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

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

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

New Energies Commercial Solar Water Heating Programme in South Africa
Version 1 15 April 2008

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

The NewEnergies Commercial Solar Water Heating Programme in South Africa (hereafter referred to as the Programme of Activities (PoA)) developed by Prostart Traders 40 (Pty) Ltd, t/a NewEnergies Pty Ltd (hereafter referred to as the coordinating/managing entity of the PoA) is a small scale CDM programme of activities in South Africa (hereafter referred to as the Host Country). This PoA will include retrofitting of existing electric water heating technologies with solar based water heating technologies and/or installation of new solar water heating technologies into commercial or large-scale users of hot water in the health, hospitality, residential or industrial sectors. The coordinating/managing entity is responsible for monitoring the solar water heating installations. This is a voluntary action by coordinating/managing entity which is a private company registered in South Africa. There are no laws/policies enforcing the installation of such technologies in South Africa.

The main goal of this PoA is the promotion of renewable energy technologies across commercial and public orientated buildings, or residential buildings with large scale hot water consumption, whilst reducing measurable greenhouse gas (GHG) emissions through avoided electricity use. Currently, hot water used for various purposes (mostly for sanitary purposes) is heated by electrical water geysers (South African term for electric water heater) using coal based electricity from the grid.

The PoA is contributing to sustainable development of the Host Country. Specifically, the PoA:

- Increases employment opportunities in the solar water heating sector. Permanent employment will be created for the installation of the systems, project operation and monitoring;
- Contributes to poverty alleviation through income and employment generation. The Project will employ people throughout project operation;
- Enhances the local investment environment and therefore improves the local economy;
- Diversifies the sources of water heating, which is important for meeting growing energy demands, and facilitating the transition away from fossil fuelled water heating and electricity generation;
- Makes greater use of renewable energy resources for sustainable energy production;
- Contributes to ‘energy poverty’ alleviation by helping large scale hot water consumers to access clean energy, improves energy efficiency and reduces energy consumption;
- Demonstrates replicable clean energy technology; and
- Reduces GHG emissions by displacing fossil fuels and electricity that would otherwise have been used to heat water.

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

- Prostart Traders 40 (Pty) Ltd, t/a NewEnergies (Pty) Ltd will be the coordinating/managing entity of this PoA
- EcoSecurities Group PLC will be project participant registered in relation to this PoA and will be the entity which will communicate with the CDM Executive Board (EB) according to the Modalities of Communication which is submitted together with this PoA-DD to the UNFCCC EB (according to EB 32 Report Annex 39 Paragraph 23).

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Republic of South Africa (host)	Prostart Traders 40 (Pty) Ltd, t/a NewEnergies (Pty) Ltd	No
United Kingdom and Northern Ireland	EcoSecurities Group PLC	No

(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.

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

The PoA is a programme for installing Solar Water Heating (SWH) systems mainly into commercial and public orientated buildings. Hereafter these systems are referred to as installations.

The PoA will include installations which will retrofit existing electric heating systems as well as new installations into new buildings.
See Section A.4.2.1 for detailed information.

A.4.1. Location of the programme of activities:

The PoA is located in the Republic of South Africa

A.4.1.1. Host Party(ies):

Republic of South Africa

A.4.1.2. Physical/ Geographical boundary:

The boundary of a PoA is defined as the geographical area within which all the small-scale CDM programme activities (SSC-CPAs) included in the PoA will be implemented.
All solar water heaters in the SSC-CPAs included in the PoA will be installed in the Republic of South Africa. Therefore, the boundary of the PoA is defined as the Republic of South Africa.

A.4.2. Description of a typical small-scale CDM Programme Activity (CPA):

A typical SSC-CPA will consist of several SWH installations at commercial buildings, public orientated buildings or large scale residential hot water users.

A CPA may contain both SWH installation types:

- Installations retrofitting existing water heating technologies with solar based water heating technologies; and
- New installations at newly built facilities (no existing heating technologies are in place).

It may also include indirect as well as direct installations as described in Section A.4.

The total number of installed square meters of all installations of a specific CPA will be below the 64,000 m^2 threshold[1].

The main goal of this PoA is the promotion of renewable energy technologies across commercial and public orientated buildings, or residential buildings with large scale hot water consumption.

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

All installations will include either a direct or an indirect SWH system. In direct systems, the service water is heated directly by the solar panels; in indirect systems the fluid in the solar water heating part is physically separated from the service water for frost protection purposes and the systems are connected via a heat exchanger.

Each direct system typically consists of:

- Solar panels;
- Storage tank (existing or new);
- Equipment to protect against potential high pressures;
- Piping and equipment to link collector and tank;
- Solar collector array support/fixation structure;
- Piping system for cold water supply and hot water supply to the user;
- Regulated circulation pump; and
- Monitoring equipment.

Each indirect system typically consists of:

- Anti freezing liquid;
- Heat exchanger;
- Liquid solar panels;
- Storage tank (existing or new);
- Equipment to protect against potential high pressures;
- Piping and equipment to link collector and tank;
- Solar collector array support/fixation structure;
- Piping system for cold water supply and hot water supply to the user;
- Regulated circulation pump; and
- Monitoring equipment.

A typical SSC-CPA employs state-of-the art and recognised solar water heating technology. The solar panels directly convert the energy provided by the sun into thermal energy for heating water.

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1 Appendix B to the decision 21/cp.8 of the document FCCC/CP/2002/7/Add.3, of simplified procedures for small-scale activities states 'For thermal applications of solar energy projects, 'maximum output' shall be calculated using a conversion factor of 700 Wth/m^2 of aperture area of glazed flat plate or evacuated tubular collector i.e. eligibility limit in terms of aperture area is 64,000 m^2 of the collector.'

Cold water is fed into the storage tank(s). A differential thermostat controls the water circulation in the panels. When the water in the solar panels exceeds a certain temperature threshold compared to the temperature of the water in the storage tank(s) (the exact value of the threshold may differ from installation to installation - depending on local circumstances) pumps circulate water from the storage tanks through the panels, thereby heating up the water.
Some installations located in areas with winter frost will be designed as indirect systems to avoid frost damage. In indirect installations, the fluid (antifreeze liquid) in the solar water heating part is physically separated from the usage water for frost protection purposes. The solar heating component and the usage water systems are connected via a heat exchanger.

All installations are equipped with an electric backup heating system to ensure that there is enough hot water in the mornings and during rainy days. A thermostat and timer control the heating elements.
Monitoring equipment is installed at the inlet and outlet of the solar panels. The input temperature as well as output temperature of the water circulating through the panels is measured. In addition the amount of water circulating through the panels is measured by a water flow meter. With these 3 parameters, the thermal energy produced by the solar system can be calculated.
The set up of the installation (all types) ensures that water is only flowing through the solar panels if there is demand for hot water, i.e. when the temperature of the storage tanks drops. Therefore, only the required quantity of hot water is produced and thereby monitored. (This implies that the electricity consumption for the back up system does not need to be monitored as emission reductions are only claimed for the energy directly produced by the solar panels).

For retrofit installations, the existing water heating equipment will remain on site and will be used for back-up purposes[2].

All the solar water heaters in a typical SSC-CPA are produced by domestic companies (if there is a shortage of production some equipment may be imported). Monitoring equipment is imported.

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

Criteria for including a SSC-CPA into the PoA are:

- All SWH installations of a CPA are installed either by the coordinating/managing entity or by affiliated companies or by companies appointed by the coordinating/managing entity acting in the name of the coordinating/managing entity.
- All SWH installations of a CPA have monitoring equipment installed, and access for monitoring is granted to the coordinating/managing entity by the owner of the facility where the SWH systems are installed.
- All owners of the facilities of the SWH installations of a CPA have signed a contract with the coordinating/managing entity, specifying the ownership rights of the CERs generated by the installation.
- For installations which are not directly installed by the coordinating/managing entity, the coordinating/managing entity is the owner of the monitoring equipment and is responsible for setting up and operating the monitoring equipment[3].

[2] Therefore scrapping of existing material does not need to be considered

[3] This eligibility criteria is necessary as the coordinating/managing entity is pursuing a dual approach (explained in more detail in section A.4.3 under Investment barriers): (1) SWH systems are installed for free by the

- No water heating equipment is removed from site due to the installation of the SWH system.
- All SWH installations of a CPA must be within the project boundary as described in Section A.4.1.2.

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

Under the SSC-CPAs of this PoA, emission reductions will be achieved by the installation of multiple verifiable SWH installations. The PoA will be implemented by large users over time as a direct response to a voluntary co-ordinated private sector initiative i.e. the initiative of the coordinating/managing entity.

In accordance with Attachment A of Appendix B of the simplified modalities and procedures for small-scale CDM project activities, additionality is demonstrated for the whole PoA by showing that the programme would not have occurred anyway due to the existence of the following barriers: investment, technological, due to prevailing practice and other barriers.

Investment barriers:
Even though environmental conditions in South Africa are ideal for SWH applications (i.e. high level of solar radiation all year long), consumers are generally unwilling to purchase SWH systems, which are thus struggling to break into the South African market. In comparison to international prices of SWH systems, average costs associated with SWH technology in the Republic of South Africa are competitive. However, when compared locally to conventional water heating technologies, SWH technologies are still substantially more expensive, especially considering the local electricity tariffs, which are amongst the lowest worldwide[4]. High initial capital costs of SWH technologies combined with preferential conditions for conventional electric water heaters hinder the widespread uptake of SWH technology in South Africa.
The PoA is based on the innovative business model of the coordinating/managing entity, which attempts to overcome this investment barrier by charging for solar energy as opposed to the solar installation itself. The coordinating/managing entity follows a dual approach:

1: The coordinating/managing entity offers to provide large scale hot water consumers with a complete SWH installation free of charge. After installation, the coordinating/managing entity will charge the consumer for the hot water which is heated by the SWHs and which is used at the facility. After a certain period of time (around 10 years) the ownership of the SWH installation will be transferred to the owner of the facility.
This is a new and innovative financing model for large scale SWH installations in South Africa.

2: Should consumers wish to purchase a SWH installation in full (cash sale installations), the coordinating/managing entity will be involved with the planning and installation of the system and will provide a key turn project to the owner of the facility.

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coordinating/managing entity and the client is charged for the energy produced by the SWH. (2) If a client wishes to buy the whole system he may do so. In this case the coordinating/managing entity will install the monitoring equipment but the installation of the SWH in itself may be done by a different company.

[4] Milton, S. & Kaufman, S. (2005): Solar Water Heating as a Climate Protection Strategy: The role of carbon finance, Green Markets International, pp 15 and pp21

The business model of the coordinating/managing entity involves the need for capital to be able to provide the high upfront costs[5], which will only be repaid over time. As a result, the lack of finance dramatically affects the viability of future installations. Due to the innovative character of the business model, the coordinating/managing entity is struggling to find financing to operate. It received a favourable loan in 2004 from E & Co, a body which provides loans and equity investments to kickstart clean energy projects in developing countries. This loan assisted in developing the business model as well as in the installation of pilot projects. Since receiving this initial loan, the coordinating/managing entity has struggled to secure additional loans despite contacting several financial institutions over the past several years. These institutions include the International Finance Corporation, Tridos Bank, Development Bank of Southern Africa, Reichmans Capital, ABSA as well as Standard Bank South Africa)[6]. South African business owners often experience difficulties in obtaining necessary finance, which is often cited as a reason for business failure or non start-up. Banks have a specific threshold in terms of the amount of money they will lend (often in the region of ZAR50 million and above). Lending larger amounts of money to fewer businesses is often the case as this is less costly and administratively taxing than financing many small businesses; which is often not deemed worthwhile for banks[7]. As a small private entity, the coordinating/managing entity is not seen as being large enough or requiring a large enough loan to warrant investment by South African financial institutions.

The inability of the coordinating/managing entity to secure a financial loan from South African financial institutions emphasises the importance of CDM revenue in alleviating this barrier thereby contributing to promote the uptake of SWH technologies in South Africa. Specifically,

- the coordinating/managing entity can include an additional expected revenue stream from CDM in future loan applications;
- the credit worthiness of the coordinating/managing entity will rise, since through the CDM an international partner is involved in the project, and the coordinating/managing entity will receive CDM revenue in hard currency which will reduce currency exchange risks;
- CDM revenue may be used as collateral for loans[8] and
- in case of cash sale installations, CDM revenue would enable the coordinating/managing entity to offer a more competitive price for the installation.

Technology Barriers:
Approximately 70% of South African households have access to grid electricity[9]. Considering the traditional use of grid electricity to heat water with water geysers, people are not familiar with SHW technology. This goes along with a lack of experience in operation and maintenance of the systems. There is also a lack of skilled personal to install and maintenance SWHs in South Africa. These technical barriers slow the promotion and the deployment of SWH systems in South Africa. In the long term, the

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5 In addition to providing the SWH installations free of charge for all non cash sale installations the project developer also needs to set up the production facilities for the SWH systems

6 See records of communication with the financial institutions

7 Pretorius, M. & Shaw, G. (2004): Business Plans in Bank Decision-Making when financing new ventures in South Africa, SAJEMS 7 (2): 221-241.

8 Guidebook to financing CDM projects 2007. P.34
http://cd4cdm.org/Publications/FinanceCDMprojectsGuidebook.pdf

9 Department of Minerals and Energy, Eskom, Energy Research Institute of the University of Cape Town (2002) Energy Outlook for South Africa.

CDM registration of this PoA will assist in alleviating this barrier, as SWH installations will become more common in South Africa.

Barriers due to Prevailing Practice:
In most of the planned regions of implementation of the PoA, the market is dominated by conventional electric water heating technologies. Electricity to run these geysers is generated from fossil fuel based (predominately coal) primary energy sources. Most large commercial and public buildings have electric water heaters installed, reflecting the widespread dependence and use of this carbon intensive technology in South Africa.

In addition, prevailing institutional practices commonly hinder growth in SWH markets. The institutional inertia in the South African government and society perpetuates the dominance of electric water heating systems. Prevailing practices in government, energy utilities, building industries, and other institutions all contribute to the tilt toward electric systems. In addition, electricity utilities receive heavy government subsidies for their generation and distribution costs, including those associated with rural electrification programs. As a result, electricity tariffs are artificially depressed and alternative energy technologies are further marginalized. National and regional government offer few incentives for people to adopt alternatives to electric water heaters, and in almost every instance, where manufactured water heaters are used, electric water heaters are the norm in all new and retrofitted homes. [10]

Consumers' and institutional prevailing practices are a significant barrier for effective uptake of SWH technology in South Africa. The CDM process has already played a role in increasing the South African public's awareness of the coordinating/managing entity's business model through the stakeholder consultation process, which involved the placement of an advert in a National Newspaper i.e. The Star. Please see the stakeholder consultation section of the PoA DD (Section D.3.) for details on the comments received in response to the CDM announcement.

Summary:
Even though a few countries have implemented some successful SWH programmes, SWH technology is largely not common practice, including in the Republic of South Africa as highlighted above. A report by Green Markets International[10] confirms that the main barriers for SWH appliances internationally as also apply for South Africa:

Internationally relevant barriers[11]:

- High up-front system costs compared to conventional alternatives;
- Lack of available financing for SWH businesses and consumers;
- Lack of awareness about the favourable lifecycle economics of SWH technology vis à vis conventional water heaters;
- Lack of quality control, which often undermines consumer confidence as people associate SWH with mediocre or low quality equipment; and
- Limited credit history (of consumers or suppliers) or the lack of bank personnel's understanding of SWH.

[10] Milton, S. & Kaufman, S. (2005): Solar Water Heating as a Climate Protection Strategy: The role of carbon finance, Green Markets International, pp 15 and pp21

[11] DTI: Solar Results Purchasing. 2001 p7

South African specific barriers[12]:

- SWH are perceived as too expensive for many households. As a result, most residences receive their hot water from conventional electric systems, as up-front equipment costs are modest and electricity tariffs are exceptionally low. The same argument also applies for commercial hot water users; and
- Electricity utilities receive heavy government subsidies for their generation and distribution costs. As a result, electricity tariffs are artificially depressed and alternative energy technologies are further marginalized.

This shows that the New Energies Commercial Solar Water Heating Programme in South Africa would not have been implemented in the absence of this registered PoA.

Nevertheless, considering the CDM can help to alleviate all of the barriers mentioned above:

- CDM can help to reduce the upfront costs of SWH technologies. The coordinating/managing entity has a dynamic business model which offers the equipment for free, while only charging for the hot water produced.
- CDM can help to raise the credit worthiness of the SWH supplier, as another revenue stream is increasing the financial attractiveness of the project. CDM revenue is paid in international currency and due to the CDM, an international partner is considered part of the project.
- The CDM implementation process itself facilitates the awareness of the project, through the involvement of government authorities (due to the DNA approval process) as well as the general public (due to the CDM stakeholder consultation). This helps to address a big barrier which is a lack of information about the technology.
- Furthermore, CDM revenue can be used to finance marketing initiatives and a registered CDM project is a quality certificate in itself as the project has gone through an intensive validation and registration process. The registration process also includes a validation of the quality of the technology installed.

CDM consideration:

The benefits that the CDM and carbon trading could offer to the coordinating/managing entity's Solar Water Heating programme were taken into consideration early in the decision-making process, as highlighted below:

- September 2003: The coordinating/managing entity initiated contact with the Development Bank of Southern Africa (DBSA). Mr Rob Short of DBSA expressed interest in the Carbon saving potential of the coordinating/managing entity's business.[13]

- May 2004: The coordinating/managing entity initiated contact with the Central Energy Fund (CEF) in order to discuss financing options. Carbon revenue was mentioned by the

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[12] REEP documents : Renewable Energy Financing in South Africa

[13] See email correspondence between Emile Du Toit of DBSA and Neriel Hurwitz of the coordinating/managing entity, 8 September 2003.

coordinating/managing entity as being under investigation as a possible source of additional revenue.[14]

- October 2004: In discussions with Standard Bank to secure funding, the coordinating/managing entity mentioned the potential of CDM involvement.[15]

- October 2004: The coordinating/managing entity made a number of enquiries to Assif Strategies in Israel about the potential for GHG trading through the use of SWH technology in South Africa. The potential for the use of the CDM in South Africa was discussed, followed by an investigation by Assif Strategies on the status of the CDM in South Africa. Assif Strategies advised that the project would be possible under the CDM in South Africa, and expressed interest in working with the coordinating/managing entity.[16]

- The coordinating/managing entity completed its first pilot energy project in mid 2004[17]. Although South Africa ratified the Kyoto Protocol on 31 July 2002[18], the Designated National Authority (DNA) was only established in late 2004[19].

- In November 2006 the coordinating/managing entity came into contact with EcoSecurities to assess cooperation potential for developing the CDM project[20]. An Emission Reduction Purchase Agreement was signed between the coordinating/managing entity and EcoSecurities Group PLC on March 27, 2007. At this time the programmatic framework was not yet available as the UN Executive Board (EB) adopted procedures regarding the registration of a programme of activities as a single CDM project at EB32 in June 2007 and approved various programmatic document templates at EB33 in July 2007[21]. This provided a suitable framework under which the coordinating/managing entity could register their solar water heating installations under the CDM.

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

A.4.4.1. Operational and management plan:

The following arrangements have been made by the coordinating/managing entity to ensure a reliable operation and management of the PoA:

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[14] See email correspondence between Cara van Straaten and Sibusiso Ngubane of CEF and Neriel Hurwitz of the coordinating/managing entity, 19 and 24 May 2004.

[15] See email correspondence between Colin King of Standard Bank and Neriel Hurwitz of the coordinating/managing entity, 8 October 2004.

[16] See email correspondence between Noam Gressel of Assif Strategies and Neriel Hurwitz of the coordinating/managing entity, 10, 11, 14 October 2004 and 12, 15 November 2004.

[17] See the coordinating/managing entity website: http://www.newenergies.co.za/The%20Business%20model.html

[18] See UNFCCC website: http://maindb.unfccc.int/public/country.pl?country=ZA

[19] See Department of Minerals and Energy website: http://www.dme.gov.za/dna/index.stm

[20] See email conversation between NewEnergies and EcoSecurities on the 6-11-2006

[21] See UNFCCC website: http://cdm.unfccc.int/ProgrammeOfActivities/index.html

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

A record keeping system will be set up by the coordinating/managing entity. It contains the following information for each installation in a SSC-CPA (see section A.4.1.2 of the SSC-CPA-DD).

a. Name of facility where SWH systems will be installed.
b. Postal Address
c. City/Town
d. Province
e. GPS coordinates
f. Number of m^2 of solar panels installed
g. Date of commissioning

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

A system/procedure will be put in place to avoid double accounting e.g. to avoid the case of including a new CPA that has been already registered either as a CDM project activity or as a CPA of another PoA. The procedure will also ensure that no installation is added to more than one CPA.

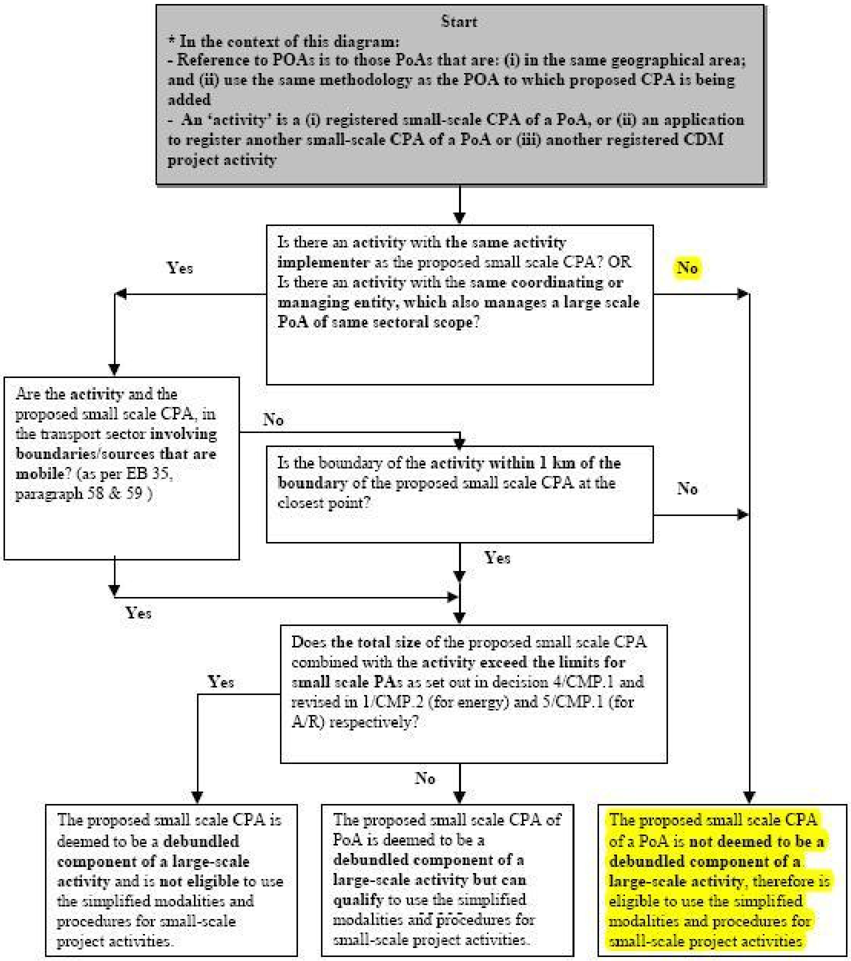
(iii) The SSC-CPA included in the PoA is not a de-bundled component of another CDM programme activity (CPA) or CDM project activity:

The compendium of guidance on the de-bundling for SSC project activities (EB36) is used to demonstrate that the SSC-CPA included in the PoA is not a de-bundled component of another CDM programme activity (CPA) or CDM project activity.

There is no other registered small-scale CPA of a PoA, nor an application to register another small-scale CPA of a PoA or another registered CDM project activity which:

a) has the coordinating/managing entity as an activity implementer, and the coordinating/managing entity does not manage a large scale PoA of the same sectoral scope.
b) The boundary is within 1 km of the boundary of the proposed small-scale CPA, at the closest point.

In accordance with the compendium of guidance on the debundling for SSC project activities (EB36), the SSC-CPA included in the PoA is not a de-bundled component of another CDM programme activity (CPA) or CDM project activity. The decision tree as of EB 36 Annex 27 Page 5 illustrates this:



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

All owners of the facilities where the SWH systems are installed and/or the owners of the cash sale SWH systems are aware and have agreed that their installation is being subscribed to a CPA under the PoA through legal contracts that will be put in place before the specific CPA is added to the PoA.

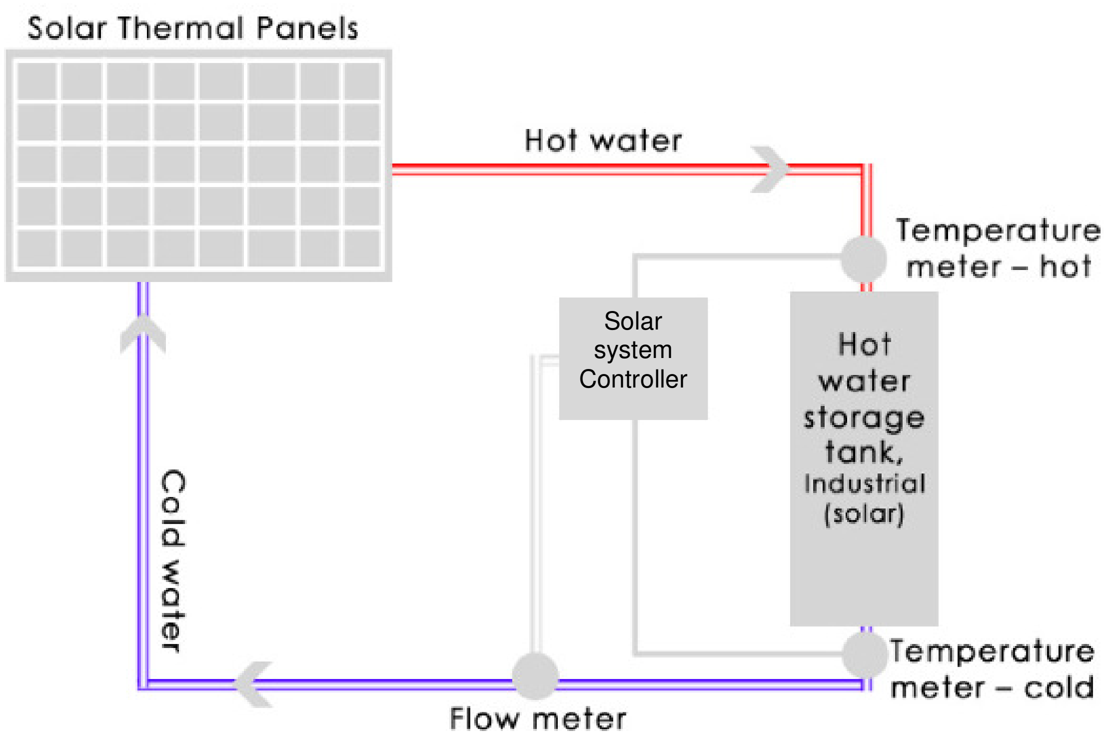
A.4.4.2. Monitoring plan:

The monitoring methodology as defined in Appendix B for the category I.C. "Thermal energy for the user" version 13 is applied in this PoA DD. This methodology consists of:

a) Metering the energy produced by a sample of the systems (a system is equivalent to one SWH installation). Emission reductions are calculated by multiplying the total energy produced by all installations of the CPA with an emission coefficient (grid emission factor).

The set up of the monitoring system for the energy produced for a typical installation is shown in Figure A.4.4.1. (The actual location of the temperature and flow meters may differ from installation to installation)

Figure A.4.4.1 Meter location for theoretical SWH installation[22]



The monitoring systems installed at each installation may differ slightly from the technical design but all will follow the same principle:
A solar system controller will be installed that meters the amount of energy generated by the system. Such a measurement device establishes energy on the basis of temperature differences and flow of water.
According to the methodology a sample of the CPA added to this PoA will be verified while data is provided for all installations. Before the start of the crediting period a transparent monitoring system will be implemented, which will make sure that each installation within one CPA can be easily identified. The time period of each installation for which CERs are claimed will be clearly stated in order to rule out double counting.

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

There will be no public funding allocated for the implementation of this PoA. If during the course of the crediting period of this PoA any public funding is provided to the coordinating/managing entity it will be confirmed that no official development assistance is diverted to the implementation of the PoA (according to EB 32, Annex 39, 2 n))

[22] The exact location of the meters may differ for different SWH installations

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

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

27/03/2007 start of the programme (initial ERPA signed)

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

28 years

SECTION C. Environmental Analysis

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

Environmental analysis as per requirements of the CDM modalities and procedures is undertaken at the PoA level, since the impacts of all CPAs will be similar. In addition, the relevant impacts are the ones from all the SWH installations under the PoA, rather than the impacts of a certain group of SWH of a CPA.

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

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

The negative environmental impacts of a SWH installation and a group of SWH installations are not considered significant. The positive impacts include:

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

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

No EIA is required for this project type in South Africa as the project intervention is not a listed activity in the following relevant South African environmental legislations:

- EIA regulations 1182 & 1183 under Environmental Conservation Act
- National Environmental Management Act s24 principal
- NEMA Second Amendment Bill

The South African LoA which is necessary for this project substantiates this claim as a LoA would not been given if an EIA was required and not provided.

SECTION D. Stakeholders' comments

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

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

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

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

The stakeholder consultation process consisted of a variety of nationally targeted initiatives, due to the implementation of the PoA countrywide. An advertisement inviting all stakeholders' and interested parties' input and comments was placed in the national newspaper '*The Star*' on Friday 25 January 2008. The period for comments and suggestions extended until 3 March 2008. The same advertisement was placed on website of the coordinating/managing entity[23]. As a result of this advertisement, the coordinating/managing entity was contacted for an interview by FinWeek, a South African financial publication linked to media portals Media24 and Fin24. FinWeek is South Africa's premier source of breaking news and financial data and is South Africa's most visited financial portal[24]. The article was published in FinWeek on 7 February 2008[25]. It described the nature of solar water heating in South Africa and the business of the coordinating/managing entity. It also mentioned that the programme is in the process of being registered as a CDM project.

Further media attention resulted from the initial advert and call for stakeholder inputs. The coordinating/managing entity was contacted for an interview by the Beeld Newspaper, with a consequent article published in the online portal 'Sake24' on Saturday 9 February 2008[26]. This was followed by a radio interview on Classic FM Business Show on 13 February 2008[27]. Both interviews highlighted the potential of the solar water heating industry in South Africa and the role of the coordinating/managing entity in supplying thermal energy to consumers.

D.3. Summary of the comments received:

An email was received by an individual who stated that he intended to comment about the project; however no comments were actually received.

Apart from this, no comments were received as part of the stakeholder consultation process.

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[23] NewEnergies, 2008: Programmatic CDM Project. Available from: http://www.newenergies.co.za/Programmatic%20CDM%20Project.html

[24] Media24, (2007): www.Fin24.co.za Available from: http://www.media24.com/generic.aspx?i_BusinessUnitID=4&i_CategoryID=163&lang=Eng

[25] See copy of Article.

[26] See copy of Article and English translation.

[27] See transcript of radio interview.

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

No comments were received as part of the stakeholder consultation process, and as such no account was taken of any comments.

SECTION E. Application of a baseline and monitoring methodology

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

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

Methodology AMS-I.C. v 13, Thermal energy for the user
Type I: Renewable Energy Project, Category C: Thermal Energy for the User.
The approved SSC baseline and monitoring methodology AMS.I.C. Thermal energy for the user, version 13, approved for use in a PoA at EB33, is thus applied to each SSC-CPA included in the PoA.

The baseline methodologies and monitoring methodologies can be downloaded from the Executive Board (EB) website: http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html

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

AMS.I.C version 13 is applicable to a SSC-CPA since a SSC-CPA meets all the requirements set in the methodology:

- A SSC-CPA comprises renewable energy technologies that supply users with thermal energy, namely solar water heaters
- A SSC-CPA displaces fossil fuels, namely electricity from the fossil-fuel intense South African grid.
- The total number of installed square meters of all installations of a specific SSC-CPA does not exceed the applicable SSC threshold: the total number of installed square meters of a SSC-CPA is below the 64,000 m^2 threshold[28].

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

The GHG reduced through the CPAs under this PoA is CO_2. The reduction takes place through the avoidance of fossil fuel used for generating grid electricity, which would have been used to heat the water in the absence of the CPAs.

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

Table E.3.1. Emission sources and gases included in the SSC-CPA boundary

	Source	Gas	Included?	Justification / Explanation
Baseline	South African grid electricity production	CO_2	Yes	According to AMS.I.C which refers to AMD.I.D and thus the “Tool to calculate the emission factor for an electricity system”, only CO_2 emissions from electricity generation should be accounted for.
		CH_4	No	According to AMS.I.C.
		N_2O	No	According to AMS.I.C.
SSC-CPA Activity	Solar water heaters thermal energy production	CO_2	No	According to AMS.I.C.
		CH_4	No	According to AMS.I.C.
		N_2O	No	According to AMS.I.C.

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

The baseline is identified in section E.5 as the continuation of the current situation (please see section E.5. for details).

In South Africa, hot water for large scale consumers is currently predominantly provided by electric water heating systems. In rare occasions, gas is also used to heat water. For simplification, any SWH installations where water was heated by gas in the baseline will not be added to a CPA and are not part of the PoA.

Therefore, as defined in AMS.I.C, the baseline scenario for SWH that displace electricity supplied from the grid is as follows:
The amount of electricity displaced by the SWH multiplied by the CO_2 emission factor for that grid. The emission factor for grid electricity is calculated as per the procedures detailed in AMS.I.D, which refers to the “Tool to calculate the emission factor for an electricity system”.

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

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

A typical SSC-CPA consists of several installations of SWH systems. The installations fall under the authority of the coordinating/managing entity as described in section A.4.2.2.

As described in section A.4.3, SWH systems are not common practice and they would not be installed in the absence of the CPA to which they belong being included in the registered PoA. As a result, a typical CPA is additional. As described, CDM helps to overcome the barriers that the coordinating/managing entity is facing to roll out their SWH business and thus the users to install a SWH system. This clearly

stipulates that without the SSC-CDM-PoA, no SWH installations and therefore no CPAs would be implemented.
One can therefore assume that without the CDM, the coordinating/managing entity could not offer its services, and the installations under a typical SSC-CPA would not take place.

The assessment of additionality is therefore done on a PoA level and a typical SSC-CPA implemented by the coordinating/managing entity under the SSC-CDM-PoA is therefore deemed to be additional in itself.

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

Future SSC-CPAs should demonstrate additionality based on the following criteria:

As demonstrated in E.5.1, CDM enables the coordinating/managing entity to provide its renewable energy services. It is assumed that all SWH installations and hence all SSC-CPAs which are going to be included in the registered PoA are additional, provided they meet the eligibility criteria for inclusion of a SSC-CPA in the PoA as set in section A.4.2.2.

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

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

As discussed in section E.1, the approved baseline and monitoring methodology AMS.I.C is applied to a typical SSC-CPA included in the PoA.

As defined in sections E.4 and E.5 as well as in AMS.I.C, the baseline scenario is the following:
SWH installations displace electricity supplied from the grid: *the amount of electricity displaced by the SWHs multiplied by the* CO_2 *emission factor for that grid. The emission factor for grid electricity is calculated as per the procedures detailed in AMS.I.D, which refers to* the “Tool to calculate the emission factor for an electricity system”.

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

This section explains how the procedures in the latest version of AMS.I.C to calculate project emissions, baseline emissions, leakage emissions and emission reductions are applied to the proposed SSC-CPA.

Emission reductions are calculated as:

$$BE = ER - PE \qquad \textbf{(1)}$$

Where:

BE	Baseline Emissions
ER	Emission Reductions
PE	Project Emissions

According to AMS.I.C, no project emissions need to be taken into account.
Therefore, PE = 0 tCO_2e and $BE = ER$

According to AMS.I.C no leakage has to be considered if no energy generating equipment is transferred from another activity or if the existing equipment is transferred to another activity. This is the case for this PoA. (see section A.4.2.2.)

Baseline Emissions are calculated as:

$$BE = \sum_i E_i * EF \qquad \textbf{(2)}$$

Where

E_i	Annual energy output of all SWH systems *i* installed under the CPA in MWh
EF	Emission factor (*EF)* for grid electricity (tCO_2/MWh)

Emission factor for grid electricity:

AMS.I.C refers to the procedures detailed in AMS.I.D in order to calculate the EF for grid electricity.

In detail:

AMS I.D. (Version 13, EB 36) offers two choices for calculating the emission coefficient):

(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 kg CO_2e/kWh) of the current generation mix. The data of the year in which project generation occurs must be used.

Option (a) above will be applied for this project, which uses 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".

The description below follows the steps of the latest version of the "Tool to calculate the emission factor for an electricity system" and focuses on the key process of the calculation of the emission factors. Please see Annex 3 for the baseline data underlying the calculations.

Step 1. Identify the relevant electric power system

The project activity is supplying electricity to the South Africa Power Grid. Therefore the South African national power grid is selected as the electric power system.

Step 2. Select an operating margin (OM) method

The "Tool to calculate the emission factor for an electricity system" offers four methods to calculate the OM emission factor ($EF_{grid,OM,y}$):

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

Of these procedures, Option (a) (Simple OM) is applied. This is because low-cost / must run resources constitute less than 50% [29] of total grid generation in average of the five most recent years

The "Tool to calculate the emission factor for an electricity system" offers the choice between two data vintages calculate the Simple OM emission factor ($EF_{grid,OMsimple,y}$):

- *Ex-ante* option: A 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation, without requirement to monitor and recalculate the emissions factor during the crediting period.
- *Ex-post* option: The year in which the project activity displaces grid electricity, requiring the emissions factor to be updated annually during monitoring.

$EF_{grid,OMsimple,y}$ is calculated *ex-ante* using the data from 2003 to 2005 (as this is the most recent period for which information is available, see Annex 3 for explanation). This data vintage remains fixed during the crediting period.

Step 3. Calculate OM emission factor according to the selected method

The "Tool to calculate the emission factor for an electricity system" offers three options to calculate $EF_{grid,OMsimple,y}$:

- *Option A*: Based on data on fuel consumption and net electricity generation of each power plant / unit
- *Option B*: Based on data on net electricity generation, the average efficiency of each power unit and the fuel type(s) used in each power unit
- *Option C*: Based on data on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system.

Detailed data on the individual power plants connected to the South African grid necessary for applying option A is not available for all power plants. Therefore, option A cannot be used and option B is applied.

$EF_{grid,OMsimple,y}$, is calculated based on the electricity generation of each power unit and an emissions factor for each power unit, as follows:

$$EF_{grid,OMsimple,y} = \frac{\sum_{i} EG_{m,y} \times EF_{EL,m,y}}{\sum_{m} EG_{m,y}} \quad \textbf{(3)}$$

Where

$EF_{grid,OMsimple,y}$	Simple operating margin CO_2 emission factor in year y (tCO_2/MWh)
$EG_{m,y}$	Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
$EF_{EL,m,y}$	CO_2 emission factor of power unit m in year y (tCO_2/MWh)
m	All power units serving the grid in year y except low-cost / must-run power units
y	The three most recent years for which data is available at the time of submission of the CDM-PDD to the DOE for validation

For power units m, option B1 is applied and the emission factor of each power unit m ($EF_{EL,m,y}$) is calculated as follows:

[29] See Annex 3

$$EF_{EL,m,y} = \frac{\sum_i FC_{i,m,y} \times NCV_{i,y} \times EF_{CO2,i,y}}{EG_{m,y}} \quad \textbf{(4)}$$

Where

$EF_{EL,m,y}$	CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
$FC_{i,m,y}$	Amount of fossil fuel type *i* consumed by power unit *m* in year *y* (mass or volume unit)
$NCV_{i,y}$	Net calorific value (energy content) of fossil fuel type *i* in year *y* (GJ / mass or volume unit)
$EF_{CO2,i,y}$	CO_2 emission factor of fossil fuel type *i* in year *y* (tCO_2/GJ)
$EG_{m,y}$	Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
m	All power units serving the grid in year *y* except low-cost / must-run power units
i	All fossil fuel types combusted in power unit *m* in year *y*
y	The three most recent years for which data is available at the time of submission of the CDM PoA-DD to the DOE for validation

The values and sources of all data used are given in Annex 3. For some power sources, a default efficiency, electricity generation or specific fuel consumption have been used due to the lack of publicly available information (all assumptions made are conservative and explained in Annex 3).

Coal emission factor is based on a country specific IPCC 1996 value for South Africa, as it represents a more conservative value than the most recent default value from the IPCC 2006 updated version.

Step 4. Identify the cohort of power units to be included in the build margin

According to the "Tool to calculate the emission factor for an electricity system", the sample group of power units *m* used to calculate the build margin consists of either:

a) The set of five power units that have been built most recently, or
b) The set of power capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.

Project participants should use the set of power units that comprises the larger annual generation.

Option b) is used as the set of five power units that have been built most recently comprise more than 20% of the annual generation. All units, in the set of power units that have been built most recently, were built more than 10 years ago. For the year 2005 for which most recent information is available, there are no grid connected power projects registered as CDM project activities. Thus, no CDM project activities can be included in the set of power units that have been built most recently. The set of power units remain unchanged.

Note: Using 2005 data to estimate the build margin underestimates the actual Build Margin emission factor, as the trend is to put back into use old, inefficient coal-fired power plants that had been shut down decades ago (Eskom 2006)[30]. This is due to "a sharp increase in the demand for electricity"; any effort to

[30] See http://www.eskom.co.za/live/content.php?Item_ID=162M:

> "the Eskom Board of Directors took a final decision in 2003 for the Return to Service (RTS) of the three power stations, Camden, Grootvlei and Komati, that were mothballed in the late 1980's and early 1990's. Unit 6 at Camden Power Station was then identified as the first unit to be commissioned. Another 2 units

reduce this demand, such as the one undertaken in the project, could therefore directly avoid the production of electricity from these marginal plants (both in terms of operating margin and build margin), whose electricity production is more carbon intensive than any other plant on the grid. As a result, the value of the $EF_{BM,y}$ is conservative.

The "Tool to calculate the emission factor for an electricity system" offers the choice between two data vintages to calculate the BM:

- *Option 1*. For the first crediting period, the build margin emission factor is calculated *ex-ante* based on the most recent information available on units already built for sample group *m* at the time of CDM-PDD submission to the DOE for validation.
- *Option 2*. For the first crediting period, the build margin emission factor shall be updated annually, *ex-post*, including those units built up to the year of registration of the project activity

The BM emission factor ($EF_{grid,BM,y}$) is calculated *ex-ante* using the data from 2005, based on the most recent information available on units already built for sample group *m* at the time of CDM-PDD submission to the DOE for validation.

Step 5. Calculate the build margin emission factor

According to the "Tool to calculate the emission factor for an electricity system", $EF_{grid,BM,y}$ is the generation-weighted average emission factor of all power units *m* during the most recent year *y* for which power generation data is available, calculated as follows.

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}} \quad \textbf{(5)}$$

Where

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

The CO_2 emission factor of each power unit *m* ($EF_{EL,m,y}$) is be determined as per the guidance in step 3 (a) for the simple OM, using option B1, with data from year 2005, which is the most recent historical year for which power generation data is available, and using for *m* the power units included in the build margin.

Step 6. Calculate the combined margin emission factor

The combined margin (CM) emissions factor ($EF_{grid,CM,y}$) is calculated as follows:

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will be commissioned in 2006, 3 units in 2007 and the last of the 8 units in 2008. Unit 6 […] went on commercial load on 16 July 2005."

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM} \quad (6)$$

Where:

$EF_{grid,CM,y}$	Combined margin CO_2 emissions factor in year y (tCO_2/MWh)
$EF_{grid,BM,y}$	Build margin CO_2 emission factor in year y (tCO_2/MWh)
$EF_{grid,OM,y}$	Operating margin CO_2 emission factor in year y (tCO_2/MWh)
w_{OM}	Weighting of operating margin emissions factor, which is 0.5 by default
w_{BM}	Weighting of build margin emissions factor, which is 0.5 by default

For detailed information, please see Annex 3.

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

Data / Parameter:	$\sum E_i$
Data unit:	**MWh**
Description:	Annual energy output of all SWH systems *i* installed under the CPA
Source of data used:	Monitored at each installation and then aggregated for all SWH installations in the specific CPA
Value applied:	
Justification of the choice of data or description of measurement methods and procedures actually applied :	This data is measured. Data will be recorded monthly and aggregated by the coordinating/managing entity.
Any comment:	

Data / Parameter:	$FC_{i,m,y}$
Data unit:	**T**
Description:	Amount of fossil fuel type *i* consumed by the group of power units *m* in year *y* (mass or volume unit)
Source of data used:	National Energy Regulator (NER), South Africa
Value applied:	See Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	ESKOM 2008
Any comment:	http://www.ner.org.za

Data / Parameter:	$NCV_{i,y}$
Data unit:	**GJ/mass or volume unit**
Description:	Net calorific value (energy content) of fossil fuel type *i* in year *y*
Source of data used:	IPCC 2006
Value applied:	See Annex 3

Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC default value and official released statistics by the national energy regulator
Any comment:	

Data / Parameter:	$EF_{CO2,i,y}$
Data unit:	**tCO_2/TJ**
Description:	CO_2 emission factor of fossil fuel type *i* in year *y*
Source of data used:	IPCC 2006
Value applied:	See Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC default value
Any comment:	

Data / Parameter:	$EG_{m,y}$
Data unit:	**MWh**
Description:	Net electricity generated and delivered to the grid by power plant / unit *m* in year *y*
Source of data used:	National Energy Regulator South Africa (NERSA), 2002-2005
Value applied:	See Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	http://www.ner.org.za

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

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

Data / Parameter:	E_i
Data unit:	MWh
Description:	Energy output of each SWH installed under the specific CPA i.
Source of data to be used:	Each SWH installation
Value of data applied for the purpose of	Value reported in Section B.6.1 of the CPAs added to this PoA

calculating expected emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	A solar system controller will be installed that meters the amount of energy generated. Such a measurement device establishes energy on the basis of temperature differences in and flow of water
QA/QC procedures to be applied:	Equipment is maintained and calibrated in line with manufacturer's recommendations.
Any comment:	

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

As all CPAs and all installations of a CPA are individually monitored, the monitoring plans for the SSC-CPA and for the overall PoA are the same:

The energy generation of the SWH installations which are part of a specific CPA will be monitored as described in Section A.4.4.2.

In addition, procedures will be developed to assure a transparent and complete monitoring system. Such procedures will detail:
- Data collection,
- Data QA/QC
- Data storage and back-up
- Maintenance and calibration of monitoring equipment
- Staff training

Please note that all personnel involved in gathering, aggregating and archiving the monitoring data will be trained before the start of the crediting period.

The coordinating/managing entity will aggregate the data for all installations and calculate the total energy generated by all SWH installations of the CPA. Total energy generated will be multiplied with the South Africa's national grid emission coefficient to derive the total emission reductions.

The system to monitor all SWH installations will be maintained by the coordinating/managing entity or by an entity appointed by the coordinating/managing entity.

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

Date of completion of the application of the baseline study and monitoring methodology: 30/03/2008

EcoSecurities is the company determining the baseline and the monitoring plan.
The persons responsible for its development are:

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Annex 1

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

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There is no public funding involved in this project.

Annex 3
BASELINE INFORMATION

Data and sources used to calculate the **grid emission factor** are given below:

Plant name and type	Fuel	OM plant?	2004 BM plant? (1=yes)	2005 BM plant?	Date of commission	Licensed capacity (MW)	Net energy sent out MWh 2002	2003	2004	2005	Fossil fuel consumption (various units - see separate column) 2002	2003	2004	2005	Unit
Grand Total						43 034	204,511,108	219,198,686	226,393,919	226,346,226	173,221	178,408	184,716	187,998	
Eskom generation						39 810	196,067,796	210,218,785	217,919,213	217,754,872	93,823	96,460	104,370	109,898	
Coal fired stations		1				35 607	181,749,299	194,046,490	203,564,592	206,605,894	93,823	96,460	104,370	109,898	
Arnot	Coal	1			1971/09/21	1 980	11,974,764	14,135,237	13,032,188	11,798,514	5,595	5,799	6,655	6,609	*kt*
Camden	Coal	1		1	2005-2006	1 520				768,108	-	-	-	390	*kt*
Duvha	Coal	1			1980/01/18	3 450	23,320,444	21,384,335	25,450,613	25,034,970	10,560	10,682	9,989	11,908	*kt*
Grootvlei	Coal	1			1969/06/30	1 130				-	-	-	-	-	*kt*
Hendrina	Coal	1			1970/05/12	1 895	12,752,987	12,329,325	12,037,179	12,513,689	6,475	6,551	6,432	6,644	*kt*
Kendal	Coal	1			1988/10/01	3 840	26,006,905	27,820,202	27,005,053	26,897,931	13,518	14,156	15,746	15,430	*kt*
Komati	Coal	1			1969/06/30	891				-	-	-	-	-	*kt*
Kriel	Coal	1			1976/05/06	2 850	19,165,265	18,347,304	19,866,814	20,120,150	10,033	10,020	9,307	9,297	*kt*
Lethabo	Coal	1	1	1	1985/12/22	3 558	22,019,627	23,505,543	22,807,524	24,041,645	15,309	15,368	16,410	17,042	*kt*
Majuba	Coal	1	1	1	1996/04/01	3 843	4,600,976	10,015,560	12,539,663	17,170,166	2,593	2,370	5,539	6,363	*kt*
Matimba	Coal	1	1	1	1987/12/04	3 690	25,145,393	26,510,802	26,894,454	28,401,085	12,362	12,960	13,803	13,786	*kt*
Matla	Coal	1			1979/09/29	3 450	25,577,292	25,802,219	25,673,648	23,938,437	12,884	12,924	13,169	13,445	*kt*
Tutuka	Coal	1	1		1985/06/01	3 510	11,185,646	14,195,963	18,257,456	15,921,199	4,493	5,629	7,320	8,984	*kt*
Gas turbine stations		1				342	-	341	350	77,942					
Acacia	Kerosene	1			1976/05/13	171	0	299	305	47,848	7	18	43	17,488	*kl = m3*
PortRex	Kerosene	1			1976/09/30	171	0	42	45	30,094	1	106	17	10,999	*kl = m3*
Hydro power stations		-				661	2,356,753	777,041	777,041	725,360					
Gariep	Hydro	-			1971/09/08	360	1,164,640	383,991	383,991	402,432	-	-	-	-	
Vanderkloof	Hydro	-			1977/01/01	240	1,192,113	393,050	393,050	322,928	-	-	-	-	
Colleywobbles(Mbashe)	Hydro	-				42	-	-	-	-	-	-	-	-	
First Falls	Hydro	-				6	-	-	-	-	-	-	-	-	
Second Falls	Hydro	-				11	-	-	-	-	-	-	-	-	
Ncora	Hydro	-				2	-	-	-	-	-	-	-	-	
Nuclear stations		-				1 800	11,961,744	12,662,591	13,365,123	11,292,654					
Koeberg	Nuclear	-			1984/07/21	1 800	11,961,744	12,662,591	13,365,123	11,292,654	-	-	-	-	
Pumped-storage stations		1				1 400	-	2,732,322	212,107	(946,978)					
Drakensberg	Hydro	1			1981/06/17	1 000	-	1,787,554	-	-	-	-	-	-	
Palmiet	Hydro	1	1	1	1988/04/18	400	-	944,768	212,107	-	-	-	-	-	
Municipal generation						1 837	1,218,826	1,326,122	1,040,945	1,476,686	11,772	10,148	10,031	10,890	
Coal fired stations		1				1 323	1,201,006	1,038,433	1,027,337	1,110,036	11,685	10,104	9,996	10,800	
Athlone	Coal	1			n/a	180	76,596	76,596	10,230	(84)	745	745	100	(1)	*TJ*
Kroonstad	Coal	1				30					-	-	-	-	*TJ*
Swartkops	Coal	1				240					-	-	-	-	*TJ*
Bloemfontein	Coal	1			n/a	103	8,233	19,444	5,931	16,890	80	189	58	164	*TJ*
Orlando	Coal	1				300					-	-	-	-	*TJ*
Rooiwal	Coal	1			n/a	300	949,078	826,217	895,000	985,000	9,234	8,039	8,708	9,584	*TJ*
Pretoria West	Coal	1			n/a	170	167,099	116,176	116,176	108,230	1,626	1,130	1,130	1,053	*TJ*
Gas turbine stations		1				330	7,189	3,654	2,976	7,445	86	44	36	89	
Roggebaai	Kerosene	1			n/a	50	2,787	2,787	1,141	7,037	33	33	14	84	*TJ*
Athlone	Kerosene	1			n/a	40	867	867	1,827	229	10	10	22	3	*TJ*
Port Elizabeth	Kerosene	1			n/a	40	-	-	8	279	-	-	0	3	*TJ*
Johannesburg	Kerosene	1			n/a	176	3,535	-	-	(100)	42	-	-	(1)	*TJ*
Pretoria West	Kerosene	1				24					-	-	-	-	*TJ*
Hydro power stations		-				4	10,632	10,632	10,632	10,632	-	-	-	-	
Lydenburg	Hydro	-			n/a	2	6,000	6,000	6,000	6,000	-	-	-	-	
Ceres	Hydro	-			n/a	1	1,082	1,082	1,082	1,082	-	-	-	-	
Piet Retief	Hydro	-			n/a	1	3,550	3,550	3,550	3,550	-	-	-	-	
Pumped-storage stations		1				180	-	273,403	-	348,573	-	-	-	-	
Steenbras	Hydro	1			n/a	180	-	273,403	-	348,573	-	-	-	-	
Private generation						1 387	7,224,486	7,653,779	7,433,761	7,114,668	67,627	71,800	70,314	67,210	
Bagasse / coal fired stations		-				105	259,317	259,317	192,337	192,337	-	-	-	-	
Tongaat-Hulett Amatikulu	Bagasse-coal	-			n/a	12	26,781	26,781	26,781	26,781					
Tongaat Hulett - Darnall	Bagasse-coal	-			n/a	12	21,704	21,704	21,704	21,704	(Assumed pure bagasse by conservativeness)				
Tongaat Hulett - Felixton	Bagasse-coal	-			n/a	32	66,510	66,510	66,510	66,510	=> Fossil fuel consumption = zero				
Tongaat Hulett - Maidstone Mill	Bagasse-coal	-			n/a	29	67,397	67,397	67,397	67,397					
Transvaal Suiker Ltd	Bagasse-coal	-			n/a	20	76,925	76,925	9,945	9,945					
Coal fired stations		1				1 279	6,950,506	7,379,448	7,226,761	6,907,668	67,627	71,800	70,314	67,210	
Kelvin	Coal	1			n/a	540	1,721,353	1,721,353	1,568,666	1,568,666	16,748	16,748	15,263	15,263	*TJ*
Sasol Synth Fuels	Coal	1			n/a	600	4,421,074	4,738,677	4,738,677	4,606,484	43,016	46,106	46,106	44,820	*TJ*
Sasol Chem Ind	Coal	1			n/a	139	808,079	919,418	919,418	732,518	7,862	8,946	8,946	7,127	*TJ*
Hydro power stations		-				3	14,663	15,014	14,663	14,663	-	-	-	-	
Friedenheim	Hydro	-			n/a	3	14,663	15,014	14,663	14,663	-	-	-	-	

Calculation of fuel emission factors:				
	NCV GJ/t fuel	EF tCO2/TJ	Density t / m3	=> Emission factor
Coal	19.9	89.5		1.781 tCO2/t coal
Kerosene	42.4	70.8	0.804	2.414 tCO2/m3

Conversion factor:	277.78	MWh/TJ

Emission factors (tCO2/MWh)	**2004**	**2005**
OM	0.900	0.908
BM	0.950	0.951
CM	**0.925**	**0.930**

Sources and Assumptions made for the grid emission calculation

Sources:

1a/b/c/d. NERSA (2005/2006/2007/2008) Electricity supply statistics for South Africa 2002/2003/2004/2005 (brochures, with 2004 & 2005 electronic versions copied in tabs 1c, 1d)		
2. Eskom (2008) Website (http://www.eskom.co.za/live/content.php?Item_ID=4226)		
	%	i.e. MWhprod /TJcons
3a. Using CDM Tool default efficiency for old oil-fired gas turbines	30%	83.3
3b. Using CDM Tool default efficiency for old subcritical coal-fired plants	37%	102.8
4. IPCC (2006) Guidelines on National GHG Inventories, table 1.2 of Chapter 1 of Vol. 2 (Energy) Default values at the lower limit of the uncertainty at a 95% confidence interval		
5. Engineers Edge (2008) - See http://www.engineersedge.com/fluid_flow/fluid_data.htm		
Areas shaded: where net electricity sent out is negative, it is set to zero		

Note: White and grey cells are for calculations

Annex 4

MONITORING INFORMATION

All the monitoring information is indicated in the relevant sections of the PoA-DD.

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