li>▪ Company name</li><li>▪ Contact details</li></ul>
4	Installation Details	<ul style="list-style-type: none"><li>▪ Serial number</li><li>▪ HP/SWH type</li><li>▪ HP/SWH size</li><li>▪ HP input power</li><li>▪ HP / SWH heating capacity</li><li>▪ SWH absorber area</li><li>▪ SWH back up element size</li></ul>
5	Baseline Details	<ul style="list-style-type: none"><li>▪ Power of existing geyser</li><li>▪ Size of existing geyser</li></ul>
6	CPA identification number	<ul style="list-style-type: none"><li>▪ E.g. CPA-001</li></ul>
7	Confirmation that the building has electricity and water connection.	
8	Copy of the Carbon Ceding form signed by the resident/ company together with a copy of installation form.	

A database hosted by a specialised database company will be used to capture all above mentioned information including a scan of the carbon ceding rights form. This is done either directly via the web interface or by database synchronisation with a third party database (this may vary in each CPA). The GPS coordinates are used to locate each HP/SWH together with the serial number of the product. 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.

### Procedure to avoid double accounting

The database ensures that all installations 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 HP/SWH has been installed. The installation sheet is attached to the ceding of the carbon rights form. Either the SPV or the installers/suppliers will input the information in an electronic form (data capturing software – described above) and submit copies of all installation sheets, and ceding of the carbon rights to the coordinating entity. Each HP/SWH will have a unique identifying number (serial number) which matches the unique identifier physically attached to the HP/SWH. With the help of the serial number and GPS coordinates, each HP/SWH can be linked to a specific building and can be viewed spatially in the database.

### **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 a de-bundling check i.e. considered as not being a de-bundled component of a large scale activity.

According to AMS.II.C. “Demand-side energy efficiency activities for specific technologies” the small scale threshold for energy saving projects is maximum 60 GWh electrical saving, of which 1 % equals to 600 MWh saving per year. A typical household electric geyser has an electric element with a capacity of 3 to 4 kW<sup>25</sup>. Even if water would be heated 24 hours a day, which is a very unlikely scenario, and a hybrid solution providing 90 % saving would be used, the annual saving would be 31 MWh. In industrial facilities, bigger saving per system can be achieved. However, only systems that fulfil the de-bundling rules will be included under this PoA.

According to “Appendix B of the Simplified modalities and procedures for small-scale clean development mechanism project”, the small-scale threshold for solar energy projects is 64,000 m<sup>2</sup>. 1 % of this equals to 640 m<sup>2</sup>. As described under the section A.4.2.1 the typical collector sizes vary between 1 and 5.5. m<sup>2</sup> which is clearly below the 1 % threshold (640m<sup>2</sup>).

The conformity with the de-bundling rules shall be discussed in each CPA-DD under section A.4.6.

### **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 will enter into a binding formal agreement with each supplier or project developer to develop and implement the identified CPA under the PoA. The agreement inter-alia contains the roles and responsibilities for each of the parties. Furthermore legally binding agreements will be signed by all residents and commercial/industrial customers for the installation of a HP and/or SWH under the PoA, making them aware that they are participating in the programme and that their HP/SWH will be included in a CPA and that the ownership of the carbon is ceded to the coordinating entity (possibly via suppliers), who is the legal owner of the Certified Emission Reductions (CERs) from the installed HP/SWH.

## **SECTION D. Duration of PoA**

### **D.1. Start date of PoA**

25/01/2012

This is the signing date of the validation agreement between International Carbon and Det Norske Veritas.

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<sup>25</sup> Rankin and & van Eldik 2010, An Investigation into the Energy Savings and Economic viability of Heat Pump Water Heaters applied in the residential sector, page vi; Kwikot 2011, Electric Water Heating brochure page 2 and 3.



## D.2. Length of the PoA

28 years.

## SECTION E. Environmental impacts

### E.1. Level at which environmental analysis is undertaken

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

### E.2. Analysis of the environmental impacts

In August 2010 the new National Environmental Management Act (“NEMA”) Environmental Impact Assessment (“EIA”) regulations<sup>26</sup> came into effect, signalling the start of the official implementation process of a new regime aimed at improving the efficiency and effectiveness of EIAs in South Africa.

The NEMA EIA 2010 regulations and the listing notices thereto replace the NEMA EIA regulations of 2006 and its associated listing notices.

Three listing notices<sup>27</sup> have been published in conjunction with the new regulations, whereby depending on the type and scope of the activity, the activity must either be subjected to a Basic Assessment or to the more thorough Scoping and EIA process.

Listing notice one stipulates the activities requiring a basic assessment report. These are typically activities that have the potential to impact negatively on the environment but due to the nature and scale of such activities, these impacts are generally known. Listing notice two identifies the activities requiring both scoping and an Environmental Impact Report these are typically large scale or highly polluting activities and the full range of potential impacts need to be established through a scoping exercise prior to it being assessed. Listing notice three contains activities that will only require an environmental authorisation through a basic assessment process if the activity is undertaken in one of the specified geographical areas indicated in that listing notice.

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<sup>26</sup> and <sup>26</sup> <http://www.info.gov.za/speech/DynamicAction?pageid=461&sid=11887&tid=13916>

These regulations govern EIAs, and do 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.<sup>28</sup>

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 airborne particulates (ash) and pollutant gases which cause air quality problems. The installations will take place in existing infrastructures i.e. residential and commercial buildings. The heat pumps installed under this programme will apply non ozone depleting refrigerants.

Hence, the environmental effects gained from the project implementation are of a positive nature.

## **SECTION F. Local stakeholder comments**

### **F.1. Solicitation of comments from local stakeholders**

Local stakeholder consultation is done at PoA level, since the programme will be national.

Comments from local stakeholders were invited via a national news paper and through personal invites, which were sent to the key stakeholders. The key stakeholders were identified to be the municipal managers, the Designated National Authority, the Department of Energy, Eskom, funders and some corporate, as well as HP/SWH suppliers. Altogether 74 personal invites were sent out. The news paper advert was placed on October 9 in Sunday Times inviting people to a public participation meeting, and to submit comments and queries via phone, email and mail. The public participation meeting was held on October 24 in Sandton, Gauteng. Two meetings took place at 2 pm and 5 pm. In these meetings the implementation framework, the Clean Development Mechanism, technical details and corporate rollout was presented. Comments were invited until the May 24, 2010.

### **F.2. Summary of comments received**

All together 4 calls and emails from 4 interested parties were received. The questions raised can be summarized as follows:

- Details of the public participation meeting;
- How to participate in the programme as supplier;
- When will the programme start in other parts (than Gauteng) of South Africa.

The questions raised in the public participation meeting, that was attended by 31 people were very similar. Additional to the above questions two main questions were raised:

- Implementing Structure;
- Financing Structure.

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<sup>28</sup> More information on the national EIA law and process is available at:  
<http://www.eiatoolkit.ewt.org.za/process/what.html>

### F.3. Report on consideration of comments received

Most of the comments and questions received were around how to join the programme as supplier and how the programme is structured. The implementation framework of the programme as well as participation possibilities and requirements were specified and the interested were asked to keep in contact with International Carbon in order to join the programme.

### SECTION G. Approval and authorization

The Letters of Approval from the Republic of South Africa and United Kingdom were not available at the time of submitting the PoA-DD to the validating DOE.

## PART II. Generic component project activity (CPA)

### SECTION A. General description of a generic CPA

#### A.1. Purpose and general description of generic CPAs

In South Africa, electricity is used to heat water for domestic and industrial hot water purposes. Eskom, as the state-owned electricity supplier, dominates the generation capacity, which is driven mainly by coal (>90%). Since 2008, South Africa is subject to electricity shortfalls. Although new generation capacity is under construction (three new coal power stations being built by Eskom) electricity supplies are still predicted to be tight over the next three to five years. Due to the historically low cost of electricity, alternatives such as HPs and SWHs have not been considered. Additional reasons for low market penetration rates for these include comparatively high upfront costs and a lack of awareness of their environmental and economic benefits.

As described in section A.6. above a typical CPA consists of a group of SWHs and/or HPs either in residential and/or commercial/industrial buildings. The aggregate energy savings by a single CPA may not exceed the equivalent of 60,000 MWh per year for electrical end use energy efficiency technologies, and the total number of installed square meters of collectors of each individual CPA will remain below the small-scale threshold of 64,000 m<sup>2</sup> applicable to solar energy projects, as per Appendix B of the Simplified modalities and procedures for small-scale clean development mechanism projects. Hence the maximum number of the installations in each CPA is determined by the total energy savings of the HPs and SWHs and the collector area of the SWHs installed.

The CPA-XXX will consist of... [confirm installation type, size and number of units, if available]

This project is a voluntary initiative coordinated by Low E Co, which is a special purpose vehicle (hereafter referred to as “SPV”) established to operate the programme. The households, commercial/industrial facilities as well as suppliers joining the programme will enter to an agreement with the CME and hence will know that they are part of the programme.

Eskom supports the installation of HPs and SWHs for both domestic and industrial use by providing a subsidy. However, reduction of electricity use or installation of HPs/SWHs is not required by law. The

stated goal of the PoA is to install HPs and SWHs in households and industry, thereby displacing carbon intensive electricity from the grid currently used to provide hot water. Therefore, CPA-XXX is a voluntary action of the CPA implementer, XXX [name(s)].

The proposed SSC CPA is expected to reduce X XXX XXX tCO<sub>2</sub> over the selected ten years crediting period.

## SECTION B. Application of a baseline and monitoring methodology

### B.1. Reference of the approved baseline and monitoring methodology(ies) selected

From Appendix B of the “Simplified modalities and procedures for small scale CDM projects”, the following methodologies apply to the project activity:

**Project Type:** Type I – Renewable energy projects

**Project Category:** AMS-I.C. – Thermal Energy Production with or without electricity, Version 19

Available at:

[http://cdm.unfccc.int/filestorage/G/U/9/GU9MEH14PBSNCKJIOV3L7W82RTZY06/EB61\\_repan16\\_Revision\\_AMS-I%20C\\_ver19.pdf?t=SUF8bTJ4bGoyfDDSO33VpIJ\\_fXK7-SjW\\_QxB](http://cdm.unfccc.int/filestorage/G/U/9/GU9MEH14PBSNCKJIOV3L7W82RTZY06/EB61_repan16_Revision_AMS-I%20C_ver19.pdf?t=SUF8bTJ4bGoyfDDSO33VpIJ_fXK7-SjW_QxB)

**Project Type:** Type II – Energy Efficiency

**Project Category:** AMS-II.C – Demand-side energy efficiency activities for specific technologies, Version 13

Available at:

[http://cdm.unfccc.int/filestorage/S/6/K/S6KJMZ0A7UON324I5QHER8BTPLDFCX/EB48\\_repan16\\_AMS\\_II.C\\_ver13.pdf?t=WVR8bTJ4bG1xfDDSiqypzDnoxNVxMBuBObfY](http://cdm.unfccc.int/filestorage/S/6/K/S6KJMZ0A7UON324I5QHER8BTPLDFCX/EB48_repan16_AMS_II.C_ver13.pdf?t=WVR8bTJ4bG1xfDDSiqypzDnoxNVxMBuBObfY)

Furthermore the following tools are applied:

“Tool to calculate baseline, project and/or leakage emissions from electricity consumption, Version 01”

Available at: <http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-05-v1.pdf>

“Tool to calculate the emission factor for an electricity system, Version 02.2.1”

Available at: <http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v2.2.1.pdf>

As per the “General Guidelines to SSC CDM methodologies”, PoAs can apply multiple methodologies without preapproval from the CDM Executive Board if these methodologies have been previously applied, in combination, in a registered project activity. The project with reference no 0079, has applied AMS.IC and AMS-II.C in combination.

### B.2. Application of methodology(ies)

AMS.I.C version 19 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 grid energy (*paragraphs 1 and 25*)

- The methodology comprises technologies such as solar thermal water heaters (*paragraph 1*)
- A SSC-CPA individually does not exceed the applicable SSC threshold which is 64 000 m<sup>2</sup> i.e. the CPAs are below the 64,000 m<sup>2</sup> threshold (*paragraph 7 (d)*)<sup>29</sup>

AMS.II.C version 13 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 energy-efficient equipment, which replaces existing equipment, or possibly are installed at new sites (*paragraph 1*)
- The aggregate energy savings of the CPA will not exceed the equivalent of 60 GWh electric energy per year (*paragraph 1*)
- The level of the output/service (e.g. water temperature) will not be significantly smaller (maximum - 10%) or significantly larger (maximum + 50%) than in the baseline situation (*paragraph 2*).

### B.3. Sources and GHGs

As defined in AMS.I.C and AMS.II.C, the project boundary is the physical, geographical site of the energy efficiency/water heating measure including the building consuming the thermal energy produced. Hence the boundary for a SSC-CPA comprises the physical site of each HP/SWH within the CPA as well as the South African grid system, as the HP/SWH replaces grid electricity. Each CPA (CPA number) and HP/SWH (serial number) can be identified based on unique identification numbers.

The GHG reduced through the CPAs under this PoA is CO<sub>2</sub>. 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.

### B.4. Description of baseline scenario

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. The annual geyser element sales in South Africa totals over 720 000 units.<sup>30</sup>

Electric hot water geysers/cylinders are pressurized electric hot water heaters. The geysers are normally connected to the main supply continuously, while the thermostat keeps the hot water at the set temperature (typically between 55-60 °C). Whenever it drops below the set point (typically 6°C below, in practice), the electric element switches on in order to reheat the water in the geyser to the set point.

The baseline emissions are determined by calculating the energy consumed by the water heating system in the baseline multiplied by an emission factor for the fossil fuel displaced. With respect to AMS-I.C

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<sup>29</sup> General Guidelines to SSC CDM methodologies, version 17, paragraph 4 d 'For thermal applications of solar energy projects, 'maximum output' shall be calculated using a conversion factor of 700 Wth/m<sup>2</sup> of aperture area of glazed flat plate or evacuated tubular collector i.e. eligibility limit in terms of aperture area is 64000 m<sup>2</sup> of the collector.'

<sup>30</sup> N. Magubabe 2009, Speaking Notes of the Acting Director-General of Department of Energy Ms Nelisiwe Magubabe, Johannesburg 5 November 2009; O.D Dintchev 2004, Evaluation of Domestic Solar Water Heaters – Domestic Use of Energy Conference 2004; A. Harris, M. Kilfoil and E-A. Uken, Options for Residential Water Heating, page 2.

(paragraph 21) and AMS.II.C (paragraph 6) the baseline for the displacement of electricity shall be calculated as per the procedures detailed in AMS-I.D. This further states 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” (option a), or the weighted average emissions of the current generation mix (option b). Option b is selected and the equations used to calculate the baseline are shown in the section B.6.1.

South Africa has a temperate climate. 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<sup>2</sup> per day, and the average annual winter temperature is above 13°C and summer temperature above 21°C. Regardless of the favourable climate conditions and subsidy programme (see section E.5.) only a few HPs/SWHs are in the market. More than 76 % of middle and high income households use an electric geyser, which is the identified baseline scenario.<sup>31,32</sup>

Each CPA-DD shall present the key parameters for the baseline determination for that specific CPA under the section D.4. The key parameters to be considered are, is available:

Parameter	Unit	Value
Size	litre	[insert value]
<i>Electric geysers:</i>		
Heating Capacity	kW	[insert value]
<i>For heat pumps:</i>		
Heating Capacity	kW	[insert value]
Operation hours	h	[insert value]
<i>For solar water heats:</i>		
Energy Output per Day (Q)	kWh	[insert value]
SABS Test Period	h	[insert value]
Power Rating of a SWH	kW	[insert value]
Absorber Area	m <sup>2</sup>	[insert value]

The CPAs under this PoA will apply the small scale methodology AMS-I.C. “Thermal energy production with or without electricity”, version 19 for SWHs, and AMS-II.C. “Demand-side energy efficiency activities for specific technologies”, Version 13 for HPs. For hybrid solutions both methodologies are applied.

With respect to AMS-I.C paragraph 21, the baseline for the 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 gives the option to use the weighted average emissions of the current generation mix as emission factor.

With respect to AMS.II.C paragraph 6, the baseline is the product of the baseline energy consumption of equipment/appliances and the emission factor for the electricity displaced determined as per AMS-I.D.

The equations used to determine the emission reduction are discussed in B.6.1.

<sup>31</sup> Wikipedia, Geography of South Africa, 5 October 2011: [http://en.wikipedia.org/wiki/Geography\\_of\\_South\\_Africa](http://en.wikipedia.org/wiki/Geography_of_South_Africa)

<sup>32</sup> Department of Energy Website 15 August 2011: [http://www.energy.gov.za/files/renewables\\_frame.html](http://www.energy.gov.za/files/renewables_frame.html)

**B.5. Demonstration of eligibility for a generic CPA**

The SSC CPA meets all the eligibility criteria for inclusion of a SSC CPA in the PoA as listed in Part I section B.2 above.

No	Criteria	Analysis
1	<p>The SWHs to be included in the CPA shall meet the applicability requirements of the CDM methodology AMS.I.C. Thermal energy production with or without electricity, version 19.</p> <p>The HPs to be included in the CPA shall meet the applicability requirements of the CDM methodology AMS.II.C. Demand-side energy efficiency activities for specific technologies, version 13.</p> <p>The CPAs shall apply both methodologies, if both technologies SWHs and HPs are installed within one CPA. However, a CPA may also consist of only SWHs or HPs, in which case only the relevant applicability requirements to the techno in questions shall apply.</p>	[add]
2	The Standard for Sampling and Surveys for CDM Project Activities and Programme of Activities shall be applied also for monitoring, and hence a 95/10 confidence/precision is requested as per section B.7.2 of this document.	[add]
3	The CPAs to be included in this PoA shall meet either the SSC additionality rules as per Attachment A to Appendix B of the Simplified modalities and procedures or the microscale additionality rules as per the Guidelines for demonstrating additionality of microscale project activities. The CPA-DD shall identify whether SSC or microscale additionality rules are applied as per section B.5. of this document.	[add]
4	Each system included under the programme shall fulfill the relevant debundling rules i.e. annual savings $\leq$ 600 MWh and/or absorber area $\leq$ 640 m <sup>2</sup> as per Section C of this document.	[add]
5	Installation shall take place in residential, commercial or industrial buildings within the geographical boundaries of South Africa.	[add]
6	The start date of the CPA is determined to be the first signed installation/carbon cession form with the household and/or business under that CPA. The starting date of the CPA cannot be prior the date of 12/02/2012.	[add]
7	All the HPs and SWHs under the SSC-CPA shall comply with all relevant SABS/SANS Standard Specification for HP or SWH systems.	[add]
8	In order to ensure that all CPAs under this PoA are neither registered as an individual CDM project activity	[add]



	<p>nor included in another registered PoA:</p> <p>a. Each CPA shall be uniquely identified and defined by way of the unique identifying numbers (serial numbers) attached to each SWH and HP;</p> <p>b. Each CPA developer/supplier and household will sign an agreement with the CME which; 1) cedes the carbon to the CME, and 2) clarifies that the installations are not part of another CDM activity.</p>	
9	All participants joining the programme shall have electricity and water connection, as well as existing electric geyser.	[add]
10	All participants joining the programme shall have a proof of identity (ID), or corporate registration certificate.	[add]
11	Funding for the CPA may not come from Official Development Aid from Annex I Countries.	[add]
12	Each SSC-CPA must be approved by the coordinating entity and Designated Operational Entity (hereafter referred to as “DOE”) prior to its incorporation into the PoA.	[add]
13	When installing heat pumps or hybrid solutions the level of the output/service (e.g. water temperature) shall not be significantly smaller (maximum - 10%) or significantly larger (maximum + 50%) than in the baseline situation.	[add]

In accordance with “Attachment A to Appendix B” of the simplified modalities and procedures, the following barriers have been identified for the CPAs:

#### ***Other Barriers: Financial Resources***

As demonstrated in section B.1, the common practice and preferred way of water heating in South Africa is an electric geyser. The high upfront costs create a significant barrier for HPs and SWHs. According to Eskom, the average the cost of a household HP is between ZAR 12 000 and ZAR 16 000, and the average cost for installed household SWH is between ZAR 12 000 and ZAR 35 000<sup>33</sup>, whereas electric geysers cost between 1/3 and 1/2 of the price. Even though the payback period facilitated by 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. Even the Eskom subsidy for HPs (ZAR 3 668 - ZAR 4 320) and for SWHs (ZAR 3 280 - ZAR 8 969)<sup>34</sup> has not managed to make HPs and SWHs attractive for the customers and consumers still prefer an electric geyser. Please see also A.6 regarding the Eskom subsidy.

Between October 2007 and February 2008, South Africa suffered major supply interruptions due to insufficient power station capacity to supply the demand (load) from all the customers. The construction of two open-cycle gas turbine power stations and the recommissioning of three mothballed coal-fired power stations are in process to address these challenges. However, to build new power station capacity takes eight to ten years and hence the national power utility Eskom established a Demand Side

<sup>33</sup> Please see point 25 under [http://www.eskomdsm.co.za/?q=Solar\\_water\\_heating\\_FAQs](http://www.eskomdsm.co.za/?q=Solar_water_heating_FAQs); Eskom 2009, Effective Water Heating, page 5; Eskom Presentation from 2010, Using Heat Pumps for Domestically, Commercial and Industrial Applications to Save Energy, slide 10.

<sup>34</sup> Eskom 2011. Residential Heat Pump Rebate Programme, page 8; and Eskom Letter from April 2011 on SWH Rebates, page 2.

Management (DSM) initiative to promote energy efficiency measures in the country with significant power shortages. The DSM initiative promotes load shedding and energy efficiency measures to reduce demand on the electricity network. The DSM provides rebates to consumers with the purchase and installation of an approved SWH or HP. However, the Eskom subsidy is not sufficient to cover all costs associated with the installation, maintenance and monitoring of a HP/SWH over a 10 year period and hence additional carbon finance is needed to attract a mass market.<sup>35</sup>

#### ***Other Barriers: Limited Information***

The lack of awareness of HPs/SWHs and related energy efficiency benefits, hinders the uptake of HPs/SWHs. People are not aware of the advantages of solar water heating and how much water heating contributes to electricity bills in general. Furthermore, knowledge of the Eskom subsidy and requirements is limited. Even if a consumer were aware of the alternative possibilities, the variety of HP and SWH products available on the Eskom supplier list is huge (> 1,000 products/suppliers) and difficult to assess. As part of the programme, the SPV will undertake targeted marketing of a selected product range, and increase people's knowledge about climate change, energy efficiency and HP/SWH systems.

#### ***Simplified Additionality for Micro Scale Projects***

According to the "Guideline for Demonstrating Additionality of Microscale Project Activities", 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 4 500 kW thermal installed capacity and the end users of the subsystem or measure are households/communities/SMEs. The SWHs installed under this PoA are significantly smaller than 4 500 kW and are likely to be installed in households or SMEs. This shall be demonstrated individually in each CPA.

Furthermore, energy efficiency projects with savings up to 20 GWh/year are additional, if each of the independent subsystems/measures in the project activity achieves estimated annual energy savings equal to or smaller than 600 MWh and the end users of the subsystem or measure are households/communities/SMEs.

As demonstrated in section A.4.4.1 under the demonstration that the SSC-CPA is not a de-bundled component of another CDM project, the independent HPs are estimated to achieve much smaller savings than 600 MWh/year. Most HPs will be installed in households or SMEs and this shall be demonstrated individually in each CPA.

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

Each CPA, that is funded and implemented under this PoA, shall demonstrate the additionality of the CPA based on one the barriers identified above, as follows:

<b>Barrier</b>	<b>Criteria</b>
Financial Resources	A cash flow model with and without CERs shall be provided in the CPA-DD.
Limited Information	Comprehensive argumentation shall be provided in the CPA-DD.
Simplified Additionality	The CPA-DD shall show that both 1) the individual system installed (HP/SWH), and 2) the CPA in total, fulfil the simplified

<sup>35</sup> Eskom Annual Report 2008

additionality rule.
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## B.6. Estimation of emission reductions of a generic CPA

### B.6.1. Explanation of methodological choices

#### *Baseline Emissions*

According to AMS.II.C paragraph 6 option 1, baseline emissions are determined as follows:

$$BE_y = E_{BL,y} \times EF_{CO_2,ELEC,y} + Q_{ref,BL} \times GWP_{ref,BL}$$

Where,

$BE_y$  = Baseline Emissions in year  $y$ , tCO<sub>2</sub>e;

$E_{BL,y}$  = Energy consumption in the baseline in year, kWh;

$EF_{CO_2}$  = CO<sub>2</sub> Emission factor, tCO<sub>2</sub>/kWh.

$Q_{ref,BL}$  = Average annual quantity of refrigerant used in the baseline to replace the refrigerant that has leaked, t/year;

$GWP_{ref,BL}$  = Global Warming Potential of the baseline refrigerant, tCO<sub>2</sub>e/t refrigerant.

$$E_{BL,y} = \sum_i (n_i \times \rho_i \times o_i) / (1 - l_y)$$

Where,

$n_i$  = Number of devices of the group of “ $i$ ” replaced;

$\rho_i$  = Power of the devices of the group of “ $i$ ” baseline devices;

$o_i$  = Average annual operating hours of the devices of the group of “ $i$ ” baseline devices;

$l_y$  = Average annual technical grid losses (transmission and distribution) during year  $y$  for the grid serving the locations where the devices are installed, expressed as a fraction.

The paragraph 21 of AMS-I.C applicable for displacement electricity from a grid refer to AMS-I.D (version 17), 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:

$$BE_y = EG_{BL,y} * EF_{CO_2}$$

Where,

$BE_y$  = Baseline Emissions in year  $y$ , tCO<sub>2</sub>e;

$EG_{BL,y}$  = Net quantity of energy supplied as a result of the implementation of the project activity in year,  $y$  MWh;

$EF_{CO_2}$  = CO<sub>2</sub> Emission factor, tCO<sub>2</sub>/MWh.

The net energy supplied is the energy output determined by SABS test<sup>36</sup> (used for ex-ante calculation) adjusted by estimated solar geyser contribution, which has been calculated as follows:

$$Q = (\alpha_1 H + \alpha_2 (T_a - T_c) + \alpha_3) / 3.6 / 1000 * n$$

Where,

- Q = Energy output in MJ  
H = The energy input i.e. irradiation in MJ per m<sup>2</sup>  
T<sub>a</sub> = The ambient air temperature and  
T<sub>c</sub> = 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<sup>37</sup> for the solar absorption efficiency of a domestic solar water heating system. For more detailed explanation of SABS test in appendix 4. Please note that Q-Factor is only applied for ex ante emission reduction estimates.

### ***CO<sub>2</sub> Emission factor***

According to the methodology AMS-I.D. version 17, in paragraph 12, the baseline is the MWh produced by the renewable generation unit multiplied by an emission factor (measured in tones CO<sub>2</sub>/MWh) calculated in a transparent and conservative manner in either way (a) or (b) as follows:

- (a) 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’.

OR

- (b) The weighted average emissions (in tCO<sub>2</sub>/MWh) of the current generation mix. The data of the year in which project generation occurs must be used.

Option a is selected and the grid factor is calculated in accordance with 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 exist. Public information on the Eskom power plants exists until 2008, and the private generators’ information is available only partly until 2005. It is considered 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.<sup>38</sup>

In South Africa the grid system is a nationwide grid system, and the fuel consumption as well as net electricity generation data is available for all Eskom systems. The calculation has been provided in Grid

<sup>36</sup> The SABS test results determine also the level of Eskom subsidy.

<sup>37</sup> South African National Standard as published by the South African Bureau of Standards ([www.sabs.co.za](http://www.sabs.co.za))

<sup>38</sup> Electricity supply statistics of South Africa, 2005 (the latest one), page 6, 14. Available under: <http://www.nersa.org.za/documents/ArchivedESSDocuments.aspx>



Factor Calculation of the PoA-DD. The power plant data has been obtained from the Eskom website and the data for most recent years (2007/8, 2008/9, 2009/10) has been applied, available under:

<http://www.eskom.co.za/c/article/236/cdm-calculations/>

The grid system is part of the national grid system, and fuel consumption as well as net electricity generation data is available for all Eskom systems. However, as per the data provided by Eskom, only coal power plants are have been producing electricity in the last 5 years and hence it is assumed that coal forms part of low-cost/must-run resources, and hence average OM has been selected as suitable calculation method (step 4 d, option A, equation 1 and option 1A equation 2 of the tool are applied). The operating margin has been calculated *ex-ante* based on 3-year generation-weighted average on the most recent publicly available data.

The build margin is calculated based on 20 % generation capacity including grid connected CDM projects as well as plants older than 10 years, as the generation capacity of plants built within the last 10 years is marginal (< 1 %). The option 1 and equation 12 are applied.

The combined margin is calculated based on weighted average (step 6, option a), which is determined to be used for all project types other than wind and solar projects.

The detailed calculation is presented in Grid Factor Calculation of the PoA-DD.

### ***Project Emissions***

According to AMS.II.C and AMS.I.C project emissions, relevant to the project activity, consist of electricity consumption from onsite electricity consumption. The project emission shall be determined *ex ante*.

For AMS.II.C as follows:

$$PE_y = E_{PJ,y} \times EF_{CO_2,ELEC,y} + Q_{ref,PJ} \times GWP_{ref,PJ}$$

Where,

$PE_y$  = Project Emissions in year y, tCO<sub>2</sub>e;

$E_{PJ,y}$  = Energy consumption in the project in year, kWh;

$EF_{CO_2}$  = CO<sub>2</sub> Emission factor, tCO<sub>2</sub>/kWh.

$Q_{ref,PJ}$  = Average annual quantity of refrigerant used in the project to replace the refrigerant that has leaked, t/year;

$GWP_{ref,PJ}$  = Global Warming Potential of the project refrigerant, tCO<sub>2</sub>e/t refrigerant.

$$E_{PJ,y} = \sum_i (n_i \times \rho_i \times o_i) / (1 - l_y)$$

Where,

- $n_i$  = Number of devices of the group of “ $i$ ” replaced;
- $\rho_i$  = Power of the devices of the group of “ $i$ ” project devices;
- $o_i$  = Average annual operating hours of the devices of the group of “ $i$ ” project devices;
- $l_y$  = Average annual technical grid losses (transmission and distribution) during year  $y$  for the grid serving the locations where the devices are installed, expressed as a fraction. According Eskom these losses are 8.45 %.<sup>39</sup>

AMS.I.C paragraph 45 determines that project emissions are calculated according the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”, as follows:

$$PE_{EC,y} = \sum_j EC_{PJ,j,y} \times EF_{EL,j,y} \times (1 + TDL_{j,y})$$

Where,

- $PE_{EC,y}$  = Project emissions from electricity consumption in year  $y$ , tCO<sub>2</sub>;
- $EC_{PJ,j,y}$  = Quantity of electricity consumed by the project electricity consumption source  $j$  in year  $y$ , MWh;
- $EF_{EL,j,y}$  = Emission factor for electricity generation for source  $j$  in year  $y$ , tCO<sub>2</sub>/MWh;
- $TDL_{j,y}$  = Average annual technical grid losses (transmission and distribution) during year  $y$  for the grid serving the locations where the devices are installed, expressed as a fraction. Same as  $l_y$  (above).

$EC_{PJ,j,y}$  the quantity of electricity consumed by the project electricity consumption source is estimated as a percentage of baseline for ex ante calculations, and following values shall be applied: 30% for 200 litre SWH and 90% for hybrid solutions<sup>40</sup>. In case of hybrid systems the HP functions as back up element for SWHs.

For  $EF_{EL,j,y}$  the Scenario A and option A1 of the tool is applied to determine the grid factor. According the option 1 the combined margin shall be determined according the Tool to calculate the emission factor for an electricity system. Hence, the combined margin is calculated according the same principle and equations presented above for baseline.

### Leakage

According AMS.I.C., leakage shall be considered if the energy generating equipment currently being utilised is transferred from outside the boundary to the project activity.

<sup>39</sup> Eskom Annual Report, 2010, page 32.

<sup>40</sup> Eskom 2009, Measurement and Verification, Project name: SHL and RLM Research Study, page 10, and supplier information <http://www.engnet.co.za/c/c.aspx/TAS006/productdetail/domestic-heat-pump-tas-8wb>;  
<http://www.technoheatpumps.co.za/index.html>

According to AMS.II.C., leakage shall be considered if the energy efficiency technology is equipment transferred from another activity.

Furthermore both methodologies state that in the case of PoAs, if the project activity involves the replacement of equipment, the leakage effect of the use of the replaced equipment in another activity can be neglected because the replaced equipment is scrapped.

Under this PoA only new SWH/HP technology will be installed. In case of new installation (i.e. no pre-feed or retrofit) the electric element is disconnected. By disconnecting the electric element the geyser is made unusable. Pre-feed or retrofit installation which accounts for approx. 5% of installations under the Eskom subsidy scheme, the existing element is left in place. However, the element is downgraded in order to apply for Eskom subsidy. In case of any pre-feed or retrofit installation the electricity usage of the element is monitored and will form part of project emissions, and hence is not a leakage occurs.<sup>41</sup>

Leakage ( $LE_y$ ) is considered to be zero under this programme.

### *Emission Reductions*

$$ER_y = BE_y - PE_y - LE_y$$

#### **B.6.2. Data and parameters that are to be reported ex-ante**

<b>Data / Parameter</b>	$EF_{grid}$
<b>Unit</b>	tCO <sub>2</sub> e/MWh
<b>Description</b>	The emission factor for the electricity system.
<b>Source of data</b>	Calculated based on data provided by Eskom. Available at: <a href="http://www.eskom.co.za/c/article/236/cdm-calculations/">http://www.eskom.co.za/c/article/236/cdm-calculations/</a>
<b>Value(s) applied</b>	0.967 tCO <sub>2</sub> e/MWh
<b>Choice of data or Measurement methods and procedures</b>	As per the Tool to calculate the emission factor for an electricity system
<b>Purpose of data</b>	Calculation of baseline and project emissions
<b>Additional comment</b>	Please see Grid Factor Calculation of the PoA-DD for detail calculation.

<sup>41</sup> Eskom. New Installation Guidelines for SWH requirement 9.3 on p 9; Emailing 02 May 2012, with Eskom; Eskom basic requirements for participation on the heat pump rebate, p 3<sup>41</sup>; Eskom Programme Requirements.



<b>Data / Parameter</b>	Q
<b>Unit</b>	TJ
<b>Description</b>	Daily solar energy output by the SWH in the day
<b>Source of data</b>	SABS test results
<b>Value(s) applied</b>	To be determined in CPA-DD
<b>Choice of data or Measurement methods and procedures</b>	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 calculations.
<b>Purpose of data</b>	Calculation of baseline emissions
<b>Additional comment</b>	Used only for SWHs. The value applied is the average SABS value for 200 litre units published at Eskom website.

<b>Data / Parameter</b>	$N_{estimate}$
<b>Unit</b>	Units
<b>Description</b>	Estimated number of units installed under the CPA
<b>Source of data</b>	Estimated based on the CPA design
<b>Value(s) applied</b>	To be determined in CPA-DD
<b>Choice of data or Measurement methods and procedures</b>	CPA design. Used for ex-ante estimates.
<b>Purpose of data</b>	Calculation of baseline emissions
<b>Additional comment</b>	Shall be determined for all solutions relevant to the CPA: HP, SWH and hybrid.

<b>Data / Parameter</b>	$\rho_i$
<b>Unit</b>	kW
<b>Description</b>	Power of the devices of the group of “i” for both baseline and project devices
<b>Source of data</b>	Baseline and supplier data
<b>Value(s) applied</b>	To be determined in CPA-DD
<b>Choice of data or Measurement methods and procedures</b>	<p>The following values can be applied for ex ante calculations, if relevant to the CPA design:</p> <p>Baseline:  <math>\rho_i = 3</math> to 4 kW<sup>42</sup></p> <p>Project:  <math>\rho_i</math> 0.5-0.95 kW (domestic)  <math>\rho_i</math> 1.06-1.9 kW (commercial)</p>
<b>Purpose of data</b>	Calculation of baseline and project emissions
<b>Additional comment</b>	Please note that the baseline capacities are based on typical domestic geysers. In case of industrial installation, the power shall be determined in the CPA DD. Furthermore, it should be noted that the power of the actual baseline device is recorded into the database for ex post calculations. Please note that this parameter is relevant only for CPAs that include HPs

<b>Data / Parameter</b>	$o_i$
<b>Unit</b>	H
<b>Description</b>	Average annual operating hours of the devices of the group of “i” project devices
<b>Source of data</b>	Estimated based on literature or measurements.
<b>Value(s) applied</b>	To be determined in CPA-DD
<b>Choice of data or Measurement methods and procedures</b>	Literature or measurements data (if available) will be used for ex ante emission reduction calculation.
<b>Purpose of data</b>	Calculation of baseline and project emissions
<b>Additional comment</b>	Please note that this parameter is relevant only for CPAs that include HPs

<sup>42</sup> Rankin and & van Eldik 2010, An Investigation into the Energy Savings and Economic viability of Heat Pump Water Heaters applied in the residential sector, page vi; Kwikot 2011, Electric Water Heating brochure page 2 and 3.

<b>Data / Parameter</b>	$GWP_{ref, PJ}$
<b>Unit</b>	t CO <sub>2</sub> e/t refrigerant
<b>Description</b>	Global Warming Potential of the refrigerant that is used in the project equipment
<b>Source of data</b>	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual, p.2.45, HFC-125.
<b>Value(s) applied</b>	To be determined in CPA-DD
<b>Choice of data or Measurement methods and procedures</b>	The IPCC Guidelines.
<b>Purpose of data</b>	Calculation of project emissions ex ante
<b>Additional comment</b>	Please note that all heat pumps under this programme are CFC free. Leaks will take place only in case of equipment failure/ The suppliers will implement all necessary measures to minimise leaks and estimate leak. The ex ante calculation does not foresee any leaks. The value applied is for HFC-125 which is one of the most common refrigerants.

### B.6.3. Ex-ante calculations of emission reductions

#### Baseline Emissions

For AMS.II.C as follows:

$$BE_y = E_{BL,y} \times EF_{CO_2, ELEC,y} + Q_{ref,BL} \times GWP_{ref,BL}$$

Where,

$BE_y$  = Baseline Emissions in year y, tCO<sub>2</sub>e; [add value]

$E_{BL,y}$  = Energy consumption in the baseline in year, MWh; [add value]

$EF_{CO_2}$  = CO<sub>2</sub> Emission factor, tCO<sub>2</sub>/MWh. 0.967

$Q_{ref,BL}$  = Average annual quantity of refrigerant used in the baseline to replace the refrigerant that has leaked, t/year; [add value]

$GWP_{ref,BL}$  = Global Warming Potential of the baseline refrigerant, tCO<sub>2</sub>e/t refrigerant. [add value]

$$E_{BL,y} = \sum_i (n_i \times \rho_i \times o_i) / (1-l_y)$$

Where,

$n_i$  = Number of devices of the group of “i” replaced; [add value]

$\rho_i$  = Power of the devices of the group of “i” baseline devices; [add value]



$o_i$	= Average annual operating hours of the devices of the group of “ <i>i</i> ” baseline devices;	[add value]
$l_y$	= Average annual technical grid losses (transmission and distribution) during year <i>y</i> for the grid serving the locations where the devices are installed, expressed as a fraction.	[add value]

For SWHs AMS.I.C is applied as follows:

Where,

$BE_y$	= Baseline Emissions in year <i>y</i> , tCO <sub>2</sub> e;	[add value]
$EG_{BL,y}$	= Net quantity of energy supplied as a result of the implementation of the project activity in year, <i>y</i> MWh;	[add value]
$EF_{CO_2}$	= CO <sub>2</sub> Emission factor, tCO <sub>2</sub> /MWh.	0.967

$EG_{BL}$  is calculated as follows ex ante:

$$Q = (\alpha_1 H + \alpha_2 (T_a - T_c) + \alpha_3) / 3.6 / 1000 * n$$

Where,

$Q$	= Energy output in MJ	[add value]
$H$	= The energy input i.e. irradiation in MJ per m <sup>2</sup>	[add value]
$T_a$	= The ambient air temperature and	[add value]
$T_c$	= Incoming cold water temperature	[add value]
$\alpha_1, \alpha_2, \alpha_3$	= Specific coefficients determined in the SABS test	[add value]
$n$	= Number of units	[add value]

The determination of  $Q_{i,y}$  complies with the SANS 6211-1: 2003 test<sup>43</sup> for the solar absorption efficiency of a domestic solar water heating system. For more detailed explanation of SABS test please see appendix 4.

### ***CO<sub>2</sub> Emission factor***

$EF_{grid}$	= CO <sub>2</sub> Emission factor, tCO <sub>2</sub> /MWh.	0.967
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The detail calculation is provided in the Emission Reduction Calculations for CPA001

### ***Project Emissions***

For AMS.II.C as follows:

$$PE_y = E_{PJ,y} \times EF_{CO_2,ELEC,y} + Q_{ref,PJ} \times GWP_{ref,PJ}$$

Where,

$PE_y$  = Project Emissions in year y, tCO<sub>2</sub>e; [add value]

$EG_{PJ,y}$  = Energy consumption in the project in year, kWh; [add value]

$EF_{CO_2}$  = CO<sub>2</sub> Emission factor, tCO<sub>2</sub>/kWh. [add value]

$Q_{ref,PJ}$  = Average annual quantity of refrigerant used in the project to replace the refrigerant that has leaked, t/year; [add value]

$GWP_{ref,PJ}$  = Global Warming Potential of the project refrigerant, tCO<sub>2</sub>e/t refrigerant. [add value]

$$E_{PJ,y} = \sum_i (n_i \times \rho_i \times o_i) / (1 - l_y)$$

Where,

$n_i$  = Number of devices of the group of “i” replaced; [add value]

$\rho_i$  = Power of the devices of the group of “i” project devices; [add value]

$o_i$  = Average annual operating hours of the devices of the group of “i” project devices; [add value]

$l_y$  = Average annual technical grid losses (transmission and distribution) during year y for the grid serving the locations where the devices are installed, expressed as a fraction. 8.45 %.<sup>44</sup>

For AMS.I.C as follows:

$$PE_{EC,y} = \sum_j EC_{PJ,j,y} \times EF_{EL,j,y} \times (1 + TDL_{j,y})$$

Where,

$PE_{EC,y}$  = Project emissions from electricity consumption in year y, tCO<sub>2</sub>; [add value] (Not relevant for ex-ante calculations, as the efficiency of solar system/hybrid is assessed when calculating baseline emissions.)

$EC_{PJ,j,y}$  = Quantity of electricity consumed by the project electricity consumption source j in year y, MWh; [add value]

$EF_{EL,j,y}$  = Emission factor for electricity generation for source j in year y, tCO<sub>2</sub>/MWh; [add value]

$TDL_{j,y}$  = Average annual technical grid losses (transmission and distribution) during year y for the grid serving the locations where the devices are installed, expressed as [add value]

<sup>43</sup> South African National Standard as published by the South African Bureau of Standards ([www.sabs.co.za](http://www.sabs.co.za))

<sup>44</sup> Eskom Annual Report, 2010, page 32.

a fraction. Same as  $l_y$  (above).

Hence project emissions ( $PE_y$ ) determined ex ante in year  $y$  are **XX** tCO<sub>2</sub> under the **CPA-XXX [confirm]**.

### *Leakage*

$LE_y = 0$  under this the CPA **XXX [confirm]**.

### *Emission Reductions*

**[add value for  $ER_y$ ]** = **[add value for  $BE_y$ ]** – **[add value for  $PE_y$ ]** - **[add value for  $LE_y$ ]**

For more detailed information please see the Emission Reduction Calculations for CPA **XXX**

## **B.7. Application of the monitoring methodology and description of the monitoring plan**

### **B.7.1. Data and parameters to be monitored by each generic CPA**

<b>Data / Parameter</b>	$N_{SWH}$
<b>Unit</b>	-
<b>Description</b>	Number of SWH operating in the year
<b>Source of data</b>	Site visits: visual and technical checks, as well as failure reporting
<b>Value(s) applied</b>	-
<b>Measurement methods and procedures</b>	Sample in accordance with the “General guidelines for sampling and surveys for SSC project activities”.
<b>Monitoring frequency</b>	Annually
<b>QA/QC procedures</b>	
<b>Purpose of data</b>	Calculation of baseline and project emissions
<b>Additional comments</b>	100 % applied for ex-ante. For ex-post, this will be reduced based on the results of the sample and reported failures. Please note that this parameter is relevant only for CPAs that include SWHs.



<b>Data / Parameter</b>	$N_{HP}$
<b>Unit</b>	-
<b>Description</b>	Number of HPs operating in the year
<b>Source of data</b>	Site visits: visual and technical checks, as well as failure reporting
<b>Value(s) applied</b>	-
<b>Measurement methods and procedures</b>	Sample in accordance with the “Standard for Sampling and Surveys for CDM Project Activities and Programme of Activities”.
<b>Monitoring frequency</b>	Annually
<b>QA/QC procedures</b>	
<b>Purpose of data</b>	Calculation of baseline and project emissions
<b>Additional comments</b>	100 % applied for ex-ante. For ex-post, this will be reduced based on the results of the sample and reported failures. Please note that this parameter is relevant only for CPAs that include SWHs.

<b>Data / Parameter</b>	$Q_y$
<b>Unit</b>	MWh
<b>Description</b>	Solar energy used by the household in the year $y$ , MWh
<b>Source of data</b>	Calculation
<b>Value(s) applied</b>	-
<b>Measurement methods and procedures</b>	The calculation based on the monitoring results of inlet and outlet temperature and water flow.
<b>Monitoring frequency</b>	Calculation bases on continuous measurement results
<b>QA/QC procedures</b>	
<b>Purpose of data</b>	Calculation of baseline emissions
<b>Additional comments</b>	Please note that this parameter is relevant only for CPAs that include SWHs.

<b>Data / Parameter</b>	$V$
<b>Unit</b>	litres
<b>Description</b>	Volume of daily warm water usage (water flow)
<b>Source of data</b>	Measured on-site
<b>Value(s) applied</b>	-
<b>Measurement methods and procedures</b>	A volumetric flow meter will measure the water flow at the inlet of the SWH i.e. amount of water entering to the tank.
<b>Monitoring frequency</b>	Calibration of the flow meter as per manufacturer specifications, but at least once in three years, or replacement of temperature probe with a new one.
<b>QA/QC procedures</b>	litres
<b>Purpose of data</b>	Calculation of baseline emissions
<b>Additional comments</b>	The volume is used to calculate mass (m) of water.



<b>Data / Parameter</b>	$T_{\text{outlet}}$
<b>Unit</b>	Celsius or Kelvin
<b>Description</b>	Temperature of water outlet point
<b>Source of data</b>	Measured on-site
<b>Value(s) applied</b>	-
<b>Measurement methods and procedures</b>	The temperature will be monitored with a temperature probe. Probe must be installed on the outlet before distribution to the house. If the hot water is mixed with cold water (to prevent the hot water temperature rising above 55 °C degrees i.e. for safety reasons) the probe must be installed at the mixing point before distribution to the house. The meter should be installed as specified by the equipment supplier.
<b>Monitoring frequency</b>	Continuous measurement (every minute), when water withdrawn by household.
<b>QA/QC procedures</b>	Calibration of the temperature probe as per manufacturer specifications, but at least once in three years.
<b>Purpose of data</b>	Calculation of baseline emissions
<b>Additional comments</b>	The outlet water of the SWH is mixed with cold water before distribution to the house. The thermostatic mixing valve is typically set at 55 °C for safety reasons. Please note that this parameter is relevant only for CPAs that include SWHs.

<b>Data / Parameter</b>	$T_{\text{outlet}}$
<b>Unit</b>	Celsius or Kelvin
<b>Description</b>	Temperature of water outlet point
<b>Source of data</b>	Measured on-site
<b>Value(s) applied</b>	-
<b>Measurement methods and procedures</b>	The temperature will be monitored with a temperature probe. Probe must be installed on the outlet before distribution to the house. If the hot water is mixed with cold water (to prevent the hot water temperature rising above 55 °C degrees i.e. for safety reasons) the probe must be installed at the mixing point before distribution to the house. The meter should be installed as specified by the equipment supplier.
<b>Monitoring frequency</b>	Continuous measurement (every minute), when water withdrawn by household.
<b>QA/QC procedures</b>	Calibration of the temperature probe as per manufacturer specifications, but at least once in three years.
<b>Purpose of data</b>	Calculation of baseline emissions
<b>Additional comments</b>	The outlet water of the SWH is mixed with cold water before distribution to the house. The thermostatic mixing valve is typically set at 55 °C for safety reasons. Please note that this parameter is relevant only for CPAs that include SWHs.



<b>Data / Parameter</b>	$\rho_i$
<b>Unit</b>	kW
<b>Description</b>	Power of the devices of the group of “i” for project devices
<b>Source of data</b>	Project devices installed
<b>Value(s) applied</b>	-
<b>Measurement methods and procedures</b>	The power of the nameplate data of the project device will be recorded into the database. 100 % of the data shall be recorded.
<b>Monitoring frequency</b>	Once at installation
<b>QA/QC procedures</b>	
<b>Purpose of data</b>	Calculation of project emissions
<b>Additional comments</b>	Please note that this parameter is relevant only for CPAs that include HPs.

<b>Data / Parameter</b>	$\rho_i$
<b>Unit</b>	kW
<b>Description</b>	Power of the devices of the group of “i” for baseline devices
<b>Source of data</b>	Baseline device replaced
<b>Value(s) applied</b>	-
<b>Measurement methods and procedures</b>	The power of the nameplate data of the baseline device will be recorded into the database. 100 % of the data shall be recorded.
<b>Monitoring frequency</b>	Once at installation
<b>QA/QC procedures</b>	
<b>Purpose of data</b>	Calculation of baseline emissions
<b>Additional comments</b>	Please note that this parameter is relevant only for CPAs that include HPs.

<b>Data / Parameter</b>	$E_{usage}$
<b>Unit</b>	kWh
<b>Description</b>	Annual energy usage of the devices of the group of “i” project devices
<b>Source of data</b>	Electricity meter
<b>Value(s) applied</b>	-
<b>Measurement methods and procedures</b>	Sample based on the General Guidelines for Sampling and Surveys for Small-Scale CDM Project Activities.
<b>Monitoring frequency</b>	Continuous measurement of a sample of units
<b>QA/QC procedures</b>	
<b>Purpose of data</b>	Calculation of baseline and project emissions
<b>Additional comments</b>	Please note that this parameter is relevant only for CPAs that include HPs, and will be used to determine the operating hours.



<b>Data / Parameter</b>	$TDL_{j,y} / I_y$
<b>Unit</b>	%
<b>Description</b>	Average annual technical grid losses (transmission and distribution) during year y for the grid serving the locations where the devices are installed, expressed as a fraction.
<b>Source of data</b>	Literature
<b>Value(s) applied</b>	8.45 % based on Eskom's Annual Report from 2010
<b>Measurement methods and procedures</b>	Latest Eskom information available
<b>Monitoring frequency</b>	Annually
<b>QA/QC procedures</b>	
<b>Purpose of data</b>	Calculation of project emissions
<b>Additional comments</b>	

<b>Data / Parameter</b>	$Q_{ref,PJ}$
<b>Unit</b>	t
<b>Description</b>	Average annual quantity of refrigerant used in the project to replace the refrigerant that has leaked, t/year
<b>Source of data</b>	Project equipment
<b>Value(s) applied</b>	-
<b>Measurement methods and procedures</b>	In case any of the HPs apply a refrigerant with a GHG potential, and this refrigerant is replaced due to leakage, the amount of refrigerant replaced shall be recorded. The extend of a leakage (amount of refrigerant discharge/recharge) is measured through pressure measurement.
<b>Monitoring frequency</b>	Measured in case of leakage
<b>QA/QC procedures</b>	
<b>Purpose of data</b>	Calculation of project emissions
<b>Additional comments</b>	Please note that all heat pumps under this programme are CFC free. This parameter is only relevant for refrigerants with GHG potential. Leaks will take place only in case of equipment failure/ The suppliers will implement all necessary measures to minimise leaks and estimate leak.

<b>Data / Parameter</b>	$Q_{ref,BL}$
<b>Unit</b>	t
<b>Description</b>	Average annual quantity of refrigerant used in the baseline to replace the refrigerant that has leaked, t/year
<b>Source of data</b>	Baseline equipment
<b>Value(s) applied</b>	-
<b>Measurement methods and procedures</b>	n/a
<b>Monitoring frequency</b>	n/a
<b>QA/QC procedures</b>	n/a
<b>Purpose of data</b>	Calculation of baseline emissions
<b>Additional comments</b>	Please note that the baseline equipment electric geyser does not apply any refrigerants.

### B.7.2. Description of the monitoring plan for a generic CPA

The coordinating entity will implement a system that will allow the DOE to verify the emission reductions for each individual CPA and to consolidate the CPAs to determine the emission reductions for the PoA as a whole. The coordinating entity will contract a specialised data management company, which will establish and maintain a database for the PoA that contains sufficient data, specific to each CPA and each installation, to allow the DOE to calculate the emission reductions for each individual CPA.

#### 1. Heat Pumps:

Methodology AMS.II.C. “Demand-side energy efficiency activities for specific technologies”, Version 13, determines that if the devices have a variable current (ampere) characteristics, the monitoring can consist of:

- Metering the “energy use” of an appropriate sample of the devices installed.
- Annual checks of a sample of non-metered systems to ensure that they are still operating.

Furthermore, if the devices installed replace existing devices, the number and “power” of a representative sample of the replaced devices shall be recorded in a way to allow for a physical verification by the DOE.

A sample of the HPs will be equipped with an electricity meter that meters the electricity consumption of the HPs. This will further be used to determine the operational hours. The name plate dates for each installation, including baseline data, are captured into a database, which can be viewed by the DOE. Each installation can be uniquely identified based on address, GPS coordinates and serial number of the equipment.

#### 2. Solar Water Heaters:

The methodology AMS-I.C. “Thermal energy production with or without electricity”, Version 19, determines that if the emission reduction per system is less than 5 tonnes CO<sub>2</sub> per year; or in the case of household or commercial applications/systems whose maximum output capacity is less than 45 kW

thermal and where it can be demonstrated that the metering of thermal energy output is not plausible, monitoring shall consist of:

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

### *Implementation of the Methodology in the Programme*

The estimation of the operational hours as such is not appropriate as the SWHs receive solar radiation constantly during the day, and the amount of energy replaced is subject to the households' hot water usage.

The amount of energy provided by a SWH [ $Q$ ] on a specific day and used by a household can be calculated from:

1. the difference between inlet and outlet water temperature [ $\Delta T$ ]; and
2. the water flow rate i.e. volume of water usage [ $V$ ].

The average annual hours of operation can be determined with the help of the energy usage measure (i.e. energy replaced/saved) and the rated capacity of the SWH.

Continuous measurements are undertaken to meter the actual demand profiles: the following parameters are metered in a sample of units:

Parameter	Unit	Symbol
Inlet water temperature	° C	$T_{\text{inlet}}$
Outlet water temperature	° C	$T_{\text{outlet}}$
Volume of daily water flow (water usage)	litre	$V$

This data is used to calculate the energy output  $Q$  ex post. Each SWH is linked to the nearest measurement point with the help of GPS coordinates and the database. The measurement at each of the metered sites is continuous, and will be integrated daily. Furthermore the electricity use of the backup element is metered and this is reduced from the amount of energy provided by a SWH ( $Q$ ).

### **3. Sample Size for Operationality**

To confirm the number of operating systems, 97 installations in each CPA are sampled for functionality every year, as well as to check the data capture accuracy (i.e. spot-checks). The database will annually allocate the 97 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. The results are used to adjust the ex-post emission reduction calculation (i.e. % of SWHs/ HPs that are operational).

The “Standard for Sampling and Surveys for CDM Project Activities and Programme of Activities” require PoAs to use 95/10 confidence/precision as the criteria for reliability of sampling efforts. This reliability specification shall be applied to determine the sampling requirements for each individual parameter value determined through a sampling effort”. This applies to the determination of the sample size with 95% probability of falling in the range of  $\pm 10\%$  of the true population value (often denoted as 95/10 confidence/precision) and can be calculated based on a normal / Gaussian distribution.

The number of SWHs / HPs operating shall be determined annually with a sample. To estimate the sample size (n) of the SWHs installed and operating under the programme in the households with a maximum 10% margin of error at the desired confidence level of 95%, the optimal sample size n of the SWHs / HPs is given by:

$$1.96 \frac{\sigma}{\sqrt{n}} \leq 0.1$$

And the sample size n is:

$$n \geq \frac{(1.96)^2}{(0.1)^2} \sigma^2 \approx 384.16$$

The value 1.96 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 0.95, and can be obtained from normal distribution tables. Since the maximum value of  $\sigma^2$  is  $\frac{1}{4}$ , the sample size  $n=96.04$  should suffice, and hence the sample size for each CPA is determined to be a minimum of 97 SWHs/HPs.

The database will annually allocate the 97 sites for inspection by an automated random number generator. The installers/ suppliers of the SWH/HPs will inspect the determined SWH/HPs.

#### 4. Sample Size for Monitoring

The same “General Standard for Sampling and Surveys for CDM Project Activities and Programme of Activities” shall be applied also for monitoring, and hence a 95/10 confidence/precision is requested.

To determine the dispersions of the relevant quantities (inlet and outlet water temperatures, volume of the daily water flow) one has to take into account the temperature variations around the country and the fact that the water usage is subject to household's consumption habits. To reach 95/10 confidence/precision following is applied:

1. Country is divided to climatic zones, and each zone shall have a measurement site subject to the number of units installed in that specific zone. Inlet and outlet water temperatures are measured specific to each climatic zone;
2. It is suggested that the water consumption habits do not depend on the climate zones so that the water flow estimate can be based on the whole sample.

#### 5. Leakage of Refrigerant

A refrigerant leak occurs only due to a technical failure of a heat pump. Under this programme the supplier is responsible for the functionality of the HP over the 10 year crediting period. In case of failure the HP is either fixed and the refrigerant is replaced or the HP is replaced with new equipment.

To date there has been no legislation pertaining to the disposal of refrigerants in South Africa; however the SABS 0147 Code of Practice (Refrigerant systems including plants associated with air conditioning

systems) has been introduced as a guideline. In case of discharge/recharge of the refrigerant or disposal of the HP certified companies that follow the Code of Practice will be used.

The amount/extend of physical leakage of refrigerant from the project equipment is measured through pressure measurement. The results (amount of refrigerant discharge/recharge) are reported into the database, and applied for the ex post emission reduction calculations.

## 6. Data Recording

The following data is recorded in the database for monitoring purposes for each CPA:

1	Location of the SWH(s)	<ul style="list-style-type: none"><li>▪ Street address</li><li>▪ GPS coordinates</li></ul>	<ul style="list-style-type: none"><li>▪ Once when joining the programme</li></ul>
2	Residence / Company Details	<ul style="list-style-type: none"><li>▪ First name and surname / Company name</li><li>▪ ID number / Company registration number</li><li>▪ Contact details</li></ul>	<ul style="list-style-type: none"><li>▪ Once when joining the programme</li></ul>
3	Installer Details	<ul style="list-style-type: none"><li>▪ Installation date</li><li>▪ Installer name</li><li>▪ Company name</li><li>▪ Contact details</li></ul>	<ul style="list-style-type: none"><li>▪ Once when joining the programme</li></ul>
4	Technical Specifications	<ul style="list-style-type: none"><li>▪ Serial number</li><li>▪ HP/SWH type</li><li>▪ HP/SWH size</li><li>▪ HP input power</li><li>▪ HP / SWH heating capacity</li><li>▪ SWH absorber area</li><li>▪ SWH back up element size</li></ul>	<ul style="list-style-type: none"><li>▪ Once when joining the programme</li></ul>
5	Baseline Details	<ul style="list-style-type: none"><li>▪ Power of existing geyser</li><li>▪ Size of existing geyser</li></ul>	<ul style="list-style-type: none"><li>▪ Once when joining the programme</li></ul>
6	Data from the sample group indicating the number of HPs/SWHs operating during the monitoring period		<ul style="list-style-type: none"><li>▪ Annually</li></ul>
7	Measurement data for a sample group	SWH: <ul style="list-style-type: none"><li>▪ Inlet water temperature</li><li>▪ Outlet water temperature</li><li>▪ Water flow</li></ul> HP: <ul style="list-style-type: none"><li>▪ Electricity consumption</li></ul>	<ul style="list-style-type: none"><li>▪ Continuous/ daily</li></ul>
8	Measured	Quantity of refrigerants replaced, in case of leakage	<ul style="list-style-type: none"><li>▪ In case of leakage</li></ul>
9	Monitoring period of the CPA		<ul style="list-style-type: none"><li>▪ Annually/ relevant period</li></ul>

An electronic database that is hosted by a specialised data company in a secure environment will capture all above information. Data will be archived for two years over the 10 year crediting period. Relevant data capture, verification and storage procedures will be followed in maintaining the data to ensure its accuracy, validity and completeness.

The sampling (operationality of SWH/HP units) and maintenance will be undertaken by the relevant suppliers. International Carbon will produce a monitoring report for each monitoring period in order to verify the information related to the emission reductions contained in the CPA.



A Monitoring Manual has been established to guide the CME and CPAs with the monitoring.



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**Appendix 1: Contact information on entity/individual responsible for the PoA**

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**Appendix 2: Affirmation regarding public funding**

**Appendix 3: Application of methodology(ies)**

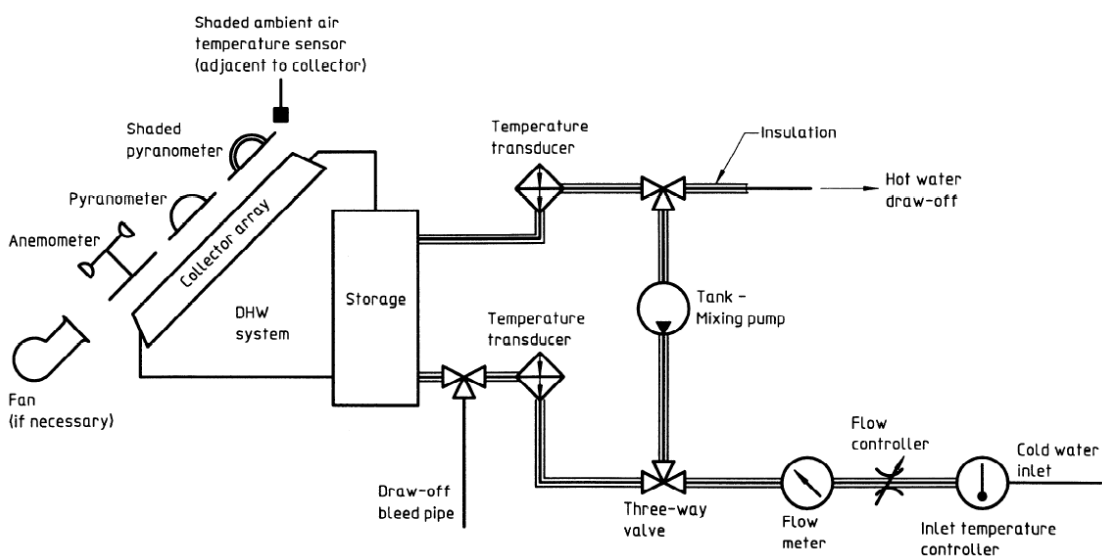
## Appendix 4: Further background information on ex ante calculation of emission reductions

### The South African Bureau of Standards Test for SWHs

The test results from the SANS<sup>45</sup> 6211-1:2003, characterises a Solar Water Heating System in terms of its Energy Output (Q). A Code Of Practice has been established for the SWH installers and the SABS<sup>46</sup> defines the standards for SWH equipment. The SABS test complies with the SANS and has three main elements thermal performance, mechanical performance and safety. The thermal performance test SANS 6211, further bases on the ISO 9459-2 standard. ISO 9459-2 is a establishes test procedures for characterizing the performance of solar domestic water heating systems operated without auxiliary boosting, and for predicting annual performance in any given climatic and operating conditions. The SABS product certification approval is voluntary scheme, but it is a requirement for the Eskom subsidy, which bases on the system rating (Q factor) of each SWH.

The SABS test method correlates the Energy Output (Q), to the Solar Energy (H) incident on the system and the difference between the daily average ambient temperature ( $T_a$ ) and the incoming cold water temperature ( $T_c$ ). Each SABS test involves a solar heating period of not less than 6 hours, equally spaced about solar noon. On each day of the test, the SWH system is allowed to operate outdoors and a single draw-off is applied at the end of day. At the start of each day of the test, the system is preconditioned by flushing it with water at a known temperature. At the end of each day the accumulated hot water is drawn off. During the draw-off, temperatures, water flow and volume are measured. The values of temperature versus volume withdrawn are plotted on a draw-off profile graph, of which the energy output for each test day can be determined. A minimum of 6 tests will be carried out. The test procedure is described in detail in SANS 6211 and the equation applied is presented under section D.6.1. The picture 1 below gives a schematic representation of the apparatus applied for performance test.

Picture 1. The apparatus applied for performance test.



<sup>45</sup> South African National Standards (SANS)

<sup>46</sup> South African Bureau of Standards

**Appendix 5: Further background information on the monitoring plan**

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**History of the document**

<b>Version</b>	<b>Date</b>	<b>Nature of revision(s)</b>
02.0	EB 66 13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the programme design document form for small-scale CDM programmes of activities" (EB 66, Annex 13).
01	EB33, Annex43 27 July 2007	Initial adoption.
<b>Decision Class:</b> Regulatory <b>Document Type:</b> Form <b>Business Function:</b> Registration		