Appendix A[1] to the simplified modalities and procedures for small-scale CDM project activities
ref: http://cdm.unfccc.int/Reference/Documents/SSC_PDD/English/SCCPDD_en.doc

CLEAN DEVELOPMENT MECHANISM **SIMPLIFIED PROJECT DESIGN DOCUMENT** **FOR SMALL SCALE PROJECT ACTIVITIES (SSC-PDD)** **Version 14a (28th February , 2005)**

CONTENTS

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1 This appendix has been developed in accordance with the simplified modalities and procedures for small-scale CDM project activities (contained in annex II to decision 21/CP.8, see document FCCC/CP/2002/7/Add.3) and it constitutes appendix A to that document. For the full text of the annex II to decision 21/CP.8 please see http://unfccc.int/cdm/ssc.htm).

Other supporting documentation

Attachment F:	Letter from DEAT, indicating that an EIA is not required
Attachment G:	Summary of stakeholder consultations
Attachment H:	The SSN Technology Maintenance Training Manual
Attachment I:	Residential water heating systems – theoretical and real usage efficiencies.
Attachment J:	Local expert review

A. General description of project activity

A.1 Title of the project activity:
Kuyasa low-cost urban housing energy upgrade project, Khayelitsha (Cape Town; South Africa):

A.2 Description of the project activity:
This project activity is aimed as an intervention in an existing low-income housing development with households in Kuyasa, Khayelitsha, as well as in future housing developments (100 ha) in this area. The project activity aims to improve the thermal performance of the existing and future housing units, improve lighting and water heating efficiency. This will result in reduced current and future electricity consumption per household, significant avoided CO_2 emissions per unit. Other co-benefits of the project activity include a reduction in local air pollution with subsequent decreases in pulmonary pneumonia, carbon monoxide poisoning and other respiratory illnesses. A decrease in accidents and damage to property as a result of fire is also anticipated.

The project activity relates to the following 3 interventions per household unit:
- Insulated ceilings;
- Solar Water Heater installation; and
- Energy Efficient Lighting.

Improved end-use energy efficiency combined with the use of solar energy for water heating will result in measurable avoided pollutant emissions and measurable energy consumption savings. This contributes to 'energy poverty' alleviation.

By increasing the use of renewable energy and improving thermal performance energy services are provided cleaner with respect to local pollutants and cheaper than in the baseline situation. The improvements in the thermal performance will moderate indoor air temperature with associated comfort and health benefits.

A.3 Project participants:
The Project Participant is the City of Cape Town. The City of Cape Town is represented by the following officials:

(i) Craig Haskins – Manager at the Environmental and Development Planning at City of Cape Town.
(ii) Monwabisi Booi – Urban Renewal Directorate, City of Cape Town

(Please list Party(ies) and private and/or public entities involved in the project activity and provide contact information in annex 1 of this document.)

(Please designate one of the above as the official contact for the CDM project activity.)

A.4 Technical description of the project activity:

A.4.1 Location of the project activity:

A.4.1.1 Host country Party(ies): **South Africa**

A.4.1.2 Region/State/Province etc.: **Western Cape**

A.4.1.3 City/Town/Community etc: **Cape Town**

A.4.1.4 Detailed description of the physical location, including information allowing the unique identification of this project activity *(max one page)*:

This project is located in Khayelitsha, a relatively new low-income residential area located in the south-eastern sector of the City of Cape Town, in the Western Cape Province of South Africa.

This project will be considered in number of phases**:**

- **Phase 1 of the project**: This phase will be implemented in an area in which approximately 2309 households have recently been constructed. Uptake of the technologies will be based on the individual household choice. The number of installations will be monitored and actual emissions reductions calculated on this basis.
- **Phase 2a of the project**: There exist many areas with low cost housing in need of energy retrofitting to which this Project Design Document will apply within the limitations of the small-scale debundling limitations.
- **Phase 2b of the project**: This phase will form part of the construction phase of Town 3 (100 ha), a "green fields" project, which will be located alongside the recently completed Town 2. The number of dwellings to be constructed in Town 3 will be determined by the Development Planning Study currently underway. It is estimated that the area will have more than 4000 housing units, according to the EIA, undertaken for this site; all of the 100 ha is suitable for housing. 800 houses in the Kuyasa "remainder" which are planned to be built before March 2005.

This project design document deals with the retrofits of existing houses, i.e. the first phase of the project activity, but will be applied to the second phase (Phase 2a) at a suitable point in the future.

The installation of the technologies will be undertaken by a number of small – emerging contractors. These contractors will be sourced through a tendering process facilitated by the existing Ward Development Forum (WDF) in Khayelitsha. The project activity is modular and likely to be applied to other areas in future. The project size will be limited by the small-scale thresholds of 15 GWHs/year for the insulated ceilings and CFLs and 15MW for the Solar Water Heaters within the project boundary/ies.

A.4.2 Type and category(ies) and technology of project activity

This is a small-scale energy efficiency improvement project activity consisting of the following categories:

- Renewable Energy Projects: Type I.C. Thermal Energy for the user: Installation of Solar Water Heaters;
- Energy Efficiency Improvement Projects: Type II.C. Demand – Side Energy Efficiency Programmes for Specific Technologies: Retrofitting of incandescent bulbs with Compact Fluorescent Light bulbs; and
- Energy Efficiency Improvement Projects: Type II.E. Energy Efficiency and Fuel Switching Measures for Buildings: Introduction of insulated ceilings.

The technologies employed are solar water heaters, ceiling boards (9 mm rhino board – gypsum and cardboard) and sisalation (one-sided foil sandwiched fibre), and compact fluorescent lamps. The technologies are supported by other housing infrastructure including roofing trusses, SWH cradles, pipes, drains, showers, taps, shower bases, wiring and luminaries, switches etc. These technologies are all locally available.

- The installation of insulated ceilings in the houses will result in the reduction of temperature amplitude extremes (daily and seasonal), making the houses more comfortable all year round. The reduced demand in energy consumptions will in turn lead to lower electricity consumption in future and/or less dependence on other fuel sources for space heating purposes at present. All of this will carry significant economic and environmental health benefits.

- Installation of solar water heaters, if fitted with timers, could also result in reduced peak demand as heating loads peak in the evening in winter even if the systems are backed up using an electrical heating element. In all houses in Kuyasa, the installation of solar water heaters will be coupled with the installation of showers, shower basins, hot, cold and grey water ducting, and shower curtains. Households actually reported that they would prefer a tap to fill buckets for washing rather than showers (Social Research Study for Kuyasa, 2003, attachment B). Part of the costs of installation (finishing) will accrue to the account of the household.

- Energy efficient lighting projects do not contribute significantly to the reduction of carbon emissions. However, when packaged as part of a bigger project, they can make a significant contribution to the reduction of CO_2 emissions and result in cost savings to the household and reduction in peak demand with all the associated electricity infrastructure savings. Maintenance and proper care (during monitoring periods) will be taken to ensure ongoing use of the CFLs should they expire before the end of the project period.

The maximisation of the effectiveness of the solar water heaters and their maintenance will be part of a training course that has been designed by the project facilitators and will be augmented by maintenance training for owners and artisans. The correct disposal of the CFL will need to be explored, as will the potential for sand build-up on ceilings (The **South***South*North Technology Maintenance Training Manual 2003, attachment H).

A.4.3 Brief statement on how anthropogenic emissions of greenhouse gases (GHGs) by sources are to be reduced by the proposed CDM project activity:

This CDM project activity is to reduce emissions of anthropogenic greenhouse gasses (GHGs) by sources with the installation of various energy efficiency and renewable energy technologies. None of the technologies pay for themselves at the discount rate seen by the households at their current level of consumption.

A.4.4 Public funding of the project activity:

South African public money is used in the project activity. No Annex I funds are used in the implementation of the CDM project activity.

A.4.5 Confirmation that the small-scale project activity is not a debundled component of a larger project activity:

The project involves the retrofitting of a number of low-cost houses. There will be other small-scale CDM project activities from the same project participant. These other project activities will be registered within two years but they will not be in the same project category and technology/measure, and the project boundaries between them will not be within one kilometre of this proposed small-scale project activity's boundary. If, however, future phases of the project commence, a new PDD may be prepared for that housing development that will include the three interventions in this PDD with other additional interventions.

This project activity will serve as a pilot that can be extended to larger CDM projects in future Greenfield and retrofit housing developments in Cape Town, South Africa and perhaps, beyond.

B. Baseline methodology

B.1 Title and reference of the project category applicable to the project activity:

The project activities use the Indicative Simplified Baseline and Monitoring Methodologies for Selected Small-Scale CDM Project Activity Categories. The project activity falls within the small-scale size thresholds for both renewable energy and energy efficiency and therefore qualifies for simplified procedures, i.e. this project activity will generate an equivalent of less than 15 MW of thermal energy and it will reduce energy consumption on supply/demand side of less than 15 GWh per year.

Project categories applicable to the project activities:

Type I Renewable Energy Projects: Type I.C. Thermal Energy for the user: This category encompasses renewable energy technologies that supply individual households or users with thermal energy that displaces fossil fuel or non-renewable sources of biomass. Electrical backup for SWH will be installed to ensure equality between service delivery in the project baseline and the project activity. Empirical data gathered from the sample of households used in the baseline study indicates that households do not use the backup systems due to their high costs; however the quality of service of hot water on demand is technically available to the households.

Type II Energy Efficiency Improvement Projects: Type II. E. Energy Efficiency and Fuel Switching Measures for Buildings. This category encompasses project activities aimed primarily at energy efficiency. Examples include technical efficiency measures such as better insulation.

Type II Energy Efficiency Improvement Projects: Type II.C. Demand-Side Energy Efficiency Programmes for Specific Technologies. This category encompasses the adoption of energy efficient Compact Fluorescent Lamps. These lamps will replace existing incandescent lamps of a similar lighting service.

Table 1: Categories of project activities

Intervention	*Category*	*Number of units*	*Small-Scale threshold contribution*
<u>Type IC</u>: Solar Water Heater Year 1 (3kW input power equivalent for solar water heater back up (project activity) and electric hot water storage heater (baseline)	Renewable energy project activity with a maximum output capacity equivalent of up to 15 MW	Per household.	3kW/house[2] If water heated by solar radiation were to averaged out as a RE power supply over the year = 912kWh/year equivalent to = 0.09kW Reaching the threshold could take 144000 houses within the small-scale limit or a quarter of this if the average solar power were calculated over periods with solar radiation.
<u>Type IIE</u>: Insulated Ceilings Year 1	Energy efficiency improvement project activity which reduces energy consumption on the demand side up to the equivalent of 15 GWh per year	Per household	1494 [3] kWh/year. To reach the threshold of 15GWh/year this could be extended to 10 040 houses
<u>Type IIC</u>: Compact florescent Light Bulbs Year 1	Energy efficiency improvement project activity which reduces energy consumption on the demand side up to the equivalent of 15 GWh per year	Per household	257[4] kWh/year. To be within the limit this could be applied to 58442 houses.
Type IIC and E combined	If the combined type 2 thresholds were to be applied, the number of households with thermal; performance improvements and efficient lighting	Per household	To be within the limit it would be decreased to 8567 households.

B.2 Project category applicable to the project activity:

General description

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[2] That is: 3kW[2] (baseline), the 3kW is the electricity back up. This could also be calculated as amount of heat in the solar heated warm water (in kWh/year divided by 24 and 365).

[3] That is: Average 4162.7 kWh/year (amount of energy needed, modelled in the morning) + 2776.8 kWh/year (amount of energy modelled in the evening[3]) = 6939.5 kWh/year (baseline) less project activity emissions at 3325.8 kWh/year (amount of energy modelled in the morning) + 2268.7 kWh/year (amount of energy modelled in the evening) = 5594.5 kWh/year (project activity). Thus savings per year is 1345kWh/year. Including the transmission losses this is 1494kWh/year.

[4] That is: 2*60*6.8*365/1000 = 298 kWh/year (baseline) less (11+16)*6.8*365/1000 = 67 kWh/year (project activity) difference taking transmission losses into account = 257 kWh/year.

This is an application of the Indicative Simplified Baseline and Monitoring methodologies for selected small-scale CDM project activity categories which will incorporate the principle of suppressed demand for energy services in poor households. Suppressed demand for energy services refers to a state where current levels of access to energy services – before any CDM intervention – are inadequate because of income or infrastructure constraints, thus not reflecting real demand for energy services by energy poor households. The CDM project will eliminate part, but not all, of the suppressed demand by decreasing the cost of energy services, thus increasing access to energy services whilst allowing energy poverty to decline.

The implication for the baseline scenario is that the baseline should reflect the technology and/or service levels that would be required if suppressed demand did not exist, rather than the technology currently in use by poor households. This reflects the project participants' understanding of paragraph 46 of the CDM Modalities and Procedures, namely that "the baseline may include a scenario where future anthropogenic emissions by sources are projected to rise above current levels, due to the specific circumstances of the host Party."

For all three energy services – water heating, space heating, and lighting – demand is suppressed due to lack of income or lack of access to capital, although these income levels would be expected to increase over time. The argument for suppressed demand is based on socio-economic secondary data as well as primary socio-economic and technical monitoring of the sample 10 households in Kuyasa (Suppressed Demand in low cost housing in Kuyasa 2003, attachment A; Social Research Study for Kuyasa 2003, attachment B)

Demand would be suppressed similarly in other communities in South Africa with a similar socio-economic status, so control groups, as required by the thermal efficiency IIE monitoring methodology are not suitable for developing a baseline scenario. This section describes the tools used, including logical, transparent and conservative models, to estimate baseline energy demand that takes suppressed demand into consideration. Importantly, however, even with the CDM interventions, it is likely that some suppressed demand will still continue to exist. For example, even after houses have insulated ceilings, the inhabitants may still not be able to afford to heat them to optimal thermal comfort during the coldest times of the year. This means that, although energy service levels will hopefully rise to full satisfaction levels in the future, with the support of these interventions, we can not assume that suppressed demand will be eliminated within the crediting period.

Models can be used to predict both the baseline and project activity emissions for water heating and thermal performance at the new unsuppressed level of energy service. These models can be calibrated against real data to conservatively optimise the energy consumption predictions. The methodologies are transparent but require an expert to understand the detail of the multi-parameter optimisations in the case of the thermal performance model and the logic involved in the solar water heater model. To aid transparency and interpretation, algorithms are presented that give the main calculation steps[5].

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[5] See detailed algorithm for calculation steps in the theoretical model. Thermal Modelling Report, 2004 (attachment D).

Space heating *(See Thermal Modelling Final Report 2004, attachment D).*
The SSC rules for Type II.C energy efficiency in buildings state, that "The energy baseline consists of the energy use of the existing equipment that is replaced in the case of retrofit measures and of the facility that would otherwise be built in the case of a new facility…"

The suppressed demand argument is that the baseline technology for space heating should be a home without insulated ceilings, which is "the existing equipment that is replaced in the case of retrofit measures", but that the energy *use* should be based on the amount of energy required to heat the homes to a level of thermal comfort (determined empirically from monitoring heating behaviour and indoor temperatures). In this case the standard heating fuel would have been increasingly electricity. Electricity is therefore used as the baseline fuel and is assumed to provide space heat at 100% efficiency[6]. However, due to lack of income, households cannot keep their homes at the desired levels of thermal comfort in winter. Installing insulated ceilings will make space heating services more effective with homes achieving a higher indoor temperature using similar amounts of space heating.

Energy measurements of the current situation before and after the interventions do not reflect the energy use in the absence of the suppressed demand (Paragraph 69b). Also, the quantification of suppressed demand based on comparable use in similar socio-economic situation was found not to be a straight forward option, as it refers to currently non-existent conditions. Thus to account for and quantify suppressed demand, calibrated theoretical models can be used to determine how much energy would have been required in houses without insulated ceilings (baseline) to reach the thermal comfort.

The following baseline methodology option (using calibrated models[7]) can be used to estimate avoided emissions due to suppressed demand;

1. A predictive theoretical thermal model can be employed to calculate the amount of energy needed to reach (21 ^{0}C) during non-sleeping periods of occupation[8]. In this option, the predictive model can be used to simulate the baseline and project activity levels *ex ante* (to predict energy consumption before and after the installation of insulated ceilings) as required. Thus, the degree to which the heating service is suppressed is expressed as the difference between the predictions with and without the interventions in meeting thermal comfort. This can then be expressed as emissions of CO_2 equivalent.

Water heating

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[6] The study "Cost benefit analysis of energy efficiency in low cost housing" by Winkler & Spalding-Fecher (2000) (EDRC) indicates that 75% of low-income households use electricity for space heating (against 2% for coal, 19% paraffin and 2% LP Gas). Additional energy source and usage information pertaining to this study should result from the Social Behavioural study (Cousins and Mahote, 2003).

[7] The model was then constrained by assuming that: No cooling energy was required; space heating would be necessary during the colder six months of the year (April through to September); and a diurnal use of energy for space heating was required. This was defined as being between the hours 06:00 to 08:00 and 18:00 to 21:00.

[8] The times are based upon real non-sleeping occupancy, approximated by observing lighting and other loads sensed by the data loggers and then conservatively refined. The level of "thermal comfort" is reached for two periods (morning and evening) of the day for the 6 coldest winter months for South Africa.

The SSC rules for Type I.C thermal energy for user states, (para. 18 of appendix B to the SS M&P) "For renewable energy technologies that displace technologies using fossil fuels, the simplified baseline is the fuel consumption of the technologies that would have been used in the absence of the project activity times an emission coefficient for the fossil fuel displaced. For renewable energy technologies that displace electricity, the simplified baseline is the electricity consumption times the relevant emission factor calculated as described in category I.D, paragraphs 28 and 29."

Warm water on demand technologies were not installed as a component of low cost housing delivery in South Africa. Water heating is currently achieved through batch heating of water in pots using different fuel sources such as kerosene, LPG or electricity. However, for this baseline scenario, the suppressed demand argument is that the technology that would have been used in absence of the project activity is an electric hot water storage geyser, rather than kerosene stoves. This is the technology that would be chosen by typical homes without suppressed demand when hot water on demand technologies were installed (Social Research Study for Kuyasa 2003, attachment B).

In order to calculate the baseline electricity consumption, we need to know the amount of electricity required to deliver the same quantity of hot water from an electric geyser that is delivered by the solar water heating system. We therefore need to know the amount of energy needed to heat the available warm water delivered by the project, as well as the efficiency of the electric hot water storage geyser. The efficiency of the electric storage geyser is be based on the manufacturers' specifications (70%), as tested by national or international certifiers (Department of Minerals and Energy - Appliance labelling, as per paragraph 5d of Appendix B to the SSC M&P rules.)

To provide an *ex-ante* estimate of the baseline energy use, a calibrated model has been developed (and included as Attachment C) in which empirical data has been used to estimate the amount of water heating energy that will be replaced by solar radiation (Solar Water Heating Model for Kuyasa 2004, Attachment C). As the calibrated model predicts the amount of warm water that will be available from the specific solar water heater using average input temperatures, draw-off patterns, solar radiation, average orientations etc. Monitoring will be described in section D below. The type of solar water heaters will determine the quality of the service. A sample of the SWH types employed in the project will have to be tested (draw-off tests) in order to provide data to calibrate the SWH theoretical model, during the project verification process and after every seven-year period.

Lighting

For this project, the baseline technology replaced is an incandescent lamp. In each home, two 60W incandescent lamps will be replaced by two compact fluorescent lamps (11W and 16W). In the baseline study sample houses, attention has been paid to which 2 lights are in use the most number of hours (Attachment E: Kuyasa Monitoring Report 2003). These will be the lights that will be replaced as the project activity. Survey data in the baseline study showed that the average daily operating time as 6.8 hours.

B.3 Description of how the anthropogenic GHG emissions by sources are reduced below those that would have occurred in the absence of the proposed CDM project

activity *(i.e. explanation of how and why this project is additional and therefore not identical with the baseline scenario)*

This CDM project activity is to reduce emissions of anthropogenic greenhouse gasses (GHGs) by sources with the installation of various energy efficiency and renewable energy technologies. None of the technologies pay for themselves at the discount rate seen by the households at their current level of consumption.

- **Insulated Ceilings**

  Ceilings and ceiling insulation are not part of the existing low-cost houses in Kuyasa. No houses sampled in Kuyasa have installed ceilings prior to the design of this project. New housing in Khayelitsha will include ceilings, were this exists as part of the plans for housing, ceilings will be removed from the baseline, but insulation may be included where this is not specified in the plans.
- **Installation of Solar Water Heaters**

  In low-cost households, water heating is achieved through batch heating of water in pots/kettles using mostly electrical appliances and different fuel sources.
- **Installation of Compact Fluorescent Light Bulbs.**

  CFLs are currently not installed in any of the sampled houses in Kuyasa; however, initiatives are underway through the National Electricity Utility (Eskom) to install CFLs in the future which will be reflected in the baseline.

B.4 Description of the project boundary for the project activity:

Project Boundary

According to the rules for small-scale CDM projects, the project boundary should be the "physical, geographical site of the energy generated or equipment used".

Also, the definition of the project boundary as related to the baseline methodology is applied in the project activity in the sense that the project boundary has been set by each project activity (i.e. SWH installation, insulated ceiling and compact florescent light bulbs).

Therefore, the project boundary for the three project activities is the area of the houses in Khayelitsha, Cape Town, South Africa.

B.5 Details of the baseline and its development:

B.5.1 Specify the baseline for the proposed project activity using a methodology specified in the applicable project category for small-scale CDM project activities contained in appendix B of the simplified M&P for small-scale CDM project activities:

- Baseline for SWH: Electric hot water storage geysers are replaced by solar water heaters. See attachment C on Solar Water Heating Model Report, 2004.
- Baseline for Thermal Performance: Low-cost houses without ceilings have insulated ceilings installed. See attachment D on Thermal Performance Report, 2004.
- Baseline for Lighting (CFLs): Two (60 watt) incandescent light bulbs will be replaced by (a 16 and an 11 watt) Compact Fluorescent Light bulbs in each household (6.8 hours a day): See attachment B: Social Research Study for Kuyasa, 2003.

B.5.2 Date of completing the final draft of this baseline section:

(1/11/2004):

B.5.3 Name of person/entity determining the baseline:

Glynn Morris (AGAMA Energy)

Rendani Kharive (AGAMA Energy)
Greg Austin (AGAMA Energy)
Thomas Cousins (Energy Consultant)
Fikiswa Mahote (Energy Consultant)
Monwabisi Booi (City of Cape Town) (Project Participant)
Craig Haskins (City of Cape Town) (Project Participant)
Project Steering Committee the Kuyasa Community Facilitated by SouthSouthNorth

C. Duration of the project activity and crediting period

C.1 Duration of the project activity:

C.1.1 Starting date of the project activity:
June 2005

C.1.2 Expected operational lifetime of the project activity: *(in years and months, e.g. two years and four months would be shown as: 2y-4m.)*
21 years (With 7 year intervals for reviewing the baseline and other related issues)

C.2 Choice of the crediting period and related information: *(Please underline the selected option (C.2.1 or C.2.2) and provide the necessary information for that option.)*

C.2.1 Renewable crediting period *(at most seven (7) years per crediting period)*

C.2.1.1 Starting date of the first crediting period *(1/09/2005)*:

C.2.1.2 Length of the first crediting period *(in years and months, e.g. two years and four months would be shown as: 2y-4m.)*: 7 years

C.2.2 Fixed crediting period *(at most ten (10) years)***:**

C.2.2.1 Starting date *(DD/MM/YYYY)*:

C.2.2.2 Length (max 10 years): *(in years and months, e.g. two years and four months would be shown as: 2y-4m.)*

D. Monitoring methodology and plan

Simplified modalities and procedures for small-scale projects are employed for all project activities. In keeping with the simplification philosophy, 30 houses in the universe will be selected on a random basis for quarterly monitoring. Each quarter a new sample will be selected. The number of houses will remain 30 unless more than 2400 houses are included in the project at which time 1.25% of the total will be used in place of 30. Each house should be visited once during the project crediting period. A larger sample in the project boundary and another sample outside the project boundary will be polled from specific data as defined in the monitoring plan. In all cases energy (in $kWh_{equivalent}$) and energy intensity for South African electricity including transmission and losses (10%) will need to be continually monitored.

Monitoring will be undertaken by the project participant or its nominated agent on a quarterly basis. Verification of monitoring data will be undertaken as required by the cash flow, but at least once every seven years at which time a report will be issued. The data will be stored at the City of Cape Town offices of Environmental Management or its nominated agent. Monitoring will be used to inform the project participants maintenance activities.(See The SSN Technology Maintenance Training Manual, attachment H)

A detailed monitoring plan will be devised at the inception of the project.

D.1 Name and reference of approved methodology applied to the project activity:

- **Installation of Solar Water Heaters: Type I Renewable Energy Projects: Type I.C. Thermal Energy for the user.**

  For projects where metering energy production directly is not appropriate, the SSC rules state that the Monitoring for systems that reduce emissions by less than 5 tonnes/year shall include:

  (i) "Recording annually the number of systems operating (evidence of continuing operation, such as on-going rental/lease payments could be a substitute); and

  (ii) Estimating the annual hours of operation of an average system, if necessary using survey methods. Annual hours of operations will be estimated from total output (sic) and output per hour if an accurate value of output per hour is available."

  To apply this to solar water heating, average operating hours is not an appropriate measure, since the system constantly receives solar radiation during the day. The appropriate interpretation would be to estimate the energy in the available hot water that otherwise would have been provided using electricity. The calibrated model provides an estimate of the amount of energy required using average solar radiation data and specific SWH performance data. The empirical data used to calculate the system efficiency is subjected to a 95% confidence level. A calibrated model will be employed for each solar water heater model used in the project.

- **Replacement of Incandescent light bulbs with Compact Florescent light bulbs: Type II Energy Efficiency Improvement Projects: Type II.C. Demand-Side Energy Efficiency Programmes for Specific Technologies.**

  As per the SCC rules, the number and power of the replaced devices shall be recorded and monitored. This shall be monitored while replacement is underway to avoid greatly inflating the baseline. In the interim 60 watt incandescent bulbs are replaced.

  Monitoring shall cover the "power rating" and operating hours of the CFLs. The power of the CFLs will be based on nameplate data. Operating hours will be measured in the sample of 10 households. In addition, a sample of non-metered households will be spot checked to ensure that the CFLs are still in use and that rebounds to incandescent lamps have not occurred.

- **Installation of ceilings and ceiling insulation: Type II Energy Efficiency Improvement Projects: Type II. E. Energy Efficiency and Fuel Switching Measures for Buildings.**

  As per the SSC rules,

  "In the case of retrofit measures, monitoring shall consist of:

  (a) Documenting the specifications of the equipment replaced; and

  (b) Calculating the energy savings due to the measures installed."

  For ceilings and ceiling insulation, there is no equipment to be replaced, but the thermal characteristics of a house without an insulated ceiling has been modeled based on empirical data from the houses in the target community.

To calculate the project activity emissions, actual energy use for space heating will be monitored as will the indoor temperature, and the building energy model used to calculate the amount of energy it would have taken for equivalent heating in a home without an insulated ceiling. This model will be calibrated with empirical data from the sample houses. Should different housing types, materials or sizes be included in the project boundary in which insulated ceilings are to be fitted, a sample of those houses will be used to calibrate a new model. If the calibrated model shows higher emissions reductions than with the original 30m^2 houses, the project participant reserves the right to utilize the original 10 household sample to determine emissions reductions on the basis of conservatism.

A sample of households across Khayelitsha (outside of Kuyasa) will be longitudinally tracked to keep track of the baseline penetration of solar water heaters, insulated ceilings and CFLs. The emissions intensity of electricity provided by the grid in South Africa will be updated annually coinciding with the publication of the annual report of the national utility/energy regulator.

D.2 Justification of the choice of the methodology and why it is applicable to the project activity:

Methodology chosen has been specified by the Appendix B, Small-scale CDM Project Activities. Modifications to these methodologies, where necessary are explained/promoted above.

D.3 Data to be monitored:

Table 2: Monitoring plan

D.2.1.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:								
ID number	**Data type**	**Data variable**	**Data unit**	**Recording Frequency**	**Proportion of data to be monitored**	**How will the data be archived? (electronic/ paper)**	**For how *long* is archived data to be kept?**	**Comment**
1a.Solar Water Heaters	Number of systems purchased from sales records of suppliers	number	number	Quarterly	30 houses per quarter (rotating) [9]	electronically	Duration of the crediting period.	Data will be used for verifying the baseline emissions, the project activity emissions and for monitoring purposes.
1b.Solar Water Heaters	Number of SWHs operating.	number	number	Quarterly	30 houses per quarter (rotating)	electronically	Duration of the crediting period	
1c. Solar Water Heaters	Recalibration of the SWH model used for the Kuyasa project activity	number	kWh equivalent /year	When new SWH models are introduced.	All new models introduced and periodic recalibrations for verification purposes	electronically	Duration of the crediting period	Recalibration of the SWH models will be undertaken for verification purposes when new SWH models are introduced or when cradles are introduced that improved the orientation.
2a. Compact Fluorescent Lamp	Number of CFLs in Kuyasa from sales records, , number of disposed CFls and number of replaced CFls.	number	number	Quarterly	All data	electronically	Duration of the crediting period	Sales records of CFLs will be used to monitor the extent of the the penetration of CFLs.
2b Compact Fluorescent	Number of operating CFLs	number	number	Quarterly	30 houses per quarter		Duration of the	Solutions on how to take into account rebound effects caused by residents not

[9] Monitoring 30 or 1.25% of the total houses affected by the sample every quarter (rotating) will result in the monitoring of all houses within the project boundary i.e. approximately 2400 houses after 20 years. Should the size of the project be extended the sample size would be increased so that each house in the project is visited at least once during the crediting period.

Lamp					(rotating)		crediting period	affording to replace broken CFLs will be discussed and dealt with through the feasibility study, implementation and maintenance plans. Updating on these plans will be compiled annually and will form part of the verification documentation. The proportion of CFLs working will be used to correct the emissions reductions
3a. Insulated ceilings	Type of insulated ceilings installed in Kuyasa from sales records	number	number	Quarterly	30 houses per quarter (rotating)	electronically	Duration of the crediting period	Data will be used to document specifications of systems installed, and energy use for emissions baseline and to calibrate the thermal performance models.
3b. Insulated ceilings	Number ceilings still in place by inspecting whether the roofs are still in place.	number	number	Quarterly	30 houses per quarter (rotating).	electronically	Duration of the crediting period	Monitoring will be limited to checking that roof is in place. The proportion of insulated ceilings in place will be used to correct the emissions reductions.
4. Penetration of technologies outside of the project boundary in Khayelitsha	Number of insulted ceiling, SWHs and CFLs	number	number	After 7 years	100 houses random sample (rotating).	electronically	Duration of the crediting period	Data used to inform the baseline update.
5. Electricity emissions	kg CO_2/kWh	number		annually	all	electronically	Duration of the crediing period	Data used to inform the baseline and project activity update.

D.4 Name of person/entity determining the monitoring methodology:

Greg Austin (AGAMA Energy)
Glynn Morris (AGAMA Energy)
Facilitated by SouthSouthNorth

E. Calculation of GHG emission reductions by sources

E.1 Formulae used:

E.1.1 Selected formulae as provided in appendix B:

Of the three technologies introduced only lighting follows the equations provided in Appendix B. The other two technologies use predictive models which provide estimates of the energy and hence emissions. Lighting is therefore dealt with in E.1.1 and thermal performance and water heating in E.1.2.

Throughout, the calculations are on a basis of emissions for each technology for each household for each year. The number of households in the project boundary that install one or more of the technologies as a result of the project activity will be added to the project.

(i) Lighting provided using Compact Fluorescent Light (CFLs) bulbs

Paragraph 49 of the Appendix B to the small-scale modalities and procedures of CDM provides direction for baseline development. The calculation of energy required in the baseline is used in estimating the emissions from the project activity as well. “If the energy displaced is electricity, the energy baseline is calculated as follows:

$$EB = S\,(ni\ .\ pi\ .\ oi)\ /(1 - l)$$

Where:

EB = annual energy baseline.

ni = the number of devices of type i replaced (e.g. 40 W incandescent bulb, 5hp motor) for which the replacement is operating during the year.

pi = the power of the devices of type i replaced (e.g. 40 W, 5 hp). In the case of a retrofit programme,

“power” is the weighted average of the devices replaced. In the case of new installations, “power” is the weighted average of devices on the market.

oi = the average annual operating hours of the type i replaced.

l = average technical distribution losses for the grid serving the locations where the devices are installed, expressed as a fraction.

The project activity makes use of 16 and 11 Watt CFLs for lighting in and inside and outside fittings. The lamps are used for 6.8 hours per day which is the average use of the lamps in the sample measured empirically. The project activity emissions and

Annual energy in Project Activity [10]Number of devices replaced * power of the devices replaced * average annual operating hours of the replaced devices) / (1-average technical distribution losses for the grid serving the locations where the devices are installed, expressed as a fraction) * days in a year = total energy used in $kWh_{equivalent}$ = (16W+11W)/1000*6.8hours*365days/(1-10%) **=74.5kWh/hh/year**

↓

[10] Kuyasa Monitoring Study, Agama Energy, 2003 (Attachment E) and Social Research for Pilot CDM Project Activity, Cousins and Mahote, 2003 (Attachment B).

Emissions from the project activity Total annual energy used in (kWh)/(years) * emission coefficient for South African grid electricity (kgsCO_2/kWh)/1000kgs/tonne CO_2 **= 0.066 tonnes CO_2/hh/year**

E.1.2 Description of formulae when not provided in appendix B:

E.1.2.1 Describe the formulae used to estimate anthropogenic emissions by sources of GHGs due to the project activity within the project boundary: *(for each gas, source, formulae/algorithm, emissions in units of CO_2 equivalent)*

(ii) Warm water supply to household using a solar water heater (SWH)

The solar water heater model is used to predict the amount of available hot water a solar water heater would provide. The estimates of the energy available in the hot water are based on drawdown tests, installed orientations and tilts, solar radiation and draw off[11] patterns. On days where excessive available radiation is incident, the amount of available warm water is capped. The level of energy in the available warm water that the solar water would provide is used to calculate the baseline emissions that would have occurred if the same quantity of water were warmed to the same temperature using electricity, accounting for the efficiency of the electric hot water storage geyser and the emissions intensity of the electricity to the point of use (including T&D losses).

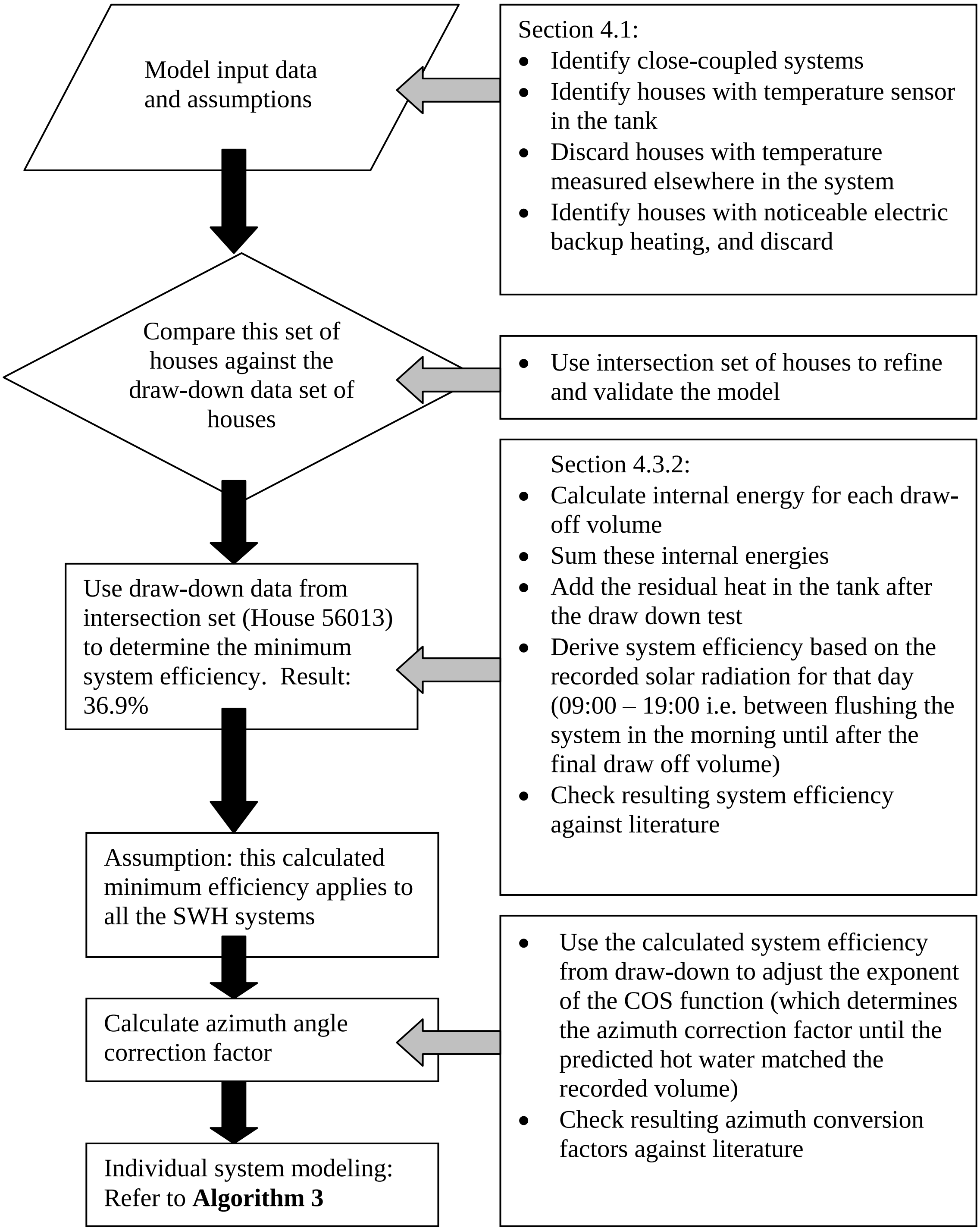
The algorithms below (reproduced from Solar Water Heating Model Annex C) provides a step by step approach to determining the quantity of energy that would be provided by solar energy in the solar water heater. Note that references within the algorithms to section numbers refer to sections of Attachment C. In the equations that follow the algorithm, the emissions are calculated.

The detailed model and calculations are included as Attachment C to the PDD.

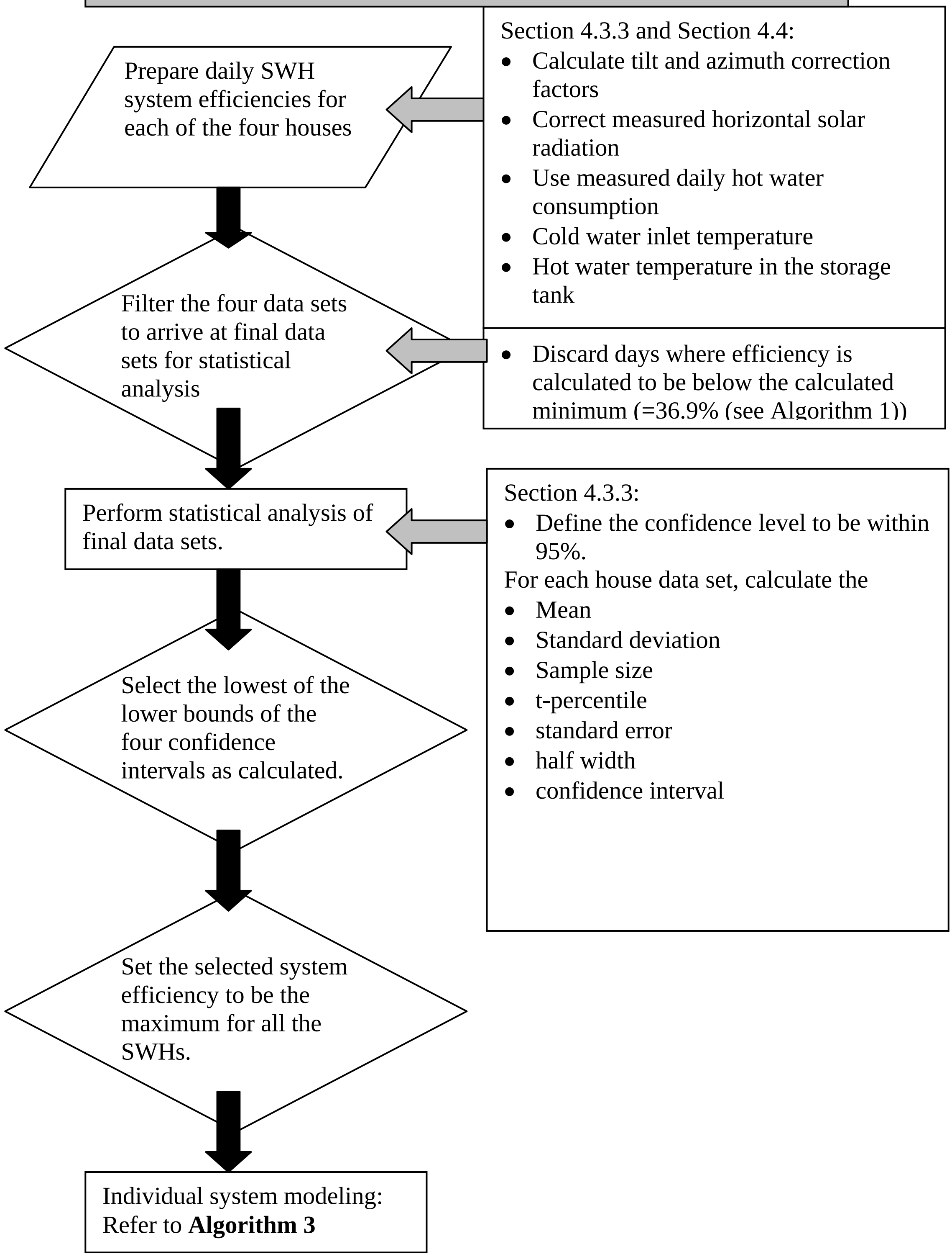
Figure 1: Solar Water Heating Model Algorithms 1-3 follow:

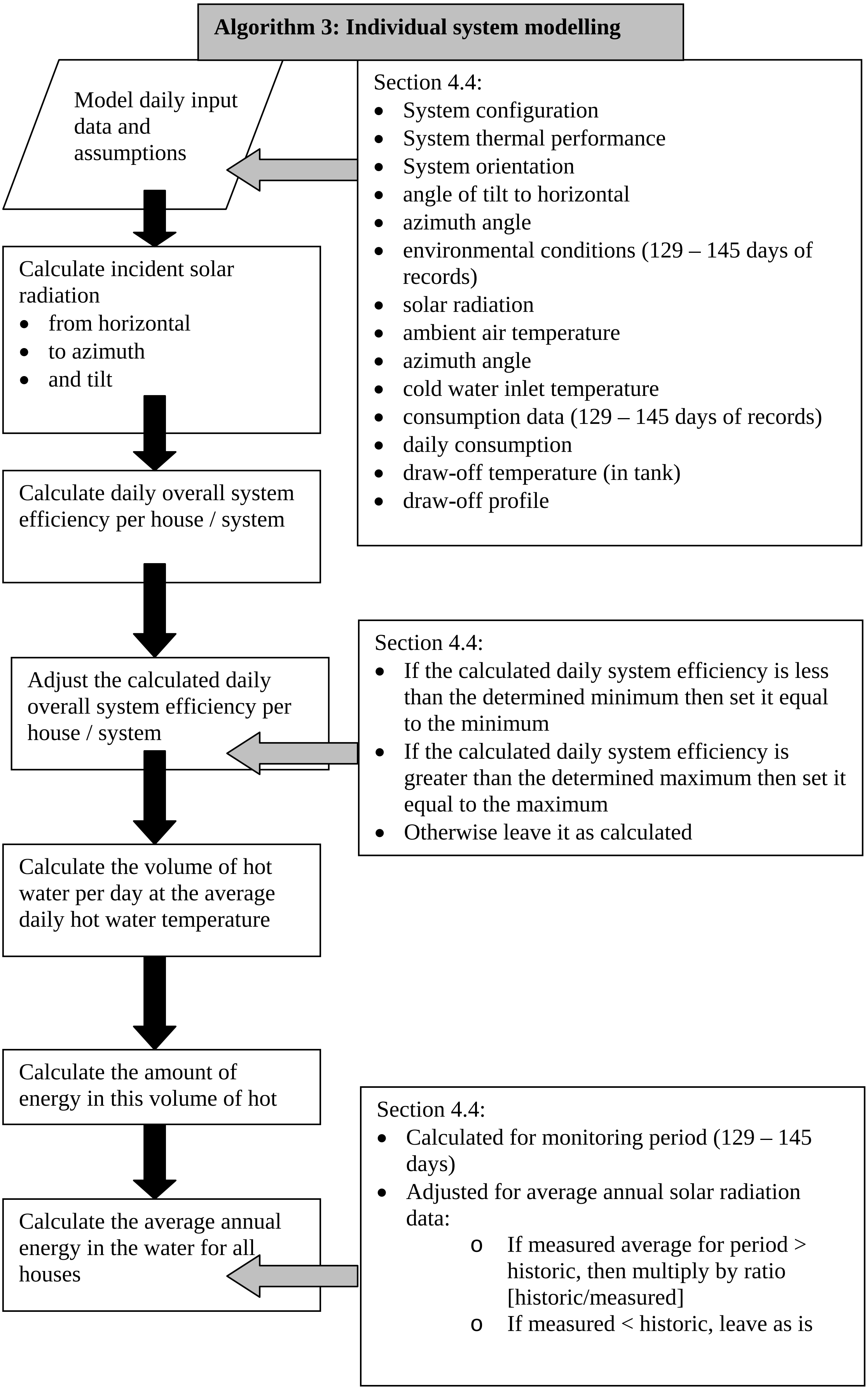
[11] A draw off test establishes the total amount of water available in a solar hot water storage cylinder. This is depicted graphically in Figure 4-1, page 3 in Solar Water Heating Model Attachment C.

Algorithm 1: Data set definition and minimum SWH system efficiency



Algorithm 2: Determining the maximum SWH system efficiency




Algorithm 3: Individual system modelling
Model daily input data and assumptions
Section 4.4:
System configuration
System thermal performance
System orientation
angle of tilt to horizontal
azimuth angle
environmental conditions (129 – 145 days of records)
solar radiation
ambient air temperature
azimuth angle
cold water inlet temperature
consumption data (129 – 145 days of records)
daily consumption
draw-off temperature (in tank)
draw-off profile
Calculate incident solar radiation
from horizontal
to azimuth
and tilt
Calculate daily overall system efficiency per house / system
Adjust the calculated daily overall system efficiency per house / system
Section 4.4:
If the calculated daily system efficiency is less than the determined minimum then set it equal to the minimum
If the calculated daily system efficiency is greater than the determined maximum then set it equal to the maximum
Otherwise leave it as calculated
Calculate the volume of hot water per day at the average daily hot water temperature
Calculate the amount of energy in this volume of hot
Section 4.4:
Calculated for monitoring period (129 – 145 days)
Adjusted for average annual solar radiation data:
If measured average for period > historic, then multiply by ratio [historic/measured]
If measured < historic, leave as is
Calculate the average annual energy in the water for all houses

Energy in project activity
Solar energy transferred to water in SWH =
The amount of solar energy per day on each solar water heater corrected for azimuth and tilt during baseline study period (kWh/household (hh)) * efficiency of SWH (%) * correction for full year (365 days/days in baseline study period) * correction for period average solar radiation versus annual average solar energy (ratio) = **912 $kWh_{equivalent}$/hh/year**

↓

Emissions from project activity
Total energy used (kWh) per annum (years) * emissions co-efficient for solar energy (kgsCO_2/kWh) /1000kgs/tonne CO_2 = **912 * 0.0kgs/$kWh_{equivalent}$ = 0 tonnes CO_2/hh/year**

(ii) Insulated Ceilings

The baseline emissions from houses with insulated ceilings is estimated using a model that calculates the amount of energy required to maintain a house at a level of thermal comfort for non-sleeping occupation periods in the year when space heating is required. Note that references within the algorithms to section numbers refer to sections of Thermal Modeling Final Report Attachment D. The model and detailed calculations are presented in attachment D to the PDD.

Figure 2: Thermal Performance algorithm - 1

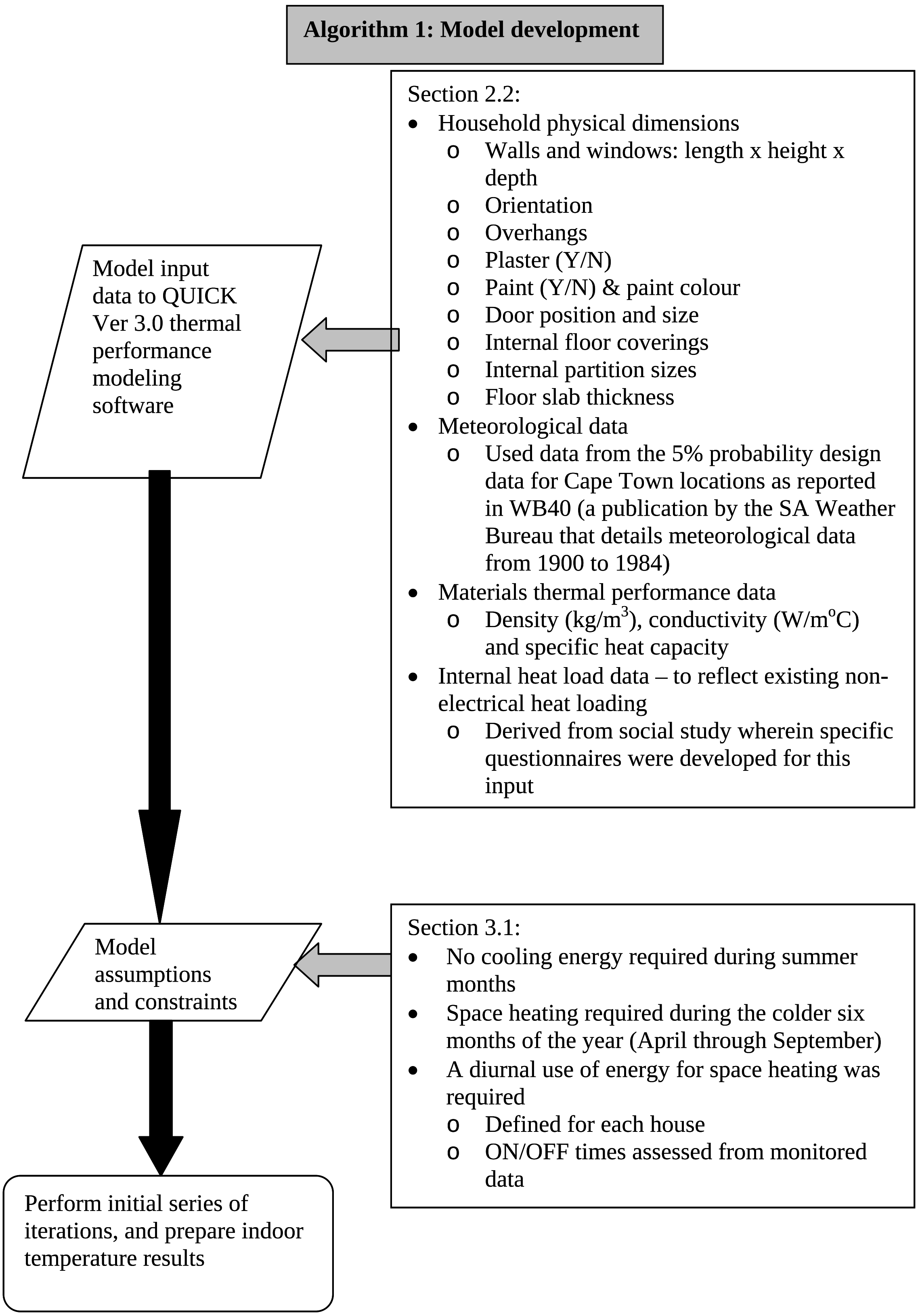
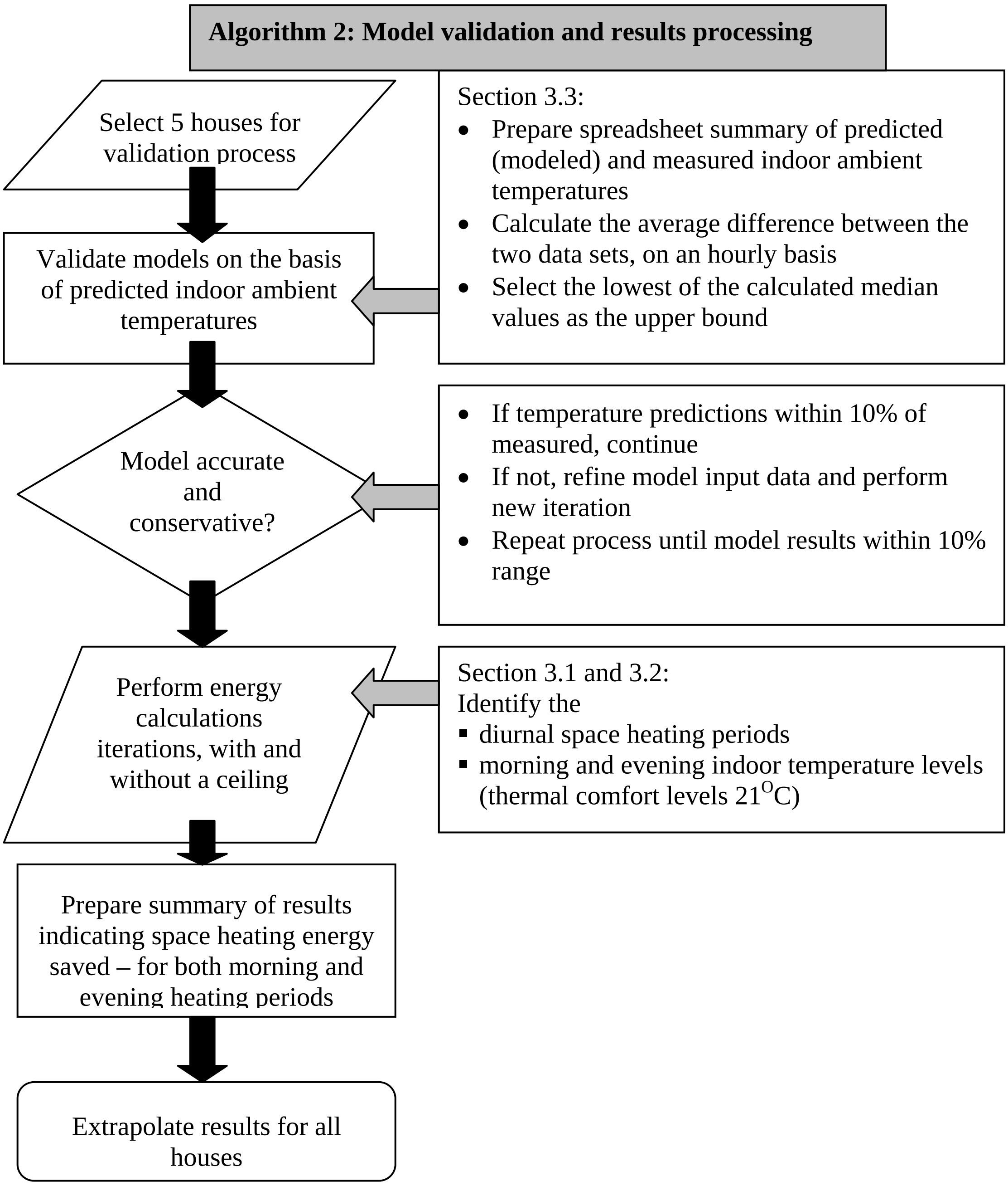


Figure 3: Thermal Performance Algorithm – 2



Energy in Project Activity
Heat required to maintain the temperature of the house at level of thermal comfort during non-sleeping occupancy for heating season of the year Energy requirement by each household to reach thermal comfort in households with insulated ceilings (from model attachment D) **=5595 kWh_e/hh/year**

↓

Emissions from a project activity
Total energy used in (kWh)/year * emission coefficient for South African grid electricity (kgsCO_2/kWh) or emission coefficient for electricity used)/1000kgs/tonne CO_2 **= 5595 * 0.89*1/(1-10%)/1000 = 5.53 tonnes CO_2/hh/year**

E.1.2.2 Describe the formulae used to estimate leakage due to the project activity, where required, for the applicable project category in appendix B of the simplified modalities and procedures for small-scale CDM project activities *(for each gas, source, formulae/algorithm, emissions in units of CO_2 equivalent)*

No leakage calculations will be required for this project activity as this project activity falls under the small-scale simplified modalities and procedures guidelines for (Type I and Type II typologies): renewable energy projects and energy efficiency improvement projects respectively, therefore leakage will not be calculated.

E.1.2.3 The sum of E.1.2.1 and E.1.2.2 represents the project activity emissions:

Table 3: Project activity emissions applying formulae/algorithms above

Project Activity				
Emission Source	*Quantity*	*Energy equivalent*	*Emissions intensity*	*CO_2 emissions*
		kWh/hh/year		*TonnesCO_2/hh/year*
Project Activity				
Compact Fluorescent Light Bulbs	2 CFLs per household	74.5	0.89 tonnes CO_2/kWh	0.066
Solar Water Heaters	One per household	0	0.89 tonnes CO_2/kWh	0
Insulated Ceilings	Ceiling and ceiling insulation for a 30m^{sq} housing unit	5595	0.89 tonnes CO_2/kWh	5.53
Subtotal		**5669.0**		**5.596**

E.1.2.4 Describe the formulae used to estimate the anthropogenic emissions by sources of GHG's in the baseline using the baseline methodology for the applicable project category in appendix B of the simplified modalities and procedures for small-scale CDM project activities: *(for each gas, source, formulae/algorithm, emissions in units of CO_2 equivalent)*

The model used to predict the amount of energy required in a house with and insulated ceiling is re-run excluding the ceilings to predict the baseline. The losses that are associated with the transmission and distribution of electricity to the point of use are factored in. The quantity of energy is then transformed into a quantity of GHG emissions using the emissions intensity of electricity.

The amount of energy that can be provided by the solar water heater in the project activity algorithm is equated to a similar amount of energy required to heat the water in an electric hot water storage geyser. The losses that are associated with the transmission and distribution of electricity to the point of availability are factored in as is the efficiency of the electric hot water storage geyser.

The emissions associated with providing the same lighting service as the two CFLs for the time they are recorded as being in use is the lighting baseline.

(i) Incandescent Light Bulbs

Energy Use baseline
(Number of devices replaced which have operated during that year * power of the devices replaced * average annual operating hours of the replaced devices) / (1- 10%) (average technical distribution losses for the grid serving the locations where the devices are installed =
2*(60W/1000)*6.8hours*365days *1/(1-10%) = 331kWh/hh/year

↓

Emissions baseline
Annual energy use baseline * 0.89 (emission coefficient for South African grid electricity (kgsCO_2/kWh)/1000kgs/tonne CO_2) *** number of houses= 0.294tonnes CO_2 /hh/year**

(ii) Warm water supply to household using electric hot water storage geysers

The water heating baseline methodology makes use of a model to predict the amount of energy that would be provided by an electric hot water storage geyser. The algorithm above provides a step by step approach to determining the quantity of energy that would be provided by solar radiation in the solar water heater.

The baseline scenario is one where the equivalent quantity of warm water is provided using electricity rather than solar energy. The algorithm presented above determines the energy in the water in both the baseline and the project activity. The difference in the two calculations therefore is in including the efficiency of the electric hot water storage geyser as a result of standing losses (see below).

The detailed model and calculations are included as Solar Water Heater Model Attachment C to the PDD.

Electric storage geysers

Energy Baseline
Electric geyser (energy used in the project activity)
The amount of electricity used per household (kWh/hh) to heat water equivalent to energy replaced by solar water heating/70% /1/(1-10%)= **1447kWh/hh/year**

↓

Emissions baseline
Total electricity used (kWh) per annum (years) * 0.89 (emissions co-efficient for South African grid electricity (kgsCO2/kWh)/1000kgs/tonne CO_2) = **1.288 CO_2 tonnes/hh/year**

(iii) Thermal Performance of Households

The baseline for thermal performance using the model (see algorithm above) is the emissions from using electricity to heat the house without insulated ceiling to the level of comfort for the periods of occupancy for six months of the year (heating season).

Energy Use Baseline
Energy requirement by each household to reach thermal comfort (MJ) (without insulated ceilings (from model) * 1/(1-10%) (average technical distribution losses for the grid serving the locations where the devices are installed)
= **7710 kWh/hh/year**

↓

Emissions baseline
Total energy used in (kWh)/year * emission coefficient for South African grid electricity (kgsCO_2/kWh)
= 6.86 tonnes CO_2 /hh/year

Table 4: Project baseline emissions applying formulae/algorithms above

Baselines				
Emission Source	*Quantity*	*Energy equivalent*	*Emissions intensity*	*CO_2 emissions*
		kWh/hh/year		*Tonnes/hh/year*
Baselines				
Incandescent Light Bulbs	2 incandescent light bulbs which have been replaced	330	0.89 tonnes CO_2/kWh	0.294
Electric geyser	Each household	1447	0.89 tonnes CO_2/kWh	1.288
No ceiling and ceiling insulation		6939	0.89 tonnes CO_2/kWh 0	6.86
Subtotal		**8716.**		**8.442**

The sample will be used to conservatively estimate the emissions reductions per technology per household. The emissions per technology per household will be multiplied by the total number of sales of the technologies. In the case where technologies are not in place or not operational, the baseline and project activity figures for the sample and the universe will be corrected accordingly.

E.1.2.5 Difference between E.1.2.4 and E.1.2.3 represents the emission reductions due to the project activity during a given period:

Table 5: Summary table of emissions reductions of project:

Source	*CO_2 emissions*
For all 3 Project Activities	**5.5966 CO_2 tonnes/hh/year**
Baseline	**8.442 CO_2 tonnes/hh/year**
Total annual CO_2 tonnes emissions avoided per household = 2.85	
Water heating	**1.288 CO_2 tonnes/hh/year**
Lighting	**0.228 CO_2 tonnes/hh/year**
Space heating	**1.33 CO_2 tonnes/hh/year**

F. Environmental impacts

F.1 If required by the host Party, documentation on the analysis of the environmental impacts of the project activity: *(if applicable, please provide a short summary and attach documentation)*

This project activity does not require an EIA, as the project intervention is not a listed activity, in terms of the following South African environmental legislation:

- EIA regulations 1182 & 1183 under Environmental Conservation Act
- National Environmental Management Act s24 & s2 principles
- NEMA Second Amendment Bill

See **attached documentation** from the environmental authorities (Attachment F).

G. Stakeholders comments

G.1 Brief description of the process by which comments by local stakeholders have been invited and compiled:

Public participation in the Kuyasa low-cost retrofit CDM project activity has formed an integral part of the project design. This process was enabled through, the *specific structure of the project design team (PDT)* as well as *public meetings*. Information on the project was also disseminated by means of varied *local and international media*, and was presented at various *local and international conferences*.

G.2 Summary of the comments received:

The community stakeholders have formed part of the project design team and all comments from other stakeholders have been incorporated. Minutes from the project design team meetings and the public meetings will are incorporated into the attached summary (Attachment G).

G.3 Report on how due account was taken of any comments received:

The GS Public Consultation Process requires least two public consultations and gives additional minimum requirements for the consultation process.

The attached summary (Attachment G) reports on how account was taken of stakeholder comments and how the project has adapted accordingly.

H: REFERENCES

1. Thermal Modelling Final Report, 2003. Agama Energy Consultants.
2. Social Research for Kuyasa Pilot CDM Project Activity. Assessment of the impact of energy efficiency interventions in a low-income housing settlement Kuyasa Khayelitsha, 2003.Thomas Cousins and Fikiswa Mahote.
3. SAARF Trends (2000-2002), Living Standard Measures for South Africa, 2003. The South African Advertising Research Foundation.

4. Financial Analysis for Kuyasa, 2003. Geoff Jennet and Associates, Financial Consultants.
5. Baselines for Suppressed Demand: CDM Projects Contribution to Poverty Alleviation, SAJEMS NS Vol. 5 (2002) No 2. Winkler H. and S. Thorne.
6. The SouthSouthNorth Sustainable Development Appraisal & Ranking Matrix Tool, the Southsouthnorth Project, 2003.
7. The SouthSouthNorth Technology Maintenance Training Manual, 2003.
8. Independent Reviewer's Report, 2004. R. Spalding-Fecher
9. The Kuyasa Monitoring Report, 2003.Agama Energy Consultants.
10. Suppressed Demand in low cost housing in Kuyasa, (publication forthcoming). Steve Thorne, Lwandle Mqadi, Njeri Wamukonya, Emilio La Rovere, Axel Michaelowa and Youba Sekonda.
11. Thurman 1999. Development and low-cost housing in Khayelitsha Development Action Group Publications.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Middle Name:	
First Name:	Monwabisi
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Mobile:	
Direct FAX:	
Direct tel:	
Personal E-Mail:	

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

Public funding from SA departments has been made available to cover the shortfall in costs of the technologies their installation and maintenance.

Annex 3

BASELINE INFORMATION

Throughout the calculations a basis of one household is used for the project activity and baseline emissions estimations.

Table A3.1: Assumptions and parameters:

Emissions factor for grid electricity (weighted average)	kg CO_2/kWh	0.89
Emissions factor for paraffin	kg CO_2/GJ	25
Technical transmission and distribution losses	%	10
Cost of electricity per household	R/kWh	0.30
Project size	Households	1000s[12]
Thermal Capacity Factor for water	kJ/^{o}C/Liter	4.2
Energy conversion factor	MJ/kWh	3.6
Efficiency of electric hot water storage geyser (Breakspear see attachment I)	%	70
Number of bulbs for lighting @cost of R6 (incandescent) and R26 for (CFLs)	Number of bulbs	2
Rating of CFLs	Watts	11 & 16
Rating of incandescent bulb	Watts	60

Annex 4

MONITORING PLAN

See section D above and Annex 5 below.

For the Gold Standard, the monitoring will include the monitoring of key SD criteria such as employment numbers, local air pollution, and livelihoods of the poor – see below.

\- - - -

Additional Annexes specific to the Gold Standard

In all cases where estimates and assumptions are made in determining the baseline scenarios, where ranges of figures exist, the extreme of the range that provided the lowest emissions was selected as the baseline used in the model. The only exception was in the level of energy service which is set higher than the status quo because of the suppressed demand. In these cases increases of energy activity were projected to reach energy service satisfaction were used to estimate baseline emissions and project activity emissions but here too the lower end of the ranges were used in developing these scenarios.

Empirical data has shown that in these households, a relatively large proportion of power is used for lighting as on average they are in use for 6.8 hours per day (in such households, electricity is often not used for cooking or heating water due to perceived high electricity costs but is mainly used for lighting purposes and to a certain extent for water heating purposes if and when required (Social Research Study for Kuyasa 2003, attachment B). Conservativeness is applied in the selection of parameters, for example, the level of

[12] The project size will be lower than the thresholds. See A4.1.4 and table 2 in B1 above.

thermal comfort was established using indoor temperature monitoring during non-sleeping occupancy periods. The clearly identifiable average monitored temperature for the evening period (21^{o}C) was therefore used as the temperature at which thermal comfort exists for this sample[13], and was used as a parameter to inform the baseline model. Similar methods were used to determine the heating season (6 months) and the diurnal requirements fluctuations (shortest non-sleeping occupancy) etc. Therefore, the baseline is the emissions that would have been emitted as a result of heating the houses without insulated ceilings to 21^{o}C during non-sleeping occupancy.

This saving might, however, be counter balanced by "take-back", whereby consumers might tend to spend their savings on more energy services. Thus assumed energy consumption may not decline nearly as much as predictions based on the technical potential of an intervention. This is also being monitored (Kuyasa Monitoring Report 2003, see attachment E).

Table A4.1 - containing the key elements used to determine the baseline (variables, parameters, data sources.)

	Data Source	**Variable**	**Parameter**
Electric geysers	Empirical consumption data has been collected from 10 demonstration housing units.	Electricity (kWh)	Energy required by a 100 litre electric geyser to heat water from input temperature to temperature in the SWH tank.
Uninsulated ceilings	Empirical data used in the calibrated models has been collected from 10 demonstration housing units.	Electricity (kWh)	A calibrated theoretical thermal model has been employed to predict the amount of energy used by monitoring *ex-post* energy consumption levels together with indoor temperatures and then predict what would have been required to reach the same temperatures without insulated ceilings.
Incandescent light bulbs	Empirical data was obtained from the 10 demonstration housing units	Electricity (kWh)	Energy required by two light bulbs (11 W and 16 W) for 6.8 hrs per day.

Annex 5

SUSTAINABLE DEVELOPMENT ASSESSMENT

This project has a particularly high rating in terms of local social sustainable development:

[13] Due to suppressed demand there was no evidence of space heating activity during the morning heating period. Since a thermal comfort temperature is a general statement of an ambient temperature that a person experiences as being comfortable, this same identified temperature of 21^{O}C reflects the indoor temperature during the morning heating period.

- The installation of these interventions will provide employment for and increase the capacity of local artisans, who will therefore also be able to assist with the maintenance of the technology interventions.
- Regional and local job creation will furthermore be increased, due to the use of locally manufactured solar water heaters.
- Savings in the cost of energy, estimated at R625.83/household/annum, will provide benefits to the beneficiaries.
- The improved thermal performance and the installation of ceilings will furthermore provide health benefits to the beneficiaries, specifically in terms of respiratory illnesses.
- The co-benefits of improved respiratory health profiles for the local residents will further offsets local, national government and state enterprise spending.

This project activity complies with the Gold Label Standard evaluation for sustainable development, as it attains positive scores in all of the pillars of evaluation. It has a particularly high rating in terms of social sustainability and local development and also has a positive reduction of GHG on the natural environment. (See section A2A Sustainable development Screen).

This project activity has been assessed by means of the Gold Standard sustainable development assessment screen, i.e.:

Table A5.1: [14]Gold Standard Sustainable Development Assessment

[14] The Gold Standard label matrix is derived from work pioneered by Helio International and The SouthSouthNorth Network. The rating include the use of numbers (-2 to 2) which indicate the following: -2 = no contribution to sustainable development, 0 = neutral and +2 - high contribution to sustainable development.

The Gold Standard Assessment indicates a positive contribution by the project activity

Indicator	Score	Comment
LOCAL/REGIONAL/GLOBAL ENVIRONMENT		
Water quality and quantity	0	Not applicable
Air quality (emissions other than GHGs)	1	The introduction of the technologies will replace coal-generated electricity, now and into the future, as well as the use of paraffin and other biomass inside the house. Emissions of suspended particulates, SO_x and NO_x are therefore reduced.
Other pollutants: (including, where relevant, toxicity, radioactivity, POPs, stratospheric ozone layer depleting gases)	0	Not applicable
Soil condition (quality and quantity)	0	Not applicable
Biodiversity (species and habitat conservation)	0	Not applicable
Sub total	**1**	
SOCIAL SUSTAINABILITY AND DEVELOPMENT		
Employment (including job quality, fulfilment of labour standards)	2	The installation of these technologies will provide employment to, and increase capacity amongst, local artisans, who will therefore also be able to assist with the installation and maintenance of these technologies. Regional and local job creation will also be increased, due to the use of locally manufactured solar water heaters.
Livelihood of the poor (including poverty alleviation, distributional equity, and access to essential services)	2	This project will contribute towards energy poverty alleviation allowing the poor to have access to affordable basic energy services.
Access to energy services	2	Access to renewable energy and the improved thermal performance of the houses, will reduce the electricity peak demand especially during the coldest months of the year. By these interventions, "leap frogging" will assist households to access "clean" renewable technologies instead of acquiring "dirty" appliances (a norm in South Africa as they are easily available and cheaper). The reduction in peak demand implies a deferral of spending on the electricity supply side, liberating funds for the further distribution of electricity. The broadening of the energy services and the savings on electricity infrastructure will contribute towards the reduction of energy and energy service poverty in low-income households.
Human and institutional capacity (including empowerment, education, involvement, gender)	2	Local plumbers, electricians and builders will be capacitated as they will have to learn to install these renewable and efficient technologies. Heads of households themselves (mostly women) through training will be empowered around issues of energy efficiency and the use of renewable technologies. The City of Cape Town which is the Project Participant is continuously being capacitated around the CDM, energy efficiency and renewables, thus its institutional capacity is being strengthened. The trend in this direction is already apparent in the setting of Renewable energy targets, and specifically a target of 10% of households with solar water heaters by 2010.
Sub total	**8**	
ECONOMIC AND TECHNOLOGICAL DEVELOPMENT		
Employment (numbers)	2	With the installation of all three technologies in each 1000 households, studies have shown will produce 110 person years' of employment will be available. A further number will be generated in the manufacture of the solar water heaters. The employment opportunities in the manufacture of the materials and the longer term maintenance of the solar water heaters have not been included.
Balance of payments (sustainability)	1	All the technologies are locally manufactured. The additional transport to site and the potential importation of the CFL bulbs could be considered as the only possible negative impacts on the balance of payments.
Technological self reliance (including project replicability, hard currency liability, skills development, institutional capacity, technology transfer)	2	Technological self-reliance is enhanced with the use of renewable energy and demand side technologies that are locally manufactured thus affecting balance of payments positively. The use of imported compact fluorescent light bulbs, however, negatively contributes towards technological self reliance. The replicability of the project will allow for further maturation of local technologies.
Sub total	**5**	

towards local and national sustainable development. The outcome of this assessment is illustrated in the table below. Those indicators scoring zero or one will be monitored to ensure the SD contribution of the project. In this case the balance of payments impact of the project and air quality will be monitored.

Annex 6
PROJECT ELIGIBILITY
All the project activities are eligible under the Gold Standard:

- Renewable energy: Solar thermal heat; and
- End-use energy efficiency improvement: Domestic energy efficiency

Annex 7

ODA SCREEN
See section A.4.5 A. ODA Additionality Screen
Project financing for this project activity will not use Official Development Assistance (ODA) Funds for the following activities:

- Monitoring , verification and certification of emission reductions
- Purchase of (new) technology
- Installation costs
- Running costs
- General project investments cost excluding CDM components
- Purchase of Certificate Emission Reductions (CERs)

There is support from the Dutch Government through the **South***South*North project to facilitate the development of the project activity by covering cost associated with the design and transaction of the project activity. The transaction process is a "hands on, learning by doing" capacity building initiative. Dutch Government resources from the **South***South*North project have also been set aside for the validation of the project. However, these are a loan to a public sector project which will be repaid after transaction and are included in the project cash flow analysis.

The CDM component (the retrofit) of this project activity may require national public sector funding (in a form of loans or debt financing from development banks) to finance some parts of project implementation.

Annex 8
ADDITIONALITY CRITERIA
B.2.A. A local or regional expert must affirm (formally in writing) that a suitable approach and an appropriate methodology have been used in combination with conservative parameters. Local or regional experts will confirm (formally in writing) that a suitable approach and an appropriate methodology have been used in combination with conservative parameters**.** Validators should consult with a local or regional expert. A local or regional expert is defined as somebody who has demonstrable experience in the sector and country/region of the proposed project activity. (Attachment J: Local expert review)

B.3.A Baselines-choice of parameters

In all cases where estimates and assumptions are made in determining the baseline scenarios, where ranges of figures exist, the extreme of the range that provided the lowest emissions was selected as the baseline used in the model. The only exception was in the level of energy service which is set higher than the status quo because of the suppressed demand. In these cases increases of energy activity were projected to reach energy service satisfaction were used to estimate baseline emissions and project activity emissions but here too the lower end of the ranges were used in developing these scenarios.

Empirical data has shown that in these households, a relatively large proportion of power is used for lighting as on average they are in use for 6.8 hours per day (in such households, electricity is often not used for cooking or heating water due to perceived high electricity costs but is mainly used for lighting purposes and to a certain extent for water heating purposes if and when required (Social Research Study for Kuyasa 2003, attachment B). Conservativeness is applied in the selection of parameters, for example, the level of thermal comfort was established using indoor temperature monitoring during non-sleeping occupancy periods. The clearly identifiable average monitored temperature for the evening period (21^{o}C) was therefore used as the temperature at which thermal comfort exists for this sample[15], and was used as a parameter to inform the baseline model. Similar methods were used to determine the heating season (6 months) and the diurnal requirements fluctuations (shortest non-sleeping occupancy) etc. Therefore, the baseline is the emissions that would have been emitted as a result of heating the houses without insulated ceilings to 21^{o}C during non-sleeping occupancy.

This saving might, however, be counter balanced by "take-back", whereby consumers might tend to spend their savings on more energy services. Thus assumed energy consumption may not decline nearly as much as predictions based on the technical potential of an intervention. This is also being monitored (Kuyasa Monitoring Report 2003, see attachment E).

Table A7.1 - containing the key elements used to determine the baseline (variables, parameters, data sources.)

	Data Source	**Variable**	**Parameter**
Electric geysers	Empirical consumption data has been collected from 10 demonstration housing units.	Electricity (kWh)	Energy required by a 100 litre electric geyser to heat water from input temperature to temperature in the SWH tank.
Uninsulated ceilings	Empirical data used in the calibrated models has been collected from 10 demonstration housing units.	Electricity (kWh)	A calibrated theoretical thermal model has been employed to predict the amount of energy used by monitoring *ex-post* energy consumption levels together with indoor temperatures and then predict what would have been required to reach the same temperatures without insulated ceilings.
Incandescent light bulbs	Empirical data was obtained from the	Electricity (kWh)	Energy required by two light bulbs (11 W and 16 W) for 6.8

[15] Due to suppressed demand there was no evidence of space heating activity during the morning heating period. Since a thermal comfort temperature is a general statement of an ambient temperature that a person experiences as being comfortable, this same identified temperature of 21^{O}C reflects the indoor temperature during the morning heating period.

	10 demonstration housing units		hrs per day.

A.4.4.A Previously announced project activities

There has been no public announcement of the project going ahead without the CDM, prior to any payment being made for the implementation of the project. The baseline study sample has been profiled in the local press, but profiled only as a pilot leading to a larger scale project once CDM finance has been raised.

A.4.4.B Barrier analysis (Additionality Screen)

1. Barriers due to prevailing practice

- **Insulated Ceilings**

  Ceilings and ceiling insulation have not been part of low-cost housing delivery until 2003 when the National Department of Housing extended the low cost housing subsidy to include ceilings in low cost housing. However, since the low cost houses in Kuyasa were built before 2003, no houses sampled in Kuyasa have installed ceilings prior to the design of this project. Empirical data also shows that in low cost households (in South Africa), extension of the size of the housing unit is usually the first step taken by households in improving their housing units whilst the installation of ceiling and ceiling insulation is usually secondary (Thurman, 1999).

- **Installation of Solar Water Heaters**

  In low to middle-income (and for that matter, middle to high income) communities in South Africa, the penetration of solar water heaters and installation of energy efficient lighting is low. In low-cost households, water heating is achieved through batch heating of water in pots/kettles using mostly electrical appliances and different fuel sources whilst most middle to high income households use electric water storage geysers for water heating.

- **Installation of Compact Fluorescent Light Bulbs.**

  CFLs are currently not installed in any of the sampled houses in Kuyasa; however, initiatives are underway through the National Electricity Utility (Eskom) to install CFLs in the future which will be reflected in the baseline.

<u>Investment Barriers</u>

The financial savings for the households as a result of using clean energy technologies will not result in repayment of the capital expenditure at the discount rates experienced by the households in Kuyasa.

<u>Other barriers</u>

Information: There is limited information readily available to low cost housing communities on the use and benefits of solar water heating technologies, thermal efficiency, and energy efficient lighting technologies.

<u>Annex 9</u>

ENVIRONMENTAL IMPACT ASSESSMENT

See section F and attachment F

Annex 10

STAKEHOLDER CONSULTATION

See section G and attachment G

Supporting Documentation related to the development of the baseline

Attachment A: Suppressed Demand in low cost housing in Kuyasa, 2003
Attachment B: Social Research Study for Kuyasa, 2003
Attachment C: Solar Water Heating Model, 2004
Attachment D: Thermal Modelling Final Report, 2003
Attachment E: Monitoring Report for Kuyasa, 2003

Other supporting documentation

Attachment F: Letter from DEAT, indicating that an EIA is not required
Attachment G: Summary of stakeholder consultations
Attachment H: The SSN Technology Maintenance Training Manual
Attachment I: Residential water heating systems – theoretical and real usage efficiencies.
Attachment J: Local expert review