Monitoring report form
(Version 03.2)

Monitoring report

Title of the project activity	SASSA Low Pressure Solar Water Heater Programme
Reference number of the project activity	PoA 4302
Version number of the monitoring report	04
Completion date of the monitoring report	28/03/2014
Registration date of the project activity	12/03/2011
Monitoring period number and duration of this monitoring period	# 3 01/01/2013 - 31/12 /2013
Project participant(s)	CME: Solar Academy of Sub Saharan Africa (Pty) Ltd PPs: International Carbon Ltd, Eneco Energy Trade B.V., Standard Bank Plc
Host Party(ies)	Republic of South Africa
Sectoral scope(s) and applied methodology(ies)	Type I – Renewable energy projects AMS-I.C. -Thermal Energy Production with or without electricity, Version 17
Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD	163 854
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period	50 194
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved during the period up to 31 December 2012(if applicable)	n/a
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved during the period from 1 January 2013 onwards (if applicable).	50 194

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

The purpose of the PoA and CPAs is to install South African Bureau of Standards (SABS) approved non-pressure (also called low-pressure) storage tank and vacuum tube solar collectors to low income households free of charge.

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

The CPAs consists of 110 litre vacuum tube storage tank low pressure SWHs with each having 1.08 m^2 aperture i.e. absorber area. The below table 1 shows total installation and absorber area numbers for 2013.

Table 1. Installation number and absorber area.

CPA	Number of Installations in households	Total absorber area
001	59 000	63 720 m^2
002	31 500	34 020m^2
003	2 663	2 876m^2
Total	**93 163**	**100 616m^2**

A total of 93 163 units were therefore installed since the inception of the PoA to the end of 2013. However, only 83 495 installations have been assigned to monitoring sites and allocated as such in the database. CPA001 became full at 59 000 installations and CPA002 became full at 31 500 installations (the sum of which is 90 500 installations). Therefore considering the total installations of 93 163 as at the end of 2013, CPA003 had 2 663 installations during 2013.

However, only 83 495 installations have been assigned to monitoring sites and allocated as such in the database. Therefore, only 83 495 can be said to be generating CERs for the 2013 period. This means that only CPA001 (59 000 installations) and CPA002 (with the difference i.e. 83 495 - 59 000 = 24 495) can be included, even though we know that CPA002 became full in 2013 and CPA003 was initiated. The unassigned installations from CPA002 and CPA003 can therefore not be included in the 2013 verification, because they do not, as yet, meet the requirements of the PoA's eligibility criteria in some way or other.

There are a number of reasons why an installed unit may not yet be assigned to monitoring sites and allocated as such in the database (and hence not able to generate CERs yet), e.g.:

- Challenges with regards to the data capturing:
    - Much information is captured incorrectly or incoherently when the initial data is captured onsite by the installation teams. Please consider that these teams are largely comprised of previously disadvantaged community members whose technical skills have been developed by SASSA (project developer) in order to undertake the physical installations. However their levels of basic education are typically poor (viz. spelling, numeracy etc.). As a result, the data needs to be rigorously checked, so that all requirements of the PoA's eligibility criteria are correctly met. The recording of dates, tank serial numbers, GPS coordinates and ID numbers are noted as problem areas and data has to be regularly reviewed, cleaned-up and often recaptured entirely.
    - Another barrier to the successful capturing of data in this PoA revolves around poor IT infrastructure (in the country at large). For example, poor internet connections at the SASSA offices made the uploading of the hard copy installation information into the electronic database difficult: the constant disruptions in supply and quality of connectivity meant that the uploading process was very slow, cumbersome and labour intensive as data that was in the process of being captured electronically was often lost when internet connectivity was lost, and had to be recaptured from the very beginning.

SASSA is aware of these challenges, and during the last quarter of 2013 made moves to addressed

these (and continues to do so) through the provision of extra resources (human and IT infrastructure) and plans to automate the data capturing process in the future, as much as possible, to mitigate the risk of human error in this regard and to speed up the process in general.

- Some of the installed units are outside of the monitoring equipment's 50km radius:
    - SASSA is aware of this barrier, and is considering options to install additional monitoring units. These items however are capital intensive, and their installation has not been treated as a priority at this stage

Installations under CPA-004 were initially scheduled to commence in July 2013 but installations have not yet progressed this far. The reason for this delay relates to the sudden Eskom subsidy restrictions in 2011, which restricted SASSA to 1,100 installations per month: 5,000 units less than its installation capacity. Furthermore, Eskom has subsequently ceased the provision of a subsidy for low pressure SWHs in the country, reducing the expected demand even further.

All the SWHs comply with the SABS Standard Specification for SWH systems SANS 6211-1:2003, SANS 151-2009 and SANS 1307:2003[1] to ensure that the SWHs installed are able to withstand local climatic and water quality conditions, and convert solar radiation into thermal energy for the heating of water.

The main components of a SWH are:

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

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

The installation started on 01/07/2010 with installations in Port Elizabeth in Nelson Mandela Bay Metropolitan Municipality, Eastern Cape. Other sites where commissioned as follows:

- Ekurhuleni Metropolitan Municipality: 07/01/2011
- Free State Province: 02/01/2011
- eThekwini Metropolitan Municipality: 03/02/2011
- Western Cape Province: 05/02/2011
- North West Province: 01/01/2011
- KwaZulu Natal: 08/12/2010
- Gauteng: 01/10/2010
- Mpumalanga: 19/04/2011

The dates for the CPAs are as follows:

- Start date of CPA001: 01/07/2010;
- Start date of CPA002: 09/10/2010;
- Start date of CPA003: 18/07/2013;
- CPA001 became full: 28/02/2012;
- CPA002 became full: mid-2013. The exact date will only be available once all the related unassigned units are assigned to monitoring stations in the database. Units can only be said to be generating CERs once assigned in the database;
- CPA003: Installations still continuing.

As discussed above, none of the CPA003 installations in 2013 were assigned to monitoring sites in 2013, and hence they cannot be said to be generating any CERs. The CPA003 CER generation has therefore been delayed and hence CPA003 is not part of the 2013 issuance.

Dates for commissioning the monitoring sites/ equipment are given in below table 2.

Table 2. Commissioning dates of the monitoring sites.

No.	***City /***	***Province***	***Address***	***Latitude***	***Longitude***	***Commissioning***

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

	Municipality					***date***
1	Port Elizabeth/ Nelson Mandela Bay Metropolitan Municipality	Eastern Cape	224 K.D Matanzima Crescent Erf 3621 Motherwell	-33.80345	25.615417	12/03/2011
2	Durban / eThekwini Metropolitan Municipality	KwaZulu Natal	3324 Welbedacht West Chatsworth	-29.921317	30.831017	19/04/2011
3	Botshabelo / Manganung Municipality	Free State	1230 U Section Botshabelo	-29.261933	21.67115	2/08/2011
4	Calitzdorp/Kannal and Municipality/ Eden District	Western Cape	6th Road Calitzdorp	-33.5228	21.67115	23/08/2011
5	Ekhurleni Metropolitan Municipality	Gauteng	7226 Cisticola Street	-26.1101	27.189333	01/09/2011
6	Kroonstad / Moqhak Municipality	Free State	11858 Relebohile, Dingalo Street Kroonstad	-27.654117	27.189333	1/09/2011
7	Potchefstoom / Tlokwe Local Municipality	North West	8186 Thladi Street, Potch	-26.730184	27.053916	1/09/2011
8	Vredenburg / Saldhana Bay Local Municiplaity	Western Cape	13 Yster Street, Vredenburg	-32.91555	18.0207	29/09/2011
9	Uitenhage, Rocklands / Nelson Mandela Bay Municipality	Eastern Cape	301 Rocklands Street	-33.856783	25.289017	16/02/2012
10	Uitenhage, Nelson Mandela Bay Municipality	Eastern Cape	22 Heron Street	-33.731783	25.377383	16/02/2012
11	Uitenhage, Rocklands / Nelson Mandela Bay Municipality	Eastern Cape	334 Rocklands Street	-33.858217	25.28795	01/03/2012
12	City of Johannesburg	Gauteng	32 Field Street, Alexandra	-26.087583	28.112809	26/09/2012
13	Caledon / Theewaterskloof Municipality	Western Cape	2532 School Street Genadendal 7234	-34.245499	19.420878	26/09/2012
14	Klipplaat / Ikwezi Municipality	Eastern Cape	1317, Klipplaat	-33.01851667	24.34828333	30/09/2012
15	Machadodorp / Emakhazeni Municipality	Mpumalanga	795 Shabalala Ave eNtokozweni	-25.69405	30.24405	01/09/2012
16	Willowmore / Baviaans Municipality	Eastern Cape	7th Avenue Willowmore	-33.28205	23.49858333	30/09/2012
17	Barrydale/ Swellendam Municipality	Western Cape	6750 Protea Ave, Barraydale	-33.913683	20.737983	10/10/2012
18	Pellsrus, Jeffreys Bay / Kouga Municipality	Eastern Cape	11 Galjoen Street, Pellsrus Jeffreys Bay	-34.06516667	24.9195	30/09/2012
19	Buitesig / Mangaung	Free State	54592 Monyatsi St, Buitesig	-29.130817	26.231533	30/09/2012
20	Darnall / Ilembe District Municipality	Kwa Zulu Natal	2320 Zamani; Darnall; Stanger	-29.28175	31.356117	09/10/2012
21	Caledon/ Theewaterskloof	Western Cape	2210 Edsin Ave; Theewaterskloof;	-34.079083	19.9013	11/10/2012

	Municipality		Caledon				

As per the registered PoA-DD to confirm the number of operating systems 1 % of the installations in each CPA are sampled for functionality. The database will annually allocate the 1 in 100 sites for inspection by an automated random number generator, which will be set to never select the same site for inspection over the 10 years period. Therefore 10 percent of all the installations will be inspected over the 10 years monitoring period. The results are used to adjust the ex-post emission reduction calculation (i.e. % of SWHs operational). The operationality checks took place in October 2013.

Total GHG emission reductions achieved in this monitoring period: 50 194 tons CO_2.

The CPA001 contains a total of 59,000 units installed in houses, CPA002 a total of 31 500 units installed in houses and CPA003 a total of 2 663 units and as discuss above CPA004 contains 0 units installed in houses i.e. there are a total of 93 163 installations in households under this PoA in 2013. However, in 2013 only 83 495 installations where allocated to measured sites due to delays in data upload process and installation of monitoring equipment. Hence the 2013 emission reductions are based only on 83 495 installations. This also means that emissions from CPA001 and CPA002 only are considered in this 2013 Monitoring Report. The actual figures in this regard, i.e. successfully allocated to monitoring equipment and therefore eligible for the development of CERs, relate to CPA001: 59 000 houses and CPA002: 24 495 houses, and therefore the total in this regard is 83 495.

A.2. Location of project activity

Host Party: Republic of South Africa

Region/ State/ Province / City/ Town/ Community:

Installations took place in the following areas:

- Nelson Mandela Bay Metropolitan Municipality in the Eastern Cape Province
- Ikwezi Municipality in the Eastern Cape Province
- Baviaans Municipality in the Eastern Cape Province
- Kouga Municipality in the Eastern Cape Province
- eThekwini Metropolitan Municipality in the KwaZulu Natal Province
- Botshabelo Metropolitan Municipality in the Free State Province
- Moqhaka Municipality[2] in the Free State Province
- Ekurhuleni Metropolitan Municipality in Gauteng Province
- City of Johannesburg Metropolitan Municipality in Gauteng Province
- Tlokwe Local Municipality[3] in the North West Province
- Saldhana Bay Local Municipality[4] in the Western Cape Province
- Mossel Bay Municipality in the Western Cape Province
- Theewaterskloof Local Municipality in the Western Cape Province
- Kannaland Municipality and Eden District in the Western Cape Province

Physical/ Geographical location:

As defined in AMS.I.C, the project boundary is the physical, geographical site of the renewable energy generation including the residential facility consuming the thermal energy produced. Hence the boundary for the PoA and the relevant CPAs comprises the physical site of each SWH within the CPA as well as the South African grid system, as the SWH will replace grid electricity. The GHG reduced through the CPAs is CO_2. The reduction takes place through the avoidance of fossil fuels (predominantly coal) used in the production of electricity to heat water, in the absence of the CPAs.

The exact geographical locations of each installation under each CPA are presented in the detailed House List with GPS-coordinates, as provided to the verifying DoE.

A.3. Parties and project participant(s)

[2] Also known as Kroonstad
[3] Also known as Potchefstroom
[4] Also known as Saldhana and Verenburg

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 (host)	Solar Academy of Sub Saharan Africa (Pty) Ltd	No
United Kingdom	Standard Bank Plc	No
United Kingdom	International Carbon Ltd	No
United Kingdom	Eneco Energy Trade B.V	No

A.4. Reference of applied methodology

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

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

A.5. Crediting period of project activity

CPA001: 12/03/2011 – 11/03/2021 (Fixed crediting period of ten years).
CPA002: 01/04/2012 – 31/03/2022 (Fixed crediting period of ten years).
CPA003: 01/01/2013 – 31/12/2023 (Fixed crediting period of ten years).
CPA004: 01/07/2013 – 30/06/2023 (Fixed crediting period of ten years).

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

Under the PoA, SABS approved Cistern Type Tasol SWH systems have been installed. These systems consisted of an insulated 110 litre tank that is integrated with 12 vacuum-insulated absorbing glass tubes. The solar radiation that is absorbed by the hollow glass tubes heats the water contained in the insulated tank directly through the process of thermo-siphoning. The systems are installed on the outside roof of a low income domestic building.

System specifications:
Tank volume under test: 111 litres
Number of tubes: 12
Diameter of tubes: 58 mm
Exposed length of tubes: 1 800 mm
Absorbing area of the tubes: 50 mm
Total absorber/ aperture area of the tubes: 1.8 m * 0.05 m *12 = 1.08m^2
Total absorber/ aperture area of CPA001: 1.08 m^2 * 59 000 = 63 720 m^2
Total absorber/ aperture area of CPA002: 1.08 m^2 * 31 500 = 34 020 m^2

The installation of the SWHs under the CPA001 started on 01/07/2010 with installations in Port Elizabeth in Nelson Mandela Bay Metropolitan Municipality, Eastern Cape. The CPA001 became full on 28/02/2012, which is the date of the last installation done under CPA001. The CPA002 started on 09/10/2010 also with installations in Port Elizabeth in Nelson Mandela Bay Metropolitan Municipality, Eastern Cape. The CPA002 reached its full volume of 31 500 installed units in households in mid-2013[5]. However, in 2013 only 83 495 installations were assigned to measured sites. This was due to delays in the data upload process and the lack of recording or capturing residents' IDs (an eligibility criterion required for inclusion under the PoA). Hence the 2013 emission reductions are based only on 83 495 installations, where 59 000 units were

[5] Exact date to be established once all outstanding units have been assigned in the database

installed (and assigned to monitoring sites) under CPA001 and 24 495 were installed (and assigned to monitoring sites) under CPA002.

As per the monitoring plan of the registered PoA-DD, one (1) in ten thousand (10,000) installations is monitored in real time so as to perform comprehensive measurement and verification. Furthermore the site selection is based on the geographical location, namely there must be at least 1 metered site within 50 km[6] from any simulated site. The measured ambient temperature, cold water temperature and solar irradiation are loaded onto the independent central project database. The data at each of the metered sites is recorded every 5 minutes and integrated daily. At midnight every day, the simulation is executed on each home based on the daily measured values. The available solar irradiation at each site, together with daily average ambient and cold water temperatures is used in accordance with the SABS performance test to determine the delivered energy to that site.

Table 3. Dates for commissioning the monitoring sites/ equipment:

No.	***Address***	***Commissioning date***
1	224 K.D Matanzima Crescent Erf 3621 Motherwell, Port Elizabeth	12/03/2011
2	3324 Welbedacht West Chatsworth, Durban	19/04/2011
3	1230 U Section, Botshabelo, Manganung Municipality	02/08/2011
4	6th Road Calitzdorp, Eden District	23/08/2011
5	7226 Cisticola Street, Ekhurleni	01/09/2011
6	11858 Relebohile, Dingalo Street Kroonstad	01/09/2011
7	8186 Thladi Street, Potchefstoom	01/09/2011
8	13 Yster Street, Vredenburg	29/09/2011
9	301 Rocklands Street, Uitenhage	16/02/2012
10	22 Heron Street, Uitenhage	16/02/2012
11	334 Rocklands Street, Uitenhage,	01/03/2012
12	32 Field Street, Alexandra, Johannesburg	26/09/2012
13	2532 School Street Genadendal 7234, Caledon / Theewaterskloof	26/09/2012
14	1317, Klipplaat	30/09/2012
15	795 Shabalala Ave eNtokozwen, Machadodorp	01/09/2012
16	7th Avenue Willowmore	30/09/2012
17	6750 Protea Ave, Barraydale, Swellendam	10/10/2012
18	11 Galjoen Street, Pellsrus Jeffreys Bay	30/09/2012
19	54592 Monyatsi St, Buitesig, Mangaung	30/09/2012
20	2320 Zamani; Darnall; Stanger	09/10/2012
21	2210 Edsin Ave; Theewaterskloof; Caledon	11/10/2012

As per the registered PoA-DD, to confirm the number of operating systems 1 % of the installations in each CPA are sampled for functionality. The database will annually allocate the 1 in 100 sites for inspection by an automated random number generator, which will be set to never select the same site for inspection over the 10 years period. Therefore 10 percent of all the installations will be inspected over the 10 years monitoring period. The results are used to adjust the ex-post emission reduction calculation (i.e. % of SWHs operational). The operationality checks took place in October 2013.

As mentioned above the installation of the equipment was delayed due to correction of errors from the onsite manual capturers (i.e. inputting installation and home owner information from installation forms into the database).This was in specific relation to the GPS co-ordinates as there are several official formats in which GPS co-ordinates can be captured. The GPS originally captured did not synchronise with the RTE database formats, hence all the co-ordinates had to be edited and corrected manually, one by one and verified by the onsite installation teams and the data-capturing teams at head office. Any errors detected were immediately referred back to the installation teams for the correction and verification of the data. As this project involves a mass-roll out of thousands of solar water heaters the process to ensure data integrity was lengthy and took meticulous attention to detail. The longer it took to capture the installations with GPS coordinates into the RTE database, the longer it took to determine where to install monitoring equipment in order to determine correct monitoring site and fulfil 50 km radius and 1/10 000 units monitoring requirements. Hence only 83 495

[6] The rationale for the selection of the 50km radius is based on measurements from three (3) weather stations near Nelson Mandela Bay, namely Addo [33° 34'E; 25° 42' S; Altitude 85m], Jansenville [32° 59'E; 25° 36' S; Altitude 60m] and East London [33° 01'E; 27° 49' S; Altitude 155m]. Addo is 115km from Jansenville and the annual average global radiation variance is 2%. Addo is 252km from East Loandon and the annual average global radiation variance is 0.4%. Jansenville is 303km from East London and the annual average global radiation variance is 1.7%. A monthly statistical analysis shows that the lowest confidence level is 94.16%. It is therefore assumed that at a 50km radius the average annual error per home will be less than 5.84%. (Ref 4:)

installations of 93 163 total installations where monitored in 2013.

The reasons for the figures above are described below:

1. The information from the installations is captured manually on site by the installers. This includes among others carbon ceding document, installation sign off, details of home owners, GPS co-ordinates and serial number of the units.

2. The actual forms with the captured information are then sent to SASSA head office in batches.

3. The data is double checked and captured on to an excel spread sheet by allocated resources dedicated to this process at SASSA head office.

4. Errors (e.g. GPS coordinates captured incorrectly by installer i.e. different types of GPS formatting and certain database field formats.) are checked and referred back to the data capturers on the installation site for correction, if any. Once the errors are corrected manually on the forms they are edited on the SASSA excel database, and then uploaded the RTE database.

5. Once the data has been captured into the RTE database the units which fall into the scope of the measurement sites are allocated to that particular site and indicated on the RTE database and presents the information on monitoring and measurement of carbon savings.

6. The monitoring methodology states that 1/10,000 units need to be monitored and furthermore a monitoring site shall be within 50 km radius from each site. The installation of new equipment only makes sense when certain volume can be allocated to specific monitoring equipment. In 2013, a total of 9 668 installations in different areas were not allocated to monitored sites due to their location, i.e. they were not within the 50 km radius criteria, or were missing GPS coordinates or ID numbers.

It should be noted that installations start to generate reductions only when monitoring equipment is installed.

Furthermore, a total of 3 592 households did not provide ID documentation in this regard, and hence they have been disqualified from generating CERs, which is a conservative approach. There were a number of other reasons for delays in assigning units on the database, and these relate to challenges in the data capturing process. For example, 3 347 units had invalid GPS coordinates, and 6 949 units were positioned outside of the relevant 50km monitoring radius.

Therefore, in 2013 only 83 495 installations (out of the total 93 163 installations) where allocated to measured sites and hence the emission reductions are based on 83 495 SWHs.

B.2. Post registration changes

B.2.1. Temporary deviations from registered monitoring plan or applied methodology

N/a.

B.2.2. Corrections

N/a.

B.2.3. Permanent changes from registered monitoring plan or applied methodology

N/a.

B.2.4. Changes to project design of registered project activity

N/a.

B.2.5. Changes to start date of crediting period

N/a.

B.2.6. Types of changes specific to afforestation or reforestation project activity

N/a.

SECTION C. Description of monitoring system

The diagram 1 below presents the organizational structure of the SASSA PoA:

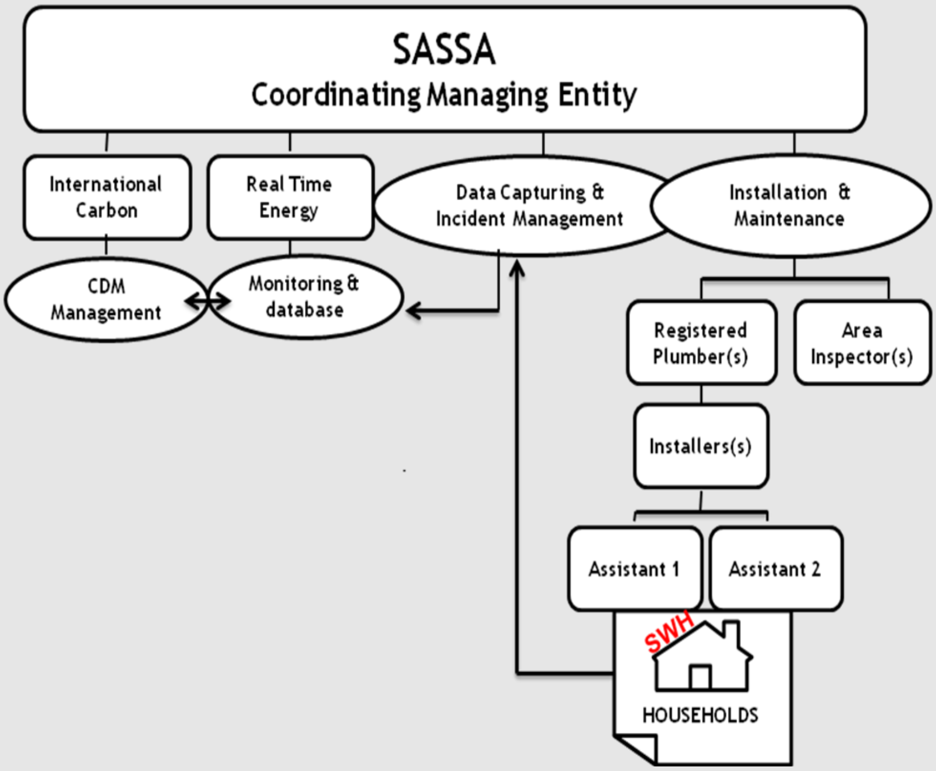


Diagram 1. Organizational structure of the SASSA PoA.

SASSA is the CME and responsible for installation and maintenance of the SWHs as well as data collection and incident management. SASSA has 27 employees, which are dedicated to data capturing, incident management and maintenance.

International Carbon Ltd ("IC"), a carbon development company, is responsible for the CDM Cycle Management including establishment Monitoring Reports.

Real Time Energy (Pty) Ltd ("RTE") is responsible for the monitoring and database hosting of the SASSA Low Pressure Solar Water Heater Programme. Real Time Energy (Pty) ltd has two (2) integral staff members that managed the SASSA contract in 2013 which where:

- Shaun Worthmann, a registered professional engineer, measurement and verification professional and carbon reduction manager. He is responsible for the measurement and verification methodology and is also the client relationship manager for the SASSA contract.
- Derek Pheonix is the primary frontend and SQL database programmer.
- Willem Vermeulen is the hardware and database engineer that integrates the GSM based field measurement devices with the house installation data and couples this with the measurement and verification methodology in a Real Time On-Line SQL database.

Remote monitoring is used to gather data from distant locations, when data collection would be difficult for a variety of reasons (e.g. high number of small installations spread throughout the country). In remote monitoring, inputs, outputs, analogue signals and specialized instruments perform measurement of physical quantities that can be transmitted to a via a GSM network server. The database used is a SQL database that is hosted in a secure hosted environment. All information is inputted from the residential agreement/installation form into the database directly via the web. The Global Positioning System (GPS) coordinates are used to locate each SWH in a Google map to enable spatial integration.

The information can be accessed via a web interface, where information can be managed and reports can be established. The data in a database is organized into the logical components visible to users who may both view reports and manage the data. The data will be archived for two years once the 10 year crediting period has lapsed.

As per the registered PoA-DD following data was collected for installation:

1. Location of the SWH systems registered (address and GPS coordinates);
2. Name and ID of the SWH system /property owner;
3. Installation date of the SWH system;
4. Details of the SWH installer
5. Technical specifications of the SWH system (including type, size/volume, collector area);
6. Unique identification number of the SWH (serial number);

It was initially intended that the SWHs would be uniquely identified with ERF number and serial number of the SWH. The ERF numbers available were not complete, i.e. 21, digits and hence not unique[7]. In 2013 SASSA successfully requested a post registration change in this regard, where the result is that ERF numbers are no longer required as an eligibility criterion. The SWHs installed can instead be uniquely identified based on the unique number allocated by the database and linked to the owners Identification Number, GPS coordinates and the SWH serial number.

As per the monitoring plan of the registered PoA-DD, one (1) in ten thousand (10,000) installations is monitored in real time to perform comprehensive measurement and verification. Furthermore the site selection is based on the geographical location, namely there must be at least 1 metered site within 50 km[8] from any simulated site. The measured ambient temperature, cold water temperature and solar irradiation are loaded onto the independent central project database. The data at each of the metered sites is recorded every 5 minutes and integrated daily. At midnight every day, the simulation is executed on each home based on the daily measured values. The available solar irradiation at each site, together with daily average ambient and cold water temperatures is used in accordance with the SABS performance test to determine the delivered energy to that site. The data recorders will have an error margin of ±0.5 %.

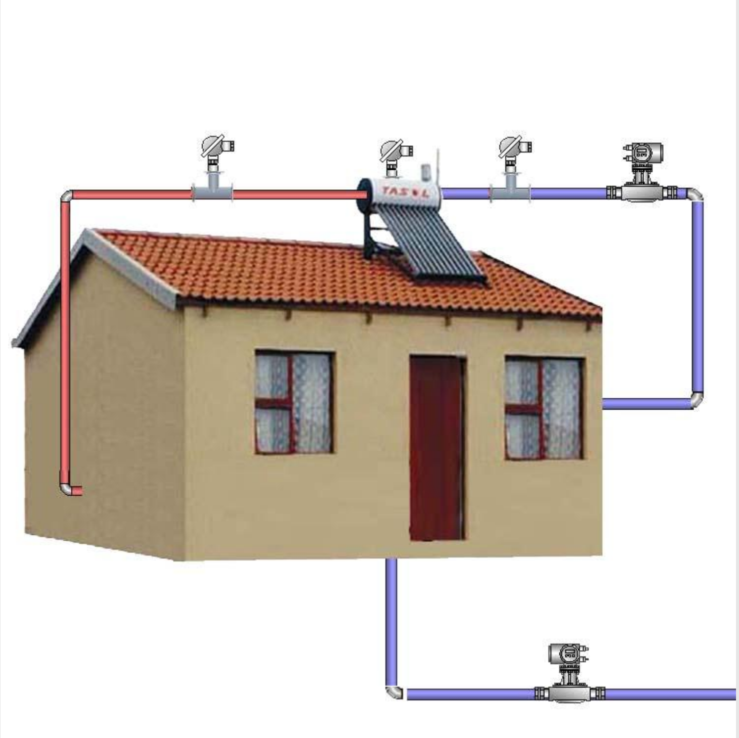
The following parameters are at every measured house:

1. Cold water feed temperature to the geyser,
2. Ambient air temperature,
3. Water flow/quantity of water used in SWH,
4. Pyranometer readings (a pyranometer measures solar irradiation),
5. Hot Water temperature to the home.

The picture 1 below shows the placement of the monitoring equipment.

[7] The ERF is an alphanumeric key (21 digits) of the Cadastral7 Land Parcel. The 21 digits are made up a number of different components, which are surveyor's General office (e.g. Pretoria), registration division used for registration in a deeds office, administrative districts, parcel number.

[8] The rationale for the selection of the 50km radius is based on measurements from three (3) weather stations near Nelson Mandela Bay, namely Addo [33° 34'E; 25° 42' S; Altitude 85m], Jansenville [32° 59'E; 25° 36' S; Altitude 60m] and East London [33° 01'E; 27° 49' S; Altitude 155m]. Addo is 115km from Jansenville and the annual average global radiation variance is 2%. Addo is 252km from East Loandon and the annual average global radiation variance is 0.4%. Jansenville is 303km from East London and the annual average global radiation variance is 1.7%. A monthly statistical analysis shows that the lowest confidence level is 94.16%. It is therefore assumed that at a 50km radius the average annual error per home will be less than 5.84%. (Ref 4:)



Picture 1. Placement of the monitoring equipment.

The metering equipment was supplied by RTE and installed by SASSA and/or their agents. The remote metering period began after the installation of the metering equipment and the remote metering equipment will remain in operation until the end of the crediting period.

The equipment is installed in the housing is fitted with a tamper alert switch that warns RTE in the event of someone opening the panel. The equipment is powered via a photovoltaic panel with battery back-up.

To confirm the number of operating systems 1 % of the installations in each CPA are sampled for functionality, as well as to check the data capture accuracy. The database annually allocates the 1 in 100 sites for inspection by an automated random number generator, which will be set to never select the same site for inspection over the 10 years period. Therefore 10 percent of all the installations will be inspected over the 10 years monitoring period.

In October 2013 a random sample of 995 sites was issued and sites where inspected. The operationality check procedure is managed by SASSA and follows the above mentioned criteria (1/100).The operationality check procedure and related results are presented in section E.3 below.

Additional to the operationality checks, SASSA record all incidents reported into an electronic incident management log book. (The beneficiaries/ households receive a manual which includes the call centres phone number of SASSA. In case of a failure of a SWH, the household will contact SASSA via given phone number.) The purpose of the incident management log record is twofold:

1) To manage and respond to incidents reported by residents such as leaks closed valves etc.;

2) To identify and inspect any systems which were completely non-operational i.e. the system is not working and not producing hot water and has failed indefinitely. Such systems would be fixed or replaced under warranty by the community maintenance manager of the specific community.

The incident management procedure includes the following:

1. Upon installation, the household resident beneficiaries (here after termed as the “client”) are provided with material on their system. A dedicated call centre number has been established to manage client complaints, queries and incidents;

2. Should an incident occur (minor incidents such as leaks or total system failure) the client phones the

SASSA call centre;

3. The incident is logged by the call centre agent in the incident management spread sheet;

4. The maintenance manager in the community is then contacted with the respective details via telephonic call and SMS to tend to the matter;

5. The maintenance manager is to respond and inspect the unit within 24 hours of the call incident being logged;

6. Once the unit has been inspected the maintenance manager commences to fix the respective unit accordingly and reports back to the call centre with feedback on the status of the system and the resolution;

7. Through this mechanism it is possible to monitor the performance of the technology in terms of operationallity and to detect faults that lead to system failure.

The incidents are typically reported immediately and managed within a 24 hour call out period. This means that the affected SWH unit needs to have been inspected and fixed within 24 hours of the client reporting the incident to the SASSA call centre. Many incidents reported are however maintenance orientated and comprise of leaks, or residents whom have accidently closed valves. These are minor fixable and easy incidents that do not necessarily mean that the SWH is out of operation. In 2013 a total of 83 incidents were reported which were incidents where the unit was not operational and/or not providing hot water.

The SASSA maintenance teams that are placed within the communities where interviewed to find out maximum reporting time from a beneficiary to SASSA maintenance team/ ward counsellor. In most instances beneficiaries report the malfunction of a SWH immediately. However, in some cases this can take up to 4 days. As SASSA response time is 24 hours, the 83 units that were reported to be non-operational are accounted for not operational for six days (144 hours). This is a conservative approach, as most incidents are reported and fixed immediately i.e. within 24-48 hours.

SECTION D. Data and parameters

Parameters recorded:

- Cold water feed temperature to the geyser,
- Ambient air temperature.
- Water flow/quantity of water used in SWH
- Pyranometer readings (a pyranometer measures solar irradiation).
- Hot Water temperature to the home

The equipment used to monitor each parameter is:

Pyranometer to measure irradiation. One paranometer will be required on each site. The pyranometers supplied are to be in accordance with the World Meteorological Organisation (WMO). The detector of the pyranometer is a high stability silicon photovoltaic detector (blue enhanced), and the sensor housing is weatherproof anodized aluminum case with acrylic diffuser and stainless steel hardware. The accuracy of the meters is presented in the table 4 below.[9]

Table 4. Accuracy of the pyranometers.

Specifications	**Value**
Model	LI200X
Accuracy	Absolute error in natural daylight is ±5% maximum; ±3% typical
Stability	< ±2% change over a 1 year period
Operating Temperature	-40 to +65 °C
Response Time	10 µs
Linearity:	Maximum deviation of 1% up to 3000 W/m^2

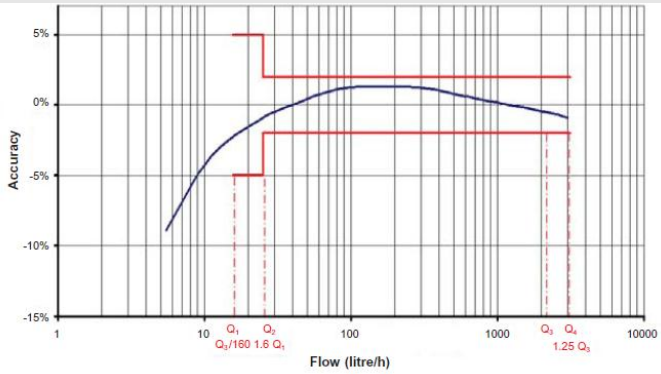
[9] LI200X Pyranometer, instruction manual.

Temperature transducers to measure cold water temperature, hot water temperature and ambient air temperature. The measurement site will require two water temperature transducers and one ambient temperature probe per metered site. The water temperature transducers must have an error margin of no greater than ±0.35 °C and a precision of ±0.358°C. The ambient air temperature probe has an accuracy error margin of no greater than ±0.35°C and a precision of ±0.35°C. The Temperature transducers have been tested according DIN EN 60751:2009 and DIN IEC 751. The accuracy of the Temperature transducers is presented in table 5 below[10]:

Table 5.Accuracy of the Temperature transducers

Temperature rage	Accuracy	
Model	Pt100	
- 30 … + 300 °C	At 0 °C	± 0.15 °C
	At 100 °C	± 0.35 °C

Flow meters to measure water flow on cold water supply to the solar water heater (equal to the hot water consumed). The accuracy is a function of the flow rate and can be seen in the accuracy curve below (picture 2). The accuracy of the 220 C model flow meter is 100% when the flow is 40 litres per hour or 0.67 per minute. The average flow on a 5 minute sample rate for 2013 was 31.59, well within the range, and the maximum flow rate is 258 litres per hour also within expect limit. At these flows the error is ± 2 % (shown in read in the below curve).[11]



Picture 2. Accuracy of the flow meters.

The pyranometer, the ambient temperature probe, the cold and hot water temperature probe and cold water flow meter have valid calibration certificates. The calibration certificate dates are presented in the below tables (6-8):

Table 6. Pyranometer serial number and validity date.

No.	Monitoring site	Pyranometer Serial No	Certificate Date	Valid until
1	224 K.D Matanzima Crescent Erf 3621 Motherwell, Port Elizabeth, Nelson Mandela Bay Metropolitan Municipality, Eastern Cape	PY 67126	25/09/2010	12/03/2015
2	3324 Welbedacht West Chatsworth, eThekwini Metropolitan Municipality, Kwazulu- Natal	PY 69976	15/07/2010	19/04/2015
3	1230 U Section Botshabelo, Manganung Municipality, Free State	PY 71636	08/09/2010	02/08/2015
4	6th Road Calitzdorp, Kannaland Municipality, Eden District, Western Cape Province	PY71635	08/09/2010	23/08/2015
5	7226 Cisticola Street, Ekhurleni Metropolitan Muncipality, Gauteng	PY 71637	08/09/2010	01/09/2015
6	11858 Relebohile, Dingalo Street Kroonstad, Moqhak Municipality, Free State	PY 71638	08/09/2010	01/09/2015
7	8186 Thladi Street, Potchefstoom, Tlokwe Local Municipality, North West Province	PY 71639	08/09/2010	01/09/2015

[10] Wika technical information sheet: Usage limitations and accuracies of platinum resistance thermometers in industrial applications, page 4; and Wika Temperature, Basic Values and Tolerances for Resistance elements, page 1.
[11] Sensus Metering System, LD 1660 INT, Volumetric Meter Composite Body Protected Dial, page 2.

8	13 Yster Street, Vredenburg, Saldhana Bay Local Municiplaity, Western Cape	PY 71645	08/09/2010	29/09/2015
9	301 Rocklands Street, Uitenhage, Nelson Mandela Bay Metropolitan Municipality, Eastern Cape	PY 71640	08/09/2010	16/02/2016
10	22 Heron Street, Uitenhage, Nelson Mandela Bay Metropolitan Municipality, Eastern Cape	PY 71632	08/09/2010	16/02/2016
11	334 Rocklands Street, Uitenhage, Nelson Mandela Bay Metropolitan Municipality, Eastern Cape	PY 71633	08/09/2010	12/03/2016
12	32 Field Street, Alexandra, Gauteng	PY 79120	06/03/2012	26/09/2016
13	2532 School Street Genadendal 7234, Caledon / Theewaterskloof Municipality, Western Cape	PY 67482	25/08/2009	26/09/2016
14	1317, Klipplaat, Ikwezi Municipality,Eastern Cape	PY 79118	06/03/2012	30/09/2016
15	795 Shabalala Ave;eNtokozweni, Machadodorp, Emakhazeni Municipality, Mpumalanga	PY 79121	06/03/2012	01/09/2016
16	7th Avenue Willowmore, Baviaans Municipality, Eastern Cape	PY 79119	06/03/2012	30/09/2016
17	6750 Protea Ave, Barraydale, Swellendam Municipality, Western Cape	PY 79124	06/03/2012	10/10/2016
18	11 Galjoen Street, Pellsrus Jeffreys Bay, Kouga Municipality, Eastern Cape	PY 79123	06/03/2012	30/09/2016
19	54592 Monyatsi St, Buitesig, Mangaung, Free State	PY 79122	06/03/2012	30/09/2016
20	2210 Edsin Ave; Theewaterskloof; Caledon, Western Cape	PY 79125	06/03/2012	11/10/2016
21	2320 Zamani; Darnall; Stanger, Ilembe District Municipality, Kwa Zulu Natal	PY 79132	06/03/2012	09/10/2016

Table 7. Flow meter serial number and validity date.

No.	Monitoring site	Flow meter Serial No	Certificate Date	Valid until
1	224 K.D Matanzima Crescent Erf 3621 Motherwell, Port Elizabeth, Nelson Mandela Bay Metropolitan Municipality, Eastern Cape	100016981	13/06/2011	12/03/2016
2	3324 Welbedacht West Chatsworth, eThekwini Metropolitan Municipality, Kwazulu- Natal	100016982	13/06/2011	19/04/2016
3	1230 U Section Botshabelo, Manganung Municipality, Free State	100016986	13/06/2011	02/08/2016
4	6th Road Calitzdorp, Kannaland Municipality, Eden District, Western Cape Province	100016983	13/06/2011	23/08/2016
5	7226 Cisticola Street, Ekhurleni Metropolitan Muncipality, Gauteng	100016984	13/06/2011	01/09/2016
6	11858 Relebohile, Dingalo Street Kroonstad, Moqhak Municipality, Free State	100016988	13/06/2011	01/09/2016
7	8186 Thladi Street, Potchefstoom, Tlokwe Local Municipality, North West Province	100016985	13/06/2011	01/09/2016
8	13 Yster Street, Vredenburg, Saldhana Bay Local Municiplaity, Western Cape	100016987	13/06/2011	29/09/2016
9	301 Rocklands Street, Uitenhage, Nelson Mandela Bay Metropolitan Municipality, Eastern Cape	120053141	12/06/2012	16/02/2017
10	22 Heron Street, Uitenhage, Nelson Mandela Bay Metropolitan Municipality, Eastern Cape	120053142	12/06/2012	16/02/2017
11	334 Rocklands Street, Uitenhage, Nelson Mandela Bay Metropolitan Municipality, Eastern Cape	120053143	12/06/2012	01/03/2017
12	32 Field Street, Alexandra, Gauteng	120026915	12/06/2012	26/09/2017
13	2532 School Street Genadendal 7234, Caledon / Theewaterskloof Municipality, Western Cape	120053146	12/06/2012	26/09/2017
14	1317, Klipplaat, Ikwezi Municipality,Eastern Cape	120026912	12/06/2012	30/09/2017
15	795 Shabalala Ave;eNtokozweni, Machadodorp, Emakhazeni Municipality, Mpumalanga	120026914	12/06/2012	01/09/2017
16	7th Avenue Willowmore, Baviaans Municipality, Eastern Cape	120026904	12/06/2012	30/09/2017
17	6750 Protea Ave, Barraydale, Swellendam Municipality, Western Cape	120026916	12/06/2012	10/10/2017

18	11 Galjoen Street, Pellsrus Jeffreys Bay, Kouga Municipality, Eastern Cape	120026909	12/06/2012	30/09/2017
19	54592 Monyatsi St, Buitesig, Mangaung, Free State	120026905	12/06/2012	30/09/2017
20	2210 Edsin Ave; Theewaterskloof; Caledon, Western Cape	120026917	12/06/2012	11/10/2017
21	2320 Zamani; Darnall; Stanger, Ilembe District Municipality, Kwa Zulu Natal	120027220	12/06/2012	09/10/2017

Table 8. Temperature transducers serial number and validity date.

No	Monitoring site	Certificate No	Ambient Temp (tag no.)	Water Temp In (tag no.)	Certificate Date	Validity Date
1	224 K.D Matanzima Crescent Erf 3621 Motherwell, Port Elizabeth, Nelson Mandela Bay Metropolitan Municipality, Eastern Cape	WCT-CF-DBN-T1001	T-01-1001	T-02-1001	15/03/2010	15/03/2014
2	3324 Welbedacht West Chatsworth, eThekwini Metropolitan Municipality, Kwazulu- Natal	WCT-CF-DBN-T1001	T-03-1001	T-04-1001	15/03/2010	15/03/2014
3	1230 U Section Botshabelo, Manganung Municipality, Free State	WCT-CF-DBN-T1001 WCT-CF-DBN-T1111	T-05-1001	TE-01-1101	15/03/20100 8/03/2011	15/03/20140 4/08/2015
4	6th Road Calitzdorp, Kannaland Municipality, Eden District, Western Cape Province	WCT-CF-DBN-T1111	TE-02-1101	TE-03-1101	08/03/2011	08/03/2015
5	7226 Cisticola Street, Ekhurleni Metropolitan Muncipality, Gauteng	WCT-CF-DBN-T1111	TE-04-1101	TE-05-1101	08/03/2011	08/03/2015
6	11858 Relebohile, Dingalo Street Kroonstad, Moqhak Municipality, Free State	WCT-CF-DBN-T1111	TE-06-1101	TE-07-1101	08/03/2011	08/03/2015
7	8186 Thladi Street, Potchefstoom, Tlokwe Local Municipality, North West Province	WCT-CF-DBN-T1111	TE-08-1101	TE-09-1101	08/03/2011	08/03/2015
8	13 Yster Street, Vredenburg, Saldhana Bay Local Municiplaity, Western Cape	WCT-CF-DBN-T1111 WCT-CF-DBN-T1111/1	TE-10-1101	TE-11-1101	08/03/2011	08/03/2015
9	301 Rocklands Street, Uitenhage, Nelson Mandela Bay Metropolitan Municipality, Eastern Cape	WCT-CF-DBN-T1111/1	TE-12-1101	TE-13-1101	08/03/2011	08/03/2015
10	22 Heron Street, Uitenhage, Nelson Mandela Bay Metropolitan Municipality, Eastern Cape	WCT-CF-DBN-T1111/1	TE-14-1101	TE-15-1101	08/03/2011	08/03/2015
11	334 Rocklands Street, Uitenhage, Nelson Mandela Bay Metropolitan Municipality, Eastern Cape	WCT-CF-DBN-T1111/1 WCT-CF-DBN-T1118	TE-16-1101	TE-01-1102	08/03/2011	08/03/2015
12	32 Field Street, Alexandra, Gauteng	WCT-CF-DBN-T1118	TE-02-1102	TE-03-1102	08/03/2011	08/03/2015
13	2532 School Street Genadendal 7234, Caledon / Theewaterskloof Municipality, Western Cape	WCT-CF-DBN-T1118	TE-04-1102	TE-05-1102	08/03/2011	08/03/2015
14	1317, Klipplaat, Ikwezi Municipality,Eastern Cape	WCT-CF-DBN-T1118	TE-06-1102	TE-07-1102	08/03/2011	08/03/2015
15	795 Shabalala Ave;eNtokozweni, Machadodorp, Emakhazeni Municipality, Mpumalanga	WCT-CF-DBN-T1118	TE-08-1102	TE-09-1102	08/03/2011	08/03/2015
16	7th Avenue Willowmore, Baviaans Municipality, Eastern Cape	WCT-CF-DBN-T1118 WCT-CF-DBN-T1118/1	TE-10-1102	TE-11-1102	08/03/2011	08/03/2015

17	6750 Protea Ave, Barraydale, Swellendam Municipality, Western Cape	WCT-CF-DBN-T1118/1	TE-12-1102	TE-13-1102	08/03/2011	08/03/2015
18	11 Galjoen Street, Pellsrus Jeffreys Bay, Kouga Municipality, Eastern Cape	WCT-CF-DBN-T1118/1	TE-14-1102	TE-15-1102	08/03/2011	08/03/2015
19	54592 Monyatsi St, Buitesig, Mangaung, Free State	WCT-CF-DBN-T1118/1	TE-16-1102	TE-17-1102	08/03/2011	08/03/2015
20	2210 Edsin Ave; Theewaterskloof; Caledon, Western Cape	WCT-CF-DBN-T1118/1	TE-18-1102	TE-19-1102	08/03/2011	08/03/2015
21	2320 Zamani; Darnall; Stanger, Ilembe District Municipality, Kwa Zulu Natal	WCT-CF-DBN-T1118/1 WCT-CF-DBN-T1118/2	TE-20-1102	TE-21-1102	08/03/2011	08/03/2015

As mentioned in section C above, the data at each of the metered sites is recorded every 5 minutes and integrated daily. The measurement data/ records are then transmitted to a via a GSM network server into RTE's SQL database that is hosted in a secure hosted environment. At midnight every day, the simulation is executed on each home/ SWH installation based on the daily measured values.

The measurement process, data transfer and calculation of saving and emission reductions are completely automated. In case of any failures in communication with the measurement equipment the RTE database alerts the responsible RTE staff.

Determination of calculation methods for relevant parameters:

Three relevant parameters are calculated, of which the energy delivered and operational hours are calculated based on monitoring data, and grid emission factor is calculated based on Eskom data. The available solar irradiation at each site, together with the daily average ambient and cold water temperatures, are used in accordance with the SABS performance test to determine the delivered energy to that site.

This is done using the Formula provided by the SABS ***Q***-Factor test conducted as per SABS 6211-1: 2003.

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

Where,

$\boldsymbol{Q}$	= Energy output in MJ
H	= The energy input i.e. irradiation in MJ per m^2
T_a	= The ambient air temperature and
T_c	= Incoming cold water temperature
α_1,	= H coefficient determined in the SABS test,
α_2,	= Delta T coefficients determined in the SABS test,
α_3	= Intercept coefficients determined in the SABS test.

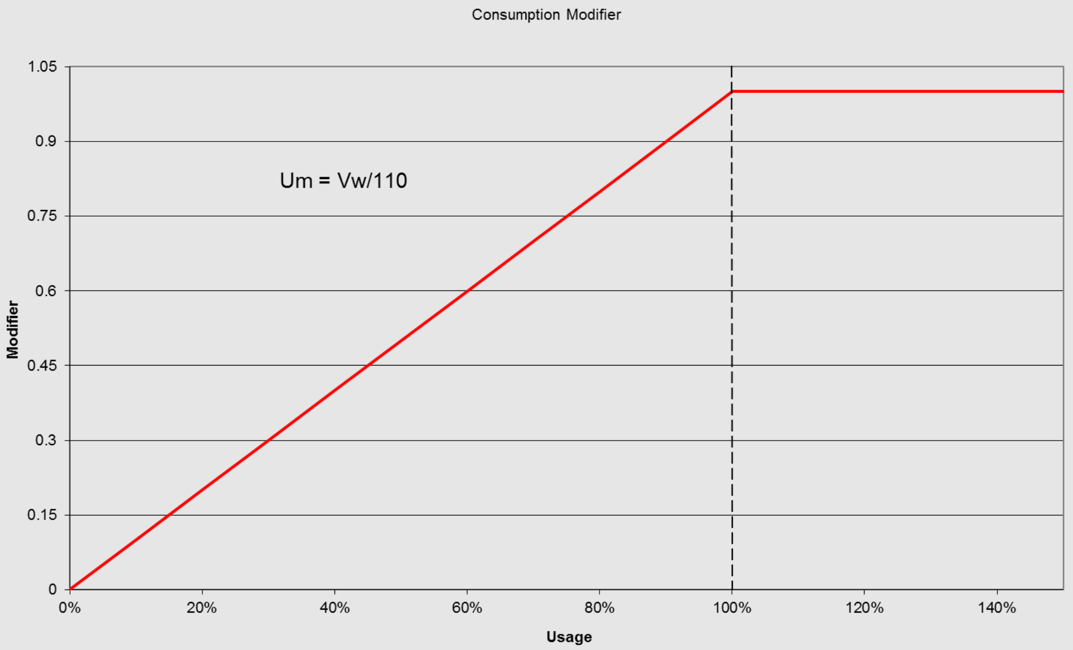
The determination of ***Q*** complies with SABS 6211-1 (SABS, 2003) test for the solar absorption efficiency of a domestic solar water heating system. ***Q*** is measured in MJ and is limited to a maximum of 16 MJ per day[12]. This sets a maximum ***Q***-Factor of 13.692MJ.[13] When the measured H value is greater than 16 MJ, H is set at 16 MJ i.e. limited to ***Q*** of 13.692MJ.

The water meter, measures the volume of water that is drawn through the solar geyser. The usage pattern is plotted for each day and integrated to determine the total consumption for each day. If the consumer uses the full 110 liters of hot water the full ***Q***-factor energy is used as the energy reduction for that day. However, a linear regression is used to discount the energy reduction as the water consumption decreases. Please see graph 1 below.

V_w = Daily Hot Water Usage in Liters
U_m = Usage Modifier

[12] *See Reference 1 page 57*
[13] *Revised SABS 6211*

If V_w is less than 110 liters then the following applies:
$U_m = V_w/110$



Graph 1. Usage Modifier

The calculation is done daily based on the 5 minute interval measurement results in each of the eight sites and the $Q_{,y}$ is a sum of these measurements multiplied by the total number of units in each measurement area, which increased daily in 2013. Appendix I presents the calculation of Q daily and the tables 10-30 shows the monitored parameters at each site.

The average annual hours of operation are calculated with the help of the energy baseline $EG_{BL,y}$ and the rated capacity of the SWH as per SABS test, as follows:

$h = EG_{BL,y}$ *[kWh] / Q [kW]*

As per registered PoA-DD the weighted average emissions (in tCO2/MWh) of the current generation mix are used to determine the grid emission factor, and are calculated as follows:

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

Where;

EF_{EL}	= EnergCO2 emission factor for power unit , in year y (tCO2/MWh)
$FC_{i,m,y}$	= Amount of fossil fuel type i consumed by power unit m in year y (t)
$NCV_{i,y}$	= Net caloric value of fossil fuel type i in year y (MJ/t)
$EF_{CO2,i,y}$	= CO2 emission factor for fossil fuel type i in year y (tCO2/MJ)
$EG_{m,y}$	= Net quantity of electricity generated and derived to the grid by power unit m in year y (MWh)
M	All power units serving the grid in a year y
I	All fossil fuel types combusted in power unit m in year y
Y	The relevant year

The latest data available from Eskom has been used to calculate the grid emission factor. The detailed data and calculation is presented in appendix I. The table 9 presents the data and sources applied:

Table 9: Data and Sources applied for determination of GEF.

Data	Source
Fuel consumption per plant 2012[14]	http://www.eskom.co.za/c/article/236/cdm-calculations/
Electricity generation per plant 2012[15]	http://www.eskom.co.za/c/article/236/cdm-calculations/
NCVs: Coal: 19 450 MJ/t	Eskom annual report 2011,p.324 , http://financialresults.co.za/2011/eskom_ar2011/downloads/eskom-ar2011.pdf
Kerosene: 42 000 MJ/t Diesel: 41 400 MJ/t	2006 IPCC Guidelines for National Greenhouse Gas Inventories, volume 2, table 1.2
Emission Factors: Coal: 89.5 t CO_2/TJ Kerosene: 70.8 t CO_2/TJ Diesel: 72.6 t CO_2/TJ	2006 IPCC Guidelines for National Greenhouse Gas Inventories, volume 2, table 1.4.

Parameters Monitored:

The below tables 10-30 shows the monitoring results for each monitored sites:

Table 10. Average Daily values measured at site no 12, 32 Field Street, Alexandra, City of Johannesburg.

	Water Flow (V)	***Cold Water Temp (Tc)***	***Ambient Temp (Ta)***	***Solar Irradiation (H)***	***Pyronometer***
	[l]	[°C]	[°C]	[MJ/m^2]	[W/m^2]
January	55.87	25.92	22.16	20.73	240.76
February	47.96	26.13	22.15	22.25	258.36
March	55.48	24.17	20.05	16.88	196.05
April	78.08	21.04	16.33	15.92	184.86
May	89.27	18.89	13.74	13.81	160.40
June	47.95	16.95	11.55	12.34	143.32
July	73.63	17.00	11.63	12.86	149.08
August	58.19	18.32	12.94	16.23	188.51
September	16.37	22.31	18.18	17.28	200.68
October	23.50	23.56	18.89	20.81	241.71
November	27.00	25.23	21.13	22.72	264.23
December	13.69	24.00	19.98	18.24	212.13
Total Average	**49.06**	**21.92**	**17.35**	**17.46**	**202.77**

Table 11. Average Daily values measured at site no 17, 6750 Protea Ave, Barraydale.

	Water Flow (V)	***Cold Water Temp (Tc)***	***Ambient Temp (Ta)***	***Solar Irradiation (H)***	***Pyronometer***
	[l]	[°C]	[°C]	[MJ/m^2]	[W/m^2]
January	32.44	24.95	20.72	28.70	333.32

[14] 2013 data has not been realised by Eskom yet.
[15] 2013 data has not been realised by Eskom yet.

February	26.98	25.32	20.93	26.31	305.45
March	30.90	24.26	20.02	20.79	241.45
April	33.42	20.76	16.85	16.98	197.11
May	35.21	18.24	14.45	13.90	151.00
June	38.81	14.78	11.55	10.85	125.88
July	35.73	14.87	11.80	11.54	133.99
August	7.05	14.84	11.37	14.70	170.70
September	5.13	16.43	12.40	21.13	236.54
Total Average	**28.13**	**19.52**	**15.71**	**18.22**	**209.67**

Table 12. Average Daily values measured at site no 3, 1230 U Section, Botchabello.

	Water Flow (V)	***Cold Water Temp (Tc)***	***Ambient Temp (Ta)***	***Solar Irradiation (H)***	***Pyronometer***
	[l]	[°C]	[°C]	[MJ/m^2]	[W/m^2]
January	54.56	26.79	23.49	27.85	323.45
February	57.55	26.45	22.87	25.09	291.34
March	65.95	24.29	21.25	19.40	225.26
April	66.17	18.30	15.70	16.25	188.71
May	74.26	15.35	13.11	14.46	167.91
June	82.78	11.24	9.46	13.35	155.05
July	86.56	12.41	11.22	13.58	157.73
August	102.40	13.04	11.01	16.24	188.19
September	83.35	16.92	15.36	19.17	222.62
October	69.76	21.16	18.64	22.16	257.47
November	57.23	23.39	20.80	24.96	290.20
December	54.58	24.13	21.15	25.07	291.69
Total Average	**71.36**	**19.42**	**16.98**	**19.77**	**229.64**

Table 13. Average Daily values measured at site no 13, 2532 School Street, Genadendal 7234, Caledon.

	Water Flow (V)	***Cold Water Temp (Tc)***	***Ambient Temp (Ta)***	***Solar Irradiation (H)***	***Pyronometer***
	[l]	[°C]	[°C]	[MJ/m^2]	[W/m^2]
January	254.98	23.48	20.68	24.77	287.88
February	285.73	23.53	20.93	21.40	248.57
March	289.58	22.01	19.94	17.81	206.85
April	251.40	17.80	16.63	14.85	172.28
May	198.03	15.28	14.77	10.63	123.58
June	169.13	12.01	11.55	9.11	105.43
July	202.27	12.46	12.01	9.07	104.83
August	159.39	11.70	11.00	11.05	126.97
September	214.00	13.08	11.93	15.94	184.92
October	246.97	16.82	15.09	17.77	206.40
November	238.55	20.03	17.78	23.03	258.29
December	152.29	22.66	20.36	24.47	284.70
Total Average	**221.38**	**17.54**	**16.03**	**16.63**	**192.23**

Table 14. Average Daily values measured at site no 4, 6th Road, *Calitzdrop.*

	Water Flow (V)	***Cold Water Temp (Tc)***	***Ambient Temp (Ta)***	***Solar Irradiation (H)***	***Pyronometer***
	[l]	[°C]	[°C]	[MJ/m^2]	[W/m^2]
January	26.02	26.38	24.23	26.41	306.78
February	16.71	26.22	24.52	24.56	285.25
March	26.53	24.81	23.28	19.76	229.53
April	36.53	19.86	19.02	15.82	183.72
May	53.63	16.20	16.02	12.42	144.29
June	38.00	13.14	13.19	10.21	118.60
July	74.89	13.53	13.67	10.63	123.45

August	36.29	13.39	13.27	13.79	160.18
September	34.50	17.13	15.62	20.80	241.57
October	110.44	20.65	19.03	21.05	244.50
November	48.60	23.76	21.76	28.98	295.71
December	16.29	26.78	24.18	27.88	324.36
Total Average	**43.45**	**20.11**	**18.95**	**19.29**	**220.89**

Table 15. Average Daily values measured at site no 21, 2320 Zamani, Darnall.

	Water Flow (V)	***Cold Water Temp (Tc)***	***Ambient Temp (Ta)***	***Solar Irradiation (H)***	***Pyronometer***
	[l]	[°C]	[°C]	[MJ/m^2]	[W/m^2]
January	41.23	26.95	24.12	18.47	214.53
February	38.68	26.89	23.91	20.10	233.39
March	44.19	25.41	22.62	16.90	196.25
April	54.98	22.87	20.64	14.59	169.49
May	76.85	20.87	19.03	11.28	131.02
June	86.95	19.25	17.62	10.65	123.72
July	88.97	19.11	17.35	10.43	121.12
August	92.48	20.36	18.47	13.69	159.00
September	78.13	21.45	19.10	13.62	158.21
October	77.10	22.43	19.82	16.21	188.22
November	73.10	25.09	21.79	18.73	217.17
December	91.10	25.29	21.98	16.49	191.91
Total Average	**70.54**	**22.97**	**20.52**	**15.06**	**174.95**

Table 16. Average Daily values measured at site no 2, 3324 Welbedacht, West Chatsworth, Durban.

	Water Flow (V)	***Cold Water Temp (Tc)***	***Ambient Temp (Ta)***	***Solar Irradiation (H)***	***Pyronometer***
	[l]	[°C]	[°C]	[MJ/m^2]	[W/m^2]
January	30.68	28.42	24.69	16.87	195.95
February	33.71	30.89	23.83	17.26	200.52
March	33.92	29.46	22.74	15.12	175.57
April	45.55	26.55	20.82	14.35	166.64
May	64.03	24.90	19.42	11.74	136.35
June	98.58	22.58	17.52	10.27	119.29
July	101.02	22.41	17.29	10.34	120.06
August	102.90	23.66	18.12	13.78	160.01
September	97.88	24.88	18.88	14.10	163.82
October	75.76	25.80	19.36	15.25	177.15
November	50.65	27.53	21.18	15.71	181.59
December	71.73	28.22	21.77	14.84	172.71
Total Average	**67.41**	**26.24**	**20.45**	**14.12**	**163.91**

Table 17. Average Daily values measured at site no 5, 7226 Cisticola Street, Ekurhuleni.

	Water Flow (V)	***Cold Water Temp (Tc)***	***Ambient Temp (Ta)***	***Solar Irradiation (H)***	***Pyronometer***
	[l]	[°C]	[°C]	[MJ/m^2]	[W/m^2]
January	79.95	23.04	21.46	22.25	258.47
February	75.29	24.13	21.60	23.03	267.48
March	55.11	22.95	19.59	18.19	211.23
April	69.67	18.06	15.97	15.69	182.27
May	75.16	16.45	13.70	13.26	154.04
June	60.93	14.79	11.35	12.27	142.47
July	45.84	14.17	11.39	12.27	142.50
August	51.13	15.01	12.35	15.78	183.31
September	61.62	20.39	17.88	17.78	206.50
October	48.34	20.76	18.24	21.41	248.68

November	57.23	22.53	20.15	23.52	273.46
December	53.26	21.56	16.84	20.08	233.59
Total Average	**61.00**	**19.45**	**16.67**	**17.93**	**208.27**

Table 18. Average Daily values measured at site no 18, 11 Galjoen Street, Pellsrus, Jefferies Bay.

	Water Flow (V)	***Cold Water Temp (Tc)***	***Ambient Temp (Ta)***	***Solar Irradiation (H)***	***Pyronometer***
	[l]	[°C]	[°C]	[MJ/m^2]	[W/m^2]
January	59.58	22.20	21.77	25.06	291.00
February	36.75	22.32	21.85	24.08	279.68
March	36.34	20.98	20.61	17.70	205.55
April	42.25	17.77	17.36	14.55	168.95
May	47.39	17.05	16.75	11.42	132.60
June	37.32	15.28	15.16	9.75	113.23
July	34.00	15.14	15.03	9.58	111.29
August	50.69	14.38	14.30	13.40	155.68
September	52.13	15.52	15.33	18.77	217.96
October	52.77	18.36	18.10	20.33	236.06
November	48.48	19.87	19.65	22.20	257.99
December	38.13	21.09	20.66	25.61	297.99
Total Average	**44.70**	**18.31**	**18.03**	**17.65**	**205.09**

Table 19. Average Daily values measured at site no 14, 1317, Kilppalaat.

	Water Flow (V)	***Cold Water Temp (Tc)***	***Ambient Temp (Ta)***	***Solar Irradiation (H)***	***Pyronometer***
	[l]	[°C]	[°C]	[MJ/m^2]	[W/m^2]
January	24.19	23.97	22.32	24.11	280.08
February	18.59	24.57	22.80	22.83	265.15
March	14.03	22.54	21.19	18.00	209.10
April	35.18	18.18	17.03	15.56	180.68
May	7.61	15.84	15.05	12.19	141.54
June	6.12	12.26	11.72	11.03	128.07
July	14.11	12.94	12.20	11.25	130.68
August	16.00	13.34	12.55	15.03	174.37
September	31.67	15.87	14.86	20.50	238.05
October	19.77	19.53	17.99	20.36	236.43
November	22.79	21.75	20.20	23.20	269.64
December	36.35	22.82	21.10	24.27	282.42
Total Average	**20.51**	**18.59**	**17.38**	**18.15**	**210.83**

Table 20. Average Daily values measured at site no 6, 11858 Relebohile, Dingalo Street, Kroonstad.

	Water Flow (V)	***Cold Water Temp (Tc)***	***Ambient Temp (Ta)***	***Solar Irradiation (H)***	***Pyronometer***
	[l]	[°C]	[°C]	[MJ/m^2]	[W/m^2]
January	28.24	26.11	23.87	25.52	296.67
February	31.48	25.34	23.36	24.74	287.38
March	31.94	22.84	21.36	20.00	232.24
April	36.52	17.32	16.47	17.51	203.43
May	39.90	14.17	13.50	15.39	178.73
June	45.42	10.84	10.43	14.21	165.05
July	48.03	12.28	11.91	13.91	161.55
August	48.90	12.75	12.14	17.77	206.21
September	42.13	18.09	17.43	21.05	244.46
October	36.77	21.08	19.68	24.69	286.79
November	36.58	23.11	21.59	24.16	281.75
December	56.98	22.87	20.84	22.07	256.77
Total Average	**40.32**	**18.87**	**17.68**	**20.06**	**233.08**

Table 21. Average Daily values measured at site no 19, 54592 Monyatsi St, Buitesig, Mangaung.

	Water Flow (V)	***Cold Water Temp (Tc)***	***Ambient Temp (Ta)***	***Solar Irradiation (H)***	***Pyronometer***
	[l]	[°C]	[°C]	[MJ/m^2]	[W/m^2]
January	1.52	24.07	31.18	25.70	298.48
February	0.00	23.47	30.98	24.81	288.14
March	0.00	21.44	28.22	20.14	233.94
April	0.00	16.13	22.81	16.25	188.73
May	23.50	13.37	19.77	14.14	164.20
June	47.48	9.58	16.18	12.08	140.30
July	56.90	11.17	16.90	12.52	145.37
August	58.16	11.18	17.49	14.32	166.28
September	73.08	15.75	22.78	17.93	208.22
October	63.84	18.76	26.69	22.76	264.31
November	47.41	21.55	29.38	24.06	279.74
December	45.76	21.51	29.24	22.62	263.11
Total Average	**34.98**	**17.29**	**24.25**	**18.89**	**219.52**

Table 22. Average Daily values measured at site no 15, 795 Shabalala, Machadodrop.

	Water Flow (V)	***Cold Water Temp (Tc)***	***Ambient Temp (Ta)***	***Solar Irradiation (H)***	***Pyronometer***
	[l]	[°C]	[°C]	[MJ/m^2]	[W/m^2]
January	40.58	22.89	19.40	18.94	219.93
February	33.68	23.72	19.89	21.89	254.19
March	30.45	21.26	17.80	18.30	212.50
April	36.82	17.82	15.17	16.29	189.24
May	42.10	15.23	13.12	14.71	170.87
June	28.32	13.26	11.89	13.52	157.06
July	31.50	13.10	11.13	13.01	151.05
August	51.44	14.71	12.36	15.32	177.96
September	79.80	18.79	16.66	15.99	185.67
October	60.60	18.41	15.62	19.35	224.76
November	71.96	21.29	18.49	20.43	237.70
Total Average	**45.89**	**18.15**	**15.53**	**17.00**	**197.47**

Table 23. Average Daily values measured at site no 1, 224 K.D Matanzima Crescent, NMBM.

	Water Flow (V)	***Cold Water Temp (Tc)***	***Ambient Temp (Ta)***	***Solar Irradiation (H)***	***Pyronometer***
	[l]	[°C]	[°C]	[MJ/m^2]	[W/m^2]
January	82.44	23.80	21.49	24.81	288.22
February	124.04	24.20	21.52	23.34	271.02
March	89.52	21.96	20.02	17.38	201.85
April	64.37	18.88	17.32	13.83	160.58
May	106.03	17.05	16.09	10.77	125.05
June	96.28	14.63	14.27	9.16	106.41
July	119.23	14.74	14.29	9.20	106.86
August	111.92	14.49	13.80	12.58	145.96
September	119.85	16.08	14.86	18.64	216.53
October	125.42	19.05	17.43	20.55	225.07
November	241.13	21.27	18.97	23.12	258.37
December	81.52	22.44	20.11	24.17	281.29
Total Average	**113.21**	**19.02**	**17.49**	**17.26**	**198.49**

Table 24. Average Daily values measured at site no 7, 8186 Thladi Street, Potchefstroom.

	Water Flow (V)	***Cold Water Temp (Tc)***	***Ambient Temp (Ta)***	***Solar Irradiation (H)***	***Pyronometer***
	[l]	[°C]	[°C]	[MJ/m^2]	[W/m^2]

January	19.76	26.20	23.63	24.77	287.92
February	18.04	26.22	23.46	24.96	289.91
March	8.02	24.09	21.41	19.58	227.40
April	8.57	20.11	17.20	17.90	207.95
May	10.02	18.23	14.51	16.34	189.82
June	27.30	15.70	11.61	15.56	180.77
July	19.79	16.39	12.69	15.32	177.88
August	18.79	17.40	13.20	18.62	216.27
September	21.20	22.32	18.63	20.08	233.20
October	15.74	24.62	20.78	23.45	272.37
November	17.74	26.12	22.81	30.65	290.70
December	22.06	24.28	21.31	21.75	253.05
Total Average	**17.23**	**21.77**	**18.39**	**20.68**	**235.09**

Table 25. Average Daily values measured at site no 9, 301 Rocklands, Uitenhage, NMBM.

	Water Flow (V)	***Cold Water Temp (Tc)***	***Ambient Temp (Ta)***	***Solar Irradiation (H)***	***Pyronometer***
	[l]	[°C]	[°C]	[MJ/m^2]	[W/m^2]
January	104.98	22.66	20.77	22.74	264.14
February	138.73	23.26	21.42	22.94	266.46
March	165.23	21.44	20.17	17.85	207.31
April	126.75	19.03	18.24	14.98	173.95
May	127.50	17.39	17.02	12.40	144.04
June	79.28	14.96	14.79	10.68	124.03
July	116.24	14.96	14.77	10.40	120.79
August	110.32	14.99	14.56	14.50	168.06
September	135.73	15.77	14.88	20.03	232.62
October	138.13	18.52	17.28	19.43	225.62
November	134.38	20.42	18.97	26.90	267.92
December	3.05	22.24	20.01	22.20	255.39
Total Average	**114.73**	**18.78**	**17.72**	**17.85**	**203.56**

Table 26. Average Daily values measured at site no 11,334 Rockland, Uitenhagen, NMBM.

	Water Flow (V)	***Cold Water Temp (Tc)***	***Ambient Temp (Ta)***	***Solar Irradiation (H)***	***Pyronometer***
	[l]	[°C]	[°C]	[MJ/m^2]	[W/m^2]
January	108.52	23.89	20.56	22.07	256.44
February	125.05	24.28	21.20	22.10	256.71
March	0.37	22.17	19.98	16.91	196.38
April	44.97	20.01	18.18	13.83	160.59
May	0.00	17.92	17.03	11.08	128.70
June	0.00	15.13	14.73	9.29	107.88
July	0.00	15.32	14.63	9.20	106.83
August	0.00	15.82	14.50	13.32	154.76
September	0.00	16.90	14.67	18.78	217.23
October	40.42	20.01	18.13	486.11	181.31
December	29.69	24.27	20.93	21.47	253.20
Total Average	**30.31**	**19.35**	**17.49**	**25.01**	**180.27**

Table 27. Average Daily values measured at site no 8, 13 Yster Street, Vredenburg, Saldhana.

	Water Flow (V)	***Cold Water Temp (Tc)***	***Ambient Temp (Ta)***	***Solar Irradiation (H)***	***Pyronometer***
	[l]	[°C]	[°C]	[MJ/m^2]	[W/m^2]
January	51.68	25.32	20.60	29.08	337.91
February	46.64	25.25	20.99	23.97	278.40
March	65.06	24.48	20.67	18.28	212.31
April	69.27	21.54	17.90	14.61	169.64

May	115.61	19.79	16.02	10.41	120.96
June	97.98	17.64	13.79	8.84	102.64
July	107.94	17.10	13.71	9.83	114.21
August	96.65	17.12	13.31	11.73	136.26
September	103.25	17.80	13.68	15.76	183.03
October	128.00	20.46	16.64	20.90	242.72
November	120.97	23.06	19.29	25.84	303.47
December	121.03	25.22	21.14	28.55	332.21
Total Average	**94.01**	**21.21**	**17.29**	**18.12**	**210.83**

Table 28. Average Daily values measured at site no 20, 2210 Edsin Ave, Teerfswaterkloof, Caledon.

	Water Flow (V)	***Cold Water Temp (Tc)***	***Ambient Temp (Ta)***	***Solar Irradiation (H)***	***Pyronometer***
	[l]	[°C]	[°C]	[MJ/m^2]	[W/m^2]
January	29.85	24.09	21.07	23.91	277.85
February	32.27	24.03	21.20	21.97	255.13
March	22.56	22.12	19.92	17.71	205.67
April	31.05	18.28	16.36	14.46	167.91
May	46.26	15.53	14.39	10.36	120.28
June	66.60	11.85	11.45	8.69	100.92
July	75.18	12.64	11.98	9.06	105.23
August	73.31	12.23	11.40	11.42	132.69
September	76.70	14.46	12.49	17.48	202.99
October	80.26	17.94	15.44	17.28	200.73
November	51.66	21.06	17.96	22.10	257.04
December	41.31	23.92	20.60	23.79	276.78
Total Average	**52.37**	**18.14**	**16.16**	**16.47**	**191.34**

Table 29. Average Daily values measured at site no 10, 22 Heron Street, Uitehage, NMBM.

	Water Flow (V)	***Cold Water Temp (Tc)***	***Ambient Temp (Ta)***	***Solar Irradiation (H)***	***Pyronometer***
	[l]	[°C]	[°C]	[MJ/m^2]	[W/m^2]
January	33.87	25.82	21.86	21.87	254.10
February	29.61	26.19	22.14	22.25	258.46
March	32.13	23.68	20.73	16.84	195.56
April	33.65	20.33	18.10	14.14	164.19
May	49.31	17.72	16.63	11.24	130.55
June	73.45	14.88	14.71	10.06	116.78
July	74.29	15.20	14.68	9.54	110.82
August	70.18	15.68	14.52	12.99	150.48
September	83.80	18.29	15.37	18.88	219.23
October	102.81	20.76	17.69	18.43	214.10
November	83.69	23.39	19.79	26.10	256.48
December	73.56	23.96	20.71	22.11	257.26
Total Average	**61.82**	**20.45**	**18.05**	**16.97**	**193.35**

Table 30. Average Daily values measured at site no 16, 7th Avenue Willowmore.

	Water Flow (V)	***Cold Water Temp (Tc)***	***Ambient Temp (Ta)***	***Solar Irradiation (H)***	***Pyronometer***
	[l]	[°C]	[°C]	[MJ/m^2]	[W/m^2]
January	58.08	26.12	20.19	27.42	318.45
February	42.54	27.33	21.07	22.38	259.90
March	44.48	24.22	19.21	16.58	192.58
April	37.80	17.71	14.59	11.31	112.70
May	7.00	18.51	13.75	212.99	152.58
July	4.00	16.34	12.37	467.94	200.00
August	67.34	13.47	10.36	12.76	150.98

September	71.90	17.10	12.37	18.10	210.20
October	80.53	21.21	15.92	18.75	217.80
November	66.93	23.63	17.78	24.70	287.01
December	23.16	25.39	19.34	25.99	302.45
Total Average	**53.61**	**22.14**	**17.00**	**24.93**	**232.20**

D.1. Data and parameters fixed ex ante or at renewal of crediting period

Data / Parameter:	Q
Unit:	MJ
Description:	Daily solar energy output by the SWH in the day
Source of data:	SABS test results
Value(s) applied):	13.692 MJ
Purpose of data:	Calculation of baseline emissions (ex ante)
Additional comment:	The solar water heater system analysis is based on SANS 6211-1:2003. The SABS test determines the energy output of the SWH. The SABS test result is used for ex-ante calculation. For ex-post calculation the SABS test is adjusted based on the real-time measurements.

Data / Parameter:	**$N_{estimate}$**	
Unit:	Units	
Description:	Estimated number of units installed under the CPA	
Source of data:	Estimated based on size of absorber area	
Value(s) applied):	122,000	
Purpose of data:	Calculation of baseline emissions (ex ante)	
Additional comment:	CPA001: 59,000 It is estimated that the no. of SWH installed with this CPA includes 59 000 installations, based on the collector area of 1.08 m^2. The maximum total collector area of each CPA shall be 64 000 m^2. CPA002: 31,500, CPA003: 31,500 and CPA004: 31,500 Maximum number of units under the micro scale additionality limits.	

D.2. Data and parameters monitored

Data / Parameter:	N
Unit:	-
Description:	Number of SWH operating in the year
Measured/ Calculated / Default:	Calculated based on a sample (1%)
Source of data:	Operationality sample

Value(s) of monitored parameter:	83 264
Monitoring equipment:	Site visits: visual and technical checks, as well as failure reporting
Measuring/ Reading/ Recording frequency:	Annual sample
Calculation method (if applicable):	1 in 100 randomly selected sites will be inspected, the installation will be checked for data capture accuracy and system functionality. The database will annually allocate the 1 in 100 sites for inspection by an automated random number generator, which will be set to never select the same site for inspection over the 10 year period. Therefore 10 percent of all the installations will be inspected over the 10 year monitoring period. Furthermore all reported failures will be recoded into the data management system. The results of the sample and failure reporting are applied to the CPA to determine the number of SWHs operational as per the “General guidelines for sampling and surveys for SSC project activities”.
QA/QC procedures:	SASSA record all incidents reported and react within 24 hours to correct any possible failure of the SWH.
Purpose of data:	Calculation of baseline emissions
Additional comment:	Please note that a total of 93 163 units were installed in 2013. However, as explained under section B.1. above only 83 495 were monitored, of which 83 264 units are operational (see table 31, section D.3).

Data / Parameter:	**$Q_{,y}$**
Unit:	MWh
Description:	Solar energy output by the SWHs in the year *y*, kWh
Measured/ Calculated / Default:	Calculated
Source of data:	Measurement results
Value(s) of monitored parameter:	50 355.90
Monitoring equipment:	n/a
Measuring/ Reading/ Recording frequency:	Daily
Calculation method (if applicable):	The calculation is based on the SABS test results, which is adjusted with the real-time measurement results. Please see section D above for more details.
QA/QC procedures:	-
Purpose of data:	Calculation of baseline emissions

Additional comment:	Please see section D above and the appendix I.

Data / Parameter:	H_{year}
Unit:	MJ/m^2
Description:	Annual average irradiation
Measured/ Calculated / Default:	Measured
Source of data:	Onsite measurements
Value(s) of monitored parameter:	Annual average daily irradiation:
Monitoring equipment:	Pyranometer
Measuring/ Reading/ Recording frequency:	The data at each of the metered sites is recorded every 5 minutes and integrated daily.
Calculation method (if applicable):	n/a
QA/QC procedures:	-
Purpose of data:	Calculation of baseline emissions
Additional comment:	Solar radiation is measured using a pyranometer and is measured in W/m^2. These readings are integrated into daily values and reported in kWh per installation. Please see section D above.

Month	Total (W/m^2)	Total (MJ/m^2)
January	277.73	23.91
February	266.71	22.96
March	210.22	18.10
April	176.39	15.25
May	145.84	13.88
June	128.86	11.10
July	129.88	11.91
August	165.64	14.27
September	210.22	18.13
October	231.64	24.75
November	264.66	23.73
December	264.62	22.75
Total av.	**205.22**	**18.31**

Data / Parameter:	$Ta_{, year}$
Unit:	Celsius
Description:	The average annual ambient air temperature
Measured/ Calculated / Default:	Measured
Source of data:	Onsite measurements

Value(s) of monitored parameter:	Annual average daily ambient air temperature: Month / Total January 22.39 February 22.51 March 20.99 April 17.58 May 15.69 June 13.23 July 13.51 August 13.54 September 15.94 October 18.33 November 20.50 December 21.18 **Total av. 17.92**
Monitoring equipment:	Temperature probe
Measuring/ Reading/ Recording frequency:	The data at each of the metered sites is recorded every 5 minutes and integrated daily.
Calculation method (if applicable):	n/a
QA/QC procedures:	-
Purpose of data:	Calculation of baseline emissions
Additional comment:	Used to adjust the energy output determined in the SABS test. Please see section D above.

Month	Total
January	22.39
February	22.51
March	20.99
April	17.58
May	15.69
June	13.23
July	13.51
August	13.54
September	15.94
October	18.33
November	20.50
December	21.18
Total av.	**17.92**

Data / Parameter:	**$Tc_{,\ year}$**
Unit:	Celsius
Description:	The average annual Cold Water Temperature
Measured/ Calculated / Default:	Measured
Source of data:	Onsite measurements

Value(s) of monitored parameter:	Annual average Cold Water Temperature: Month / Total January 24.91 February 25.22 March 23.36 April 19.46 May 17.28 June 14.54 July 14.85 August 15.17 September 17.90 October 20.52 November 22.86 December 23.81 **Total av. 19.95**
Monitoring equipment:	Temperature probe
Measuring/ Reading/ Recording frequency:	The data at each of the metered sites is recorded every 5 minutes and integrated daily.
Calculation method (if applicable):	n/a
QA/QC procedures:	-
Purpose of data:	Calculation of baseline emissions
Additional comment:	Used to adjust the energy output determined in the SABS test. Please see section D above.

Data / Parameter:	**V**
Unit:	Litres
Description:	Volume of daily cold water flow
Measured/ Calculated / Default:	Measured
Source of data:	Onsite measurements

Value(s) of monitored parameter:	Annual average daily water flow: **Month** / **Total** January 58.05 February 60.00 March 54.37 April 57.44 May 63.72 June 61.55 July 70.20 August 65.86 September 71.75 October 81.50 November 79.21 December 54.52 **Total** **64.68**
Monitoring equipment:	Volumetric flow meter
Measuring/ Reading/ Recording frequency:	Continuous measurement i.e. when water withdrawn by household.
Calculation method (if applicable):	n/a
QA/QC procedures:	-
Purpose of data:	Calculation of baseline emissions
Additional comment:	The volume is used to calculate mass (m) of water. Please see section D.

Data / Parameter:	$Q_{on-site}$
Unit:	MWh
Description:	Solar energy output by the SWH in the year *y*, MWh
Measured/ Calculated / Default:	Calculated
Source of data:	Onsite measurements
Value(s) of monitored parameter:	90 504.72
Monitoring equipment:	n/a
Measuring/ Reading/ Recording frequency:	Daily
Calculation method (if applicable):	The SWHs are measured for irradiation, ambient air temperature, for water inlet temperature and water flow to determine daily solar energy output. Please see section D above for more details.

QA/QC procedures:	-
Purpose of data:	Calculation of baseline emissions
Additional comment:	The measured SWHs are used to adjust the energy output determined in the SABS test. However, the total reduction is capped in a maximum daily reduction as per SABS (see parameter $\mathbf{Q}_{,y}$) to be conservative.

Data / Parameter:	$\mathbf{EF_{grid}}$
Unit:	tCO2e/MWh
Description:	The emission factor for the electricity system.
Measured/ Calculated / Default:	Calculated
Source of data:	http://www.eskom.co.za/c/article/236/cdm-calculations/; Eskom annual report 2011, p.324, http://financialresults.co.za/2011/eskom_ar2011/downloads/eskom-ar2011.pdf; Emission Factors IPCC 2006.
Value(s) of monitored parameter:	0.9996
Monitoring equipment:	n/a
Measuring/ Reading/ Recording frequency:	Annual
Calculation method (if applicable):	The calculation follows the guidance of AMS.I.D option b as per the registered PoA-DD.
QA/QC procedures:	-
Purpose of data:	Calculation of baseline emissions
Additional comment:	Please see appendix I for the detailed calculation.

D.3. Implementation of sampling plan

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

In 2013, 995 installations were checked for operationality. As demonstrated in the registered PoA-DD, the sample size meets well the requirements of “General guidelines for sampling and surveys for SSC project activities” i.e. the sample size shall be determined with minimum 90% confidence interval and 10% maximum error margin.

The random sample was issued by RTE and sample houses where inspected by SASSA’s maintenance teams, who checked if the SWHs provide hot water to the households. Furthermore the SWHs where inspected for optimal functionality and checked for leaks, over flow, or breakages. It should be noted that SASSA does continuous maintenance, in case household’s report any faults. The results of the inspection were captured manually in a form, which then were scanned and the data results of the inspection, either

operational or not operational, were captured by SASSA data capturers into the RTE database.

In October 2013 a random sample of 995 sites was issued.

The operationality check procedure is managed by SASSA, and entails the following:

1. A random sample of houses with the installed solar water heating units for inspection was issued by the Real Time Energy database system;
2. The sample size was based on the above mentioned minimum criteria (1/100) of the total CPA size.
3. Solar water heating unit “operationality check list” was developed by the SASSA technical team to define operationality;
4. The SASSA teams, on the ground in the respective areas were briefed according to the operationality check list to audit the homes allocated by the issued sample;
5. Team managers inspected the units at the respective homes.

During the 2011 inspections, it was noted that not all households visited where home during the inspection time or some houses where not accessible due to security issues. Therefore, two criterions were developed to mitigate time delays and to accommodate this social phenomenon, which is beyond the control of the project developer. These criteria included:

i. If access can be gained to the SWH unit, without breaching Health and Safety regulations or causing damage to property and the unit can be inspected without the home owner being present, then the unit would be inspected according to the operationality checklist.

ii. If the home owner is not home and/or there is no access to the unit and it cannot be inspected safely, the house is excluded from the original operationality sample.

6. Once all the units were inspected, the operationality checklist documents were sent back to SASSA’s head office. Where the data was captured via web interface and documents uploaded to the database accordingly.

All together 995 households were allocated for inspected, of which 2 were the house next door. The following analysis can therefore be derived from the operationality sample:

Table 31: Confidentiality

Population as per total installations in 2013	93 163		
Population as per installations assigned to measured sites	**83 495**	Installed	Measured
Sample size inspected	**995**	1.068%	1.192%
sampling fraction, f	0.0107		
Operational/ success, r	993		
Not operational	2		
sample proportion, p	0.9980		
not operational, q	0.0020		
SQRT		0.0000	0.0000
standard error		0.0014	0.0014
standard error (%)		0.14%	0.14%
absolute precision @90%		0.0023	0.0023
		0.00	0.00
relative precision @90%		0.0023	0.0023
		0.23%	0.23%
absolute precision@95%		0.00	0.00
		0.00	0.00
relative precision @95%		0.0028	0.0028
		0.277%	0.277%
Maximum number of units not operational		258	231
Number of units operational		**92 905**	**83 264**

The detailed calculation is presented in appendix I.

SECTION E. Calculation of emission reductions or GHG removals by sinks

E.1. Calculation of baseline emissions or baseline net GHG removals by sinks

*BEy = EGBL, y * EFgrid*

Where,

Symbol	***Description***	***Value Applied***
BE_y	= Baseline Emissions in year *y*, tCO_2	50 194
$EG_{BL,y}$	= Energy baseline in year *y*, MWh	50 216
EF_{grid}	= CO_2 Emission factor, tCO_2/MWh.	0.9996

The Energy Baseline ($EG_{BL,y}$) is the solar energy output ($Q_{,y}$) of SWHs, which is multiplied by the operationality ratio (i.e. number of SWHs operational, N) and further adjusted with maintenance downtime as follows:

$EG_{BL,y}$ = 50 356 MWh * 99.72 % - 0.68 MWh = 50 216 MWh

Where,

Symbol	*Description*	*Value Applied*
$EG_{BL,y}$	= Energy baseline in year *y*, MWh	50 216
$Q_{,y}$	= Solar energy output, MWh	50 356
N	= SWHs operationality ratio	99.72%
MD	= Maintenance Downtime, MWh	0.68

The average annual hours of operation are calculated with the help of the energy baseline $EG_{BL,y}$ and the rated capacity of the SWH as per SABS test, as follows:

h = 50 216 MWh / 13.692 MJ = 50 216 MWh /0.0038 MWh = 13 203 037 h

E.2. Calculation of project emissions or actual net GHG removals by sinks

As per the registered PoA-DD and the methodology AMS.I.C, version 17 the project emissions consist of CO_2 emissions from onsite fossil fuel consumption. As this PoA does not include an electric backup system, there are no emissions related to the project activity. Hence the project emissions in year y is zero (PEy = 0) under this programme and the CPA001 and CPA002.

E.3. Calculation of leakage

As per the registered PoA-DD and the methodology AMS.I.C, version leakage shall be considered if the SWH is transferred from another activity, or the PoA includes replacement of existing equipment. The PoA takes place in poor income households that currently lack proper water heating equipment, and hence heat up water with electric kettles and electric and kerosene stoves. Hence the SWH is rather seen as a new installation opposite to the replacement of existing equipment (see section E.4 for suppressed demand argumentation in the PoA-DD). The baseline water heating systems will be further used for cooking and do not create a leakage. Hence, leakage (LE,y) is considered to be zero under this programme and CPA001 and CPA002.

E.4. Summary of calculation of emission reductions or net anthropogenic GHG removals by sinks

Item	**Baseline emissions or baseline net GHG removals by sinks (t CO_2e)**	**Project emissions or actual net GHG removals by sinks (t CO_2e)**	**Leakage (t CO_2e)**	**Emission reductions or net anthropogenic GHG removals by sinks (t CO_2e)**
Total	50 194	0	0	50 194

E.5. Comparison of actual emission reductions or net anthropogenic GHG removals by sinks with estimates in registered PDD

Item	**Values estimated in ex-ante calculation of registered PDD**	**Actual values achieved during this monitoring period**
Emission reductions or GHG removals by sinks (t CO_2e)	163 854	50 194

E.6. Remarks on difference from estimated value in registered PDD

The emission reductions received are less than initially estimated in the Design Documents for 2013.
The following causes of the decrease have been identified:

1. During 2013, four measured sites went out of service and therefore the applicable CO2 emission reductions could not be accounted for. The reasons for this included vandalism and system malfunction. Corrective measures have been undertaken where possible.

2. Monitoring results lower than initially estimated in the PoA-DD and CPA-DDs. The ex ante estimation were based on the daily thermal capacity of the SWH as per SABS test results. These results gave an estimated 1.3 t CO2 per SWH per year (resulting in a monthly average of 0.1 tCO2). The daily capacity of a 110 litre SWH is based on the idea that a household would uses 110 litre of water daily. Based on literature values on typical daily water consumption, minimum required water consumption, average household size and free allocation of water in low income areas in South Africa, it was estimated that each household would use a minimum of 110 litre of water. However, the measurement results show that daily water consumption seems to vary significantly more i.e. some days households use significantly less than 110 litres, and other days more than 110 litres. To be conservative as required per CDM rules, the daily SABS thermal capacity was therefore set as a basis for maximum daily consumption, i.e. CO2 reduction, and hence days that household's actually use more water and thermal energy can be accounted only up to SABS capacity.

3. Furthermore due to the sudden Eskom subsidy restrictions in 2011, the installation figures are less than initially predicted. SASSA is currently installing approximately 1,000 units per month which is 5,000 units less than its installation capacity. Eskom has subsequently ceased the provision of a subsidy for low pressure SWHs in the country, reducing the expected demand even further.

E.7. Actual emission reductions or net anthropogenic GHG removals by sinks during the first commitment period and the period from 1 January 2013 onwards

Item	Actual values achieved up to 31 December 2012	Actual values achieved from 1 January 2013 onwards
Emission reductions or GHG removals by sinks (t CO_2e)	n/a	50 194

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Document information

Version	*Date*	*Description*
03.2	5 November 2013	Editorial revision to correct table in page 1.
03.1	2 January 2013	Editorial revision to correct table in section E.5.
03.0	3 December 2012	Revision required to introduce a provision on reporting actual emission reductions or net anthropogenic GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB70, Annex 11).
02.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01	28 May 2010	EB 54, Annex 34. Initial adoption.

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