

# Indicative Program, Baseline and Monitoring Methodology

for

## Large Scale Supply and Distribution

of

## Efficient Light Bulbs, Showerheads and Other Water Saving Products to Households

### Voluntary Gold Standard

Version	Date	Nature of Revision(s)
02	22/03/2010	To extend applicability to include supply and installation of Water Saving Products in households with fossil fuel-fired water heaters. Inquiries with regard to revision of this methodology are welcome. Please contact: <a href="mailto:georgetmaher@itr-inc.org">georgetmaher@itr-inc.org</a> and/or <a href="mailto:f.villasana@southpolecarbon.com">f.villasana@southpolecarbon.com</a>
01	06/08/2009	Initial Adoption. Methodology was developed by Green Alliance Pty Ltd, Sydney, NSW, Australia. Inquiries with regard to application of this methodology are welcome. Please contact <a href="mailto:john.major@ani.net.au">john.major@ani.net.au</a>

## Table of Contents

<b>Section I: SOURCE AND APPLICABILITY</b>	<b>5</b>
1. Source	5
2. Definitions	5
3. Applicability	8
<b>Section II: BASELINE METHODOLOGY</b>	<b>13</b>
1. Project Boundary	13
2. Procedure for the selection of the most plausible baseline scenario	14
3. Additionality	15
4. Emission reductions	17
Step 1: Determination of the project and sub-project boundary(s)	17
Step 2: Defining the sub-projects and their individual boundaries	18
Step 3: Description of the proposed project activities	18
Step 4: Identification of the relevant emission sources	19
Step 5: Proposed products included in the program	19
Step 6: Identification of activity levels, emission and other factors	20
Baseline Activity Emissions	20
Project Activity Emissions	20
Emission Factors	20
Installation Discount Factors	20
Other Project Factors	21
Step 7: Establishment of a project database	23
Step 8: Random sampling of installations	24
Methodology	24
Sampling Process	25
Minimising Sources of Error	28
Step 9: Calculation of the overall project Baseline Emissions	29
Step 9A: Extended Monitoring Procedure Option	29
Existing Lights	30
Existing Showers	31
Step 9B: Simplified Monitoring Procedure Option	33
Existing Lights	34
Existing Showers	35
Step 10: Calculation of the overall Project Emissions	38

Step 10A: Extended Monitoring Procedure Option	38
Replacement Energy Efficient Lights	38
Replacement Showers	39
Step 10B: Simplified Monitoring Procedure Option	42
Replacement Energy Efficient Lights	42
Replacement Showers	43
Calculations of Penetration Factor (PF)	46
Calculation of Installation Discount Factor (IDF)	46
Step 11: Calculation of the emissions abatement	47
Step 11A: Extended Monitoring Procedure Option	47
Step 11B: Simplified Monitoring Procedure Option	47
5. Leakage	48
6. Data and parameters not monitored	49
<b>Section III: MONITORING METHODOLOGY</b>	<b>56</b>
1. Monitoring Options	56
Simplified Monitoring Procedure Option	57
Extended Monitoring Procedure Option	58
2. Monitoring procedures	59
3. Data Collection Procedures	61
4. Quality Assurance procedures	62
5. Data storage procedures	63
6. Equipment calibration procedures	63
7. Data and parameters monitored	63
<b>Section IV: ANNEXURES</b>	<b>73</b>
1. Public Consultation Process	73
2. Environmental Impact of CH <sub>4</sub> and N <sub>2</sub> O Gases	73
3. Size of Existing Incandescent Light bulbs	74
4. Abatement Period for the Replacement Energy Efficient Light bulbs	76
5. Existing Inefficient Showerheads and Measurement of Water Flow	77
6. Abatement Period for the Replacement Low-Flow Showerheads	77
7. Number of Showers per day per Household	8
8. Number of Shower Days per Household	79
9. Time of each Shower Period	79
10. Temperature of Shower Outlet Water	81
11. Temperature of Fixture Incoming Cold Water	81

12. Low-Flow Showerheads and Flow Regulators	81
13. Total number of CFL's to be installed and the Number per Household	83
14. Total number of LFS's to be installed and the Number per Household	83
15. Energy Rating of Installed CFL's	84
16. Acceptability of Nominated Address	84
17. Monitoring of Legislative Changes	84
18. Ensuring Supplied Product has been and Remains Installed	85
19. Market Penetration of Energy Efficient Products	85
20. Efficiency of Electric Hot Water Heaters	88
21. Lifetime of Appliances	89
22. Randomisation of Selected Samples	91
23. Formula Used by Sample Calculator	91
24. Collection and Disposal of CFL Products	92
25. Direct Measurement of Exhaust Gases from Water Heaters	92

## Section I: SOURCE AND APPLICABILITY

### 1. Source

This methodology is applicable to the program activities involving the Supply only of CFLs, or Supply & Installation of either CFLs, Low-Flow Showerheads (LFS), Flow Regulators (FR) or other Water Saving Products (WSP) or a combination of these to households located within the individual project boundaries to abate greenhouse gas emissions.

The project activity is implemented by the Project coordinator who acts as a project participant. The individual households assign the reduction in the greenhouse gas in their individual households generated due to their acceptance of the supply and/or installation of the provided products over to the Project coordinator.

### 2. Definitions

For the purpose of this methodology, the following definitions apply:

**Abatement Period:** being the period during which the abatement is able to be calculated for each installed product type as defined by technical specifications, local and/or regulatory requirements and/or GS requirements. This is different from the crediting period and in use when the Project coordinator nominates in the Project specific VER-PDD that the CFLs, LFSs and/or other WSPs installed are certified under an international quality standard or an official standard of the host country which will allow for a “Simplified Monitoring Procedure”. The abatement period in such a case is defined by the rated lifetime of the CFLs, but the end of the abatement period cannot exceed the end of the standard crediting period as defined in the Gold Standard Requirements. Only one abatement period is claimable in a given targeted group of households.

**Compact fluorescent Lamp (CFL):** a lighting device that may be used to provide light within a defined property nominated by the Project coordinator in programs developed and implemented under this methodology.

**Crediting Period:** being the monitoring period during which the abatement is able to be calculated for each installed product type and where the Project coordinator nominates in the project specific VER-PDD that the CFLs, LFSs, FRs and/or other WSPs installed may not be certified under an international quality standard. The crediting period is a standard crediting period, as defined in the Gold Standard Requirements. Monitoring of the abatement generated is to be undertaken at a minimum frequency as nominated by the Gold Standard. The Project coordinator may nominate a higher frequency in the project specific VER-PDD to achieve “good practice”.

**Flow Regulator (FR):** a device that is able to be inserted within a Showerhead, bathroom or kitchen

faucets and used to restrict the flow of water down to an acceptable level. In showerhead applications the FR should conform to official standards as per host country or other international guidelines acceptable in the host country. For bathroom and kitchen faucets the FR should produce a flow rate of at least 1 lt/min below the normal flow of the Water Fixture it replaces.

**Installation Discount Factor:** a factor that is applied to the overall calculation that takes into account the possibility that the provided products may not have been installed or that the provided products may have been removed and replaced by non approved products or the provided products may no longer be operating.

**Life Reduction factor:** a factor that takes into account situations when electricity supply quality issues encountered impact the lifetime of the products installed such that the actual lifetime of these products is significantly lower than the 'Rated Life'.

**Light bulb:** a replaceable component that is designed to produce light from electricity and that can be connected to a lamp socket. The different groups of light bulbs are: incandescent lamps (which include halogen lamps), gas discharge lamps, fluorescent lamps, CFLs, and LED lamps (solid state lighting).

**Light appliance:** electric appliances that produce light and are connected to the electricity supply of the household, including the light bulb, the lamp socket, and, if applicable, any transformers or electronic control gear to transform the grid voltage (240 V) to an applicable voltage levels (e.g. 12 or 24 V) and any dimmers to regulate the level of light. Appliances that have other purposes but also produce light (e.g. television) are not included.

**Low-Flow Showerhead (LFS):** a device fixed to a water pipe that is used to create a spray pattern of water for the purposes of personal washing and designed to accommodate the functional requirements of a showerhead while using a flow of water that either conforms to official standards as per host country or other international guidelines acceptable in the host country and is at least 1 lt/min below the normal flow of currently installed showerhead.

**Monitoring period x:** the time in days between two spot checks that occur on defined dates when the Project coordinator elects to use the "Extended Monitoring Procedure" option. The Project coordinator is to nominate the frequency of such monitoring with the maximum period to not exceed the GS minimum requirements.

**Project coordinator:** entity, which is a project participant, organizing the sale, at a reduced price, or the free distribution and/or installation of efficient light bulbs, Showerheads and Water Saving Products to the households participating in the project activity.

**Program area:** the total geographical area in which light bulbs, Showerheads, FRs and/or other Water Saving Products are distributed and/or installed under the individual project activities

**Project area(i):** distinct geographical area in which light bulbs, LFSs, FRs, Water Saving Products and/or associated equipment (transformers etc) are distributed and/or installed under the project activity. Each project activity area is to be defined by boundaries that contain distinct project characteristics including those associated with emission from electricity generation (for CFL and LFS products) and/or groundwater temperatures (for LFS and WSP only). The Project coordinator is to undertake separate project emission calculations for each defined project area. The VER program may encompass one or more project activity areas. All project activity areas together correspond to the total project activity area.

**Rated Life:** Rated Life is the Life of the CFL bulb that is proposed for installation in the project based on test data obtained in accordance with the requirements of IEC/ISO60969 Clause 10 which specifies how the wattage of CFL should be measured. The requirements include specifications for ageing, test voltage, ambient test temperature and test circuit. To the extent possible, this guidance should be applied. The “Rated Life” is the time(Hrs) the light is able to produced the defined lumens of light under the defined test conditions. It includes switching and non-operating periods during the test period. The “Rated Life” is therefore either the life of the bulb in a defined time frame (generally operating hours or years) based on the number of hours per day the light is used as defined by the Project coordinator within the project specific VER-PDD based on either project measurement data, data available from authenticated independent external studies or the abatement period of the project as defined by the GS approval, whichever is the shorter.

**Sub-Project area (si):** distinct geographical area in which light bulbs, LFSs, FRs and/or Water Saving Products are either distributed under the project activity or supplied and installed under the project activity. Note that WSPs cannot be included in the Supply Only projects. Each project activity area must have common project characteristics. The VER project activity may encompass one or more project activity areas. All project activity areas together correspond to the total project area.

**Showerhead:** a device fixed to a water pipe that is used to create a spray pattern of water for the purposes of personal washing.

**Water Fixture:** A device that forms part of a water distribution system and is configured to enable a particular use such as proving a flow or spray of water for the purpose of personal and/or household cleaning or washing.

**Water Saving Product (WSP):** A device designed to replace, or be affixed unto, an existing Water Fixture or water pipe that maintains the same functional performance for the purposes of cleaning or washing while reducing the amount of water consumed. Eligible devices under this category consist exclusively of low-flow showerheads and flow regulators installed on water fixtures that typically dispense hot water to household residents on a regular basis. These fixtures are limited to bathroom and kitchen sinks.

**Water heater:** A device for heating water for domestic use, usually supplied at a temperature in the range between 120°F and 140°F (approx. 50°C and 60°C). Water can be heated via the use of electricity or fossil fuels such as natural gas, liquefied petroleum gas (LPG), oil etc. Furthermore, a water heater may operate in continuous-flow (tankless) or comprise a vessel where water can be stored (tank type).

### **3. Applicability**

This methodology is applicable to locations where all or part of the electricity or thermal energy generated is associated with GHG emissions. The methodology is therefore applicable to project activities that reduce the production of greenhouse gases by enhancing energy-efficient lighting in households and/or by reducing the use of water in households where the heating of the water is provided via the use of electricity or fossil fuels. The project activity is implemented by a Project coordinator who is the project participant.

The project activity may include the following scenarios or combinations of these scenarios:

Under the Supply Only projects, the Project coordinator, at no cost (or at a nominal cost at the discretion of the Project coordinator) to the household:

- (a) supplies CFLs to households within a distinct geographical area, thereby replacing less energy efficient light bulbs;

Under the alternative Supply and Installation projects, the Project coordinator, at no cost (or at a nominal cost at the discretion of the Project coordinator) to the household:

- (b) supplies and installs CFLs and/or associated equipment to households within a distinct geographical area, thereby replacing less energy efficient light bulbs and/or associated equipment; and/or
- (c) supplies and installs a LFS to households within a distinct geographical area, thereby reducing the energy used to heat the water through reduction in the volume of water used; and
- (d) supplies and installs sufficient FRs to households within a distinct geographical area such that, in-conjunction or in place of with the supplied LFS, the water flow from all Showerheads in the household is reduced, thereby reducing the energy used to heat the water through reduction in the total volume of water used.



- (e) supplies and installs a set of WSPs, which may include LFS and FRs, to households within a distinct geographical area where water is heated via the use of fossil fuels, thereby reducing the energy requirements through reduction in the total volume of water used.

Project participants should document in the Project Design Document which scenarios apply and clearly describe the situation before and after the start of implementation of the project activity.

The following applicability conditions are for Scenarios (a) and (b)

- A light bulb and/or associated equipment that is supplied to and/or installed in a household by the Project coordinator should:
  - Be more efficient (i.e. use less electricity per lumen output) than the light bulb it replaces, and
  - Be functionally equivalent, i.e. provide the same level of comfort as the light bulb it replaces.
- The replaced light bulbs will have a rated power consumption of 100 W or less.
- The households are connected to a national or regional electricity grid.
- In the Supply Only projects the households are provided with sufficient CFLs such that the total number supplied is equivalent to the total number of previously used and functioning inefficient light bulbs returned to the Project coordinator.
- In the Supply & Installation projects the households are provided with sufficient CFLs and/or associated equipment such that all lamps, wall and ceiling lights that have inefficient incandescent and/or halogen bulbs and/or associated equipment are changed to CFLs.
- At the commencement of a project in each defined geographical region, the Project coordinator ensures that all of the replaced light bulbs are collected at the point of product distribution. These bulbs are to be analysed to obtain their wattage, with the calculated average used in the overall project calculations for the amount of saving in greenhouse gas for both the “Supply Only” and the “Supply and Installation” projects.
- The returned light bulbs are to be stored in sealed containers and kept by the Project coordinator for future audit purposes. Project coordinator ensures that the all returned inefficient incandescent or halogen light bulbs are not reused or resold.
- During both the “Supply Only” and the “Supply and Installation” projects the Project

coordinator is to collect all of the replaced light bulbs. These collected light bulbs are to be taken to the Project coordinator's central warehouse and stored for later destruction with recycling of the resultant waste material.

The following applicability conditions are for Scenarios (c) and (d):

- LFS and FR products are only installed in households that have their hot water heated via the use of electricity.
- The households are connected to a national or regional electricity grid.
- Households in the project activity are provided with sufficient equipment such that all inefficient Showerheads in the household (those that provide a flow higher than recognized standards for WSPs) are replaced with LFS or fitted with FRs as appropriate to reduce the volume of water used thus the amount of hot water that needs to be heated.

The following applicability conditions are for Scenario (e):

- A set of WSPs that is supplied to and installed in a household by the Project coordinator should be more efficient than the Water Fixtures it will replace. The combination of installed WSPs will reduce the volume of water used and, consequently, the amount of hot water that needs to be heated.
- The water is heated via the use of fossil fuels, either in continuous-flow (tankless) water heaters or in traditional "tank-type" storage water heaters.
- The Project coordinator will make sure that households in the project activity are provided with sufficient equipment such that all inefficient Showerheads in the households (those that provide a flow higher than recognized standards for WSPs) are replaced with LFS. Other fixtures that provide hot water on a daily basis to household residents are eligible to be retrofitted with WSPs, such as FRs.
- The Project coordinator should make an inventory of all the Water Fixtures at each household in the project activity. The inventory should specify which fixtures provide hot water to the household residents.
- The Project coordinator is to collect all of the replaced inefficient Water Fixtures. These collected fixtures are to be taken to the Project coordinator's central warehouse, or a secured storage facility, for later destruction with recycling of the resultant waste material.

The following applicability conditions are for all scenarios:

- To ensure that the CFLs, LFS, FRs, and other WSPs have been installed to replace the existing inefficient products, the Project coordinator, for both the “Extended” and the “Simplified” monitoring procedure, is to have an assurance program that will provide a 95% level of confidence that the individual households, as project beneficiaries, have installed the supplied products and they have not been subsequently removed and replaced with inefficient products. For the “Extended Monitoring Option” such assurance monitoring is to occur at the times as per GS requirements. For the “Simplified Monitoring Option” such assurance monitoring is to occur immediately after product supply and/or installation.
- For the “Extended Monitoring Option”, the Project coordinator may provide an incentive to the beneficiaries included in the baseline sample group (BSG) and the project sample group (PSG) for each project area to reduce the possibility of the beneficiaries leaving the sample groups during the total crediting period of the proposed project. The Project coordinator is to ensure that such proposed incentive does not create a significant monetary household income that could have an impact on the household’s product usage behaviour. The Project coordinator is to undertake sufficient on-site sampling/auditing of completed installations at individual households to confirm the “Installation Discount Factor” (IDF) for each individual project.
- The Project co-ordinator is to contract an external, independent survey / sampling organisation to undertake sufficient sampling of the individual households to confirm the “Installation Discount Factor” (IDF) for each individual project as obtained/calculated by the Project coordinator and confirm that the results obtained have achieved a 95% confidence level.
- The electricity consumption of each CFL replacement light appliance and/or associated equipment is based on the test data obtained from the relevant CFL manufacturer together with its “Rated Life” (see Annexure 4) in accordance with the relevant standard.
- For the “Extended Monitoring Procedure” option, the Project coordinator is to either install metering equipment to record the utilisation hours or the electricity consumption of each light appliance and/or water used by Showerhead or relevant Water Fixtures in the BSG / PSG or alternatively the Project coordinator is to provide data based on independent studies that shows the current utilisation of the products in the proposed geographical location or in a geographical location with similar socio-economic characteristics.
- The Project coordinator may obtain data on the varying efficiencies of the electric heaters used to heat the hot water for the Showerheads and use this data within the calculations for the Showerhead baseline and project emissions. This option is not available to the Project coordinator where the Project coordinator elects to use the “Simplified Monitoring Procedure” option.
- The Project coordinator is to monitor the installations during the abatement period as outlined in this methodology and calculate the achieved abatement based on the results of

the monitoring. However, where the Project coordinator procures the necessary CFLs by specifying their conformance to an international (or equivalent national) standard for product quality and the specified standard includes for lifetime, on/off cycles, start time and color rendering, the Project coordinator may elect to use a “Simplified Monitoring Procedure” this being a “deemed saving approach”. This simplified monitoring process excludes monitoring of the use of the product during the abatement period. Monitoring relevant to the determination of the emission reductions only occurs during the installation period, with the exception of the product autonomous penetration factors during the abatement period to ensure that allocated credits have not been over-calculated. The allocated credits are to be those that are calculated for the expected lifetime of the CFL product.

- At the completion of the overall program, and during the program at the end of each crediting period when the “Extended Monitoring Procedure” option is chosen, the Project coordinator is to demonstrate that all CFL bulbs that have been returned by the participating households because they cease to meet their necessary functionality requirements (ceased to operate or provide insufficient light) have been collected.
- For the “Extended Monitoring Procedure” option the Project coordinator is to replace the CFL bulbs at the end of their lifetime in order to be able to claim the associated abatement credits for the remaining time in the crediting period. All collected CFL bulbs are to be safely stored and appropriately disposed. The project coordinator may offer an appropriate incentive to participating households for the return of all such CFL bulbs. Refer to Section IV: Annexure – Clause 24: Collection and Disposal of CFL Products.
- For project activities making use of the ‘Simplified Monitoring Procedure’, only one abatement period is eligible for the crediting of emission reductions within one group of targeted households.

## Section II: BASELINE METHODOLOGY

The following section describes the calculations and procedures applicable for scenarios (a), (b), (c) and (d).

For calculations and procedures related to scenario (e) please refer to Appendix I - Supply and Installation of WSPs.

### 1. Project Boundary

The spatial extent of the overall program boundary encompasses the physical, geographical location of each Project area *i* and the spatial extent of the electricity system(s) that the households are connected to. The project boundary includes each lighting appliance and Showerhead together with their associated equipment replaced under the project activity and all of the power plants physically connected to the electricity system that the households are connected to within the project boundary. The distinct geographical boundary of each project area *i* should be clearly documented by the Project coordinator in the project specific VER-PDD using maps.

The geographic and system boundaries for the relevant electricity grid can be clearly identified and the relevant, up to date emission characteristics of the applicable grid are published by the relevant local authorities. Where the relevant emission characteristics are not published by the relevant local authorities, or when they are more than five (5) years old, or when there are indications that the available data is not accurate, the necessary information to calculate the grid emission factors according to the latest approved version of “Tool to calculate emission factor for an electricity system”<sup>1</sup> is to be available. The Validator will be required to provide a statement on whether the available grid emission factor data are appropriate or whether the “Tool to calculate emission factor for an electricity system” should be used.<sup>2</sup>

Table 1 below illustrates which emission sources are included in the project boundary.

**Table 1: Summary of gases and sources included in the project boundary and justification/explanation where gases and sources are not included**

	Source	Gas	Included?	Justification / Explanation
Baseline	Power plants servicing the	CO <sub>2</sub>	Yes	Allow for the full cycle emissions

<sup>1</sup> [http://cdm.unfccc.int/methodologies/Tools/EB35\\_repan12\\_Tool\\_grid\\_emission.pdf](http://cdm.unfccc.int/methodologies/Tools/EB35_repan12_Tool_grid_emission.pdf)

<sup>2</sup> In the latter case, only CO<sub>2</sub> emissions can be taken into account in the calculation of the grid emission factor. CH<sub>4</sub> and N<sub>2</sub>O are not to be included.

<b>Baseline</b>	grid	CO <sub>2</sub>	Yes	and transmission line losses
		CH <sub>4</sub>	Yes/No	Allow for the full cycle emissions including combustion, fuel extraction and transmission line losses. Only if recent data published by local authorities.
		N <sub>2</sub> O	Yes/No	Allow for the full cycle emissions including combustion, fuel extraction and transmission line losses. Only if recent data published by local authorities.
<b>Project Activity</b>	Power plants servicing the grid	CO <sub>2</sub>	Yes	Allow for the full cycle emissions including combustion, fuel extraction and transmission line losses
		CH <sub>4</sub>	Yes/No	Allow for the full cycle emissions including combustion, fuel extraction and transmission line losses. Only if recent data published by local authorities.
		N <sub>2</sub> O	Yes/No	Allow for the full cycle emissions including combustion, fuel extraction and transmission line losses. Only if recent data published by local authorities.

## **2. Procedure for the selection of the most plausible baseline scenario**

The baseline scenario is that lighting in the households in the total project area which would, in the absence of the project activity, have occurred:

- (a) By utilisation of the currently used light bulbs (these light bulbs will include inefficient light bulbs but may also include some efficient light bulbs) and/or currently used Showerheads; and
- (b) By utilisation of new light bulbs and/or Showerheads partially of the same efficiency as those currently existing (autonomous replacement) and partially of an improved efficiency

(autonomous improvement).

The Project coordinator is to recognise that there may be an underlying trend within their proposed project geographical location towards greater use of efficient lighting and Showerhead products. The baseline scenario is to therefore include for the autonomous penetration of such efficient products during the defined crediting period based on averaged historical penetration rates which are to be obtained from credible, published historical data or a survey at the time of installation and assuming no advanced products five years before, and taking into account the effects of a potential ban of incandescent light bulbs. Alternatively, the Project coordinator is to review the baseline scenario light bulb wattage for each monitoring period (Refer to definition of parameter  $W_{b,i,x}$  in Calculation 2 and parameter  $W_{b,i}$  in Calculation 8). Under the baseline scenario the assumption has therefore been made that if the inefficient light and Showerhead products fail, part of the households will replace such failed products with similar inefficient products due to the low price and availability of such inefficient products and part of the households will switch to advanced efficient products. The baseline scenario is therefore based on the use of the existing inefficient lights and Showerheads for the full “Rated Life” (see definition) of the proposed efficient replacement products for the fraction of the households not switching to advanced products autonomously.

For advanced lighting project activities, it requires the size (wattage) of the existing inefficient light bulbs that are replaced with efficient light bulbs to be defined. This is determined through the collection of the replaced bulbs from an initial number of properties such that a statistically acceptable number of bulbs are collected in the Supply and Installation sub-projects in each project area to achieve a 95% confidence level in the results of the wattage calculations. The wattage of all collected replaced bulbs are to be added to provide a grand total wattage, and then divided by the total number of such collected bulbs to provide the overall average wattage figure that will be used in the baseline calculations. The results of the average wattage are used for both the Supply Only and the Supply and Installation sub-projects baseline emissions calculations.

### **3. Additionality**

**Demonstration:** Additionality shall be demonstrated using the latest version of an approved, applicable tool (see Gold Standard Toolkit for details).

**Double Counting:** The Project coordinator is to demonstrate how possible double counting with other similar demand-side energy reduction domestic programs that may be operating within the same geographical region as their proposed program is to be prevented.

#### **4. Emission Reductions**

The baseline emissions involve the emissions resulting from the use of fossil fuel associated with the generation of electricity for lighting and heating of water in residential facilities. The project activity enhances the efficiency of lighting and/or hot water heating in households and thereby reduces electricity consumption of the participating households. Emission reductions are calculated based on the applicable grid emission factor as defined above and the quantity of electricity saved by the households as a result of the project activity.

The electricity savings by the households for the light bulb replacement projects are calculated based on the number of light bulbs replaced together with the wattage of the replaced inefficient bulbs together with their associated equipment compared with that of the replacement efficient bulbs with their associated equipment, with the utilisation of the light bulbs supported by either monitoring of the utilisation hours in a statistically representative sample of households over a predetermined period of time or the use of a conservative assumption of up to a defined number of hours per day per replaced light bulb (possibly an average of 3 to 5 per day over a twelve month period) supported by several available and convincing references. The utilisation hours assumption is to be defined and justified by the Project coordinator in the project specific VER-PDD.

The electricity savings by the households for the Low Flow Showerhead replacement projects are calculated based on the number of persons per household<sup>3</sup> and thus the number of showers per household per year, the flow-rating of the existing Showerheads and with the utilisation time supported by either monitoring of the utilisation hours of showers in a statistically representative sample of households over a predetermined period of time or the use of a conservative assumption supported by several available and convincing references. The utilisation time assumption is to be defined and justified by the Project coordinator in the project specific GS-VER PDD.

The total electricity consumption for lighting and water heating is also adjusted using a calculated Installation Discount Factor (IDF) based on a random product installation field audit program, a random telephone sampling program with both supported by random external, independent sampling, the size of the samples being selected in a statistically representative manner and defined to provide a 95% confidence level. These, together, are used to calculate the overall emission reductions.

The project implementation and determination of emission reductions involves the following steps:

---

<sup>3</sup> Based on statistical data obtained from the relevant government department of the project country



### **Step 1: Determination of the project and sub-project boundary(s) *i***

The total program should be divided into a number of single Project areas (*i*). Each Project area should be a geographical region / state with the boundaries defined by the relevant electricity grid characteristics. Projects can be divided into a number of individual sub-projects based upon the product type and/or its delivery method. Sub-project areas should, where possible, be the same as the project areas.

The distinct geographical boundary of each Project area (*i*) should be clearly documented in the project specific VER-PDD using maps.

### **Step 2: Define the sub-projects and their individual boundaries – *is***

Projects can be divided into a number of individual sub-projects based upon the product type and/or its delivery method. Sub-project areas are to be defined should they not be the same as the project areas.

The distinct geographical boundary of each sub-project area (*is*) should be clearly documented in the project specific VER-PDD using maps.

### **Step 3: Description of the proposed project activities**

The provision of a full description of the activities that will be undertaken during the project is to be developed, specifying how the project will be implemented. This should be established and documented in the project specific VER-PDD, including, *inter alia*, information on:

- The number of project activity light bulbs and any associated equipment that are planned to be distributed by the project activities in each Project area *i* over the duration of the crediting period;
- The total number of project activity light bulbs by type that are planned to be distributed by the project activity over the duration of the crediting period;
- The number of project activity LFSs and FRs that are planned to be distributed by the project activities in each Project area *i* over the duration of the crediting period;
- The total number of project activity LFSs and FRs that are planned to be distributed by the project activity over the duration of the crediting period;
- The numbers of households that will invited to participate in the proposed program in each project area and how the household numbers are calculated;
- Which households are eligible to participate in the project activity (e.g. households that are customers of an electric utility, households that were constructed prior to a certain date, etc);
- How the light bulbs, their associated equipment, Showerheads and FRs will be distributed to household consumers, including a description of all measures employed under the project and a description how final consumers are motivated to participate in the project;

- The applicable data that will be recorded to provide evidence that the products have been supplied and installed, including methods of recording all such data;
- The process flow charts for the proposed project(s);
- An organisational structure for the proposed program including a listing of management authorities and responsibilities;
- The monitoring processes for the overall project including parameters, operations and activities that need to be monitored together with the assigned responsibilities and authorities for such monitoring;
- The operational control of the overall project including operations/activities that are to be controlled, the definition of the controlling mechanisms to be used, the documentation of the relevant operational criteria and measures to control the identified risks;
- The training and competence requirements for the various identified positions, including associated training regimes, the required training material and the training schedules;
- The Corrective and Preventive Actions;
- The monitoring equipment necessary for each project type;
- The collection and control of the necessary data during the project including that used to support the calculated achieved abatement;
- The control of all relevant data and records including defining the records that need to be kept, the necessary audit trails, the maintenance of the records, storage, retention of the records and making the records available as and when required.

#### **Step 4: Identification of the relevant emission sources**

Refer to Table 1 above.

#### **Step 5: Proposed products included in the program**

Identification of each proposed product to be provided under the program including, *inter alia*, information on:

- The type of light bulbs and any associated equipments (transformers etc) that are to be distributed and/or installed by the Project coordinator, including information on the manufacturer, any label, the product number, the lumen, the power rating, technical characteristics, etc;
- The type of water efficient Showerheads that are to be distributed and installed by the Project coordinator, including information on the manufacturer, any label, the product number, water consumption in Litres/minute, any applicable efficiency rating scheme<sup>4</sup>, the

---

<sup>4</sup> Applicable country rating system or certification. For example:

associated testing certificates, etc;

- The type of FRs that are to be distributed and installed by the Project coordinator, including information on the manufacturer, any label, any product number, water consumption in Litres/minute, any applicable efficiency rating scheme<sup>7</sup>, the associated testing certificates, etc;

#### **Step 6: Identification of activity levels, emission and other factors**

Identify the various activity levels and their associated emission factors for the various identified activities and provide an assessment of the relevance and/or impact of each of those activities on the emission savings of the overall program, including:

##### **Baseline Activity Emissions:** including

- Energy expended through the operation of the existing light bulbs;
- Energy expended through the operation of the existing Showerheads based on temperature of the hot water, temperature of the cold water (taking into account the variations associated with seasonal ground temperatures by location of the household due to the incoming cold water flowing in buried pipes), the time period of the average shower, the flow rate of the existing showers, and the number of persons per household;

##### **Project Activity Emissions:** including

- Energy expended through the operation of the replacement CFL bulbs and/or associated equipment;
- Energy expended through the operation of the replacement Showerheads based on temperature of the hot water, temperature of the cold water (taking into account the variations associated with seasonal ground temperatures by location of the household due to the incoming cold water flowing in buried pipes), the time period of the average shower, the flow rate of the replacement LFS and/or Flow Regulated showers, and the number of persons per household;

##### **Emission Factors:** including

- Electricity – see section II, Table 1

---

[http://search.waterrating.com.au/showers\\_srch.asp](http://search.waterrating.com.au/showers_srch.asp),

<http://www.conagua.gob.mx/CONAGUA07/Contenido/Documentos/Dispositivos%20y%20Productos%20Ahorradores.pdf>

### **Installation Discount Factors:**

Each project / sub-project is to have an Installation Discount Factor (IDF) applied to the abatement.

In the Supply Only sub-projects, this factor is to take into account the difference between the number of products supplied to the individual household compared with the number of products that have been installed by the household and remain operating.

In the Supply and Installation sub-projects the IDF is to take into account the difference between the number of products installed and recorded by the assigned Installer at the household as installed compared with the number of products that remain installed and operating.

The calculation of the IDF for each sub-project is to be based on data that has been obtained by the Project coordinator undertaking random field audits of the households that have been either supplied with product for them to install or have had product supplied and installed by the Project coordinator's assigned installers. Such data is also to be supported by that independently obtained by an external, suitably qualified, telephone sampling organisation using a statistically calculated sample quantity such that the results achieve a 95% confidence interval/level for a targeted geographical population. The IDF's are to be further adjusted based on their application in either "baseline" or "project" emission calculations. Refer to Notes to calculations (26) and (27).

### **Other Project Factors:** including

- **Project period:** being the period during which the project is able to be implemented based on local and/or regulatory requirements;
- **Abatement period:** being the period during which the abatement is able to be calculated for each installed product type as defined by local and/or regulatory requirements and/or the Monitoring Methodology the Project coordinator elects to use;
- **Uncertainty:** There will be a level of uncertainty that will be applicable for baseline and proposed project parameters used in the overall calculations for the project abatement where the value of an individual parameter is confirmed via statistical sampling to achieve a 95% level of certainty in the result. These are to be listed by the Project coordinator per project parameter with the relevant explanation outlining the basis of the parameter calculation. The lower or upper bound of the confidence interval must be selected for the considered parameter in such a way that calculations are conservative. If the parameter is used in an equation for the calculation of baseline emissions, the bound that leads to lower

baseline emissions must be selected. If the parameter is used in an equation for the calculation of project emissions, the bound that leads to greater project emissions must be selected confidence.

- **Product Penetration:** A number of countries where this methodology may be used may already have energy efficient products available in their marketplace that are similar to those proposed for installation. This methodology accepts that energy efficient products may already be available within the marketplace located within the proposed project areas and that these products are increasing their market share of product sales.

The Project coordinator is to research the penetration of energy efficient products based on 5 years of historical data, where such data is available, and, based on this data, generate a graph that accurately shows the reduction of the existing products over time, with a minimum decline in market share of the existing inefficient products being 1% per year. The graph must also take into account any proposed future bans on the importation of energy inefficient products into the marketplace. The Project coordinator is to outline in the project specific VER-PDD the data available, the analysis of such data and the resultant decline graph based on all such data. The graph is to be used by the Project coordinator to calculate the Penetration Factor **PF<sub>i</sub>**. Refer to Section IV: - Annexures, Clause 19: - Market Penetration of Inefficient Products.

## Step 7: Establishment of a project database

Prior to the commencement of the distribution and/or installation of the light bulbs, associated equipment, the Showerheads and/or the FRs by the Project coordinator, the Project coordinator should establish a database containing all relevant information necessary for recording households, including, *inter alia*:

- A list of all Project areas *i*, including the name or number of the project area and an outline map or appropriate description to delineate the area;
- A list of the households that participate in the program, including information to identify the household (First name, last name, address, contact telephone number, fax number, email, property type, applicable Project area *i*)<sup>5</sup>;
- Name and ID number of the Project coordinator's representative who supplied and/or installed the provided products;
- ID number for each property address that participates in the program. This may be a unique identifier on the signed property form;
- For each household that participates in the program information that defines:
  - The type of hot water heating system at the house;
  - The year the house was constructed/received its last major upgrade (product installation program only). Note subject to the local building energy efficiency regulations this information may impact on the acceptability of a house located in Project area *i* being able to be included in the program;
  - Number of existing Showerheads in the house and whether they are already energy efficient (product installation program only);
  - Number of incandescent light bulbs removed by size (wattage) and fitting type (Eddison screw/bayonet);
  - Number of CFL light bulbs supplied by size (wattage) and fitting type (Eddison screw/bayonet);
  - Number of inefficient Showerheads in the property (where hot water is electrically heated);
  - Number of Showerheads supplied and/or installed (product installation program only);
  - Number of FRs supplied and/or installed (product installation program only);

---

<sup>5</sup> The Project coordinator is to define the level of privacy/confidentiality that is to be applied to such collected information and the period that it will be retained by the Project coordinator.

- Date product supplied and/or installed;
- Signature of product distributor/installer that:
  - product has been supplied/installed;
  - that resident's ID (drivers licence, electricity bill or relevant social security card) has been sighted and is acceptable; and
  - the resident is at or exceeds the minimum legal age for signing such documentation;
- Signature of resident accepting that:
  - Product has been supplied/installed;
  - Product operating satisfactorily (product installation program only);
  - Acceptance that the generated credits are transferable to the Project coordinator
- Any other relevant information that may be applicable to the project location;
- For each installation/audit interval/monitoring period  $x$  (as applicable), a list of households in Project area  $i$  included in the audit (name, address, applicable Project area  $i$ ).

An outline of the database is to be attached to the project specific VER-PDD and an applicable extract for the monitoring or abatement period (as applicable) is to be attached to each audit report.

### **Step 8: Random Sampling of installations**

In this methodology, a key prerequisite for achieving statistically representative results and the calculation/confirmation of the Installation Discount Factor (IDF) for each sub-project type (Supply only of energy efficient light bulbs, Supply and Installation of energy efficient light bulbs, Supply and Installation of energy efficient LFSs/FRs) is that the participating households in both the Supply Only and the Supply and Installation projects in each Project area  $i$  are sampled. Sampling is carried out by the Project coordinator and results are confirmed using an external, suitably qualified sampling organisation.

### **Methodology**

The Project coordinator's proposed sampling process is to include in the sampling frame all households where installations have been undertaken within Project Area  $i$ , and to select at random the participating households in the proposed sample that are to be contacted. More households are to be selected than required, to allow for those that are unable to be contactable, and those that decline to complete an interview. (Refer to "Sampling Process" below for the random sampling process used for selection of households to be contacted).

The interview with the participating households is to cover the following points:

- Asking to speak to the designated contact person;
- Arrange an alternative call back time if the designated contact person is not immediately available;
- Accept another informant at the household if they are aware of the household installing the devices and know what has been done since installation

When speaking to the contact person/alternative informant:

- Ask if they recall having the products installed (if not thank and terminate); do not count – select an alternative household from the random sample;
- Ask what has been installed (number of lights; number of LFSs/FRs);
- Ask if any of the efficient installed products have been removed from use (number of lights; number of LFSs/FRs);
- If some or all lights and/or LFSs/FRs are not still in use;
  - (optional) why not – answers to this question may be used in future to segment households;
- Obtain the relevant demographics (age group, gender, highest level of education, type of dwelling, whether own or rent).

The Project coordinator is to establish an estimation procedure that would allow a report to be provided that would:

- Certify an estimated rate of discontinued use of the installed product that can be used as the basis for the discount factor;
- Provide a 95% confidence level for the estimate for each proposed Project Area;
- Provide a 5% confidence interval for the estimate for each proposed Project Area;
- Define whether, within the limits of the statistical power provided by the sample, different proposed Project Areas within the same overall proposed program can be treated as having the same installation rate, or show whether they show statistically significant differences;
- Show, separately for both the lights and the LFSs, whether there are distinct segments; e.g.,
  - Those who have continued to use all lights that have been installed;
  - Those that may have removed some or all of the energy efficient lights installed through the proposed program and replaced them with incandescent lights;
  - Those that may have removed some or all of the energy efficient LFSs and/or FRs installed through the proposed program and replaced them with Showerheads that allow higher water volumes to be emitted;
- Highlight any demographic differences in the continued use rate.



## Sampling Process

The Project coordinator is to use sampling methods/procedures for the two separate processes during the proposed project installation and monitoring programs, these being during the installation phase, followed by the ongoing monitoring phase (where the Project coordinator elects to use the Extended Monitoring Procedure option).

During the installation phase the Project coordinator is to:

- Continuously monitor the installation process through ongoing reviews of the data recorded at the installation sites;
- Undertake telephone calls to households where product has been supplied and/or installed such that sufficient numbers of households are successfully contacted and the interview completed with meaningful data obtained for the purposes of later analysis to achieve a confidence level of 95% in the results obtained.
- Additional households may be contacted by the Project coordinator to achieve a 5% contact level of all completed installations for the telephone audits;
- The households contacted for the telephone audits may not necessarily be randomly selected. They are to be selected based on the completed and signed off data received and adjusted regularly to ensure that:
  - Installations undertaken by each individually trained, inducted and appointed installer are monitored to achieve a confidence level of 95% in the results obtained;
  - Installations undertaken by each appointed installation organisation are monitored to achieve a confidence level of 95% in the results obtained;
  - The recorded data provided by the installer and or the installation organisation is confirmed by the resident of the household when contacted;
- Increase the number of contacted households for a defined installer/installation organisation when the data obtained from the telephone contact is significantly different from that recorded by the appointed installer at the time of product installation;
- Increase the number of contacted households when complaints are received and/or data analysis shows that unacceptable data trends are developing.
- Undertake separate field audits of households where product has been supplied and/or installed such that sufficient of the households are successfully contacted, accessed and field audits completed with meaningful data obtained for the purposes of later analysis;
- The households to be field audited are to be randomly selected to achieve a confidence level of 95% in the results obtained.
- Additional field audits may be required that are not necessarily randomly selected but are selected based on the completed and signed off data received and adjusted regularly to

ensure that:

- Installations undertaken by each individually trained, inducted and appointed installer are monitored to achieve a confidence level of 95% in the results obtained;
- Installations undertaken by each appointed installation organisation are monitored to achieve a confidence level of 95% in the results obtained;
- The recorded data provided by the installer and or the installation organisation is confirmed by the field auditor during the audit process.

During the Monitoring phase the Project coordinator is to:

Use the following procedure to undertake telephone and field sampling:

- A list of all households in a defined Project Area where an installation was carried out in a reporting period would be sourced by the Project coordinator
- A random sample of these households is selected by the Project coordinator for each defined Project Area large enough to allow for completing interviews with 60% of selected households in the sample;
- To select the required random sample for a Project Area *i*, the following steps are to be followed:
  - The total number of households within Project Area *i* are identified;
  - The Sample Number is calculated by:
    - The total number of installations within Project Area *i* is identified (population);
    - The target number of sample households is calculated using an appropriate statistical tool<sup>6</sup> and using input data for Confidence Level at 95% and Confidence Interval at  $\pm 5\%$  (Refer to Section IV: Annexures, Clause 23: “Formula used by Sample Calculator”);
    - The number of sample households nominated in the calculator is to then be increased by 60% to allow for those not able to be contacted or not willing to be surveyed;
  - A list of ID numbers from 1 to “N” are generated where N = the number of households with a completed installation in the monitoring period and equal to the population number used in the calculator nominated above;
  - This list must be randomised<sup>7</sup> (Refer to Section IV: Annexures, Clause 22: “Randomisation of Selected Samples”);

---

<sup>6</sup> Such as the calculator available at <http://www.surveysystem.com>

<sup>7</sup> For example by using the list randomiser procedure available at <http://www.random.org>, or by using a random number generator from SQL database (Postgresql or similar)

- The total list for a Project Area is then sorted in the randomised order, with the target number of households to be called selected from those commencing at the top of the list;
- If additional households are required to complete the target number of interviews, additional households are to be drawn in order from those remaining in the sample list of un-contacted households.

### **Minimising Sources of Error**

The Project coordinator is to minimise the sources of potential error that may occur during the sampling process including errors due to “Loss of households”, “Bias” and “Sample Attrition”.

- *Loss of Households*

While the sample of households selected for interview will be a random sample, those households for which interviews are completed will not. While households may have agreed to be interviewed, and the level of completing interviews is anticipated to be very high, it will not be possible to achieve contact and complete interviews with all randomly selected households.

This will only introduce a source of bias if the retention rate for those households that do not complete interviews differs systematically from those that do.

The loss of households from the initial randomly selected sample will be minimised by the Project coordinator making multiple calls to each household at different times on different days over a period of at least two weeks before a selected sample household is abandoned. Households where contact is made but where interviews are not able to be completed immediately are to be called back, preferably at times that are agreed with the household when the appropriate informant will be available. Up to six calls are to be made to establish contact, and up to six additional calls are to be made to complete an interview once initial contact has been made. Records are to be kept of all calls made, including unsuccessful calls.

- *Testing for Bias*

To test for bias, the Project coordinator is to analyse the results obtained by the number of calls required to achieve an interview. If the outcomes do not co-vary significantly with the number of calls, this suggests that those households that could not be reached will not differ significantly from those that do.

The Project coordinator’s data on the household type and the product type(s) installed is to be analysed for households that completed an interview, households that refused an interview, and households that were not contactable or did not complete interviews within the field period, to ascertain whether there is any evidence of bias in the households where interviews were completed.

- *Sample Attrition*

To ensure that there is no loss of precision as the size of the sample reduces over time where the Project coordinator elects to use the Extended Monitoring Procedure option, the Project coordinator is to take fresh samples for each monitoring period. This will need to deal with the following issues:

- There will be some reduction in response rate, as household members move on
- Where the original residents of a sample household have moved since the product was originally installed the Project coordinator is to remove that household from the sample as the new residents might not know what was replaced originally, and what may have been done since
- There may be issues with fading recall over time, especially about the number of items originally installed that are still in use

The Project coordinator is to document in the project specific VER-PDD the sampling processes to be used for ensuring that any potential errors in the collected data are minimised.

**Step 9: Calculation of the Baseline Emissions**

**Step 9A: Extended Monitoring Procedure Option**

In order to determine the total baseline emissions when the Project coordinator elects to use the Extended Monitoring Procedure option, the baseline emissions per existing product types are calculated as:

$$BE_{i,x} = BE_{L,i,x} + BE_{S,i,x} \tag{1}$$

Where:

$$BE_{i,x} = \text{Total Baseline emissions in Project area } i \text{ (tCO}_2\text{-e) during monitoring period } x$$

- $BE_{L,i,x}$  = Total Baseline emissions in Project area  $i$  associated with the existing lights  $L$  (tCO<sub>2</sub>-e) during monitoring period  $x$ . Refer to calculation (3);
- $BE_{S,i,x}$  = Total Baseline emissions in Project area  $i$  associated with the existing Showerheads  $s$  (tCO<sub>2</sub>-e) during monitoring period  $x$ . Refer to calculation (6)

### Existing Lights:

The baseline energy associated with the existing incandescent lights is calculated as:

$$TEC_{b,l,i,x} = (T_{l,i,x} * W_{b,l,i,x} * TH_{l,i,x} * IDF_{l,i,x}) * LRF_l \quad (2)$$

Where:

- $TEC_{b,l,i,x}$  = Total Baseline energy consumption used to provide the lighting developed by the existing light bulbs in Project area  $i$  during monitoring period  $x$  (KWh);
- $T_{l,i,x}$  = Total number of light bulbs supplied and/or installed in the proposed project in the Project area  $i$  and operating during monitoring period  $x$ ;
- $W_{b,l,i,x}$  = Average energy rating during monitoring period  $x$  of the existing lights that are to be replaced in the Project area  $i$  (kW). A defined size sample batch is to be obtained at the commencement of the proposed project and the resulting wattages averaged. The size of the sample batch to be sufficient to achieve a 95% level of certainty in the results obtained. Subject to the amount of underlying activity within the defined project area new sample batches may need to be obtained for each monitoring period  $x$  to ensure that any underlining trend for any possible increased use of energy efficient lighting products is taken into account. The lower of the confidence interval must be selected for the  $W_{b,l,i,x}$  parameter to ensure that the resultant calculations are conservative. Refer to Section IV: Annexures, Clause 3: Size of existing Light Bulbs and Clause 19: Market Penetration of Energy Efficient Products;
- $TH_{l,i,x}$  = Total hours the replacement lights are operating in Project Area  $i$  during monitoring period  $x$  (hours). Refer to Section IV: Annexures, Clause 4: Abatement Period for Replacement Energy Efficient Lights and Clause 19: Market Penetration of Energy Efficient Products;
- $IDF_{l,i,x}$  = Installation Discount Factor for lights of households located in Project area  $i$  during monitoring period  $x$  (Refer to Step 10 for calculation (27) of IDF);
- $LRF_l$  = Life Reduction Factor for installed replacement light bulbs (calculated as a percentage reduction in the life of the replacement product as per Section IV: Annexures – Clause 21: Lifetime of Appliances).

The total baseline emissions during monitoring period  $x$  associated with the existing incandescent lights are calculated as:

$$BE_{L,i,x} = PF_{i,i,x} * EF_{i,x} * TEC_{b,l,i,y} / CF_{em} \quad (3)$$

Where:

- $BE_{L,i,x}$  = Total Baseline emissions resulting from the energy used during monitoring period  $x$  in the existing lights that are proposed to be replaced in Project area  $i$  (tCO<sub>2</sub>-e);
- $TEC_{b,l,i,x}$  = Total Baseline energy consumption used to provide the lighting developed by the existing light bulbs in Project area  $i$  during monitoring period  $x$ (KWh); Refer to calculation (2)
- $EF_{i,x}$  = Emission Factor for the purchase of electricity from the grid in Project area  $i$  during monitoring period  $x$ . (kgCO<sub>2</sub>-e/kWh).
- $PF_{i,i,x}$  = Penetration Factor being an accumulated percentage decline in the penetration of incandescent light bulbs in the marketplace within Project Area  $i$  during monitoring period  $x$ . The Penetration Factor is to be based on the average annual historical penetration rate reduction over the previous 5 years prior to the commencement of the proposed project and the effect of potential ban of incandescent light bulbs. Refer to Section IV: Annexure, Clause 19: Market Penetration. Refer to calculation (25)
- $CF_{em}$  = emission conversion factor from kilograms (kg) to Tonnes;

### Existing Showers:

The baseline energy per household and per day used to heat the water associated with the existing Showerheads is calculated as:

$$EC_{b,s,i} = N_{s,i} * (N_{sd}/365) * T_s * W_{sb} * (T_{sw} - T_{cw,i}) * E_w / (CF_e * EF_{s,wh,i}) \quad (4)$$

Where:

- $EC_{b,s,i}$  = Baseline energy consumption used to heat the water used in an existing shower in Project area  $i$  (KWh/day);
- $N_{s,i}$  = Number of showers per day per household in project area  $i$ . The utilisation period of the showers per day, days per year and time period for each shower is to be either monitored or defined by a conservative assumption suitably supported by several available and convincing references. Refer to 4 – Emission Reductions above. Refer also to Section IV: Annexures, Clause 7: Number of Showers per Day per Household for details on actions to be taken;
- $N_{sd}$  = Number of shower days per year per household. (Refer note immediately above). This factor will take into account the impact of days when showers are not in use as residents are away for holidays. Refer to Section IV:

Annexures, Clause 8: Number of Shower Days per Household;

- $T_s$  = Time of each shower in minutes. (Refer note above). Refer also to Section IV: Annexures, Clause 9: Time of Each Shower Period;
- $W_{sb}$  = Baseline Water flow rate per shower in litres per minute. Project coordinator to either monitor this as part of the shower utilisation (Refer note above) or calculate this based on data available from suitably supported, available and convincing references. Where monitoring is proposed a defined size sample batch is to be obtained at the commencement of the proposed project and the resulting water flow rates averaged. The size of the sample batch to be sufficient to achieve a 95% level of certainty in the results obtained. The lower of the confidence interval must be selected for the  $W_{sb}$  parameter to ensure that the resultant calculations are conservative;
- $T_{sw}$  = Average temperature of the outlet shower water  $W_{sb}$  in °C. The average temperature calculated is to be based on data obtained from available and convincing references that are applicable to the project location. Refer also to Section IV: Annexures, Clause 10: Temperature of Shower Outlet Water;
- $T_{cw,i}$  = Average temperature of the incoming cold water to the shower in Project area  $i$  in °C. The temperature of the incoming cold water into the shower is impacted by the location of the household, the associated climatic conditions and therefore varies dependent upon the time of the year. The Project coordinator is to calculate and use the average temperature of the cold water in the Project area,  $i$ , during the overall abatement period. The average temperature calculated is to be based on data obtained from available and convincing references that are applicable to the project location. Refer also to Section IV: Annexures, Clause 11: Temperature of Shower Incoming Cold Water;
- $EF_{s,wh,i}$  = Average electrical efficiency rating of electric hot water heating system. To be based on averaged data published by the heating system manufacturers for the systems used within the Project area  $i$ . Refer to Section IV: Annexures, Clause 20: Efficiency of Electric Hot Water Heaters;
- $E_w$  = Energy required per litre to heat cold water per 1°C, in kilojoules (kj);
- $CF_e$  = Energy conversion factor from kilojoules (kj) to Kilowatt Hours (KWh).

The total baseline energy consumption associated with the existing Showerheads replaced in all households of Project Area  $i$  and for the overall monitoring period  $x$  is calculated as:

$$TEC_{b,s,i,x} = (EC_{b,s,i} * THW_{s,i,x} * IDF_{s,i,x}) * TD_{s,i,x} \quad (5)$$

Where:

- TEC<sub>b,s,i,x</sub> = Total Baseline energy consumption used to heat the water used in the existing showers in Project area *i* during the abatement period during monitoring period *x* (KWh);
- EC<sub>b,s,i</sub> = Baseline energy consumption used to heat the water used in an existing shower in Project area *i* (KWh/day); Refer to calculation (4)
- THW<sub>s,i,x</sub> = Number of households with electrically heated hot water systems located in Project area *i* during monitoring period *x*;
- IDF<sub>s,i,x</sub> = Installation Discount Factor of households located in Project area *i* during monitoring period *x* (Refer to Step 10 for calculation (26) of IDF);
- TD<sub>s,i,x</sub> = Number of days LFS/FRs are operating during the monitoring period *x* in Project Area *i* (days).

The total baseline emissions during monitoring period *x* resulting from the energy used associated with the existing Showerheads is calculated as:

$$BE_{s,i,x} = PF_{s,i,x} * EF_{i,x} * TEC_{b,s,i,x} / CF_{em} \quad (6)$$

Where:

- BE<sub>s,i,x</sub> = Total Baseline emissions resulting from heating the water used in all the existing showers replaced in Project area *i* during monitoring period *x* (tCO<sub>2</sub>-e);
- TEC<sub>b,s,i,x</sub> = Total Baseline energy consumption used to heat the water used in all the existing showers in Project area *i* during the abatement period (KWh) during monitoring period *x*; Refer to calculation (5)
- EF<sub>i,x</sub> = Emission Factor for the purchase of electricity from the grid in Project area *i* during monitoring period *x*. (kgCO<sub>2</sub>-e/kWh).
- PF<sub>s,i,x</sub> = Penetration Factor being an accumulated percentage decline in the penetration of in-efficient non-LFSs in the marketplace within Project Area *i* during monitoring period *x*. The Penetration Factor is to be based on the average annual historical penetration reduction over the previous 5 years prior to the commencement of the proposed project. Refer to Section IV: Annexure, Clause 19: Market Penetration. Refer to calculation (25)
- CF<sub>em</sub> = emission conversion factor from kilograms (kg) to Tonnes (Tonne);



### Step 9B: Simplified Monitoring Procedure Option

In order to determine the total baseline emissions when the Project coordinator elects to use the Simplified Monitoring Procedure option, the baseline emissions per existing product types are calculated as:

$$BE_i = BE_{L,i} + BE_{S,i} \quad (7)$$

Where:

- $BE_i$  = Total Baseline emissions in Project area  $i$  (tCO<sub>2</sub>-e) during abatement period for lights and abatement period for Showerheads<sup>8</sup>
- $BE_{L,i}$  = Total Baseline emissions in Project area  $i$  associated with the existing lights  $L$  (tCO<sub>2</sub>-e) during abatement period. Refer to calculation (9);
- $BE_{S,i}$  = Total Baseline emissions in Project area  $i$  associated with the existing Showerheads  $s$  (tCO<sub>2</sub>-e) during abatement period. Refer to calculation (12)

#### Existing Lights:

The baseline energy associated with the existing incandescent lights is calculated as:

$$TEC_{b,l,i} = (T_{l,i} * W_{b,l,i} * TH_{l,i} * IDF_{l,i}) * LRF_l \quad (8)$$

Where:

- $TEC_{b,l,i}$  = Total Baseline energy consumption used to provide the lighting developed by the existing light bulbs in Project area  $i$  during abatement period (KWh);
- $T_{l,i}$  = Total number of light bulbs supplied and/or installed in the proposed project in the Project area  $i$  and operating during abatement period;
- $W_{b,l,i}$  = Average energy rating during abatement period of the existing lights that are to be replaced in the Project area  $i$  (kW). A defined size sample batch is to be obtained at the commencement of the proposed project and the resulting wattages averaged. The size of the sample batch to be sufficient to achieve a 95% level of certainty in the results obtained. The lower bound of the confidence interval must be selected for the  $W_{b,l,i}$  parameter to ensure that the resultant calculations are conservative. Refer to Section IV: Annexures, Clause 3: Size of existing Light Bulbs and Clause 19: Market Penetration of Energy Efficient Products;
- $TH_{l,i}$  = Total hours the replacement lights are operating in Project Area  $i$  during abatement period (hours). Refer to Section IV: Annexures, Clause 4: Abatement Period for Replacement Energy Efficient Lights and Clause 19: Market Penetration of Energy Efficient Products;

---

<sup>8</sup> The abatement period for CFLs and the abatement for LFs is usually different.

- IDF<sub>i</sub> = Installation Discount Factor for lights of households located in Project area *i* during abatement period (Refer to Step 10 for calculation (27) of IDF);
- LRF<sub>i</sub> = Life Reduction Factor for installed replacement light bulbs (calculated as a percentage reduction in the life of the replacement product as per Section IV: Annexures – Clause 21: Lifetime of Appliances).

The total baseline emissions resulting from the energy used associated with the existing incandescent lights replaced by CFLs in all of the households of Project Area *i* and for the abatement period is calculated as:

$$BE_{L,i} = PF_{i,i} * EF_i * TEC_{b,i,i} / CF_{em} \quad (9)$$

Where:

- BE<sub>L,i</sub> = Total Baseline emissions resulting from the energy used during abatement period in the existing lights that are proposed to be replaced in Project area *i* (tCO<sub>2</sub>-e);
- TEC<sub>b,i,i</sub> = Total Baseline energy consumption used to provide the lighting developed by the existing light bulbs in Project area *i* during abatement period (KWh); Refer to calculation (8)
- EF<sub>i</sub> = Emission Factor for the purchase of electricity from the grid in Project area *i* during abatement period. (kgCO<sub>2</sub>-e/kWh). Note that in such a monitoring approach, only ex-ante options are suitable for the determination of the grid emission factor.
- PF<sub>i,i</sub> = Penetration Factor being an accumulated percentage decline in the penetration of incandescent light bulbs in the marketplace within Project Area *i* during abatement period. The Penetration Factor is to be based on the average annual historical penetration rate reduction over the previous 5 years prior to the commencement of the proposed project and the effect of potential ban of incandescent light bulbs. Refer to Section IV: Annexure, Clause 19: Market Penetration. Refer to calculation (25)
- CF<sub>em</sub> = emission conversion factor from kilograms (kg) to Tonnes;

### Existing Showers:

The baseline energy per household and per day used to heat the water associated with the existing Showerheads is calculated as:

$$EC_{b,s,i} = N_{s,i} * (N_{sd}/365) * T_s * W_{sb} * (T_{sw} - T_{cw,i}) * E_w / (CF_e * EF_{s,wh,i}) \quad (10)$$

Where:

- $EC_{b,5,i}$  = Baseline energy consumption used to heat the water used in an existing shower in Project area  $i$  (KWh/day);
- $N_{s,i}$  = Number of showers per day per household in project area  $i$ . The utilisation period of the showers per day, days per year and time period for each shower is to be either monitored or defined by a conservative assumption suitably supported by several available and convincing references. Refer to 4 – Emission Reductions above. Refer also to Section IV: Annexures, Clause 7: Number of Showers per Day per Household for details on actions to be taken;
- $N_{sd}$  = Number of shower days per year per household. (Refer note immediately above). This factor will take into account the impact of days when showers are not in use as residents are away for holidays. Refer to Section IV: Annexures, Clause 8: Number of Shower Days per Household;
- $T_s$  = Time of each shower in minutes. (Refer note above). Refer also to Section IV: Annexures, Clause 9: Time of Each Shower Period;
- $W_{sb}$  = Baseline Water flow rate per shower in litres per minute. Project coordinator to either monitor this as part of the shower utilisation (Refer note above) or calculate this based on data available from suitably supported, available and convincing references. Where monitoring is proposed a defined size sample batch is to be obtained at the commencement of the proposed project and the resulting water flow rates averaged. The size of the sample batch to be sufficient to achieve a 95% level of certainty in the results obtained. The lower of the confidence interval must be selected for the  $W_{sb}$  parameter to ensure that the resultant calculations are conservative;
- $T_{sw}$  = Average temperature of the outlet shower water  $W_{sb}$  in °C. The average temperature calculated is to be based on data obtained from available and convincing references that are applicable to the project location. Refer also to Section IV: Annexures, Clause 10: Temperature of Shower Outlet Water;
- $T_{cw,i}$  = Average temperature of the incoming cold water to the shower in Project area  $i$  in °C. The temperature of the incoming cold water into the shower is impacted by the location of the household, the associated climatic conditions and therefore varies dependent upon the time of the year. The Project coordinator is to calculate and use the average temperature of the cold water in the Project area,  $i$ , during the overall abatement period. The average temperature calculated is to be based on data obtained from available and convincing references that are applicable to the project location. Refer also to Section IV: Annexures, Clause 11: Temperature of Shower Incoming Cold Water;

- $EF_{s,wh,i}$  = Average electrical efficiency rating of electric hot water heating system. To be based on averaged data published by the heating system manufacturers for the systems used within the Project area  $i$ . Refer to Section IV: Annexures, Clause 20: Efficiency of Electric Hot Water Heaters;
- $E_w$  = Energy required per litre to heat cold per 1°C in kilojoules (kj);
- $CF_e$  = Energy conversion factor from kilojoules (kj) to Kilowatt Hours (KWh).

The total baseline energy consumption associated with the existing Showerheads replaced in all households of Project Area  $i$  and for the overall abatement period is calculated as:

$$TEC_{b,s,i} = (EC_{b,s,i} * THW_{s,i} * IDF_{s,i}) * AP_{s,i} \quad (11)$$

Where:

- $TEC_{b,s,i}$  = Total Baseline energy consumption used to heat the water used in the existing showers in Project area  $i$  during the abatement period (KWh);
- $EC_{b,s,i}$  = Baseline energy consumption used to heat the water used in an existing shower in Project area  $i$  (KWh/day); Refer to calculation (10)
- $THW_{s,i}$  = Number of households with electrically heated hot water systems located in Project area  $i$  during abatement period;
- $IDF_{s,i}$  = Installation Discount Factor of households located in Project area  $i$  during abatement period (Refer to Step 10 for calculation (26) of IDF);
- $AP_{s,i}$  = Defined proposed abatement period for showers in Project Area  $i$  (days).

The total baseline emissions resulting from the energy used associated with the existing Showerheads is calculated as:

$$BE_{s,i} = PF_{s,i} * EF_i * TEC_{b,s,i} / CF_{em} \quad (12)$$

Where:

- $BE_{s,i}$  = Total Baseline emissions resulting from heating the water used in all the existing showers replaced in Project area  $i$  during abatement period (tCO<sub>2</sub>-e);
- $TEC_{b,s,i}$  = Total Baseline energy consumption used to heat the water used in all the existing showers in Project area  $i$  during the abatement period (KWh) during abatement period; Refer to calculation (11)
- $EF_i$  = Emission Factor for the purchase of electricity from the grid in Project area  $i$  during abatement period. (kgCO<sub>2</sub>-e/kWh). Note that in such a monitoring approach, only ex-ante options can be chosen for the determination of the grid emission factor.
- $PF_{s,i}$  = Penetration Factor being an annual percentage decline in the penetration of

in-efficient non-LFSs in the marketplace within Project Area *i* during abatement period. The Penetration Factor is to be based on the average annual historical penetration reduction over the previous 5 years prior to the commencement of the proposed project. Refer to Section IV: Annexure, Clause 19: Market Penetration. Refer to calculation (25)

$CF_{em}$  = emission conversion factor from kilograms (kg) to Tonnes (Tonne);

## Step 10: Calculation of the Project Emissions

### Step 10A: Extended Monitoring Procedure Option

In order to determine the total emissions following the project program, the project emissions per replacement product types are calculated as:

$$PE_{i,x} = PE_{L,i,x} + PE_{S,i,x} \quad (13)$$

Where:

- $PE_{i,x}$  = Total Project emissions in Project area *i* during monitoring period *x* (tCO<sub>2</sub>-e);
- $PE_{L,i,x}$  = Total Project emissions in Project area *i* associated with the existing lights *L* during monitoring period *x* (tCO<sub>2</sub>-e) Refer to calculation (15);
- $PE_{S,i,x}$  = Total Project emissions in Project area *i* associated with the existing Showerheads *s* during monitoring period *x* (tCO<sub>2</sub>-e). Refer to calculation (18);

### Replacement Energy Efficient Lights:

The project energy associated with the replacement energy efficient lights is calculated as:

$$TEC_{p,l,i,x} = [(T_{l,i,x} * W_{p,l,i,x} * TH_{l,i,x} * IDF_{l,i,x} * LRF_l] \quad (14)$$

Where:

- $TEC_{p,l,i,x}$  = Total project energy consumption used to provide the lighting developed by the replacement light bulbs in Project area *i* during the abatement period during monitoring period *x* (KWh);
- $T_{l,i,x}$  = Total number of light bulbs replaced in each household in the proposed project in the Project area *i* during monitoring period *x*;
- $W_{p,l,i,x}$  = Average energy rating during monitoring period *x* of the replacement energy efficient lights in the Project area *i* (kW). The wattage of each replacement supplied and/or installed during monitoring period *x* is recorded and the average of all replacement bulbs is calculated and used in this calculation. A

defined size sample batch is to be obtained at the commencement of the proposed project and the resulting wattages averaged. The size of the sample batch to be sufficient to achieve a 95% level of certainty in the results obtained. The upper bound of the confidence interval must be selected for the  $W_{p,l,i,x}$  parameter to ensure that the resultant calculations are conservative. Refer to Section IV: Annexures, Clause 15: Energy Rating of Installed CFLs;

- $TH_{l,i,x}$  = Total hours the replacement lights are operating in Project Area  $i$  during monitoring period  $x$  (hours). Refer to Section IV: Annexures, Clause 4: Abatement Period for Replacement Energy Efficient Lights and Clause 19: Market Penetration of Energy Efficient Products;
- $IDF_{l,i,x}$  = Installation Discount Factor of light bulbs within households located in Project area  $i$  during monitoring period  $x$  (Refer to Step 10 for calculation (27) of IDF);
- $LRF_1$  = Life Reduction Factor for installed replacement light bulbs (calculated as a percentage reduction in the life of the replacement product as per Section IV: Annexures – Clause 21: Lifetime of Appliances).

The total project emissions during monitoring period  $x$  associated with the replacement energy efficient lights in Project Area  $i$  are calculated as:

$$PE_{L,i,x} = EF_{i,x} * TEC_{p,l,i,x} / CF_{em} \tag{15}$$

Where:

- $PE_{L,i,x}$  = Total Project emissions resulting from the energy used in the replacement energy efficient lights that are proposed to be replaced in Project area  $i$  during monitoring period  $x$  (tCO<sub>2</sub>-e);
- $TEC_{p,l,i,x}$  = Total project energy consumption used to provide the lighting developed by the replacement light bulbs in Project area  $i$  during monitoring period  $x$  (KWh); Refer to calculation (14)
- $EF_{i,x}$  = Emission Factor for the purchase of electricity from the grid in Project area  $i$  during monitoring period  $x$ . (kgCO<sub>2</sub>-e/kWh)
- $CF_{em}$  = emission conversion factor from kilograms (kg) to Tonnes;

### Replacement Showers:

The project energy per household and per day used to heat the water associated with the replacement LFSs is calculated as:

$$EC_{p,s,i} = N_{s,i} * (N_{sd}/365) * T_s * W_{sp} * (T_{sw} - T_{cw,i}) * E_w / (CF_e * EF_{s,wh,i}) \quad (16)$$

Where:

- $EC_{p,s,i}$  = Project energy consumption used to heat the water used in the replacement Low-Flow Shower or installed FRs in Project area  $i$  (KWh/day);
- $N_{s,i}$  = Number of showers per day per household in Project area  $i$ . The utilisation period of the showers per day, days per year and time period for each shower is to be either monitored or defined by a conservative assumption suitably supported by several available and convincing references. Refer to 4 – Emission Reductions above. Refer also to Section IV: Annexures, Clause 7: Number of Showers per Day per Household for details on actions to be taken;
- $N_{sd}$  = Number of shower days per year per household. (Refer note immediately above). This factor will take into account the impact of days when showers are not in use as residents are away for holidays. Refer to Section IV: Annexures, Clause 8: Number of Shower Days per Household;
- $T_s$  = Time of each shower in minutes. (Refer note above). Refer also to Section IV: Annexures, Clause 9: Time of Each Shower Period;
- $W_{sp}$  = Project Water flow rate per installed Low-Flow Shower and/or FRs in litres per minute. Project coordinator to define this based on the characteristics of the product that has been installed based on data provided by relevant testing authorities;
- $T_{sw}$  = Average temperature of the outlet shower water  $W_{sp}$  in °C. The average temperature calculated is to be based on data obtained from available and convincing references that are applicable to the project location. Refer also to Section IV: Annexures, Clause 10: Temperature of Shower Outlet Water;
- $T_{cw,i}$  = Average temperature of the incoming cold water to the shower in Project area  $i$  in °C. The temperature of the incoming cold water into the shower is impacted by the location of the household, the associated climatic conditions and therefore varies dependent upon the time of the year. The Project coordinator is to calculate and use the average temperature of the cold water in the Project area,  $i$ , during the overall abatement period. The average temperature calculated is to be based on data obtained from available and convincing references that are applicable to the project location. Refer also to Section IV: Annexures, Clause 11: Temperature of Shower Incoming Cold Water;
- $EF_{s,wh,i}$  = Average electrical efficiency rating of electric hot water heating systems.

To be based on averaged data published by the heating system manufacturers for the systems used within the Project area *i*. Refer also to Section IV: Annexures, Clause 20: Efficiency of Electric Hot Water Heaters;

- $E_w$  = Energy required per litre to heat cold per 1°C in kilojoules (kj);
- $CF_e$  = Energy conversion factor from kilojoules (kj) to Kilowatt Hours (KWh).

The total project energy consumption during monitoring period *x* associated with the replacement LFSs replaced in Project Area *i* is calculated as:

$$TEC_{p,s,i,x} = EC_{p,s,i} * THW_{s,i,x} * IDF_{s,i,x} * TD_{s,i,x} \quad (17)$$

Where:

- $TEC_{p,s,i,x}$  = Total Project energy consumption used to heat the water used in the replacement LFSs in Project area *i* during the abatement period during monitoring period *x* (KWh);
- $EC_{p,s,i}$  = Project energy consumption used to heat the water used in a replacement Low-Flow Shower in Project area *i* during monitoring period *x* (KWh/day); Refer to calculation (16)
- $THW_{s,i,x}$  = Number of households with electrically heated hot water systems located in Project area *i* during monitoring period *x* that had all of their inefficient showers replaced;
- $IDF_{s,i,x}$  = Installation Discount Factor of LFSs within households located Project area *i* during monitoring period *x* (Refer to Step 10 for calculation (26) of IDF);
- $TD_{s,i,x}$  = Number of days LFS are operating during the monitoring period *x* in Project Area *i* (Days).

The total project emissions during the monitoring period *x* resulting from the energy used associated with the replacement LFSs replaced in Project Area *i* is calculated as:

$$PE_{s,i,x} = EF_{i,x} * TEC_{p,s,i,x} / CF_{em} \quad (18)$$

Where:

- $PE_{s,i,x}$  = Total Project emissions resulting from heating the water used in all the replacement Low-Flow Showers installed in Project area *i* during monitoring period *x* (tCO<sub>2</sub>-e);
- $TEC_{p,s,i,x}$  = Total Project energy consumption used to heat the water used in all the replacement Low-Flow Showers in Project area *i* during monitoring period *x* (KWh); Refer to calculation (17)
- $EF_{i,x}$  = Emission Factor for the purchase of electricity from the grid in project area *i*



$CF_{em}$  = emission conversion factor from kilograms (kg) to Tonnes (Tonne).  
 during monitoring period  $x$ . ( $kgCO_2-e/kWh$ ).

### Step 10B: Simplified Monitoring Procedure Option

In order to determine the total emissions following the project program when the Project coordinator elects to use the Simplified Monitoring Procedure option, the project emissions per replacement product types are calculated as:

$$PE_i = PE_{L,i} + PE_{S,i} \quad (19)$$

Where:

- $PE_i$  = Total Project emissions in Project area  $i$  during abatement period for lights and/or Showerheads ( $tCO_2-e$ );
- $PE_{L,i}$  = Total Project emissions in Project area  $i$  associated with the existing lights  $L$  during abatement period ( $tCO_2-e$ ) Refer to calculation (21);
- $PE_{S,i}$  = Total Project emissions in Project area  $i$  associated with the existing Showerheads during abatement period ( $tCO_2-e$ ). Refer to calculation (24);

### Replacement Energy Efficient Lights:

The project energy associated with the replacement energy efficient lights is calculated as:

$$TEC_{p,l,i} = T_{l,i} * W_{p,l,i} * TH_{l,i} * IDF_{l,i} * LRF_i \quad (20)$$

Where:

- $TEC_{p,l,i}$  = Total project energy consumption used to provide the lighting developed by the replacement light bulbs in Project area  $i$  during the abatement period (KWh);
- $T_{l,i}$  = Total number of light bulbs replaced in each household in the proposed project in the Project area  $i$  during abatement period;
- $W_{p,l,i}$  = Average energy rating during abatement period of the replacement energy efficient lights in the Project area  $i$  (kW). The wattage of each replacement supplied and/or installed during abatement period is recorded and the average of all replacement bulbs is calculated and used in this calculation. A defined size sample batch is to be obtained at the commencement of the proposed project and the resulting wattages averaged. The size of the sample batch to be sufficient to achieve a 95% level of certainty in the results obtained. The upper bound of the confidence interval must be selected for the  $W_{p,l,i}$  parameter to ensure that the resultant calculations are

conservative. Refer to Section IV: Annexures, Clause 15: Energy Rating of Installed CFLs;

- $TH_{l,i}$  = Total hours the replacement lights are operating in Project Area  $i$  during abatement period (hours). Refer to Section IV: Annexures, Clause 4: Abatement Period for Replacement Energy Efficient Lights and Clause 19: Market Penetration of Energy Efficient Products;
- $IDF_{l,i}$  = Installation Discount Factor of light bulbs within households located in Project area  $i$  during abatement period (Refer to Step 10 for calculation (27) of IDF);
- $LRF_1$  = Life Reduction Factor for installed replacement lightbulbs (calculated as a percentage reduction in the life of the replacement product as per Section IV: Annexures – Clause 21: Lifetime of Appliances).

The total project emissions during abatement monitoring period  $y$  associated with the replacement energy efficient lights in Project Area  $i$  are calculated as:

$$PE_{L,i} = EF_i * TEC_{p,l,i} / CF_{em} \quad (21)$$

Where:

- $PE_{L,i}$  = Total Project emissions resulting from the energy used in the replacement energy efficient lights that are proposed to be replaced in Project area  $i$  during abatement period ( $tCO_2-e$ );
- $TEC_{p,l,i}$  = Total project energy consumption used to provide the lighting developed by the replacement light bulbs in Project area  $i$  during abatement period (KWh); Refer to calculation (20)
- $EF_i$  = Emission Factor for the purchase of electricity from the grid in Project area  $i$  during abatement period. ( $kgCO_2-e/kWh$ ). Note that in such a monitoring approach, only ex-ante options can be chosen for the determination of the grid emission factor.
- $CF_{em}$  = emission conversion factor from kilograms (kg) to Tonnes;

### Replacement Showers:

The project energy per household and per day used to heat the water associated with the replacement LFSs is calculated as:

$$EC_{p,s,i} = N_{s,i} * (N_{sd}/365) * T_s * W_{sp} * (T_{sw} - T_{cw,i}) * E_w / (CF_e * EF_{s,wh,i}) \quad (22)$$

Where:

- $EC_{p,5,i}$  = Project energy consumption used to heat the water used in the replacement Low-Flow Shower or installed FRs in Project area  $i$  (KWh/day);
- $N_{s,i}$  = Number of showers per day per household in Project area  $i$ . The utilisation period of the showers per day, days per year and time period for each shower is to be either monitored or defined by a conservative assumption suitably supported by several available and convincing references. Refer to 4 – Emission Reductions above. Refer also to Section IV: Annexures, Clause 7: Number of Showers per Day per Household for details on actions to be taken;
- $N_{sd}$  = Number of shower days per year per household. (Refer note immediately above). This factor will take into account the impact of days when showers are not in use as residents are away for holidays. Refer to Section IV: Annexures, Clause 8: Number of Shower Days per Household;
- $T_s$  = Time of each shower in minutes. (Refer note above). Refer also to Section IV: Annexures, Clause 9: Time of Each Shower Period;
- $W_{sp}$  = Project Water flow rate per installed Low-Flow Shower and/or FRs in litres per minute. Project coordinator to define this based on the characteristics of the product that has been installed based on data provided by relevant testing authorities;
- $T_{sw}$  = Average temperature of the outlet shower water  $W_{sp}$  in °C. The average temperature calculated is to be based on data obtained from available and convincing references that are applicable to the project location. Refer also to Section IV: Annexures, Clause 10: Temperature of Shower Outlet Water;
- $T_{cw,i}$  = Average temperature of the incoming cold water to the shower in Project area  $i$  in °C. The temperature of the incoming cold water into the shower is impacted by the location of the household, the associated climatic conditions and therefore varies dependent upon the time of the year. The Project coordinator is to calculate and use the average temperature of the cold water in the Project area,  $i$ , during the overall abatement period. The average temperature calculated is to be based on data obtained from available and convincing references that are applicable to the project location. Refer also to Section IV: Annexures, Clause 11: Temperature of Shower Incoming Cold Water;
- $EF_{s,wh,i}$  = Average electrical efficiency rating of electric hot water heating systems. To be based on averaged data published by the heating system

- manufacturers for the systems used within the Project area *i*. Refer also to Section IV: Annexures, Clause 20: Efficiency of Electric Hot Water Heaters;
- $E_w$  = Energy required per litre to heat cold per 1°C in kilojoules (kj);
- $CF_e$  = Energy conversion factor from kilojoules (kj) to Kilowatt Hours (KWh).

The total project energy consumption during the abatement period associated with the replacement LFSs replaced in Project Area *i* is calculated as:

$$TEC_{p,s,i} = EC_{p,s,i} * THW_{s,i} * IDF_{s,i} * AP_{s,i} \quad (23)$$

Where:

- $TEC_{p,s,i}$  = Total Project energy consumption used to heat the water used in the replacement LFSs in Project area *i* during the abatement period (KWh);
- $EC_{p,s,i}$  = Project energy consumption used to heat the water used in a replacement Low-Flow Shower in Project area *i* during abatement period (KWh/day); Refer to calculation (22)
- $THW_{s,i}$  = Number of households with electrically heated hot water systems located in Project area *i* during abatement period that had all of their inefficient showers replaced;
- $IDF_{s,i}$  = Installation Discount Factor of LFSs within households located Project area *i* during abatement period (Refer to Step 10 for calculation (26) of IDF);
- $AP_{s,i}$  = Defined proposed abatement period for showers in Project Area *i* (Days).

The total project emissions during the abatement period resulting from the energy used associated with the replacement LFSs replaced in Project Area *i* is calculated as:

$$PE_{s,i} = EF_i * TEC_{p,s,i} / CF_{em} \quad (24)$$

Where:

- $PE_{s,i}$  = Total Project emissions resulting from heating the water used in all the replacement Low-Flow Showers installed in Project area *i* during abatement period (tCO<sub>2</sub>-e);
- $TEC_{p,s,i}$  = Total Project energy consumption used to heat the water used in all the replacement Low-Flow Showers in Project area *i* during abatement period (KWh); Refer to calculation (23)
- $EF_{i,z}$  = Emission Factor for the purchase of electricity from the grid in project area *i* during abatement period. (kgCO<sub>2</sub>-e/kWh). Note that in such a monitoring approach, only ex-ante options can be chosen for the determination of the grid emission factor.

$CF_{em}$  = emission conversion factor from kilograms (kg) to Tonnes (Tonne).

### Calculation of Penetration Factor (PF)

The Penetration Factor for each installed product type to be used within the calculations for the Baseline Emissions is to be calculated by using:

$$PF_i = PC_i + (PAG_i * (TD_i \text{ or } AP_i)) / 2 \quad (25)$$

Where:

- $PF_i$  = Penetration Factor for the existing replaced product for monitoring period  $x$  or abatement period (CFL or LFS abatement period as applicable) within Project Area  $i$  (%);
- $PC_i$  = Penetration of the existing replaced product within Project Area  $i$  as at monitoring period  $x$  commencement for the “Extended Monitoring Procedure” option and as at project commencement (%) for the “Simplified Monitoring Procedure” option;
- $PAG_i$  = Annual Percentage decline of product in the market place within Project area  $i$  (%) based on historical data (with a minimum decline of 1% per year);
- $TD_i$  or  $AP_i$  =  $TD_i$  is the project monitoring period  $x$  for the “Extended Monitoring Procedure” option in Project area  $i$  (days)(CFL or LFS crediting period as applicable) and  $AP_i$  is the product Abatement Period (CFL or LFS abatement period as applicable) of installed product in Project area  $i$  (yrs) for the “Simplified Monitoring Procedure” option.

This calculation is only valid if the Host Country has not announced a future ban on the importation of incandescent light bulbs. If a future ban has been announced refer to Section IV: Annexure, Clause 19: Market Penetration for the calculation requirements.

### Calculation of Installation Discount Factor (IDF)

Separate IDFs calculation processes are used for the LFSs/FRs (LFS/FR) and Compact Fluorescent Lights (CFL).

#### For LFS’s/FR’s:

The IDF formula for installation of LFSs/FRs (LFS/FR) in Project Area  $i$  is calculated as:

$$IDF_{s,i} = 1 - n_{s,i,rem} / n_{s,i} \quad (26)$$

Where:

- IDF<sub>s,i</sub> = Installation Discount Factor (IDF) for LFS installations in Project Area *i*,
- n<sub>s,i,rem</sub> = Number of sampled households in Project Area *i* where LFSs have been supplied to and/or installed to all Showerheads and where at least one LFS had been removed,
- n<sub>s,i</sub> = Total number of sampled households in Project Area *i* where LFSs have been installed to all Showerheads and where interviews were completed.

**For CFL's:**

The IDF formula for installation of Energy Efficient Light Bulbs (CFL) in Project Area *i* is calculated as:

$$IDF_{l,i} = 1 - k_{l,rem,i} / k_{l,in,i} \tag{27}$$

Where:

- IDF<sub>l,i</sub> = Installation Discount Factor (IDF) for light bulb installations in Project Area *i*,
- k<sub>l,in,i</sub> = Total of number of advanced light bulbs installed across all households in the sample within Project Area *i*;
- k<sub>l,rem,i</sub> = total number of advanced light bulbs removed across all households in the sample in Project Area *i*;

**Step 11: Calculation of the emissions abatement**

Emission reductions are calculated based on the number of each type of products that have been installed, adjusted by the Installation Discount Factor (IDF) and further adjusted to take into account the statistical margin of error to achieve a 95% confidence level. The electricity savings as a result of the projects are also calculated based on the number of light bulb products installed and/or the number of household where Showerhead products were installed.

The applicable calculations are as follows:

**Step 11A: Extended Monitoring Procedure Option**

$$ER_{i,x} = BE_{i,x} - PE_{i,x} \tag{28}$$

Where:

- ER<sub>i,x</sub> = Total Emission Reductions in Project area *i* during monitoring period *x* (tCO<sub>2</sub>-e);
- BE<sub>i,x</sub> = Total Baseline emissions in Project area *i* during monitoring period *x* (tCO<sub>2</sub>-e); Refer to calculation (1);
- PE<sub>i,x</sub> = Total Project emissions in Project area *i* during monitoring period *x* (tCO<sub>2</sub>-e); Refer to calculation (13).

### Step 11B: Simplified Monitoring Procedure Option

$$ER_i = BE_i - PE_i \quad (29)$$

Where:

- $ER_i$  = Total Emission Reductions in Project area  $i$  during abatement period for replacement lights and for replacement showers (tCO<sub>2</sub>-e);
- $BE_i$  = Total Baseline emissions in Project area  $i$  during abatement period for replacement lights and for replacement showers (tCO<sub>2</sub>-e); Refer to calculation (7);
- $PE_i$  = Total Project emissions in Project area  $i$  during abatement period for replacement lights and for replacement showers (tCO<sub>2</sub>-e); Refer to calculation (19).

### 5. Leakage

Three possible sources of potential leakage have been identified, these being:

a. Scrapping of inefficient lighting appliances.

The Project coordinator is to implement a process to monitor of the scrapping of lighting appliances handed in by the households to ensure that they can no longer be reused thus removing any potential for future emission leakage. The monitoring should include a check of the number of project activity lighting appliances distributed by the project and the number of scrapped lighting appliances to ensure they correspond with each other. For this purpose scrapped lighting appliances should be stored until such correspondence has been checked. The scrapping of returned lighting appliances is to be documented and independently verified.

b. Rebound

There is a possibility that the installation of energy efficient products may lead to an increased usage of such products when the project beneficiaries realise that their outgoing energy usage costs are decreasing as a result of the products installed under the proposed program..

The Project coordinator is to implement a simple spot check following the installation of the energy efficient products to ascertain/monitor if there is a possible rebound effect resulting from the installation. Such rebound could include the increased time utilisation of the installed lighting products and/or longer shower duration resulting from the use of less energy. The spot check is to be carried out on a representative sample of households in Project Area  $i$ , the households being randomly selected to provide a 95% confidence level in the results obtained.

c. Product failure

There is a possibility that a small number of the installed energy efficient products may fail during the period of their abatement as defined for the proposed project and be replaced by products having less energy efficient characteristics. For conservativeness the Project coordinator is to:

- Provide all project beneficiaries with the contact details of the Project coordinator;
- Replace all product that individual project beneficiaries (households) advise during the relevant product abatement period as having failed;
- Ensure that sampled project beneficiaries are asked during the ongoing monitoring programs (Extended Monitoring Procedure option) whether the installed products are still operating and have not been removed.
- Statistically compare the requests for failed CFLs replacement with the outcomes of the site-visits and compensate for the credits delivered in excess if necessary

The Project coordinator is to document in the project specific VER-PDD the proposed methodologies for the monitoring of leakage.

**6. Data and parameters not monitored:**

The following data and/or parameters are not monitored as part of any proposed program developed to use this methodology:

<b>Data / Parameter:</b>	<b>TH<sub>i,i</sub></b>
Data unit:	hours
Description:	The total hours of operation of the proposed replacement energy efficient light bulbs to be installed.
Source of Data:	Provided by the product manufacturer based on product test data obtained in accordance with IEC/ISO60969 Clause 10 (subject to comments noted below).
Any comment:	May be used as the proposed abatement period for the light bulbs subject to regulatory requirements / agreement. Refer also to Section IV – Annexures Clause 4 “Abatement Period for the Replacement Energy Efficient Lights”. In addition refer to Section IV: Annexures - Clause 21: Lifetime of Appliances – “a. For Light Bulbs (CFL)” and also to Section IV: Annexures - Clause 19: Market Penetration of Energy Efficient Products – specifically the potential impact associated with a Host Country imposing



	<p>any future ban on the importation of incandescent light bulbs.</p> <p>The Project coordinator to ensure that the batch of lamps used for the establishment of the 'Rated Life' is one of the batches that will be used for the project activity.</p> <p>A "Simplified Monitoring Process" may be used if CFLs procurement is based on conformance of the product to relevant International (or equivalent National) Standards. Refer to Section I – Source and Applicability – "Applicability" conditions.</p>
--	---

<b>Data / Parameter:</b>	<b>AP<sub>s</sub></b>
Data unit:	Days (or Years)
Description:	The proposed abatement period of the replacement LFS to be installed when using the "Simplified Monitoring Procedure" option.
Source of Data:	Defined by local regulatory requirements / agreement. Where there are no such regulatory requirements the abatement period is to be suggested by the project proponent based on credible references and approved by the Gold Standard.
Any comment:	<p>Refer also to Section IV: Annexures – Clause 6: "Abatement Period for the Replacement Low-Flow Showerheads".</p> <p>In addition refer to Section IV: Annexures - Clause 21: Lifetime of Appliances – "b. For Low-Flow Showerheads".</p>

<b>Data / Parameter:</b>	<b>TD<sub>s,i,x</sub></b>
Data unit:	Days (or Years)
Description:	The proposed monitoring period x of the replacement LFS to be installed in Project Area i when using the "Extended Monitoring Procedure" option.
Source of Data:	Defined by local regulatory requirements / agreement and/or the Gold Standard. Where there are no regulatory requirements the crediting period is to be suggested by the project proponent based on credible references and approved by the Gold Standard.
Any comment:	Refer also to Section IV: Annexures – Clause 6: "Abatement Period for the

	<p>Replacement Low-Flow Showerheads”.</p> <p>In addition refer to Section IV: Annexures - Clause 21: Lifetime of Appliances – “b. For Low-Flow Showerheads”.</p>
--	--

<b>Data / Parameter:</b>	<b>EF<sub>i</sub></b>
Data unit:	kgCO <sub>2</sub> -e per kWh
Description:	Emission Factor associated with the purchase of electricity from the grid in Project area <i>i</i>
Source of Data:	Literature - based on data as obtained from the local authorities, or where such data is either not available or where available but suspect then as calculated according to the CDM ‘Tool to calculate the emission factor for an electricity system’.
Any comment:	Data available from local authorities must not be more than 5 years old

<b>Data / Parameter:</b>	<b>PF<sub>i,i</sub></b>
Data unit:	Percentage
Description:	Penetration Factor being an accumulated percentage increase in the penetration of efficient light bulbs in the marketplace within Project Area <i>i</i>
Source of Data:	Project coordinator’s assessment of the market penetration based on 5 years of historical locally obtained data.
Any comment:	The Penetration Factor is to be based on the average annual historical penetration rates over the previous 5 years prior to the commencement of the proposed project with a minimum of 1% per year. Refer to Section IV: Annexure, Clause 19: Market Penetration.

<b>Data / Parameter:</b>	<b>PF<sub>s,i</sub></b>
Data unit:	Percentage
Description:	Penetration Factor being an accumulated percentage increase in the penetration of efficient LFSs in the marketplace within Project Area <i>i</i>
Source of Data:	Project coordinator’s assessment of the market penetration based on 5

	years of historical locally obtained data.
Any comment:	The Penetration Factor is to be based on the average annual historical penetration rates over the previous 5 years prior to the commencement of the proposed project with a minimum of 1% per year. Refer to Section IV: Annexure, Clause 19: Market Penetration.

<b>Data / Parameter:</b>	<b>CF<sub>em</sub></b>
Data unit:	-
Description:	Conversion factor from Kilograms (kg) to tonnes (ton)
Source of Data:	Standard data
Any comment:	-

<b>Data / Parameter:</b>	<b>N<sub>sd</sub></b>
Data unit:	days
Description:	Number of shower days per year per household
Source of Data:	355 days
Any comment	The number of shower days per year is based on each person having one shower per day for the number of days that they are in the house. Allowance should be made for the family taking holidays – say 10 days per year. Refer also to Section IV – Annexures Clause 8 “Number of Shower Days per Household”.

<b>Data / Parameter:</b>	<b>T<sub>s</sub></b>
Data unit:	minutes
Description:	Time of each shower period
Source of Data:	Literature - data source, if available, from the proposed country in which the program is located; for example, <a href="http://www.energy.com.au/energy/ea.nsf/AttachmentsByTitle/061022+Shower+Timers+WEB2/\$FILE/061022+shower+timers+WEB2.pdf">http://www.energy.com.au/energy/ea.nsf/AttachmentsByTitle/061022+Shower+Timers+WEB2/\$FILE/061022+shower+timers+WEB2.pdf</a>
Any comment:	The time taken for showering is dependent upon a number of factors

	including the amount of water available, the socio-economic conditions in the Project area etc. The Project coordinator must source independently obtained data to support the proposed time to be used in the calculations, preferably based on conditions within the relevant Project area / country. Refer also to Section IV – Annexures Clause 9 “ <i>Time of each Shower Period</i> ”.
--	--

<b>Data / Parameter:</b>	$W_{sb}$
Data unit:	Litres per minute
Description:	Baseline flow rate per inefficient, non-rated Showerhead.
Source of Data:	Literature - data source, if available, from the proposed country in which the program is located; for example, <a href="http://search.waterrating.com.au/showers_srch.asp">http://search.waterrating.com.au/showers_srch.asp</a>
Any comment:	The Project coordinator must source independently obtained data to support the proposed baseline flow rate for the existing showers that are to be replaced. Refer to Section IV – Annexures Clause 5 “ <i>Existing Inefficient Showerheads and Measurement of Water Flow</i> ”.

<b>Data / Parameter:</b>	$T_{sw}$
Data unit:	°C
Description:	Average temperature of the outlet water at the Showerhead
Source of Data:	Literature
Any comment:	The temperature of the hot water out of the shower is impacted by the local conditions in the Project area i. The Project coordinator is to obtain data on the relevant temperature to be used for the outlet temperature in the calculations for the abatement. Refer to Section IV – Annexures Clause 10 “ <i>Temperature of Shower Outlet Water</i> ”

<b>Data / Parameter:</b>	$T_{cw}$
Data unit:	°C
Description:	Average temperature of the incoming cold water to the Showerhead
Source of Data:	Literature

Any comment:	The temperature of the incoming cold water into the shower is impacted by the location of the household, the associated climatic conditions and therefore varies dependent upon the location and the time of the year. The Project coordinator must source independently obtained data to support the proposed incoming cold water temperature and is to calculate and use the average temperature of the cold water in the project area, $i$ , during the overall abatement period. Refer to Section IV – Annexures Clause 11 “ <i>Temperature of Shower Incoming Cold Water</i> ”
--------------	---

Data / Parameter:	$E_w$
Data unit:	Kilojoules (kj)
Description:	Energy required to heat 1 litre of water 1 °C
Source of Data:	Standard data
Any comment:	-

Data / Parameter:	$CF_e$
Data unit:	-
Description:	Energy conversion factor from kilojoules (kj) to Kilowatt Hours (KWh).
Source of Data:	Standard data
Any comment:	-

Data / Parameter:	$W_{sp}$
Data unit:	Litres per minute
Description:	Project flow rate per efficient or FR
Source of Data:	Literature – for example, <a href="http://search.waterrating.com.au/showers_srch.asp">http://search.waterrating.com.au/showers_srch.asp</a>
Any comment:	The Project coordinator must source independently obtained test data to support the proposed flow rate for the proposed efficient and/or FRs. Refer to Section IV – Annexures Clause 12 “ <i>Low-Flow Showerheads and Flow Regulators</i> ”

<b>Data / Parameter:</b>	<b><math>N_{s,i}</math></b>
Data unit:	Number
Description:	<p>Number of showers per day per household in Project area <math>i</math>;</p> <p>either = one (1) per person per day for each resident in the household; or</p> <p>Based on monitoring of a representative sample of households to ascertain the number of times the Showerhead(s) are used.</p>
Source of Data:	<p>Number of persons per household based on statistical data obtained from the relevant government department of the project country;</p> <p>Monitoring based on data recorded by Project coordinator prior to the commencement of the proposed project. The total number of times for all of the households is to be multiplied by the average number of persons per household in the sampled households and divided by the total number of households sampled in the project area to provide the average number per household.</p>
Any comment:	<p>Where statistical data defining number of persons per household may not be available the Project coordinator may need to assess any additional data that to be obtained during the data collection process at the point of supply and/or installation of the supplied product. Such data may also need to be confirmed during the external independent sampling process. Refer also to Section IV – Annexures Clause 7 “Number of Showers per day per Household”.</p>

## Section III: MONITORING METHODOLOGY

### 1. Monitoring Options

This methodology provides two separate alternative options for monitoring. The alternatives available are:

#### **Simplified Monitoring Procedure Option – Applicable only to scenarios (a), (b), (c) and (d)**

This option must be used for any proposed Supply Only program and may be used for proposed Supply and Installation programs. Under this option the procurement of the CFLs is based on their specified conformance to a relevant international or equivalent national standard for product quality and the specified standard includes for lifetime, on/off cycles, start time and colour rendering, the Project coordinator may use a “Simplified Monitoring Procedure” this being a “deemed saving approach”. This approach is characterised by the following:

#### *Efficient lighting:*

- The CFL products used in the program conform to a relevant international or equivalent national standard with respect to all of the following criteria: lifetime, on/off cycles, start time, and colour rendering;
- The project proponent is able to demonstrate that a scheme for the collection and appropriate disposal or recycling of CFLs at the end of lifetime is properly planned;
- The allocated credits for the CFL products are to be those that are calculated for the CFL abatement period, i.e. the rated lifetime of such installed CFL products, or the period between the installation of the considered batch and the end of the crediting period. The crediting period in such a case is defined in accordance with the Gold Standard requirements (standard crediting period) and with the installation time of the first batch of CFLs as the starting date.
- Monitoring of the use of the product during the abatement period is excluded. The necessary monitoring relevant to the determination of the emission reductions over the abatement period is all undertaken only during the installation period;
- A DOE must be contracted shortly after the installation of each batch of CFLs for the Verification of the sampling process and of the calculations performed for the evaluation of the anticipated emission reductions achieved by each batch of CFLs over the abatement period.
- If, following the product installation period, a future ban on the importation of inefficient incandescent light bulbs is announced and imposed within the project area, such a ban will not impact on the already calculated credits for the CFL products installed under the program. The fact that no ban was announced and planned before the installation of the considered

batch of CFLs within the project activity must be confirmed and validated by a DOE at the time of verification of the installation of the first batch.

- The Project coordinator is still to monitor the sustainable development aspects during the abatement period and is to nominate in the VER-PDD how this is to be achieved together with actions to be taken by the Project coordinator to ensure achievement;
- The calculated credits may be claimed at the completion of the product installation period for each one of the batches. The vintages of the credits delivered during the abatement period will be defined according to when the resultant Emission Reductions are expected to occur.
- A minimum of 10% of the calculated credits, or a minimum amount of 5,000 credits, whichever is the greater, are to be set aside. The delivery of these set aside abatement credits will only occur at the end of the abatement period and will be subject to the verification of the achievement of the nominated sustainable development aspects of the proposed program as outlined in the approved VER-PDD and as per GS rules.

#### *Efficient Showerheads:*

- Prior to the replacement of a Showerhead the Project coordinator is to measure the water flow through the existing shower to ensure that it is able to be classified as an inefficient Showerhead and thus able to be replaced under the program. Each of the LFSs and the FRs proposed for have been tested by an independent testing authority and the flow rate has been certified by that authority as being less than or equal to 9 litres per minute.
- The Project coordinator, when defining the proposed abatement period for the LFS, will take into consideration and adhere to any statutory/legislative requirements that may be applicable to recognisable abatement periods within the proposed project area and/or the project period as defined by GS, whichever is shorter.
- The allocated credits for the LFS products are to be those that are calculated for the LFS abatement period, i.e. the rated lifetime of such installed LFS products, or the period between the installation of the considered batch and the end of the crediting period. The crediting period in such a case is defined in accordance with the Gold Standard requirements (standard crediting period) and with the installation time of the first batch of LFS as the starting date.
- Monitoring of the use of the product during the abatement period is excluded. The necessary monitoring relevant to the determination of the emission reductions over the abatement period is all undertaken only during the installation period;
- The resultant calculated credits are able to be issued for the entire abatement period after the monitoring and verification by a DOE of the installation phase within a representative sample has shown that the installed LFS and FRs are operating within their respective defined flow rate parameters. The actual tested flow rates for the proposed s and FRs to be installed in the



proposed program are to be used when calculating the associated abatement credits.

- If, following the product installation period, a future ban on the importation of inefficient Showerheads is announced and imposed within the project area, such a ban will not impact on the already calculated credits for the LFS products installed under the program. The fact that no ban was announced and planned before the installation of the considered batch of LFS within the project activity must be confirmed and validated by a DOE at the time of verification of the installation of the first batch.
- The Project coordinator is still to monitor the sustainable development aspects during the abatement period and is to nominate in the VER-PDD how this is to be achieved together with actions to be taken by the Project coordinator to ensure achievement;
- The calculated credits may be claimed at the completion of the product installation period for each one of the batches. The vintages of the credits delivered during the abatement period will be defined according to when the resultant Emission Reductions are expected to occur.
- A minimum of 10% of the calculated credits, or a minimum amount of 5,000 credits, whichever is the greater, are to be set aside. The delivery of these set aside abatement credits will only occur at the end of the abatement period and will be subject to the verification of the achievement of the nominated sustainable development aspects of the proposed program as outlined in the approved VER-PDD and as per GS rules.

#### **Extended Monitoring Procedure Option – Applicable to all scenarios**

This option must be used if the procurement of the CFLs is not based on their specified conformance to a relevant international or equivalent national standard for product quality or the specified standard does not include for lifetime, on/off cycles, start time and colour rendering. By using this extended monitoring process the Project coordinator accepts that:

- Monitoring of product installation is undertaken during the installation period;
- Monitoring of the use of the product during the crediting period is included and is to be undertaken at the frequency as defined by GS as a minimum. Note that more frequent monitoring may be proposed in the GS-VER PDD by the Project coordinator to achieve “Good Practice”;
- If during the monitoring, failed product in either the BSG or the PSG is encountered such product is to be replaced;
- The allocated credits for each one of the batches of CFLs, LFS or other WSPs are to be those that are calculated for the monitoring periods of such batches of installed CFLs, LFS or other WSPs;
- If, following the product installation period, a future ban on the importation of inefficient incandescent light bulb, Showerheads or other Water Fixtures is imposed within the project

area, such a ban will not impact on the already calculated credits for the CFLs, LFS or other WSPs installed under the program, but will impact on future credits from the date of the commencement of the ban. The fact that no ban was announced and planned before the installation of the considered batch of CFLs, LFS or other WSPs within the project activity must be confirmed and validated by a DOE at the time of the first verification of the considered batch.

- The crediting period is defined in accordance with the Gold Standard requirements (standard crediting period) and with the installation time of the first batch of CFLs, LFS or other WSPs as the starting date.
- The calculated credits may be claimed at the completion of each monitoring period following verification;
- If the project activity has been registered under a renewable crediting period, the Project coordinator is to:
  - Inspect each product installation site and replace all failed products or replacement products that are not energy efficient;
  - Inspect the hot water heating system at all sites where LFS and other WSPs have been installed to ensure heating is still being provided through the use of electricity or direct combustion of fossil fuels. Where an alternative energy source, such as solar or biomass energy, is encountered, the site is to be removed from all future abatement calculations;
  - Recalculate or confirm the following Data and Parameters that are not continuously monitored and adjust the abatement calculations accordingly:
    - $EF_i$  = Grid Emission Factor;
    - $PF_{l,i}$  = Penetration Factor of efficient CFL's;
    - $PF_{s,i}$  = Penetration Factor of efficient LFS's;
    - $PF_{f,i}$  = Penetration Factor of non-LFS WSPs;

The Project coordinator is to nominate in the project specific VER-PDD which monitoring procedure is proposed to be used in the project.

## 2. Monitoring Procedures

During monitoring, the provisions as outlined in the baseline methodology, in particular steps 7, 8, 9, 10 and 11 will apply. Monitoring will involve, inter alia, the collection of the following data:

- The name and/or number of the proposed Project area  $i$ ;
- The identification and relevant details of those households that are located within the Project

area *i* and elect to become a project beneficiary in the proposed project including:

- Name;
- Address;
- contact telephone number;
- fax number;
- email;
- Nominated Verification Form number
- The eligibility data for the premises of each project beneficiary including:
  - The type of hot water heating system at the house;
  - The year the house was constructed/received its last major upgrade (product installation program only);
  - Number of existing Showerheads in the house and whether they are already energy efficient (product installation program only);
  - Number of light bulbs supplied by size(wattage) and fitting type (Screw/bayonet);
  - Number of Showerheads supplied and/or installed;
  - Number of FRs supplied and/or installed;
  - Number of WSPs supplied and installed;
  - Date product supplied and/or installed;
  - Name and ID card number of Project coordinator's representative the provided and/or installed the light bulbs / Showerheads / FRs / other WSPs;
  - The signed acceptance of the supplied and/or installed product by the project beneficiary;
  - The assignment of all project generated carbon offset credits associated with the household address from the project beneficiary to the Project coordinator;
- The details of the Project coordinator's field representatives including:
  - Name;
  - Residential address;
  - Contact telephone number;
  - Assigned ID card number;

For the Baseline Emissions Scenario with the modelled energy consumption by the existing inefficient incandescent light bulbs the following data associated with the energy usage of the bulbs needs to be monitored:

- The data associated with the existing light bulbs that will be replaced in Project area *i*, being the initial statistical sample size and the wattage of each individual bulb in the sample. The average wattage is then calculated from this sample (Data Item  $\mathbf{W}_{b,i}$ ) and used in the baseline emission calculation.

- The data associated with the wattage of the existing bulbs is regularly confirmed at two (2) monthly intervals during the product installation period through random spot checking of the collected inefficient bulbs to ensure that the initial assumption remains valid.

### **3 Data Collection Procedures**

If possible, all data that nominated in Clause 6 – “Data and Parameters Monitored” following is to be collected and recorded in the field by trained representatives of the Project coordinator using Ultra Mobile Personal Computers (UMPC’s) or similar devices that have project specific software installed on them. The UMPC’s are to be regularly synchronised with the Project coordinator’s main servers at which time all the data in the UMPC’s is to be automatically transferred over to the main servers.

Alternatively, field data sheets can be filled out by trained representatives of the Project coordinator and sent on a daily basis to a centralized data capturing and storage center where monitoring data will be entered into the main servers. All field data sheets will be kept both physically and in a digital format (scanned) for the length of the crediting period.

The other data that is collected is that associated with stock control. This data, together with the result of field audits to be undertaken by the Project coordinator and telephone audits to be undertaken by both the Project coordinator and by an appointed external independent sampling organisation is to be used to ensure that the Project coordinator’s field representatives are not over issuing installed product, or nominating on the UMPC or field data sheets that more product has been installed than has occurred in the field thereby causing an over-claim of achieved abatement.

The Project Coordinator is to carry out a field audit program to target sufficient number of the completed installations, randomly selected from the database of all installations such that each individual installer is audited and, where the installation process is subcontracted, each installation company is also audited to achieve a confidence level of 95% in the results obtained.

The Project coordinator is to undertake a telephone audit program to target sufficient number of the completed installations, randomly selected from the database of all installations such that each individual installer is audited and, where the installation process is subcontracted, each installation company is also audited to achieve a confidence level of 95% in the results obtained. The telephone audits are to be used by the Project coordinator to extrapolate the results of the Project coordinator’s field audits (see above).

Where the Project coordinator’s telephone audit program identifies that the data presented by the Project coordinator’s installation representative is inconsistent with that obtained via the telephone audit, the Project coordinator will undertake additional field audit(s) to prove that the installation data is correct.

Further, telephone audits undertaken by an appointed external independent sampling organisation are to be randomly selected from the database of completed installations with the number of audits statistically calculated to provide a 95% confidence interval in the results obtained.

#### **4 Quality Assurance Procedures**

The Project coordinator is to develop suitable processes, procedures and overall project monitoring and management plan that will address the following requirements to ensure that the data obtained and used to calculate the overall achieved abatement is valid. Such Processes, Procedures and Plans are to address:

- Project Plan Scope;
- Process Flow Charts for each differing project type;
- The Project Organisation Chart;
- Project Management Team Authorities and Responsibilities;
- Process Organisation; including:
  - Monitoring of the Project parameters, activities and operations;
  - Transfer of Emissions to other sites (Leakage);
  - Identification of variables in baseline emissions
  - Responsibilities for monitoring;
- Operational Control; including:
  - Operations and/or Activities that are to be controlled;
  - Definition of the controlling mechanisms;
  - Documentation of the relevant operational criteria;
  - Measure to be put in place to control the identified risks;
- Training and competence;
- Corrective and Preventive actions;
- Monitoring equipment
- Data; including:
  - Procedures for collection of data in the field;
  - Nominated Laboratories;
  - Intended sampling processes;
  - Estimating and controlling statistical error;
  - Quality control for ensuring data accuracy;
  - Nominated sampling call centre provider;
- Record control; including:
  - Identification of records to be kept in support of achieved abatement;
  - Record audit trail;

- Maintenance of records;
- Making records available;
- Storage and retention of records;
- Records to be kept;
- Supporting data.

## **5 Data Storage Procedures**

All monitored data should be stored in electronic databases that have been designed to suit the project requirements and ease of access for audit purposes. A complete extract of the database should be made available to the project auditor with each monitoring report.

## **6 Equipment Calibration Procedures**

Any measurement equipment that may be used in the program should be calibrated and regularly maintained and checked for its functioning according to manufacturer's specification and relevant national or international standards. Methods for undertaking such calibration and maintenance should be detailed.

## **7 Data and parameters monitored**

<b>Data / Parameter:</b>	$T_{l,i,x}$ or $T_{l,i}$
<b>Data unit:</b>	Number
<b>Description:</b>	Total number of light bulbs supplied and/or installed in the proposed project in the Project area <i>i</i> during monitoring period <i>x</i> or abatement period (as applicable);
<b>Source of Data:</b>	Counted by Project coordinator's field representatives based on their installations
<b>Measurement Procedures (if any):</b>	Counted at the time of Supply and/or Installation.
<b>Monitoring frequency:</b>	Determined for each monitoring interval <i>x</i> or at the time of installation of a new batch (as applicable) based on the data collect at time of installation and input into the database
<b>QA/QC procedures:</b>	Monitored via Project coordinator's random telephone desktop audits, random field audits and supported via independent audits by qualified

	sampling organisation
Any comment:	Refer also to Section IV – Annexure Clause 13 “Total number of CFL’s to be installed and the Number per Household”.

<b>Data / Parameter:</b>	$W_{b,i}$
Data unit:	Kilowatts (kw)
Description:	Average energy rating of the existing lights that are to be replaced in the Project area <i>i</i> .
Source of Data:	Based on the average wattage of a statistically defined sample size.
Measurement Procedures (if any):	The total wattage is to be added up and divided by the total number of bulbs obtained in the sample to provide the average
Monitoring frequency:	At the beginning of the project in the Project area <i>i</i> and spot checking every 2 <sup>nd</sup> month throughout the program to ensure that the initial assumption remains valid.
QA/QC procedures:	The initial sample bulbs are to be stored in a sealed drum and kept for the length of the project supply and/or installation period. They are to be available for external audit purposes. The two-monthly random spot checking bulbs are to be stored in sealed drums for the period from collection through until the time of the next monitoring audit. The drums are to be identified showing the month of collection. Following the monitoring audit the bulbs are to be recycled.
Any comment:	A defined size sample batch is to be obtained and the resulting wattages averaged. The size of the sample batch to be sufficient to provide a 95% level of certainty in the results obtained. Refer also to Section IV – Annexure Clause 3 “Size of Existing Incandescent Light bulbs”.

<b>Data / Parameter:</b>	$W_{p,i}$
Data unit:	Kilowatts (kw)
Description:	Average energy rating of the replacement energy efficient lights that are distributed / installed in the Project area <i>i</i> by the Project coordinator.
Source of Data:	As provided by the product manufacturer and recorded by Project

	coordinator's field representatives based on their Supply and/or Installation.
Measurement Procedures (if any):	Recorded at the time of Supply and/or Installation. The total wattage is to be added up and divided by the total number of bulbs installed in the project area to provide the average
Monitoring frequency:	Determined for each monitoring interval $x$ , or for the abatement period for the "Simplified Monitoring Procedure" option (as applicable) based on the data collect at time of installation and input into the database
QA/QC procedures:	Monitored via Project coordinator's random telephone desktop audits, random field audits and supported via independent audits by qualified sampling organisation
Any comment:	Refer to Section IV – Annexure Clause 15 "Energy Rating of Installed CFL's".

<b>Data / Parameter:</b>	<b><math>LRF_{i,i}</math></b>
Data unit:	Number (being Less than or Equal to 1)
Description:	Lifetime Reduction Factor of the replacement energy efficient lights that are distributed / installed in the Project area $i$ .
Source of Data:	Either: <ul style="list-style-type: none"> <li>• Calculated based on laboratory testing undertaken; or</li> <li>• Equal to 1 based on evidence and/or data provided by the local electricity supply authority</li> </ul>
Measurement Procedures (if any):	As per Section IV: Monitoring Methodology Section 21: Lifetime of Appliances – For Light Bulbs
Monitoring frequency:	As per Section IV: Monitoring Methodology Section 21: Lifetime of Appliances – For Light Bulbs
QA/QC procedures:	By the appointed, independent, laboratory testing organisation.
Any comment:	Refer to Section IV: Monitoring Methodology Section 21: Lifetime of Appliances – For Light Bulbs



<b>Data / Parameter:</b>	$EF_{s,wh,i}$
Data unit:	Percentage
Description:	Average electrical efficiency rating of electric hot water heating system in the Project area <i>i</i> . To be based on averaged data published by the heating system manufacturers for the systems used within the Project area <i>i</i> . Refer also to Section IV: Annexures, Clause 20: Efficiency of Electric Hot Water Heaters in the Project area <i>i</i> .
Source of Data:	Data related to the existing electrical hot water heating system is collected and recorded by Project coordinator's field representatives at the time of the shower installation.
Measurement Procedures (if any):	Recorded at the time of Installation. The efficiency ratings obtained for each heater are to be added together and averaged.
Monitoring frequency:	Determined for each monitoring interval <i>x</i> or abatement period (as applicable) based on the data collect at time of installation and input into the database. Refer also to Section IV: Annexures, Clause 20: Efficiency of Electric Hot Water Heaters.
QA/QC procedures:	Monitored via Project coordinator's random field audits
Any comment:	Refer to Section IV: Annexures, Clause 20: Efficiency of Electric Hot Water Heaters. This cannot be used in conjunction with the "Simplified Monitoring Procedure option.

<b>Data / Parameter:</b>	$IDF_{i,x} / IDF_i$
Data unit:	percentage
Description:	Installation Discount Factor of households located in Project area <i>i</i> during abatement period or monitoring period <i>x</i> (as applicable) for the installation of the lights, Showerheads or Water Fixtures – calculated separately.
Source of Data:	Calculated by the Project coordinator and confirmed by the appointed, independent, qualified, sampling organisation based on the results of their sampling process
Measurement Procedures (if any):	Telephone sampling by the Project coordinator and confirmed by the appointed, independent, qualified, sampling organisation

Monitoring frequency:	Ongoing during installation by the Project coordinator and by the appointed, independent, qualified, sampling organisation.
QA/QC procedures:	By both the Project coordinator and the appointed, independent, qualified, sampling organisation.
Any comment:	Refer to Step 10 – Random Sampling of Installations.

<b>Data / Parameter:</b>	<b>THW<sub>s,i,x</sub> / THW<sub>s,i</sub></b>
Data unit:	Number
Description:	Number of households with electrically heated hot water systems located in Project area <i>i</i> during monitoring period <i>x</i> at the time of LFS installation of a new batch (as applicable);
Source of Data:	Counted by Project coordinator's field representatives based on their installations
Measurement Procedures (if any):	-
Monitoring frequency:	Determined for the monitoring interval <i>x</i> or the abatement period (as applicable) based on the data collect at time of LFS installation and input into the database
QA/QC procedures:	Monitored via Project coordinator's random telephone desktop audits, random field audits and supported via independent audits by qualified sampling organisation
Any comment:	The Project coordinator is to define the total number of households that are anticipated to participate in the overall program. Refer also to Section IV – Annexure Clause 14 " <i>Total number of LFS's and Other WSPs to be installed and the Number per Household</i> ".

<b>Data / Parameter:</b>	<b>PC<sub>i</sub></b>
Data unit:	Percentage (%)
Description:	Penetration of the existing replaced product (lights, Showerheads and Water Fixtures) within Project Area <i>i</i> as at monitoring period <i>x</i>

	commencement for the “Extended Monitoring Procedure” option and as at project commencement for the “Simplified Monitoring Procedure” option;
Source of Data:	Project coordinator to assess the marketplace at project commencement and, where available, to source 5 years of historical data
Measurement Procedures (if any):	-
Monitoring frequency:	At project commencement for both “Extended” and “Simplified Monitoring Procedure” options and at the commencement of each new crediting period for the “Extended Monitoring Procedure” option.
QA/QC procedures:	The Project coordinator is to nominate in the VER-PDD how this process is to be monitored.
Any comment:	Refer also to Section IV – Annexure Clause 19 “ <i>Market Penetration of Energy Efficient Products</i> ”.

<b>Data / Parameter:</b>	<b>PAG<sub>i</sub></b>
Data unit:	Percentage (%)
Description:	Annual Percentage decline of product in the market place within Project area <i>i</i> (%) based on historical data (with a minimum decline of 1% per year);
Source of Data:	Project coordinator to assess the marketplace at project commencement and, where available, to source 5 years of historical data
Measurement Procedures (if any):	-
Monitoring frequency:	At GS nominated timeframes for the “Simplified Monitoring Procedure” option and at the renewal of the crediting period for the “Extended Monitoring Procedure” option.
QA/QC procedures:	The Project coordinator is to nominate in the VER-PDD how this process is to be monitored.
Any comment:	Refer also to Section IV – Annexure Clause 19 “ <i>Market Penetration of Energy Efficient Products</i> ”.

<b>Data / Parameter:</b>	<b>Efficient Showerheads</b>
Data unit:	Number
Description:	Number of Showerheads and FRs that are supplied to and installed in participating households located in Project Area <i>i</i> during abatement period or monitoring period <i>x</i> (as applicable) that have electrically heated hot water systems;
Source of Data:	Counted by Project coordinator’s representatives based on their supply and installations
Measurement Procedures (if any):	-
Monitoring frequency:	Determined for each monitoring interval <i>x</i> or at the time of installation of a new batch (as applicable) based on the data collect at time of installation and input into the database
QA/QC procedures:	Monitored via Project coordinator’s random telephone desktop audits, random field audits and supported via independent audits by qualified sampling organisation
Any comment:	The Project coordinator is to define the total number of households that are anticipated to participate in the overall program. Refer also to Section IV – Annexure Clause 14 “ <i>Total number of LFS’s and Other WSPs to be installed and the Number per Household</i> ”.

<b>Data / Parameter:</b>	<b>Destruction of Incandescent Lightbulbs</b>
Data unit:	Number
Description:	All replaced incandescent light bulbs are collected, stored until sufficient have been collected and then destroyed.
Source of Data:	Project coordinator’s representatives based on their supply and/or installations. Number of collected bulbs is to equal the number of those installed.
Measurement Procedures (if any):	-
Monitoring frequency:	Determined for each monitoring interval <i>x</i> or at the end of the abatement period for a given batch (as applicable) based on the data

	collect at time of installation and input into the database.
QA/QC procedures:	Monitored via Project coordinator's representative; regular recording of the wattages of the collected bulbs for comparison with baseline samples and waste records of the recycled materials.
Any comment:	Waste material to be recycled.

<b>Data / Parameter:</b>	<b>Rebound Effect of Increased Energy Usage resulting from higher utilisation of energy efficient products</b>
Data unit:	Kwh
Description:	Spot check of possible rebound effect being the increased usage of the installed efficient lighting and/or increased Water Fixture utilization times resulting from decreased energy costs to the householder.
Source of Data:	Project coordinator's site measurement of representative sample of households.
Measurement Procedures (if any):	To be defined in Project Specific VER-PDD
Monitoring frequency:	Determined for the initial monitoring interval x or abatement period (as applicable) based on data collected following the installation.
QA/QC procedures:	Monitored via Project coordinator's random field audits of installed products
Any comment:	-

<b>Data / Parameter:</b>	<b>Legislative Changes</b>
Data unit:	-
Description:	Legislative changes may occur during the program that will impact on the project additionality and thus on the Project coordinators ability to obtain credits for the abatement achieved.
Source of Data:	Legislative database
Measurement Procedures (if any):	-
Monitoring	The Project coordinator is to nominate the data that may be affected by

frequency:	such legislative changes and how this is to be monitored
QA/QC procedures:	-
Any comment:	Refer also to Section IV – Annexure Clause 17 “ <i>Legislative Changes</i> ”.

<b>Data / Parameter:</b>	<b>Collection and Disposal of CFL Products</b>
Data unit:	Number
Description:	CFL bulbs are collected at the end of their “ <i>life</i> ”, stored until sufficient have been collected and appropriately disposed. Such disposal is to include the removal of mercury gases and then recycling (if such facilities are available).
Source of Data:	Project coordinator’s representatives based on the collection and storage of the CFL bulbs at the end of their “ <i>life</i> ”.
Measurement Procedures (if any):	-
Monitoring frequency:	The Project coordinator is to nominate in the VER-PDD how this process is to be undertaken and monitored in accordance with GS minimal requirements.
QA/QC procedures:	Monitored via Project coordinator’s representative; regular recording of the numbers of the collected bulbs for comparison with numbers installed and waste records of the recycled materials (if such recycling facilities are available).
Any comment:	Refer also to Section IV – Annexure Clause 24 “ <i>Collection and Disposal of CFL Products</i> ”.

## Section IV: ANNEXURES

The following comments relate to the various assumptions made during the development of the proposed program in the various locations where this program may be able to be implemented:

### 1 Public Consultation Process

Public consultation is a necessary factor that must be taken into account in all projects that endeavour to reduce the impact of GHG on our environment.

There are generally two public consultation processes.

The initial process is undertaken during the project development phase and is used to obtain and assess the reaction of the public to the proposed project and incorporate any acceptable changes into the design of the overall project. Where the proposed project covers a large geographical area the period of initial public consultation process may need to be extended to ensure that all applicable organisations are consulted. If previously obtained and validated public consultation data is available for a project similar to the proposed project activity location, projects proponents may use the applicable results of these previous consultation processes as an alternative to the process as outlined above.

Where the proposed project covers large geographical areas and population concentrations it may be considered that a meaningful follow up public consultation process would be better undertaken when the Project coordinator, or his representative, meets each proposed individual project beneficiary and explains the overall project to them as part of their briefing prior to their acceptance to become involved. This may be in the format of a one-on-one discussion supported via the provision of appropriate literature that includes an explanation of the project and a set of FAQ's (frequently asked questions) with the necessary responses/answers to those FAQ's. Through this process every project beneficiary would be fully informed and able to make a decision on whether he/she wish to become part of the project as a project beneficiary.

The Project coordinator is to document the proposed public consultation method in the project specific VER-PDD.

### 2 Environmental Impact of CH<sub>4</sub> and N<sub>2</sub>O Gases

Where such data is available, the value of CO<sub>2</sub>-e as provided within the data and used in the calculations may already include in the Emission Factor EF<sub>i</sub> for the consumption of purchased electricity associated with the impact of relatively small quantities of CH<sub>4</sub> and N<sub>2</sub>O.

### 3 Size of Existing Incandescent Light bulbs

The existing incandescent light bulbs that are proposed for replacement by energy efficient light bulbs will have various energy ratings defined by the wattage of the bulbs. Under this proposed methodology it is proposed that all of the replaced bulbs are collected. It is further proposed that at regular defined two-monthly intervals the Project coordinator is to undertake spot checking of the collected bulbs, record their characteristics and compare them with those obtained from the initial sample to ensure that the initial calculations remain valid. The energy ratings of the bulbs forms part of the baseline emissions calculations and must be allowed for in those calculations. To obtain the necessary information it is proposed that the Project coordinator:

- At the commencement of the Supply and Installation sub-project within Project area *i*, collects a statistically representative sample of incandescent light bulbs from the project beneficiaries, the wattages of all of the sample bulbs be added together and then divided by the total number of such sample bulbs to provide an average wattage for the replaced bulbs;
- The replaced bulbs in the statistically representative sample are collected and stored for later access as necessary for audit purposes;
- Uses the average wattage figure in the initial calculations for the baseline emissions in both the Supply Only and the Supply and Installation sub-projects in Project area *i*;
- At regular intervals during the project installation program as nominated by the Project coordinator in the project specific VER-PDD, records the characteristics of a random sample of collected bulbs prior to their destruction, averages the wattages obtained and compares them with those obtained during the initial sampling process to ensure that the initial calculations for the baseline emissions remain valid. The bulbs collected in the random sample are to be stored until the next monitoring audit, the storage being in marked drums (or similar) that identifies the date of collection. Following the monitoring audit the random sample bulbs are to be recycled. Where the results of the random sample show that the average wattage is different from that obtained during the initial sample by a factor in excess of 5% of the initial sample average wattage the Project coordinator is to ensure that the Project Emission calculations are adjusted to take this difference into account.
- As part of the external independent sampling process to confirm the Installation Discount Factors IDF for the areas of the projects in Project area *i* during monitoring period *y*, requires the Sampling organisation to ask questions of the project beneficiary households to ascertain the size, in general terms, of the bulbs that were replaced;



- Reviews the results of these queries with the appointed sampling organisation prior to their calculation of the applicable IDF;
- Keeps records of all of the above processes.

The Project coordinator is to document the above processes in the project specific VER-PDD.

#### 4. Abatement Period for the Replacement Energy Efficient Light bulbs

The Rated Life (see Definitions), in operating hours, of the replacement energy efficient light bulbs is to be based on test data obtained in accordance with the standard IEC/ISO60969. For a summary of the standard refer to: [http://www.apec-esis.org/test\\_standard.php?no=570](http://www.apec-esis.org/test_standard.php?no=570).

In addition, the Project coordinator is to either monitor the utilization hours of the lights in a statistically representative sample of households, or require the use of a conservative enough assumption (e.g. 3 – 5 hours per day) supported by several available and convincing references.

If, however, a scientifically validated study is available for the utilisation hours of the lights within the project activity location, the Project coordinator can make use of it to define the overall Abatement Period.

When the Project coordinator opts to use the Simplified Monitoring Procedure option (allowable whenever the Project coordinator uses a national or international standard as the basis for the procurement of the CFLs) and if the Project coordinator is able to demonstrate that a scheme for the collection and appropriate disposal or recycling of CFLs at the end of lifetime is properly planned:

- The abatement period corresponds to the rated lifetime of the supplied and/or installed CFLs;
- Only one abatement period is claimable within a given group of targeted households;
- The resultant calculated credits are able to be issued for the entire abatement period after the monitoring and verification by a DOE of the installation phase within a representative sample has shown that the installed CFLs are operating properly and the anticipated emission reductions have been calculated properly.

The Project coordinator will also take into consideration and adhere to:

- Any statutory/legislative requirements that may be applicable to recognisable abatement periods within the proposed project area and/or the project period as defined by GS, whichever is shorter;
- Any reduction to the overall abatement period required as a direct result of the requirements of Clause 19: Market Penetration of Energy Efficient Products, specifically those associated with the implementation of a future ban on the importation of incandescent light bulbs.

The Project coordinator is to document the proposed method and associated calculations in the project specific VER-PDD.

## **5 Existing Inefficient Showerheads / Water Fixtures and Measurement of Water Flow**

Inefficient Showerheads are those where the water flow rate exceeds 9 litres per minute. Such Showerheads could have a flow rate that ranges from 9.1 litres per minute up to 37 litres per minute

For low-pressure water distribution systems, an inefficient Showerhead/Water Fixture can be defined as that which provides a water flow of one (1) liter per minute above the rated flow of a certified WSP.

Prior to the replacement of a Showerhead or Water Fixture in the Supply and Installation sub-project the Project coordinator is to measure the water flow through the existing shower to ensure that it is able to be classified as an inefficient Showerhead and thus able to be replaced under the program. The Project coordinator is to nominate how this measurement process is to be undertaken such that it is relevant to the proposed Project Area i. The Project coordinator is to document the proposed measurement process in the project specific VER-PDD.

For the water flow associated with the existing inefficient Showerheads/Water Fixtures to be used for the calculations of the baseline emissions the Project coordinator is to assess the existing Showerheads/Water Fixtures and use the most common configuration for in the typical house within the Project area i. The Project coordinator may also use data obtained from a scientifically valid study, where such is available and is applicable to the proposed Project Area i.

The Project coordinator is to document the proposed method in the project specific VER-PDD.

## **6 Abatement Period for the Replacement Low-Flow Showerheads**

The Project coordinator, when defining the proposed abatement period for the LFS, will take into consideration and adhere to any statutory/legislative requirements that may be applicable to recognisable abatement periods within the proposed project area and/or the project period as defined by GS, whichever is shorter.

In addition, the Project coordinator is to either monitor the utilization hours of the Showerheads in a statistically representative sample of households, or require the use of a conservative assumption supported by several available and convincing references.

If, however, a scientifically validated study is available for the Showerhead utilisation time within the project activity location, the Project coordinator can make use of it to define the

overall Abatement Period.

When the Project coordinator opts to use the Simplified Monitoring Procedure option:

- The abatement period corresponds to the rated lifetime of the supplied and installed LFS and FRs;
- Only one abatement period is claimable within a given stock of households when the Project coordinator uses the Simplified Monitoring Procedure option.
- The resultant calculated credits are able to be issued for the entire abatement period after the monitoring and verification by a DOE of the installation phase within a representative sample has shown that the installed LFS and FRs are operating within their respective defined flow rate parameters.

The Project coordinator is to document the proposed method in the project specific VER-PDD.

## **7 Number of uses per day per Household**

The number of uses for each Showerhead or Water Fixture per day per household is based on the premise that each resident in the household will have a minimum of one (1) shower per day and will utilize each Water Fixture one (1) time per day..

The number of persons residing at each residence is to be based on the statistical averages within the proposed project area *i* as obtained from the local relevant statistical data bureau.

In addition, the Project coordinator is to either monitor the number of times per day the Showerheads or other Water Fixtures are utilised in a statistically representative sample of households or require the use of a conservative assumption supported by several available and convincing references.

If, however, a scientifically validated study is available for the Showerhead utilisation time within the project activity location, the Project coordinator can make use of it to define the overall number of showers per day.

The Project coordinator is to document the proposed method in the project specific VER-PDD.

## **8 Number of Utilization Days per Household**

The Project coordinator is to assess the number of days that the showers and Water Fixtures will be used per year. It may be considered to be the number of days per year less those applicable when the house is unoccupied as the occupiers are on holidays away from the property.

The Project coordinator is to document the proposed number of days in the project specific VER-PDD.

## **9 Utilization Time of Each Water Fixture**

The Project coordinator is to assess and propose the time period that each Water Fixture is used in the proposed program in the proposed project location. To achieve this, the Project coordinator is to either monitor the duration time the Showerheads and other Water Fixtures are utilised in a statistically representative sample of households, or require the use of a conservative assumption supported by several available and convincing references.

If, however, a scientifically validated study is available for the Showerhead or Water Fixture duration time within the project activity location, the Project coordinator can make use of it to

define the overall utilization time.

The Project coordinator is to document the proposed method in the project specific VER-PDD.

## **10 Temperature of Fixture Outlet Water**

The Project coordinator is to assess and propose the temperature to be used for normal water utilization requirements for each Showerhead or Water Fixture in the proposed program in the proposed project location. To achieve this, the Project coordinator is to either monitor the temperatures at the Showerheads or Water Fixtures in a statistically representative sample of households, or require the use of a conservative assumption supported by several available and convincing references.

If, however, a scientifically validated study is available for the Showerhead or Water Fixture outlet water temperature within the project activity location, the Project coordinator can use this to support the temperatures in their proposed project.

The Project coordinator is to document the proposed method in the project specific VER-PDD with the calculations for the proposed program being based on a defined average temperature at the shower/Water Fixture outlet.

## **11 Temperature of Fixture Incoming Cold Water**

The Project coordinator is to assess and propose the temperature to be used for the incoming cold water that will be heated for use in the Water Fixtures in the proposed program in the proposed project location. To achieve this, the Project coordinator is to either monitor the temperatures of the incoming cold water in a statistically representative sample of households, or require the use of a conservative assumption supported by several available and convincing references. The measure of the temperature of the incoming cold water is to cover a time period that will ensure that seasonal and weather factors are included in the data obtained.

If, however, a scientifically validated study is available for the incoming water temperature within the project activity location, the Project coordinator can use this to support the temperatures in their proposed project.

The Project coordinator is to document the proposed method in the project specific VER-PDD with the calculations for the proposed program being based on a defined average temperature of the incoming cold water.

## 12 Low-Flow Showerheads, Flow Regulators and Water Saving Products

Each of the LFs, FRs and Other WSPs proposed for use in the project are to be tested by an independent testing authority and the flow rate is to be certified by that authority as per specifications and test methods established in applicable water conservation norms. The actual tested flow rates for the proposed LFSs and FRs to be installed in the proposed program are to be used when calculating the associated abatement credits.

The Project coordinator is to document the proposed replacement Showerhead water flow rate in the project specific VER-PDD.

## 13 Total number of CFL's to be installed and the Number per Household

For the Supply Only program the Project coordinator will provide each registered participating household with sufficient CFLs such that the total number supplied is equivalent to the total number of previously used and functioning inefficient light bulbs returned to the Project coordinator. The proposed number of houses in the Supply only program (Project Area *i*) is to be nominated by the Project coordinator. These houses can be located anywhere within the Project area *i*.

For the Supply and Installation program the Project coordinator will provide and install CFL's within each registered household with the total number per household being equal to the all of the incandescent bulbs that are able to be replaced and with a capacity less than or equal to 100 watts. The proposed number of households in the Supply and Installation program (Project Area *i*) is to be defined.

For a proposed program the proposed number of houses in the Supply and Installation program is to be nominated by the Project coordinator. These houses may be located anywhere within the Project area *i*.

## 14 Total number of LFS's and Other WSPs to be installed and the Number per Household

The Project coordinator is NOT to provide any LFSs, FRs or Other WSPs in the Supply Only program nor is the Project coordinator to claim any abatement credits for these products in a Supply Only program.

For the Supply and Installation program the Project coordinator is to inspect the hot water heating system to ensure that it is either an electrically operated system or a fossil fuel-based system.

For the households that have an electrically heated hot water system the Project coordinator

is to supply and install one (1) low flow Showerhead (LFS) together with sufficient FRs such that all of the Showerheads within the participating household will be energy efficient. While the energy saving calculations are based on the total number of residents within the participating households, not on the number of Showerheads that are changed to be energy efficient LFS the Project coordinator is to monitor the installation of the LFS Showerheads to ensure that all Showerheads are energy efficient. The proposed number of houses in the Supply and Installation program (Project Area *i*) is to be nominated by the Project coordinator. These houses can be located anywhere within the Project area *i*. These households may be the same as those provided with the CFL's under the proposed Supply and Installation program.

For the households that have a fossil fuel-fired water heater, the Project coordinator is to supply and install LFSs or sufficient FRs such that all of the Showerheads within the participating household will be energy efficient. The Project coordinator may also supply WSPs to replace or retrofit other Water Fixtures that provide hot water on a daily basis to household residents are eligible to be retrofitted with WSPs, such as FRs. The Project coordinator will keep an inventory of the set of WSPs supplied and installed at each household in the Project area *i*.

#### **15 Energy Rating of Installed CFL's**

All CFL's that are proposed in the program are to be selected by the Project coordinator such that they generally provide an equivalent lumens of light as the bulb they are to replace with the minimum being a nominal 5W (this being approximately equivalent to a 25W halogen or incandescent bulb) to a maximum being a nominal 20W CFL (this being approximately equivalent to a 100 watt halogen or incandescent bulb). The wattage of the installed bulbs is recorded by the Project coordinator at the time of installation and averaged.

#### **16 Acceptability of Nominated Address**

To ensure that the nominated addresses provided by the project beneficiary prior to the Supply and/or Installation of the provided energy efficient product are acceptable the Project coordinator will:

- Obtain a list/database of all addresses within Project Area *i* where such data is available and reliable. Government, Local Authority or postal authority database suggested;
- Ensure that the project beneficiary's address is nominated within the list/database nominated above;



- Ensure that energy efficient product has not been previously supplied to or installed at the project beneficiary's address.

Where a list/database of all addresses within Project Area i is either not available or not reliable the Project coordinator is to adjust the data collection software to ensure that the address is recorded in the field and checked to ensure that it has not been previously entered.

## **17 Monitoring of Legislative Changes**

The Project coordinator is to ensure that any changes to legislative requirements are assessed and any identified impact is immediately addressed. The monitoring of changes to legislative requirements is to include for:

- Any possible changes to the building construction requirements within the proposed Project Area that includes for the mandatory installation of energy efficient products similar or equal to those that are proposed for replacement under an approved project during the period of the project; and
- Any possible mandatory phase-out of inefficient energy products that are being replaced under an approved project within the proposed Project Area during the period of the project.

The Project coordinator is to nominate how such possible changes will be monitored.

## **18 Ensuring Supplied Product has been and Remains Installed**

The Project coordinator is to appoint an external independent sampling/survey organisation to undertake sufficient sampling of the project beneficiaries to provide a 95% confidence level in the calculations of the Installation Discount Factor (IDF) for each of the Supply Only and Supply and Installation programs. Where appointed the proposed external independent sampling/survey organisation is to be chosen based on their independence, their certification to an acceptable standard (ISO20252 or similar) and/or membership of a relevant professional body operating within the country of the proposed Project Area.

As part of this process, the sampling/survey organisation will ask suitable questions the answers to which will enable the Project coordinator to ascertain whether the supplied product has been installed by the Project beneficiary, whether the supplied and installed product remains installed, is still operating and has not been removed by the project beneficiary. The results of these queries will be incorporated into the IDF calculations.

The questions that will be asked are to include the following as a minimum:

1. Confirm all of the data collected at the date of product supply;
2. Ask the questions as listed under Section II: Baseline Methodology – Clause 4: Emission Reductions – Step 8: Random Sampling of Installations – Methodology;
3. Whether the supplied and installed product remains installed and has not been removed by the project beneficiary;
4. Confirm that the supplied and installed product that remains installed is still operating.

## 19 Market Penetration of Energy Efficient Products

The Project coordinator is to assess the market within Project Area *i* for the decline in penetration of existing non-energy efficient products. Separate calculations are to be made for each product type proposed for replacement under the program

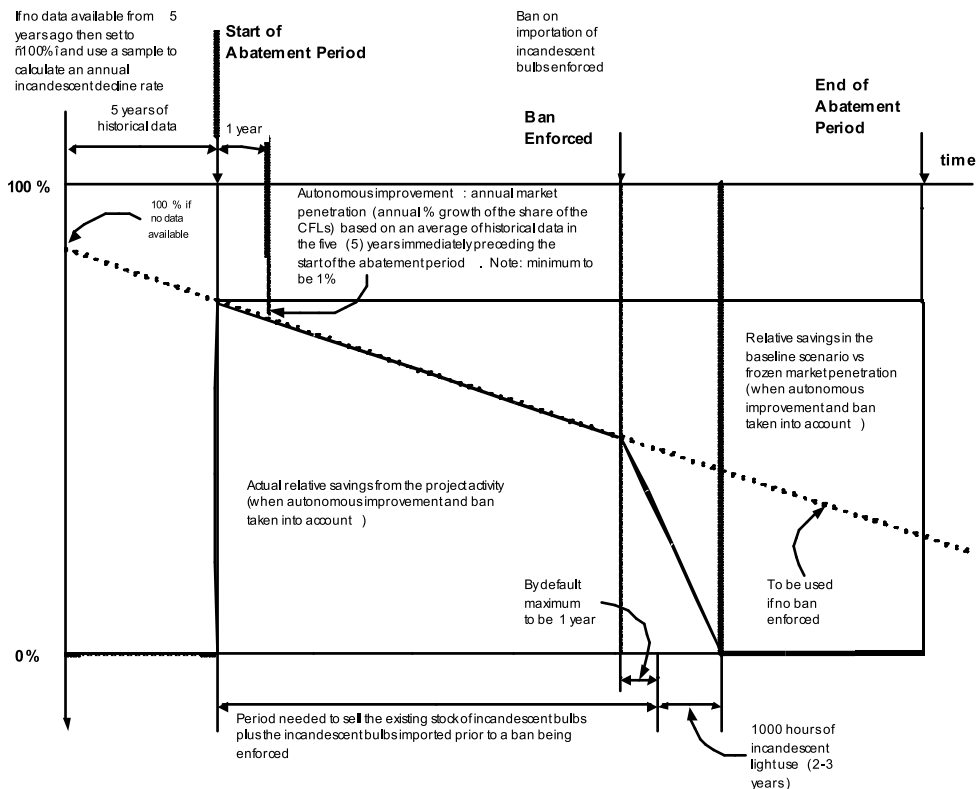
Where energy efficient products are already within the market place the Project coordinator is to obtain up to 5 years of valid historical data from the period immediately prior to the proposed commencement of the project that defines the reduction in take up of the existing non-efficient products within the market place. This is to be expressed as an annual percentage decline figure. Note that the minimum annual percentage decline value is to be 1%.

If no valid historical data is available, the Project coordinator may define an alternative calculation method based on direct observations obtained from pilot programs undertaken prior to the start of the project activity. This data shall be reviewed by an independent, third party entity.

Some potential Host Countries maybe/are proposing future bans on the use of incandescent light bulbs. Where the proposed Host Country has planned for the future implementation of a ban on the manufacture and/or the importation of non-energy efficient (incandescent) light bulbs the Project coordinator is to;

1. Develop a graph of the basic market penetration factor of the existing incandescent product together with its decline for Project Area *i* as a straight line for the overall abatement period
2. Obtain the projected implementation date of the ban;
3. Using valid projection data obtained from the Host Country, assess the projected period for the sale of all existing incandescent light bulbs in the market place together with all projected future imports of incandescent light bulbs into the market place up to the commencement date of the proposed ban;
4. Add the time period of 1000 hours of light use for incandescent light bulbs to the date

- obtained under “19.3” above being the projected total life of such bulbs;
5. On the graph line developed under “19.1” above mark the date obtained under “19.3”;
  6. From the point on the graph obtained under “19.5” above draw a further line to 0% penetration level at the date obtained under “19.4”.
  7. This graph line will define the projected market penetration reduction of the existing incandescent light bulb product during the defined abatement period.



Important

Notes:

1. If the projected adjusted market penetration decline as defined by the adjusted graph reaches 0% before either the Rated Life as defined under Clause 4 – Abatement Period for the Replacement Energy Efficient Lights above or that as defined by the Host Country requirements or that as defined by Gold Standard is achieved then the abatement period as defined by this developed graph is to be used in calculations **(2), (8), (14)** and **(20)** for  $TH_{i,j}$ .
2. Where the Project coordinator elects to use the “Extended Monitoring Procedure” option the Project coordinator is to check the validity of the original market penetration data, including any possible imposition of a future ban on the importation of incandescent light bulbs, at the commencement of each new crediting period and, where the data varies from that originally projected by more than 5%, is to recalculate all of the penetration factors for the next crediting period.
3. Where the Project coordinator elects to use the “Simplified Monitoring Procedure”

option the Project coordinator is to check the validity of the original market penetration data, including any possible imposition of a future ban on the importation of incandescent light bulbs, at the GS nominated timeframes within the overall abatement period and, where the data varies from that originally projected by more than 5%, is to recalculate all of the penetration factors for the remainder of the overall abatement period and adjust the overall abatement credits that will be achieved. This process may result in a reduction of total credits achieved by the proposed project through the cancellation of part or all of the set-aside credits (see Section III, paragraph 1).

The Project coordinator is to document the proposed Host Country factor requirements and the above processes associated with market penetration in the project specific VER-PDD, including any proposed ban that may be proposed by the Host Country in respect to the importation of incandescent light bulbs.

The Project coordinator is also to detail in the VER-PDD how the Project coordinator will ensure that the calculated credits will meet all of the GS requirements and no over-claiming of credits results from future imposition of bans on the importation of incandescent light bulbs during the during the total abatement period.

## **20 Efficiency of Electric Hot Water Heaters**

The Project coordinator may elect to take into consideration the energy efficiencies of the various electrical hot water heating systems that are installed in each of the residences where existing Showerheads are replaced by energy efficient LFS products. Where the Project coordinator makes this election the Project coordinator may only use the “Extended Monitoring Procedure” option for monitoring as outlined in Section III – Monitoring Methodology.

The Project coordinator is to measure to efficiency of the electric hot water heaters used to provide the hot water to the replacement LFSs. To obtain the necessary information the Project coordinator is to undertake the following:

- At the commencement of the Supply and Installation sub-project within Project area *i*, collects the necessary manufacturer’s data from a statistically representative sample of the electric hot water heaters that are used within Project Area *i*, measures the efficiency of such appliances, based on market penetration of each of the heater types within Project Area *i* averages the efficiency of the heaters to obtain an average efficiency rating for all of the water heating appliance in Project Area *i*;
- Uses the average efficiency rating figure in the initial calculations for the baseline emissions in the Supply and Installation sub-projects in Project area *i*;

- At each household where a Showerhead is replaced, obtains the water heating appliance manufacturer's name, appliance capacity, appliance model number and, where noted on the appliance, its efficiency rating;
- At regular intervals during the project installation program as nominated by the Project coordinator in the project specific VER-PDD, records the characteristics of a random sample of collected data, obtains the efficiency ratings from published data, averages the efficiency ratings obtained and compares them with those obtained during the initial sampling process to ensure that the initial calculations for the baseline emissions remain valid. Where the results of the random sample show that the average efficiency rating is different from that obtained during the initial sample by a factor in excess of 5% of the initial sample average efficiency rating the Project coordinator is to ensure that the Baseline Emission calculations are adjusted to take this difference into account;
- Reconfirms all of the data collected at the commencement of the proposed program above and recalculates the average efficiency rating at the commencement of each proposed seven (7) year abatement period extension; and
- Keeps records of all of the above processes.

Where the Project coordinator elects to use the "Simplified Monitoring Procedure" option the Project coordinator will not have the opportunity to calculate the additional abatement available from the inefficiencies associated with the electric hot water heating systems and the function  $EF_{s,wh,i}$  in Calculations 10 and 22 is to be 100%.

Where the Project coordinator elects to use the "Extended Monitoring Procedure" option the Project coordinator is to elect whether they will also take the opportunity to calculate the additional abatement available from the inefficiencies associated with the electric hot water heating systems and the function  $EF_{s,wh,i}$  in Calculations 4 and 16. If the Project coordinator does not elect to take the opportunity to calculate the additional abatement available from such inefficiencies the function  $EF_{s,wh,i}$  in Calculations 4 and 16 is to be 100%.

The Project coordinator is to document in the project specific VER-PDD which of the above processes is proposed for use.

## 21 Lifetime of Appliances

In some proposed Project Areas the project proponent may encounter quality issues associated with the electricity supply and/or water supply that could impact upon the overall life of the installed energy efficient products such that the actual life of the installed product is significantly reduced to be below that as defined in the individual product test results. To ensure that the impact of this is taken into consideration the Project coordinator is to:

a. For Light Bulbs (CFL):

- Obtain data from the electricity supplier that identifies the expected voltage and frequency that are prevalent in the supply grid in the proposed project area;
- Where the data from the electricity supplier identifies large or regular voltage and frequency fluctuations, undertake laboratory testing on a representative sample of the replacement energy efficient products under conditions that simulate the voltage and frequency fluctuations that are prevalent in the electricity grid in the proposed project area;
- Based on the results of the laboratory testing calculate a Life Reduction Factor for replacement lights ( $LRF_1$ ) being a percentage reduction of the “Rated Life” of the product;
- Confirm the calculated  $LRF_1$  based on the laboratory testing results via supplementary additional field testing over a defined time period that ensures that the replacement energy efficient products are fully subjected to the actual field conditions that will be encountered;
- Recalculate the Life Reduction Factor ( $LRF_1$ ) using the results of the supplementary additional field testing;
- Compare the calculated  $LRF_1$  from the laboratory tests with those of the additional field testing. If there is a difference of more than 5% between the two results then, to ensure that a realistic and conservative emissions result is obtained, the lower  $LRF_1$  result is to be used in the total emissions calculation.

If, however, evidence is available from the electricity supply authority that demonstrates that a good quality electricity supply is available within the proposed project area, the Project coordinator may use an  $LRF_1 = 1$ .

b. For LFSs

- Inspect a representative sample of existing Showerheads within the project area for a build-up of contaminants within the Showerheads that may be restricting the water flow through the Showerheads;
- If contaminants are restricting the water flows then:
  - Obtain a sample of the water that will be used in the LFS in the proposed project area and have the sample tested for impurities that may lead to a large build-up of contaminants in the water that restricts the flow to unacceptable level for personal cleaning purposes. Note that a small build-up over the defined product abatement period is acceptable as a restricted water flow will result in less emissions thus providing a conservative outcome;

- Undertake laboratory testing on a representative sample of the replacement LFS under continuous water flow for an overall time period equal to all of the time that the Showerhead will be in use during defined product abatement period and using water with characteristics that a similar or equal to those within the proposed project area;
- The product abatement period is then equal to the shorter of either:
  - When the water flow is reduced by a factor of 20% of the initial flow (LFSs with a flow rate of 9 litres per minute would be considered as reached their effective abatement period when the flow is reduced to  $9 \times 80\% = 7.2$  litres per minute); or
  - The Abatement Period for the Replacement LFSs as per Clause 6 above.

If, however, evidence is available that demonstrates that a good quality water supply is available within the proposed project area, the Project coordinator may use the Abatement Period for the Replacement LFSs as per Clause 6 above.

The Project coordinator is to document the above processes in the project specific VER-PDD.

## 22 Randomisation of Selected Samples

The algorithms for the randomisation of a defined list using the randomiser procedure as located at [www.random.org](http://www.random.org), on which the sample selection procedure for this methodology is based, are available through the site and in peer-reviewed publications listed thereon. These procedures have been shown to provide a better approximation of true randomness than other processes that are available, including the pseudo-random number generators included in such packages as Excel. “Randomising” a list through the use of the functionality available of Excel may, in some instances, produce low “random” numbers for items from the beginning of the original list, and high “random” numbers from the end of the original list. If this situation occurs, the resultant numbers are then not fully randomised.

## 23 Formula Used by Sample Calculator

The following formula are as used by the calculator located at <http://www.surveysystem.com> for the calculation of sample sizes for various input data that is to be statistically analysed.

### Sample Size

$$ss = [Z^2 * (p) * (1-p)] / ci^2$$

Where:

- ss = Sample Size
- Z = Z value (e.g. 1.96 for 95% confidence level)
- p = percentage picking; a choice expressed as a decimal (.5 used for sample size needed)
- ci = confidence interval, expressed as decimal (e.g., .04 = ±4%)

### **Correction for Finite Population**

$$ss_r = ss / \{1 + [ss-1] / pop\}$$

Where:

- ss<sub>r</sub> = Revised Sample Size
- ss = Sample Size
- pop = population

## **24 Collection and Disposal of CFL Products**

The safe collection of the installed CFL products at the end of their lifecycle together with the removal of the small amounts of mercury contained within the individual bulbs and the recycling of the remaining waste material forms a significant long-term requirement for the implementation any program resulting from the use of this methodology where suitable disposal and recycling of resultant waste materials is available in the proposed country. As such the Project coordinator is to document within the project specific VER-PDD the proposed processes to be implemented within the project for the timing, collection, safe storage, removal of the mercury contained within the CFL bulbs and the recycling of the resultant waste materials from the bulbs including the assigned responsibilities for the documented processes. Where no material recycling services are available in the proposed Project Area, the Project coordinator is to outline in the VER-PDD a detailed description of the proposed appropriate disposal of the waste products applicable to the Project Area, with particular attention to mercury.

## **25 Direct Measurement of Exhaust Gases from Water Heaters**

For scenario (e), the Project coordinator will determine CO<sub>2</sub> emissions from fossil fuel-fired water heaters that are installed in the residences where existing Water Fixtures are replaced/retrofitted by WSPs.

The project coordinator is to measure the CO<sub>2</sub> concentration and volumetric flow of the



exhaust gases from the water heaters used to provide the hot water to the replacement WSPs. To obtain the necessary information the Project coordinator is to undertake the following:

At the commencement of the Supply and Installation sub-project within Project area i, the Project coordinator is to appoint an external independent sampling organization to undertake a testing campaign on a statistically representative sample of the fossil fuel fired water heaters (considering continuous flow, tank-type or other configurations) and fossil fuels that are utilized within Project Area i. The sampling campaign shall determine the average CO<sub>2</sub> concentrations of the exhaust gas as well as the average volumetric flow to establish a CO<sub>2</sub> sampling rate for each combination of water heater and fossil fuel types. Determination of water flow rate at existing Water Fixtures and CO<sub>2</sub> emission rate from fossil fuel fired water heaters is to be carried out simultaneously to ensure that these measurements are correlated.

Flow and CO<sub>2</sub> measurements are to be obtained through the following procedure:

#### **Step 1 - Determine CO<sub>2</sub> concentration in exhaust gases**

CO<sub>2</sub> concentration will be determined via a calibrated infrared analyzer. Samples will be taken continuously over a 10 to 15 minute period (e.g. three 5-min test runs with measurements logged every 30 seconds) while the water heater flame is operating. Sampling will start after 1 min of steady operation.

Measurements will be undertaken by a third-party environmental firm specialized in air sampling.

#### **Step 2 - Determine average velocity of exhaust gases**

Given that there is no reasonably safe access to most sampling locations, exhaust gas velocity will be determined via a calibrated gas velocity meter (eg. anemometer).

Measurements will be taken continuously over a 10 to 15 minute period (e.g. three 5-min test runs with measurements logged every 30 seconds) while the water heater flame is operating. Testing will start after 2 minutes of steady operation.

#### **Step 3 - Determine cross sectional area at flue exit**

Typically, water heaters have round exhaust ducts. In order to determine the cross sectional area the duct diameter will be measured several times. The area will be calculated as follows:

$$\text{Cross sectional areas} = \text{Pi} \times (\text{average measured diameter}/2)^2$$

#### **Step 4 - Calculate volumetric flow of exhaust gases**

Volumetric flow is calculated using the equation below:

$$\text{Volumetric flow (m}^3\text{/min)} = \text{Average Gas Velocity (m/min)} \times \text{Cross Sectional Area (m}^2\text{)}$$

Flow must be corrected to standard temperature and pressure (25 degrees celsius, 1 atm) and reported on a dry basis.

### Step 5 - Calculate mass flow rate for CO<sub>2</sub>

Emission factor from direct measurement for carbon dioxide is obtained through the equation below:

$$EF_{DM,i,j,k} \text{ (kg/min)} = \text{Concentration (kg/m}^3\text{)} \times \text{Volumetric Flow (m}^3\text{/min)}$$

Where:

EF<sub>DM,i,j,k</sub> = Emission factor from direct measurement of exhaust gases from fossil fuel type *j* and water heater type *k* in Project Area *i* (kgCO<sub>2</sub>/min).

This emission factor shall be used in equations (4) and (8) of Appendix I.

### QA/QC Procedures

Parameter	Quality Control Measure	Effect
CO <sub>2</sub> concentration	Infrared analyzer calibration	Ensure accurate measurement of CO <sub>2</sub> concentration
Cross sectional area of exhaust duct	Repeated measurements	Ensure correct calculation of exhaust gas flow rate
Exhaust gas velocity	Velocity meter calibration	Ensure accurate measurement of exhaust gas flow rate

Adherence to the following requirements will enhance the quality of the data obtained from direct sampling methods:

- **CO<sub>2</sub> Concentration**  
The infrared analyzer will be calibrated on an annual basis by an accredited laboratory. The equipment will be checked with span and zero gas prior to each sampling campaign.
- **Cross sectional area of exhaust duct**  
In order to determine the cross sectional area the duct diameter will be measured several times. The average duct diameter will be used for calculating the cross sectional area.
- **Exhaust gas velocity**  
Velocity meter performance will be checked on a monthly basis. For this check, velocity measurements from the device will be compared against calibrated rotameters, pitot tubes or mass flow meters. Testing equipment shall be calibrated annually in an accredited laboratory.

- **Sampling Conditions**

Testing for CO<sub>2</sub> concentrations will not start until steady operating conditions at the water heater are met. Environmental technicians will make sure that the flame is operating and that enough time has passed (at least 2 minutes) to ensure that exhaust gas composition and flow are stable. This measurement shall be conducted simultaneously with water flow measurements at targeted Water Fixtures. Country specific health and safety requirements must be followed by all field personnel.

**Best Practices**

- The external independent sampling organization appointed by Project coordinator should be specialized in providing environmental services, particularly in air quality testing.
- Environmental technicians in charge of determining CO<sub>2</sub> emission rate should have previous experience with US EPA tests methods for emissions measurements or similar test methods valid in host country.
- Monitored data should be stored electronically in a data logger. In addition, field data sheets should be completed with the following information: date and time of test, name of technician and equipment serial number. It is recommended that measured values are written down alongside electronic data logging for cross-checking and review.
- CO<sub>2</sub> concentration and exhaust flow rate should, when possible, be determined simultaneously. Given accessibility and space constraints around domestic water heaters these measurements can be done by means of using a portable multi-gas emissions analyser.
- Performance of CO<sub>2</sub> concentration and flow metering equipment should conform to acceptable standards as specified in US EPA tests methods for emissions measurements or other test methods valid in host country. An example of test protocols for verifying the performance of environmental technologies can be found here: [http://www.epa.gov/etv/pubs/01\\_vp\\_multigas.pdf](http://www.epa.gov/etv/pubs/01_vp_multigas.pdf).

## APPENDIX I – SUPPLY AND INSTALLATION OF WATER SAVING PRODUCTS WHERE WATER IS HEATED VIA THE USE OF FOSSIL FUELS

### 1. Project Boundary

The spatial extent of the overall program boundary encompasses the physical, geographical location of each Project area *i*. The project boundary includes Water Fixtures together with their associated equipment replaced or retrofitted under the project activity and the fossil fuel-fired water heaters connected to these Water Fixtures. The distinct geographical boundary of each project area *i* should be clearly documented by the Project coordinator in the project specific VER-PDD using maps.

For estimating emissions from fossil fuel combustion in water heaters, an emission factor obtained by direct measurement of exhaust gases from water heaters should be used, taking into account procedures described in Methodology Section IV: Annexure – Clause 25: Direct Measurement of Exhaust Gases from Water Heaters.

Due to geographical conditions, technology availability and cost-effectiveness, project proponents may use of the thermal efficiency as per host country ratings for new water heaters instead of direct CO<sub>2</sub> measurements for estimating baseline CO<sub>2</sub> emissions from hot water usage. In order to more accurately reflect the baseline conditions, the project proponent may adjust this thermal efficiency to account for the following:

- Net calorific value of fossil fuel available in project area
- Atmospheric Pressure and Temperature in project area
- Efficiency losses due to age, lack of maintenance, corrosion and other factors.

Project proponents that plan to use this thermal efficiency approach should submit project specific calculation procedures and sample data independently to the Gold Standard for assessment. Emission calculation procedures must be demonstrably conservative and national values must be reliably obtained from proposed sampling methods or official sources.

Table 1 below illustrates which emission sources are included in the project boundary.

**Table 1: Summary of gases and sources included in the project boundary and justification/explanation where gases and sources are not included**

	Source	Gas	Included?	Justification / Explanation
<b>Baseline</b>	CO <sub>2</sub> emissions from baseline	CO <sub>2</sub>	Yes	Main emission source

	hot water flow obtained through fossil fuel fired water heaters	CH <sub>4</sub>	No	Excluded for simplification. This is conservative
		N <sub>2</sub> O	No	Excluded for simplification. This is conservative
<b>Project Activity</b>	CO <sub>2</sub> emissions from hot water flow in the project activity obtained through fossil fuel fired water heaters	CO <sub>2</sub>	Yes	Main emission source
		CH <sub>4</sub>	No	Excluded for simplification. This is conservative
		N <sub>2</sub> O	No	Excluded for simplification. This is conservative

## **2. Procedure for the selection of the most plausible baseline scenario**

The baseline scenario for water utilization in households in the total project area comprises:

- (a) currently used Water Fixtures; and
- (b) Water Fixtures partially of the same efficiency as those currently existing (autonomous replacement) and partially of an improved efficiency (autonomous improvement).

The Project coordinator is to recognise that there may be an underlying trend within their proposed project geographical location towards greater use of efficient Water Saving Products. The baseline scenario is to therefore include for the autonomous penetration of such efficient products during the defined crediting period based on averaged historical penetration rates which are to be obtained from credible, published historical data or a survey at the time of installation and assuming no advanced products five years before.

## **3. Additionality**

**Demonstration:** Additionality shall be demonstrated using the latest version of an approved, applicable tool (see Gold Standard Toolkit for details).

**Double Counting:** The Project coordinator is to demonstrate how possible double counting with other similar demand-side energy reduction domestic programs that may be operating within the same geographical region as their proposed program is to be prevented.

For further guidance, please refer to section II Baseline Methodology, subsection 3.

#### **4. Emission Reductions**

The baseline emissions involve the emissions resulting from the direct use of fossil fuels for heating of water in residential facilities. The project activity improves the utilization efficiency of hot water in households and thereby reduces fossil fuel consumption of the participating households.

Emission reductions are calculated based on the applicable emission rate from direct measurements of exhaust gases from fossil fuel-fired water heaters and the quantity of hot water saved by the households as a result of the project activity.

The fossil fuel savings by the households for the WSP distribution projects are calculated based on the number of persons per household<sup>9</sup> and thus the number of uses per fixture per household per year, the flow-rating of the existing WSPs and with the utilisation time supported by either monitoring of the utilisation hours of each fixture in a statistically representative sample of households over a predetermined period of time or the use of a conservative assumption supported by several available and convincing references, such as national water agencies or statistical government agencies. The utilisation time assumption is to be defined and justified by the Project coordinator in the project specific GS-VER PDD.

This methodology conservatively assumes that the operating time of fossil fuel-fired water heaters is equal to the water fixture utilization time. This is applicable to both tank-type and flowthrough water heaters. In the case of tank-type water heaters, typical utilization pattern will ensure that water is kept continuously hot and ready for use, so that each household will have access to hot water at any given time. As a result, the added time period in which the burners operate intermittently to recover the lost water temperature will exceed the water fixture utilization time. Emission reductions estimated by this methodology remain conservative in scenarios where the utilization pattern consists of turning off the water heater after each use. Under this scenario, it can be realistically expected that a tank-type water heater will still have short recovery times after each use, which will extend its operating time beyond water fixture utilization time.

The total hot water consumption is also adjusted using a calculated Installation Discount Factor (IDF) based on a random product installation field audit program, a random telephone sampling program with both supported by random external, independent sampling, the size of the samples being selected in a statistically representative manner and defined to provide a 95% confidence level. These, together, are used to calculate the overall emission reductions.

The project implementation and determination of emission reductions involves the following steps:

##### **Step 1: Determination of the project and sub-project boundary(s) *i***

The total program should be divided into a number of single Project areas (*i*). Each Project area

---

<sup>9</sup> Based on statistical data obtained from sampling or from relevant government agency in the host country

should be a geographical region / state with the boundaries defined by the relevant water distribution system. Projects can be divided into a number of individual sub-projects based upon the product type and/or its delivery method. Sub-project areas should, where possible, be the same as the project areas.

The distinct geographical boundary of each Project area (*i*) should be clearly documented in the project specific VER-PDD using maps.

### **Step 2: Define the sub-projects and their individual boundaries – *is***

Projects can be divided into a number of individual sub-projects based upon the product type and/or its delivery method. Sub-project areas are to be defined should they not be the same as the project areas.

The distinct geographical boundary of each sub-project area (*is*) should be clearly documented in the project specific VER-PDD using maps.

### **Step 3: Description of the proposed project activities**

The provision of a full description of the activities that will be undertaken during the project is to be developed, specifying how the project will be implemented. This should be established and documented in the project specific VER-PDD , including, *inter alia*, information on:

- The number and type of project activity WSPs that are planned to be distributed by the project activities in each Project area *i* over the duration of the crediting period;
- The total number and types of project activity WSPs that are planned to be distributed by the project activity over the duration of the crediting period;
- The numbers of households that will invited to participate in the proposed program in each project area and how the household numbers are calculated;
- Which households are eligible to participate in the project activity (e.g. households with a fossil fuel-fired water heater, households that were constructed prior to a certain date, etc);
- How the WSPs will be distributed to household consumers, including a description of all measures employed under the project and a description how final consumers are motivated to participate in the project;
- The applicable data that will be recorded to provide evidence that the products have been supplied and installed, including methods of recording all such data;
- The process flow charts for the proposed project(s);
- An organisational structure for the proposed program including a listing of management authorities and responsibilities;
- The monitoring processes for the overall project including parameters, operations and activities that need to be monitored together with the assigned responsibilities and authorities for such monitoring;
- The operational control of the overall project including operations/activities that are to be controlled, the definition of the controlling mechanisms to be used, the documentation of the relevant operational criteria and measures to control the identified risks;
- The training and competence requirements for the various identified positions, including associated training regimes, the required training material and the training schedules;
- The Corrective and Preventive Actions;
- The monitoring equipment necessary for each project type;

- The collection and control of the necessary data during the project including that used to support the calculated achieved abatement;
- The control of all relevant data and records including defining the records that need to be kept, the necessary audit trails, the maintenance of the records, storage, retention of the records and making the records available as and when required.

**Step 4: Identification of the relevant emission sources**

Refer to Table 1 above.

**Step 5: Proposed products included in the program**

Identification of each proposed product to be provided under the program including, *inter alia*, information on:

- The type of WSPs that are to be distributed and installed by the Project coordinator, including information on the manufacturer, any label, the product number, water consumption in Litres/minute, any applicable efficiency rating scheme<sup>10</sup>, the associated testing certificates, etc;

**Step 6: Identification of activity levels, emission and other factors**

Identify the various activity levels and their associated emission factors for the various identified activities and provide an assessment of the relevance and/or impact of each of those activities on the emission savings of the overall program, including:

**Baseline Activity Emissions:** including

- Total Hot Water expended through the operation of the existing Water Fixtures based on temperature of the hot water, temperature of the cold water (taking into account the variations associated with seasonal ground temperatures by location of the household due to the incoming cold water flowing in buried pipes), the average utilization time of the Water Fixture, the flow rate of the existing Water Fixtures, type of water heater, type of fossil fuel and the number of persons per household. An emission factor is obtained from the baseline hot water flow and the CO<sub>2</sub> emission rate from the fossil fuel-fired water heaters obtained by direct measurement of exhaust gases. Determination of water flow rate at existing Water Fixtures and CO<sub>2</sub> emission rate from fossil fuel fired water heaters is to be carried out simultaneously to ensure that these measurements are correlated.

---

<sup>10</sup> Applicable country rating system or certification. For example:  
[http://search.waterrating.com.au/showers\\_srch.asp](http://search.waterrating.com.au/showers_srch.asp),  
<http://www.cna.gob.mx/Espaniol/TmpContenido.aspx?id=e16b254f-29b7-4092-903d-57a29653454b|%20%20%20%20Certificaci%C3%B3n|0|0|139|0|0>



**Project Activity Emissions:** including

- Total Hot Water expended through the operation of the replacement Water Saving Product based on temperature of the hot water, temperature of the cold water (taking into account the variations associated with seasonal ground temperatures by location of the household due to the incoming cold water flowing in buried pipes), the average time period of water fixture utilization, the flow rate of the replacement Water Saving Product, type of water heater, type of fossil fuel and the number of persons per household. The baseline CO<sub>2</sub> emission factor for hot water flow is utilized for calculating project emissions.

**Emission Factors:** including

Emission factor for hot water based on direct measurement of the exhaust gases from fossil fuel-fired water heaters divided by baseline hot water consumption in households. See Table 1.

**Installation Discount Factors:**

Each project / sub-project is to have an Installation Discount Factor (IDF) applied to the abatement.

The IDF is to take into account the difference between the number of products installed and recorded by the assigned Installer at the household as installed compared with the number of products that remain installed and operating.

The calculation of the IDF for each sub-project is to be based on data that has been obtained by the Project coordinator undertaking random field audits of the households that have been either supplied with product for them to install or have had product supplied and installed by the Project coordinator's assigned installers. Such data is also to be supported by that independently obtained by an external, suitably qualified, telephone sampling organisation using a statistically calculated sample quantity such that the results achieve a 95% confidence interval/level for a targeted geographical population. The IDF's are to be further adjusted based on their application in either "baseline" or "project" emission calculations. Refer to Notes to calculations (9) and (10).

**Other Project Factors:** including

- Project period: being the period during which the project is able to be implemented based on local and/or regulatory requirements;
- Uncertainty: There will be a level of uncertainty that will be applicable for baseline and proposed project parameters used in the overall calculations for the project abatement where the value of an individual parameter is confirmed via statistical sampling to achieve a 95% level of certainty in the result. These are to be listed by the Project coordinator per project parameter with the relevant explanation outlining the basis of the parameter calculation. The lower or upper bound of the

confidence interval must be selected for the considered parameter in such a way that calculations are conservative. If the parameter is used in an equation for the calculation of baseline emissions, the bound that leads to lower baseline emissions must be selected. If the parameter is used in an equation for the calculation of project emissions, the bound that leads to greater project emissions must be selected.

- **Product Penetration:** A number of countries where this methodology may be used may already have energy efficient products available in their marketplace that are similar to those proposed for installation. This methodology accepts that energy efficient products may already be available within the marketplace located within the proposed project areas and that these products are increasing their market share of product sales.

The Project coordinator is to research the penetration of energy efficient products based on 5 years of historical data, where such data is available, and, based on this data, generate a graph that accurately shows the reduction of the existing products over time, with a minimum decline in market share of the existing inefficient products being 1% per year. The graph must also take into account any proposed future bans on the importation of energy inefficient products into the marketplace. The Project coordinator is to outline in the project specific VER-PDD the data available, the analysis of such data and the resultant decline graph based on all such data. The graph is to be used by the Project coordinator to calculate the Penetration Factor  $PF_i$ . Refer to Section IV: - Annexures, Clause 19: - Market Penetration of Inefficient Products.

### Step 7: Establishment of a project database

Prior to the commencement of the distribution and installation of Water Saving Products, the Project coordinator should establish a database containing all relevant information necessary for recording households, including, *inter alia*:

- A list of all Project areas  $i$ , including the name or number of the project area and an outline map or appropriate description to delineate the area;
- A list of the households that participate in the program, including information to identify the household (First name, last name, address, contact telephone number, fax number, email, property type, applicable Project area  $i$ )<sup>11</sup>;

---

<sup>11</sup> The Project coordinator is to define the level of privacy/confidentiality that is to be applied to such collected information and the period that it will be retained by the Project coordinator.

- Name and ID number of the Project coordinator’s representative who supplied and/or installed the provided products;
- ID number for each property address that participates in the program. This may be a unique identifier on the signed property form;
- For each household that participates in the program information that defines:
  - The type of hot water heating system at the house;
  - The year the house was constructed/received its last major upgrade.
  - Inventory of existing hot water dispensing Water Fixtures in the house and whether they are already energy efficient;
  - Inventory of WSPs supplied and installed;
  - Date product supplied and/or installed;
  - Signature of product distributor/installer that:
    - product has been supplied and installed;
    - that resident’s ID (drivers licence, electricity bill or relevant social security card) has been sighted and is acceptable; and
    - the resident is at or exceeds the minimum legal age for signing such documentation;
  - Signature of resident accepting that:
    - Product has been supplied and installed;
    - Product operating satisfactorily (product installation program only);
    - Acceptance that the generated credits are transferable to the Project coordinator
  - Any other relevant information that may be applicable to the project location;
- For each installation/audit interval/monitoring period  $x$  (as applicable), a list of households in Project area  $i$  included in the audit (name, address, applicable Project area  $i$ ).

An outline of the database is to be attached to the project specific VER-PDD and an applicable extract for the monitoring or abatement period (as applicable) is to be attached to each audit report.

### **Step 8: Random Sampling of installations**

In this methodology, a key prerequisite for achieving statistically representative results and the calculation/confirmation of the Installation Discount Factor (IDF) for Supply and Installation of Water Saving Products is that the participating households in each Project area  $i$  are sampled. Sampling is carried out by the Project coordinator and results are confirmed using an external, suitably qualified sampling organisation.

### **Methodology**

The Project coordinator’s proposed sampling process is to include in the sampling frame all households where installations have been undertaken within Project Area  $i$ , and to select at random the participating households in the proposed sample that are to be contacted. More households are to be selected than required, to allow for those that are unable to be contactable, and those that decline to complete an interview. (Refer to “Sampling Process” below for the random sampling process used for selection of households to be contacted).

The interview with the participating households is to cover the following points:

- Asking to speak to the designated contact person;
- Arrange an alternative call back time if the designated contact person is not immediately available;
- Accept another informant at the household if they are aware of the household installing the devices and know what has been done since installation

When speaking to the contact person/alternative informant:

- Ask if they recall having the products installed (if not thank and terminate); do not count – select an alternative household from the random sample;
- Ask what has been installed (number of Water Saving Products);
- Ask if any of the efficient installed products have been removed from use (number of Water Saving Products);
- If some Water Saving Products are not still in use;
  - (optional) why not – answers to this question may be used in future to segment households;
- Obtain the relevant demographics (age group, gender, highest level of education, type of dwelling, whether own or rent).

The Project coordinator is to establish an estimation procedure that would allow a report to be provided that would:

- Certify an estimated rate of discontinued use of the installed product that can be used as the basis for the discount factor;
- Provide a 95% confidence level for the estimate for each proposed Project Area;
- Provide a 5% confidence interval for the estimate for each proposed Project Area;
- Define whether, within the limits of the statistical power provided by the sample, different proposed Project Areas within the same overall proposed program can be treated as having the same installation rate, or show whether they show statistically significant differences;
- Show whether there are distinct segments; e.g.,
  - Those that may have removed some or all of the energy efficient Water Saving Products installed through the proposed program and replaced them with Water Fixtures that allow higher water volumes to be emitted;
- Highlight any demographic differences in the continued use rate.

## Sampling Process

The Project coordinator is to use sampling methods/procedures for the installation phase and monitoring phase.

During the installation phase the Project coordinator is to:

- Continuously monitor the installation process through ongoing reviews of the data recorded at the installation sites;
- Undertake telephone calls or visits to households where product has been supplied and/or installed such that sufficient numbers of households are successfully contacted and the interview completed with meaningful data obtained for the purposes of later analysis to achieve a confidence level of 95% in the results obtained.
- Additional households may be contacted by the Project coordinator to achieve a 5% contact level of all completed installations for the telephone audits;

- The households contacted for the telephone audits or visits may not necessarily be randomly selected. They are to be selected based on the completed and signed off data received and adjusted regularly to ensure that:
  - Installations undertaken by each individually trained, inducted and appointed installer are monitored to achieve a confidence level of 95% in the results obtained;
  - Installations undertaken by each appointed installation organisation are monitored to achieve a confidence level of 95% in the results obtained;
  - The recorded data provided by the installer and or the installation organisation is confirmed by the resident of the household when contacted;
- Increase the number of contacted households for a defined installer/installation organisation when the data obtained from the telephone contact is significantly different from that recorded by the appointed installer at the time of product installation;
- Increase the number of contacted households when complaints are received and/or data analysis shows that unacceptable data trends are developing.
- Undertake separate field audits of households where product has been supplied and/or installed such that sufficient of the households are successfully contacted, accessed and field audits completed with meaningful data obtained for the purposes of later analysis;
- The households to be field audited are to be randomly selected to achieve a confidence level of 95% in the results obtained.
- Additional field audits may be required that are not necessarily randomly selected but are selected based on the completed and signed off data received and adjusted regularly to ensure that:
  - Installations undertaken by each individually trained, inducted and appointed installer are monitored to achieve a confidence level of 95% in the results obtained;
  - Installations undertaken by each appointed installation organisation are monitored to achieve a confidence level of 95% in the results obtained;
- The recorded data provided by the installer and or the installation organisation is confirmed by the field auditor during the audit process.

During the Monitoring phase the Project coordinator is to:

Use the following procedure to undertake telephone and field sampling:

- A list of all households in a defined Project Area where an installation was carried out in a reporting period would be sourced by the Project coordinator
- A random sample of these households is selected by the Project coordinator for each defined Project Area large enough to allow for completing interviews with 60% of selected households in the sample;
- To select the required random sample for a Project Area *i*, the following steps are to be followed:
  - The total number of households within Project Area *i* are identified;
  - The Sample Number is calculated by:
    - The total number of installations within Project Area *i* is identified (population);
    - The target number of sample households is calculated using an appropriate statistical tool<sup>12</sup> and using input data for Confidence Level at 95% and Confidence Interval at  $\pm 5\%$  (Refer to Section IV: Annexures, Clause 23: “Formula used by Sample Calculator”);

---

<sup>12</sup> Such as the calculator available at <http://www.surveysystem.com>

- The number of sample households nominated in the calculator is to then be increased by 60% to allow for those not able to be contacted or not willing to be surveyed;
    - A list of ID numbers from 1 to “N” are generated where N = the number of households with a completed installation in the monitoring period and equal to the population number used in the calculator nominated above;
    - This list must be randomised<sup>13</sup> (Refer to Section IV: Annexures, Clause 22: “Randomisation of Selected Samples”);
    - The total list for a Project Area is then sorted in the randomised order, with the target number of households to be called selected from those commencing at the top of the list;
  - If additional households are required to complete the target number of interviews, additional households are to be drawn in order from those remaining in the sample list of un-contacted households.

### Minimising Sources of Error

The Project coordinator is to minimise the sources of potential error that may occur during the sampling process including errors due to “Loss of households”, “Bias” and “Sample Attrition”.

- *Loss of Households*

While the sample of households selected for interview will be a random sample, those households for which interviews are completed will not. While households may have agreed to be interviewed, and the level of completing interviews is anticipated to be very high, it will not be possible to achieve contact and complete interviews with all randomly selected households.

This will only introduce a source of bias if the retention rate for those households that do not complete interviews differs systematically from those that do.

The loss of households from the initial randomly selected sample will be minimised by the Project coordinator making multiple visits and/or calls to each household at different times on different days over a period of at least two weeks before a selected sample household is abandoned. Households where contact is made but where interviews are not able to be completed immediately are to be called back, preferably at times that are agreed with the household when the appropriate informant will be available. Up to six visits/calls are to be made to establish contact, and up to six additional visits/calls are to be made to complete an interview once initial contact has been made. Records are to be kept of all visits/calls made, including unsuccessful visits/calls.

- *Testing for Bias*

To test for bias, the Project coordinator is to analyse the results obtained by the number of

---

<sup>13</sup> For example by using the list randomiser procedure available at <http://www.random.org>, or by using a random number generator from SQL database (Postgresql or similar)

visits and/or calls required to achieve an interview. If the outcomes do not co-vary significantly with the number of visits/calls, this suggests that those households that could not be reached will not differ significantly from those that do.

The Project coordinator's data on the household type and the product type(s) installed is to be analysed for households that completed an interview, households that refused an interview, and households that were not contactable or did not complete interviews within the field period, to ascertain whether there is any evidence of bias in the households where interviews were completed.

- *Sample Attrition*

To ensure that there is no loss of precision as the size of the sample reduces over time where the Project coordinator elects to use the Extended Monitoring Procedure option, the Project coordinator is to take fresh samples for each monitoring period. This will need to deal with the following issues:

- There will be some reduction in response rate, as household members move on
- Where the original residents of a sample household have moved since the product was originally installed the Project coordinator is to remove that household from the sample as the new residents might not know what was replaced originally, and what may have been done since
- There may be issues with fading recall over time, especially about the number of items originally installed that are still in use

The Project coordinator is to document in the project specific VER-PDD the sampling processes to be used for ensuring that any potential errors in the collected data are minimised.

### **Step 9: Calculation of the Baseline Emissions**

The baseline emissions in Project area  $i$  associated with the existing Water Saving Products (tCO<sub>2</sub>-e) during monitoring period  $x$  are calculated as follows:

$$BE_{f,i,x} = \sum_{j,k,x} (EH_{hw,i,j,k} * TBH_{m,i,j,k,x} * PF_{f,i,x}) \quad (1)$$

Where:

$BE_{f,i,x}$  = Baseline emissions resulting from heating the water in fossil fuel-fired water heaters for the target Water Fixtures replaced/retrofitted in Project area  $i$  during monitoring period  $x$  (tCO<sub>2</sub>-e);

- $EH_{hw,i,j,k}$  = Emission factor for baseline hot water consumption obtained in a water heater type  $k$  using fossil fuel type  $j$  in Project Area  $i$  ( $kgCO_2/liter$ ).
- $TBH_{m,i,j,k,x}$  = Baseline hot water flow rate for each target Water Fixture  $m$  in households in Project Area  $i$  during monitoring period  $x$  (liters).
- $PF_{f,i,x}$  = Penetration Factor being an accumulated percentage decline in the penetration of in-efficient Water Fixtures in the marketplace within Project Area  $i$  during monitoring period  $x$ . Refer to Methodology Section IV: Annexure, Clause 19: Market Penetration. Refer to calculation (9)

The baseline hot water flow associated with the existing Water Fixtures is calculated as:

$$W_{hb,m,i,j,k} = W_{b,m,i,j,k} * (T_{f,m} - T_{cw,i}) / (T_{hw,i,j,k} - T_{cw,i})$$

(2)

Where:

- $W_{hb,m,i,j,k}$  = Baseline hot water flow rate for each target Water Fixture  $m$  in households with water heater type  $k$  using fossil fuel type  $j$  in Project Area  $i$  (liters/minute). $i$ .
- $W_{b,m,i,j,k}$  = Baseline water flow rate per target Water Fixture  $m$  in households with a water heater type  $k$  using fossil fuel type  $j$  in Project Area  $i$  (liters/min). Project coordinator is to either monitor this as part of the fixture utilisation (Refer note above) or calculate this based on data available from suitably supported, available and convincing references. Where monitoring is proposed a defined size sample batch is to be obtained at the commencement of the proposed project and the resulting water flow rates averaged. The size of the sample batch to be sufficient to achieve a 95% level of certainty in the results obtained. The lower of the confidence interval must be selected for the  $W_{b,m}$  parameter to ensure that the resultant calculations are conservative;
- $T_{f,m}$  = Average temperature of the water outlet in fixture  $m$  in  $^{\circ}C$ . The average temperature calculated is to be based on data obtained from available and convincing references that are applicable to the project location. Refer also to Methodology Section IV: Annexures, Clause 10: Temperature of Fixture Outlet Water;
- $T_{hw,i,j,k}$  = Average temperature for hot water outlet at water heater type  $k$  using fossil fuel type  $j$  in Project Area  $i$ .
- $T_{cw,i}$  = Average temperature of the incoming cold water to the target Water Fixture  $m$



in Project area  $i$  in °C. The temperature of the incoming cold water into the fixture is impacted by the location of the household, the associated climatic conditions and therefore varies dependent upon the time of the year. The Project coordinator is to calculate and use the average temperature of the cold water in the Project area,  $i$ , during the monitoring period  $x$ . The average temperature calculated is to be based on data obtained from available and convincing references that are applicable to the project location. Refer also to Methodology Section IV: Annexures, Clause 11: Temperature of Fixture Incoming Cold Water;

The hot water consumption associated with the existing Water Fixtures replaced in households with fossil fuel-fired water heaters of Project Area  $i$  and for the overall monitoring period  $x$  is calculated as:

$$TBH_{m,i,j,k,x} = (\sum_{m,i} W_{hb,m,i,j,k} * T_m * N_{m,i} * N_{d,m,i} / 365) * THW_{f,i,j,k,x} * TD_{f,i,x} * IDF_{f,m,i,x}$$

**(3)**

Where:

- $TBH_{m,i,j,k,x}$  = Total baseline hot water consumption for all Water Fixtures  $m$  in households with water heater type  $k$  using fossil fuel type  $j$  in Project Area  $i$  during monitoring period  $x$  (liters).
- $W_{hb,m,i,j,k}$  = Baseline hot water flow rate for each target Water Fixture  $m$  in households with water heater type  $k$  using fossil fuel type  $j$  in Project Area  $i$  (liters/minute)
- $T_m$  = Average utilization time of each target Water Fixture  $m$  in minutes. (Refer note above). Refer also to Methodology Section IV: Annexures, Clause 9: Utilization Time of Each Water Fixture;
- $N_{m,i}$  = Number of uses for Water Fixture type  $m$  per household in project area  $i$ . The utilisation period for the target fixture per day, days per year and time period for each use is to be either monitored or defined by a conservative assumption suitably supported by several available and convincing references. Refer to 4 – Emission Reductions above. Refer also to Methodology Section IV: Annexures, Clause 7: Number of Uses per Day per Household for details on actions to be taken;
- $N_{d,m,i}$  = Number of utilization days for Water Fixture type  $m$  per year per household. (Refer note immediately above). This factor will take into account the impact of days when fixtures are not in use as residents are away for holidays. Refer

to Methodology Section IV: Annexures, Clause 8: Number of Utilization Days per Household;

$THW_{f,i,j,k,x}$  = Number of households with a water heater type  $k$  using fossil fuel type  $j$  located in Project area  $i$  during monitoring period  $x$ ;

$TD_{f,i,x}$  = Number of days Water Saving Products are operating during the monitoring period  $x$  in Project Area  $i$  (days).

$IDF_{f,m,i,x}$  = Installation Discount Factor of Water Saving Product  $m$  in households located in Project area  $i$  during monitoring period  $x$  (Refer to Step 10 below for calculation (10) of IDF);

The emission factor for hot water consumption associated with the existing Water Fixtures replaced in households with fossil fuel-fired water heaters of Project Area  $i$  is:

$$EH_{hw,i,j,k} = EF_{DM,i,j,k} / \max_m(W_{hb,m,i,j,k}) \quad (4)$$

Where:

$EH_{hw,i,j,k}$  = Emission factor for baseline hot water consumption obtained in a water heater type  $k$  using fossil fuel type  $j$  in Project Area  $i$  ( $kgCO_2/liter$ ).

$EF_{DM,i,j,k}$  = Emission factor from direct measurement of exhaust gases from fossil fuel type  $j$  and water heater type  $k$  in Project Area  $i$  ( $kgCO_2/min$ ). This measurement shall be conducted simultaneously with water flow measurements at targeted Water Fixtures. Refer also to Methodology Section IV: Annexure – Clause 25: Direct Measurement of Exhaust Gases from Water Heaters.

$W_{hb,m,i,j,k}$  = Baseline hot water flow rate for each target Water Fixture  $m$  obtained in a water heater type  $k$  using fossil fuel type  $j$  in Project Area  $i$ . Refer to Step 9 for calculation (2) of  $W_{hb,m,i,j,k}$ .

### Step 10: Calculation of the Project Emissions

In order to determine the total emissions following the project program, the project emissions per replacement product types are calculated as:

$$PE_{f,i,x} = \sum_{j,k,x} (EH_{hw,i,j,k,x} * TPH_{m,i,j,k,x}) \quad (5)$$

Where:

- $PE_{f,i,x}$  = Project emissions resulting from heating the water in fossil fuel-fired water heaters for the replacement Water Saving Products replaced/retrofitted in Project area  $i$  during monitoring period  $x$  (tCO<sub>2</sub>-e);
- $EH_{hw,i,j,k}$  = Emission factor for baseline hot water consumption obtained in a water heater type  $k$  using fossil fuel type  $j$  in Project Area  $i$  (kgCO<sub>2</sub>/liter).
- $TPH_{m,i,j,k,x}$  = Project hot water flow rate for each replacement Water Saving Product  $m$  in households with water heater type  $k$  and fossil fuel type  $j$  in Project Area  $i$  during monitoring period  $x$  (liters).

The project hot water flow associated with replacement Water Saving Products is calculated as:

$$W_{hp,m,i,j,k} = W_{p,m,i,j,k} * (T_{f,m} - T_{cw,i}) / (T_{hw,i,j,k} - T_{cw,i})$$

(6)

Where:

- $W_{hp,m,i,j,k}$  = Project hot water flow rate for each replacement Water Saving Product  $m$  in households with a water heater type  $k$  using fossil fuel type  $j$  in Project Area  $i$  (liters/min).
- $W_{p,m,i,j,k}$  = Project water flow rate per replacement Water Saving Product  $m$  in households with a water heater type  $k$  using fossil fuel type  $j$  in Project Area  $i$  (liters/min). Project coordinator is to either monitor this as part of the fixture utilisation (Refer to note above) or calculate this based on data available from suitably supported, available and convincing references. Where monitoring is proposed a defined size sample batch is to be obtained at the commencement of the proposed project and the resulting water flow rates averaged. The size of the sample batch to be sufficient to achieve a 95% level of certainty in the results obtained. The lower of the confidence interval must be selected for the  $W_{p,m,i,j,k}$  parameter to ensure that the resultant calculations are conservative;
- $T_{f,m}$  = Average temperature of the water outlet in fixture  $m$  in °C. The average temperature calculated is to be based on data obtained from available and convincing references that are applicable to the project location. Refer also to Methodology Section IV: Annexures, Clause 10: Temperature of Fixture Outlet Water;
- $T_{hw,i,j,k}$  = Average temperature for hot water outlet at water heater type  $k$  using fossil fuel

type  $j$  in Project Area  $i$ .

$T_{cw,i}$  = Average temperature of the incoming cold water to the target Water Fixture  $m$  in Project area  $i$  in °C. The temperature of the incoming cold water into the fixture is impacted by the location of the household, the associated climatic conditions and therefore varies dependent upon the time of the year. The Project coordinator is to calculate and use the average temperature of the cold water in the Project area,  $i$ , during the monitoring period  $x$ . The average temperature calculated is to be based on data obtained from available and convincing references that are applicable to the project location. Refer also to Methodology Section IV: Annexures, Clause 11: Temperature of Fixture Incoming Cold Water;

The hot water consumption associated with the replacement Water Saving Products replaced in households with fossil fuel-fired water heaters of Project Area  $i$  and for the overall monitoring period  $x$  is calculated as:

$$TPH_{m,i,j,k,x} = (\sum_m W_{hp,m,i,j,k} * T_m * N_{m,i} * N_{d,m,i} / 365) * THW_{f,i,j,k,x} * TD_{f,i,x} * IDF_{f,m,i,x} \quad (7)$$

Where:

$TBH_{p,i,j,k,x}$  = Total project hot water consumption for replacement Water Saving Product  $m$  in households with a water heater type  $k$  using fossil fuel type  $j$  in Project Area  $i$  during monitoring period  $x$  (liters);

$W_{hp,m,i,j,k}$  = Project hot water flow rate for each replacement Water Saving Product  $m$  in households with a water heater type  $k$  using fossil fuel type  $j$  in Project Area  $i$  (liters/min);

$T_m$  = Average utilization time of each Water Fixture type  $m$  in minutes. (Refer note above). Refer also to Methodology Section IV: Annexures, Clause 9: Utilization Time of Each Water Fixture;

$N_{m,i}$  = Number of uses for Water Fixture type  $m$  per household in project area  $i$ . The utilisation period for the target fixture per day, days per year and time period for each use is to be either monitored or defined by a conservative assumption suitably supported by several available and convincing references. Refer to 4 – Emission Reductions above. Refer also to Methodology Section IV: Annexures, Clause 7: Number of Uses per Day per Household for details on

- actions to be taken;
- $N_{d,m,i}$  = Number of utilization days for Water Fixture type  $m$  per year per household. (Refer note immediately above). This factor will take into account the impact of days when fixtures are not in use as residents are away for holidays. Refer to Methodology Section IV: Annexures, Clause 8: Number of Utilization Days per Household;
- $THW_{f,i,j,k,x}$  = Number of households with a water heater type  $k$  using fossil fuel type  $j$  located in Project area  $i$  during monitoring period  $x$ ;
- $TD_{f,i,x}$  = Number of days Water Saving Products are operating during the monitoring period  $x$  in Project Area  $i$  (days).
- $IDF_{f,m,i,x}$  = Installation Discount Factor of Water Saving Product  $m$  in households located in Project area  $i$  during monitoring period  $x$  (Refer to Step 10 below for calculation (10) of IDF);

The emission factor for hot water consumption associated with the replacement Water Saving Products replaced in households with fossil fuel-fired water heaters of Project Area  $i$  is:

$$EH_{hw,i,j,k} = EF_{DM,i,j,k} / \max_m(W_{hb,m,i,j,k}) \quad (8)$$

Where:

- $EH_{hw,i,j,k}$  = Emission factor for baseline hot water consumption obtained in a water heater type  $k$  using fossil fuel type  $j$  in Project Area  $i$  ( $kgCO_2/liter$ ).
- $EF_{DM,i,j,k}$  = Emission factor from direct measurement of exhaust gases from fossil fuel type  $j$  and water heater type  $k$  in Project Area  $i$  ( $kgCO_2/min$ ).
- $W_{hb,m,i,j,k}$  = Baseline hot water flow rate for each target Water Fixture  $m$  obtained in a water heater type  $k$  using fossil fuel type  $j$  in Project Area  $i$ . Refer to Step 9 for calculation (2) of  $W_{hb,m,i,j,k}$ .

### Calculation of Penetration Factor (PF)

The Penetration Factor for each installed product type to be used within the calculations for the Baseline Emissions is to be calculated by using:

$$PF_{f,i,x} = PC_{f,i,x} + PAG_{f,i,x} * TD_{f,i,x} / 2 \quad (9)$$

Where:

- $PF_{f,i,x}$  = Penetration Factor for Water Saving Products for monitoring period  $x$  within

- Project Area  $i$  (%);
- $PC_{f,i,x}$  = Penetration of Water Saving Products within Project Area  $i$  as at monitoring period  $x$  commencement;
- $PAG_{f,i,x}$  = Annual Percentage decline of product in the market place within Project area  $i$  (%) based on historical data (with a minimum decline of 1% per year);
- $TD_{f,i,x}$  = Project monitoring period  $x$  in Project area  $i$  (days)

### Calculation of Installation Discount Factor (IDF)

The IDF formula for installation of WSPs in Project Area  $i$  is calculated as:

$$IDF_{f,m,i,x} = 1 - (n_{f,i,rem} / n_{f,i,m}) \quad (10)$$

Where:

- $IDF_{f,m,i,x}$  = Installation Discount Factor (IDF) for Water Saving Product  $m$  in households in Project Area  $i$ ,
- $n_{f,i,rem}$  = Number of sampled households in Project Area  $i$  where WSPs have been supplied and installed and where at least one (1) WSP has been removed,
- $n_{f,i,m}$  = Total number of sampled households in Project Area  $i$  where WSPs have been installed and where interviews were completed.

### Step 11: Calculation of the emissions abatement

Emission reductions are based on the reduced hot water flow and associated fossil fuel consumption achieved in all the project households, adjusted by the Installation Discount Factor (IDF) and further adjusted to take into account the statistical margin of error to achieve a 95% confidence level.

The applicable calculations are as follows:

$$ER_{f,i,x} = BE_{f,i,x} - PE_{f,i,x} \quad (11)$$

Where:

- $ER_{f,i,x}$  = Total Emission Reductions in Project area  $i$  during monitoring period  $x$  (tCO<sub>2</sub>-e);
- $BE_{f,i,x}$  = Total Baseline emissions in Project area  $i$  during monitoring period  $x$  (tCO<sub>2</sub>-e); Refer to calculation (1);
- $PE_{f,i,x}$  = Total Project emissions in Project area  $i$  during monitoring period  $x$  (tCO<sub>2</sub>-e); Refer to calculation (5).

## 5. Leakage

Three possible sources of potential leakage have been identified, these being:

### b. Scrapping of inefficient Water Fixtures.

The Project coordinator is to implement a process to monitor of the scrapping of Water Fixtures replaced at all households to ensure that they can no longer be reused thus removing any potential for future emission leakage. The monitoring should include a check of the number of project activity WSPs distributed by the project and the number of scrapped Water Fixtures to ensure they correspond with each other. For this purpose scrapped Water Fixtures should be inventoried before being sent for recycling.

### b. Rebound

There is a possibility that the installation of energy efficient products may lead to an increased usage of such products when the project beneficiaries realise that their outgoing energy usage costs are decreasing as a result of the products installed under the proposed program..

The Project coordinator is to implement a simple spot check following the installation of the energy efficient products to ascertain/monitor if there is a possible rebound effect resulting from the installation. Such rebound could include the increased time utilisation of the installed WSPs resulting from reduced consumption of fossil fuels. The spot check is to be carried out on a representative sample of households in Project Area i, the households being randomly selected to provide a 95% confidence level in the results obtained.

### c. Product failure

There is a possibility that a small number of the installed energy efficient products may fail during the period of their abatement as defined for the proposed project and be replaced by products having less energy efficient characteristics. For conservativeness the Project coordinator is to:

- Provide all project beneficiaries with the contact details of the Project coordinator;
- Replace all product that individual project beneficiaries (households) advise during the relevant product abatement period as having failed;
- Ensure that sampled project beneficiaries are asked during the ongoing monitoring programs whether the installed products are still operating and have not been removed.

The Project coordinator is to document in the project specific VER-PDD the proposed methodologies for the monitoring of leakage.

## 6. Data and parameters not monitored:

The following data and/or parameters are not monitored as part of any proposed program developed to use this methodology:

<b>Data / Parameter:</b>	<b><math>TD_{f,i,x}</math></b>
Data unit:	Days (or Years)
Description:	The proposed monitoring period $x$ of the replacement Water Saving Products to be installed in Project Area $i$ .
Source of Data:	Defined by local regulatory requirements / agreement and/or the Gold Standard. Where there are no regulatory requirements the crediting period is to be suggested by the project proponent based on credible references and approved by the Gold Standard.
Any comment:	Refer also to Methodology Section IV: Annexures – Clause 6: “Abatement Period for the Replacement Low-Flow Showerheads and Water Saving Products”.  In addition refer to Methodology Section IV: Annexures - Clause 21: Lifetime of Appliances.

<b>Data / Parameter:</b>	<b><math>PF_{f,i}</math></b>
Data unit:	Percentage
Description:	Penetration Factor being an accumulated percentage increase in the penetration of Water Saving Products in the marketplace within Project Area $i$
Source of Data:	Project co-ordinator’s assessment of the market penetration based on 5 years of historical locally obtained data.
Any comment:	The Penetration Factor is to be based on the average annual historical penetration rates over the previous 5 years prior to the commencement of the proposed project with a minimum of 1% per year. Refer to Methodology Section IV: Annexure, Clause 19: Market Penetration.

<b>Data / Parameter:</b>	<b><math>N_{d,m,i}</math></b>
Data unit:	Days
Description:	Number of utilization days for Water Fixture type $m$ per year per household.



Source of Data:	Literature - data source, if available, from the host country in which the program is located; for example data provided by the local census agency.
Any comment	The number of utilization days for each Water Fixture per year is based on one use per household resident per day for the number of days that they are in the house. Allowance should be made for the family taking holidays – say 10 days per year. Refer also to Methodology Section IV – Annexures Clause 8 “ <i>Number of Utilization Days per Household</i> ”.

<b>Data / Parameter:</b>	$T_m$
Data unit:	minutes
Description:	Average utilization time of each Water Fixture type $m$ in minutes.
Source of Data:	Literature - data source, if available, from the proposed country in which the program is located; for example data provided by the local water agency.  Calculated – Based on the quantity of water usage reported by government agencies and average flow in baseline.
Any comment:	The utilization time for each fixture is dependent upon a number of factors including the amount of water available, the socio-economic conditions in the Project area etc. The Project co-ordinator must source independently obtained data to support the proposed time to be used in the calculations, preferably based on conditions within the relevant Project area / country. Refer also to Methodology Section IV – Annexures Clause 9 “ <i>Utilization Time of Each Water Fixture</i> ”.

<b>Data / Parameter:</b>	$W_{b,m}$
Data unit:	Litres per minute
Description:	Baseline flow rate per inefficient Water Fixture
Source of Data:	Project coordinator is to either monitor this as part of the fixture utilisation or calculate this based on data available from suitably supported, available and convincing references (for example data from water agency in host country). Where monitoring is proposed a defined size sample batch is to be obtained at the commencement of the proposed project and the resulting water flow rates averaged. The size of the sample batch to be sufficient to

	achieve a 95% level of certainty in the results obtained. The lower of the confidence interval must be selected for the $W_{b,m}$ parameter to ensure that the resultant calculations are conservative.
Any comment:	The Project co-ordinator must source independently obtained data to support the proposed baseline flow rate for the existing Water Fixtures that are to be replaced. Refer to Methodology Section IV – Annexures Clause 5 “ <i>Existing Inefficient Showerheads / Water Fixtures and Measurement of Water Flow</i> ”.

<b>Data / Parameter:</b>	$T_{f,m}$
Data unit:	°C
Description:	Average temperature of the outlet water at each Water Fixture type $m$
Source of Data:	Literature
Any comment:	The temperature of the hot water out of each Water Fixture is impacted by the local conditions in the Project area $i$ . The Project co-ordinator is to obtain data on the relevant temperature to be used for the outlet temperature in the calculations for the abatement. Refer to Methodology Section IV – Annexures Clause 10 “ <i>Temperature of Fixture Outlet Water</i> ”

<b>Data / Parameter:</b>	$T_{ew}$
Data unit:	°C
Description:	Average temperature of the incoming cold water to the Water Fixture
Source of Data:	Literature
Any comment:	The temperature of the incoming cold water into the Water Fixture is impacted by the location of the household, the associated climatic conditions and therefore varies dependent upon the location and the time of the year. The Project co-ordinator must source independently obtained data to support the proposed incoming cold water temperature and is to calculate and use the average temperature of the cold water in the project area, $i$ , during the overall monitoring period $x$ . Refer to Methodology Section IV –

	Annexures Clause 11 “ <i>Temperature of Shower Incoming Cold Water</i> ”.
--	---

<b>Data / Parameter:</b>	$W_{p,m,j,k}$
Data unit:	Litres per minute
Description:	Project flow rate per Water Saving Product <i>m</i>
Source of Data:	Project coordinator is to either monitor this as part of the fixture utilisation or calculate this based on data available from suitably supported, available and convincing references (for example, manufacturer specifications). Where monitoring is proposed a defined size sample batch is to be obtained at the commencement of the proposed project and the resulting water flow rates averaged. The size of the sample batch to be sufficient to achieve a 95% level of certainty in the results obtained. The lower of the confidence interval must be selected for the $W_{p,m,i,j,k}$ parameter to ensure that the resultant calculations are conservative. Literature - manufacturer specifications.
Any comment:	The Project co-ordinator must source independently obtained test data to support the proposed flow rate for the proposed Water Saving Products. Refer to Methodology Section IV – Annexures Clause 12 “ <i>Low-Flow Showerheads and Flow Regulators</i> ”

<b>Data / Parameter:</b>	$N_m$
Data unit:	Number
Description:	Number of uses for Water Fixture type <i>m</i> per household  either = one (1) per fixture per person per day for each resident in the household; or  Based on monitoring of a representative sample of households to ascertain the number of times the fixture(s) are used.
Source of Data:	Number of persons per household based on statistical data obtained from the relevant government department of the project country;  Monitoring based on data recorded by Project co-ordinator prior to the

	commencement of the proposed project. The total number of times for all of the households is to be multiplied by the average number of persons per household in the sampled households and divided by the total number of households sampled in the project area to provide the average number per household.
Any comment:	Where statistical data defining number of persons per household may not be available the Project co-ordinator may need to assess any additional data that to be obtained during the data collection process at the point of supply and/or installation of the supplied product. Such data may also need to be confirmed during the external independent sampling process. Refer also to Methodology Section IV – Annexures Clause 7 “Number of uses per day per Household”.

## 7. Data and parameters monitored

<b>Data / Parameter:</b>	$THW_{f,i,j,k,x}$
Data unit:	Number
Description:	Number of households with a water heater type $k$ using fossil fuel type $j$ located in Project area $i$ during monitoring period $x$
Source of Data:	Counted by Project coordinator’s field representatives based on their installations
Measurement Procedures (if any):	-
Monitoring frequency:	Determined for the monitoring interval $x$ based on the data collect at time of WSP installation and input into the database
QA/QC procedures:	Monitored via Project coordinator’s random telephone desktop audits and/or visits, random field audits and supported via independent audits by qualified sampling organisation
Any comment:	The Project coordinator is to define the total number of households that are anticipated to participate in the overall program. Refer also to Section IV – Annexure Clause 14 “ <i>Total number of LFS’s and Other WSPs to be installed and the Number per Household</i> ”.

<b>Data / Parameter:</b>	<b>PC<sub>i</sub></b>
Data unit:	Percentage (%)
Description:	Penetration of the existing replaced product (lights, Showerheads and Water Fixtures) within Project Area <i>i</i> as at monitoring period <i>x</i> commencement for the “Extended Monitoring Procedure” option and as at project commencement for the “Simplified Monitoring Procedure” option;
Source of Data:	Project coordinator to assess the marketplace at project commencement and, where available, to source 5 years of historical data
Measurement Procedures (if any):	-
Monitoring frequency:	At project commencement for both “Extended” and “Simplified Monitoring Procedure” options and at the commencement of each new crediting period for the “Extended Monitoring Procedure” option.
QA/QC procedures:	The Project coordinator is to nominate in the VER-PDD how this process is to be monitored.
Any comment:	Refer also to Section IV – Annexure Clause 19 “ <i>Market Penetration of Energy Efficient Products</i> ”.

<b>Data / Parameter:</b>	<b>PAG<sub>i</sub></b>
Data unit:	Percentage (%)
Description:	Annual Percentage decline of product in the market place within Project area <i>i</i> (%) based on historical data (with a minimum decline of 1% per year);
Source of Data:	Project coordinator to assess the marketplace at project commencement and, where available, to source 5 years of historical data
Measurement Procedures (if any):	-
Monitoring frequency:	At GS nominated timeframes for the “Simplified Monitoring Procedure” option and at the renewal of the crediting period for the “Extended Monitoring Procedure” option.
QA/QC procedures:	The Project coordinator is to nominate in the VER-PDD how this process

	is to be monitored.
Any comment:	Refer also to Section IV – Annexure Clause 19 “ <i>Market Penetration of Energy Efficient Products</i> ”.

<b>Data / Parameter:</b>	<b>IDF<sub>f,i,x</sub></b>
Data unit:	percentage
Description:	Installation Discount Factor of households located in Project area <i>i</i> during abatement period or monitoring period <i>x</i> (as applicable) for the installation of the lights, Showerheads or Water Fixtures – calculated separately.
Source of Data:	Calculated by the Project coordinator and confirmed by the appointed, independent, qualified, sampling organisation based on the results of their sampling process
Measurement Procedures (if any):	Telephone sampling by the Project coordinator and confirmed by the appointed, independent, qualified, sampling organisation
Monitoring frequency:	Ongoing during installation by the Project coordinator and by the appointed, independent, qualified, sampling organisation.
QA/QC procedures:	By both the Project coordinator and the appointed, independent, qualified, sampling organisation.
Any comment:	Refer to Step 10 – Random Sampling of Installations.

<b>Data / Parameter:</b>	<b>Water Saving Products</b>
Data unit:	Number
Description:	Number of WSPs that are supplied to and installed in participating households located in Project Area <i>i</i> during monitoring period <i>x</i> that have fossil fuel-fired water heaters;
Source of Data:	Counted by Project coordinator’s representatives based on their supply and installations
Measurement Procedures (if any):	-
Monitoring	Determined for each monitoring interval <i>x</i> based on the data collect at

frequency:	time of installation and input into the database
QA/QC procedures:	Monitored via Project coordinator's random telephone desktop audits, random field audits and supported via independent audits by qualified sampling organisation
Any comment:	The Project coordinator is to define the total number of households that are anticipated to participate in the overall program. Refer also to Section IV – Annexure Clause 14 “ <i>Total number of LFS's and Other WSPs to be installed and the Number per Household</i> ”.

<b>Data / Parameter:</b>	<b>CO<sub>2</sub> Concentration</b>
Data unit:	KgCO <sub>2</sub> /m <sup>3</sup>
Description:	Concentration of carbon dioxide in exhaust gas from domestic water heaters.
Source of Data:	Determined via a calibrated infrared analyzer. Project coordinator is to appoint an external independent sampling organization to undertake a testing campaign on a statistically representative sample of the fossil fuel fired water heaters (considering continuous flow, tank-type or other configurations) and fossil fuels that are utilized within Project Area i.
Measurement Procedures (if any):	Refer to Section IV – Annexure Clause 25 “ <i>Direct Measurement of Exhaust Gases from Water Heaters</i> ”.
Monitoring frequency:	Determined for each monitoring interval $x$ based on the data collect at time of installation and input into the database
QA/QC procedures:	Refer to Section IV – Annexure Clause 25 “ <i>Direct Measurement of Exhaust Gases from Water Heaters</i> ”.
Any comment:	This value is required to obtain $EF_{DM,i,j,k}$ .

<b>Data / Parameter:</b>	<b>Exhaust Gas Velocity</b>
Data unit:	meters/minute
Description:	Exit velocity of exhaust gases from domestic water heaters.
Source of Data:	Determined via a calibrated gas velocity meter (eg. anemometer). Project coordinator is to appoint an external independent sampling organization to undertake a testing campaign on a statistically representative sample of the

	fossil fuel fired water heaters (considering continuous flow, tank-type or other configurations) and fossil fuels that are utilized within Project Area i.
Measurement Procedures (if any):	Refer to Section IV – Annexure Clause 25 “ <i>Direct Measurement of Exhaust Gases from Water Heaters</i> ”.
Monitoring frequency:	Determined for each monitoring interval $x$ based on the data collect at time of installation and input into the database
QA/QC procedures:	Refer to Section IV – Annexure Clause 25 “ <i>Direct Measurement of Exhaust Gases from Water Heaters</i> ”.
Any comment:	This value is required to obtain $EF_{DM,i,j,k}$ .

<b>Data / Parameter:</b>	<b>Cross Sectional Area of Water Heater Exhaust</b>
Data unit:	$m^2$
Description:	Cross sectional area of the water heater exhaust at the point where velocity measurements are taken.
Source of Data:	Physical measurement of duct diameter using vernier callipers or equivalent measuring device. Project coordinator is to appoint an external independent sampling organization to undertake a testing campaign on a statistically representative sample of the fossil fuel fired water heaters (considering continuous flow, tank-type or other configurations) and fossil fuels that are utilized within Project Area i.
Measurement Procedures (if any):	Refer to Section IV – Annexure Clause 25 “ <i>Direct Measurement of Exhaust Gases from Water Heaters</i> ”.
Monitoring frequency:	Determined for each monitoring interval $x$ based on the data collect at time of installation and input into the database
QA/QC procedures:	Refer to Section IV – Annexure Clause 25 “ <i>Direct Measurement of Exhaust Gases from Water Heaters</i> ”.
Any comment:	This value is required to obtain $EF_{DM,i,j,k}$ .

<b>Data / Parameter:</b>	<b>Legislative Changes</b>
Data unit:	-



Description:	Legislative changes may occur during the program that will impact on the project additionality and thus on the Project coordinators ability to obtain credits for the abatement achieved.
Source of Data:	Legislative database
Measurement Procedures (if any):	-
Monitoring frequency:	The Project coordinator is to nominate the data that may be affected by such legislative changes and how this is to be monitored
QA/QC procedures:	-
Any comment:	Refer also to Section IV – Annexure Clause 17 “ <i>Legislative Changes</i> ”.

Refer to Methodology Section III – Monitoring Methodology for further guidance on monitoring procedures.