CLEAN DEVELOPMENT MECHANISM

**AMS-II.C.**

# Small-scale Methodology

# Demand-side energy efficiency activities for specific technologies

Version 15.0

Sectoral scope(s): 03

United Nations
Framework Convention on
Climate Change

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# 1. Introduction

1. The following table describes the key elements of the methodology:

**Table 1. Methodology key elements**

| | |
|---|---|
| **Typical project(s)** | Installation of new energy-efficient equipment (e.g. lamps, ballasts, refrigerators, motors, fans, air conditioners, pumping systems and chillers) at one or more project sites, as retrofit or new construction (Greenfield) projects. |
| **Type of GHG emissions mitigation action** | Energy efficiency:<br>Displacement of more-GHG-intensive service by use of more-efficient technology. |

# 2. Scope, applicability, and entry into force

## 2.1. Scope

2. This methodology comprises activities that involve the installation of new, energy-efficient equipment (e.g. lamps, ballasts, refrigerators, motors, fans, air conditioners, pumping systems, and chillers) at one or more project sites. Retrofit as well as new construction (Greenfield) projects are included under this methodology. In the case of new construction projects, a stepwise approach is indicated for determining the baseline under paragraph 19 of version 17.0 of the General guidelines for SSC CDM methodologies.

## 2.2. Applicability

3. This methodology is only applicable if the service level (e.g. rated capacity or output) of the installed, project energy-efficient equipment is between 90% and 150% of the service level of the baseline equipment. Examples of service levels are light output for lighting equipment, water output and temperature for water heating systems, and rated thermal output capacity of air conditioners. The relationship of the service level of the project energy-efficient equipment to the baseline equipment can be one to one replacement (e.g. replacement of inefficient refrigerator with new and efficient refrigerator) or many-to-one (e.g. replacement of small multiple chillers with a central chiller plant). In the latter case, the service level of the project and baseline can be compared on an aggregate basis.

4. Requirements pertaining to the baseline of the retrofit projects and projects involving capacity increase are indicated in paragraphs 20 to 21 in the above cited general guidelines to SSC CDM methodologies. In the event that project output in year *y* is greater than the average historical output (average of the three most recent years prior to the project implementation[1]) and the demonstration of the baseline for the incremental capacity is not undertaken, the value of the output in year *y* is capped at the value of the historical average output level.

5. If the energy-efficient equipment contains refrigerants, then the refrigerant used in the project case shall have no ozone depleting potential (ODP).

[1] A maximum of +10% variation is permitted.

6. This methodology credits emission reductions only due to the reduction in electricity and/or fossil fuel consumption from use of more efficient equipment. However, the calculation of project emissions shall include any incremental emissions, as compared to the baseline, associated with refrigerants used in the project equipment.[2]

7. The aggregate energy savings by a single project may not exceed the equivalent of 60 GWh per year for electrical end-use energy efficiency technologies. For fossil fuel end-use energy efficient technologies, the limit is 180 GWh thermal per year in fuel input.

### 2.3. Entry into force

8. The date of entry into force is the date of the publication of the EB 89 meeting report on the 13 May 2016.

### 2.4. Applicability of sectoral scope

9. For validation and verification of CDM projects and programme of activities by a designated operational entity (DoE) using this methodology sectoral scope 03 is mandatory.

## 3. Normative references

10. Project participants shall apply the general guidelines for the small-scale (SSC) clean development mechanism (CDM) methodologies, the methodological tool for demonstration of additionality of SSC project activities at <http://cdm.unfccc.int/Reference/tools/index.html> mutatis mutandis.

11. This methodology also refers to the latest approved versions of the following approved tools and methodologies:

(a) "AMS-I.D: Grid connected renewable electricity generation";

(b) "Tool to determine the remaining lifetime of equipment";

(c) "Tool to calculate baseline, project and/or leakage emission from electricity consumption";

(d) "Tool to determine baseline efficiency of thermal and electricity systems".

## 4. Definitions

12. The definitions contained in the Glossary of CDM terms shall apply.

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

(a) **Commercial building** - a building that is primarily used for commercial purposes and Small and medium enterprises (SMEs), but excluding industrial production. Private sector commercial buildings include commercial offices, shopping centers, hotels, private hospitals and private educational facilities. Government buildings include government offices, government owned health facilities (hospitals),

[2] See EB 34 report, paragraph 17.

government owned educational facilities, galleries, museums, law courts and correctional centers.

(b) **Life (of an individual lamp)** - the length of time during which a complete lamp operates:

(i) To burn out; or

(ii) Any other criterion of life performance defined in IEC 60696 or an equivalent national standard applied.

(c) **Average life (life to 50 per cent failures)** - the length of time during which 50 per cent of the lamps reach the end of their individual life.

(d) **Rated average life (rated life to 50 per cent failures)** - the life declared by the manufacturer or responsible vendor as being the expected time at which 50 per cent of any large number of lamps reach the end of their individual lives.

# 5. Baseline methodology

## 5.1. Project boundary

14. The project boundary is the physical, geographical location of all equipment and systems affected by the project activity.[3] For example:

(a) The boundary includes each lighting fixture and circuit and any affected space heating and/or cooling systems in the case of a lighting replacement project;

(b) If two or more pumps are configured to operate in parallel at a pumping station and the project activity is retrofitting only one of the pumps, the boundary shall include the entire pumping station to enable appropriate metering and monitoring and any upstream or downstream pumping stations that may be affected by changes in pumping at the project pumping station;

(c) The boundary includes the entire chiller plant, including distribution pumps and cooling tower systems, and all of the heating, ventilation and air conditioning systems for chiller replacement projects.

## 5.2. Additionality

15. If the project lamps sold or distributed by the project coordinator to households are self-ballasted LED lamps, the project activity is deemed automatically additional. The provision is valid for three years from 28 November 2014; the Board may reassess the validity of the provision and extend or update it if needed. Any update does not affect the project activities that request registration as a CDM project activity or a programme of activities by 27 November 2017.

16. If the project lamp sold or distributed to a household by the project coordinator is self-ballasted CFLs,

(a) For countries which have no or only limited lighting efficiency regulations when the CDM-PDD or CDM-PoA-DD is published for global stakeholder consultation,

according to the Efficient Lighting Policy Status Map developed by UNEP's en.lighten initiative,[3] the project activity is deemed additional;

(b) For other countries, additionality should be demonstrated through barrier analysis using the latest version of the methodological tool "Demonstration of additionality of small-scale project activities" that is available on the UNFCCC web site. If "Investment barrier" is chosen to demonstrate additionality, the investment analysis should be applied from the perspective of the project coordinator undertaking the project activity. For "Technological barrier", it shall be assessed from the perspective of the users of the project lamps. The proposed project activity is considered as facing "Technological barrier", if the market penetration of CFLs for households in the geographical area of the project activity is less than 20 per cent.[4]

## 5.3. Procedure for estimating the end of the remaining lifetime of existing equipment

17. The point in time at which the baseline equipment and/or systems would have been replaced in the absence of the project activity, and thus triggering the requirement for a new baseline scenario, shall be estimated in a conservative manner using the "Tool to determine the remaining lifetime of equipment". The project activity shall be considered as one possible baseline scenario at the end of the useful life of existing, baseline equipment.

## 5.4. Baseline

### 5.4.1. Baseline calculation for projects involving electricity savings

18. If the energy displaced is electricity, the emission baseline is determined using one of the three following options:

#### 5.4.1.1. Option 1 – Constant load equipment

19. This option is applicable to retrofit and Greenfield projects. It applies to equipment that requires the same power (kW) to operate whenever it is energized within specified limits, i.e. is (are) constant load equipment.

20. The constant load condition shall be demonstrated by monitoring or using the historical records of energy consumption data for a one-year period prior to the project implementation. The data recording interval is monthly or less, i.e. a minimum of 12 data points. Data is considered to demonstrate a constant rate of energy consumption if 90% of the energy consumption values are within $\pm$10% of the annual mean.

21. Examples of what are typically constant load equipment are lighting equipment controlled by on/off switches and electric resistance heating. Electric motors may also qualify provided the rate of energy consumption is constant. Examples also include residential furnace blower motors and irrigation pump motors delivering a constant volume at a constant head. Annual operating hours may vary but the rate of energy consumption is fixed.

[3] Accessible at <http://www.enlighten-initiative.org/Home.aspx>.

[4] This may be demonstrated, for example, using official government data, third party independent surveys and research, academic research papers, pilot baseline studies by the project proponent.

22. The equations for calculating baseline energy use and emissions are as follows:

$$BE_y = E_{BL,y} \times EF_{CO2,ELEC,y} + Q_{ref,BL} \times GWP_{ref,BL}$$ Equation (1)

$$E_{BL,y} = \sum_i (n_i \times \rho_i \times o_i / (1 - l_y))$$ Equation (2)

Where:

| | | |
|---|---|---|
| $BE_y$ | = | Baseline emissions in year *y* ($tCO_2e$) |
| $E_{BL,y}$ | = | Energy consumption for the baseline in year *y* (kWh) |
| $EF_{CO2,ELEC,y}$ | = | Electricity emissions factor. If electricity displaced is grid, the emission factor in year *y* shall be calculated in accordance with the provisions in AMS-I.D ($tCO_2$/MWh). If electricity displaced is captive electricity, the emission factor in year *y* shall be calculated in accordance with the "Tool to calculate baseline, project and/or leakage emission from electricity consumption" |
| $\sum_i$ | = | Sum over the group of i baseline equipment (e.g. 40W incandescent lamps, 5 hp motors) replaced or that would have been replaced. The devices in group i must be closely related by type (e.g. motor), size (e.g. 5 hp), service (e.g. conveyor belt, office building chilled water pump), and any other relevant factors that determine energy consumption of the equipment |
| $n_i$ | = | Number of pieces of equipment of the group of i baseline equipment replaced or that would have been replaced |
| $\rho_i$ | = | Electrical power demand (kW) of the group of i baseline equipment (e.g. 40W incandescent lamps, 5 hp motors).<br>In the case of a retrofit activity, electrical power demand is the weighted average of the rated power (kW) of group i baseline equipment. For motors, the electrical power demand of baseline equipment is determined based on spot-measurement and/or short-term monitoring data.[5] For motors, nameplate data are not sufficient due to the potential for partial loading. Nameplate data may be used for lighting equipment with on/off controls; however it does not apply to lighting equipment with dimming controls. For large populations of motors, the spot-measurement and/or short-term monitoring data can be taken on a representative sample of motors.<br>In the case of new construction (Greenfield projects), the baseline equipment demand can be determined using one of the following approaches:<br>(a) The weighted average demand of the equipment of group i that complies with but does not exceed regulatory efficiency codes and standards, or the weighted average power demand of equipment determined to be representative of equipment on the market, if no codes or standards apply; or |

[5] Short-term monitoring compensates for small, short-term rapid fluctuations in power in an otherwise constant process. Short-term monitoring should be conducted for a period of at least six hours.

(b) Baseline demand is calculated by multiplying the demand during the crediting period for group i project equipment by the ratio of project to baseline efficiencies

| | | |
|---|---|---|
| $o_i$ | = | Average annual operating hours of the group of i baseline equipment.<br>The operating hours of the baseline equipment in year *y* can be determined using surveys by continuous measurement of usage hours of baseline equipment for a minimum of 90 days. For a large population of baseline equipment: (a) Use a representative sample (sampling determined by a minimum 90% confidence interval and 10% maximum error margin); (b) Apply correction for seasonal variation, if any; and (c) Ensure that sampling is statistically robust and relevant, i.e. the selection of the equipment to be analysed for operating hours has a random distribution and is representative of target population (size, location).<br>For project activities where it can be demonstrated that the operating hours would not vary due to project implementation, for example, fixed scheduling of the operation of water pumps in the baseline and in the project, it can be assumed that operating hours during the project are equal to the operating hours in the baseline<br>For efficient lighting project activities, default values for the hours of utilization of lamps provided in the section below may be used. |
| $l_y$ | = | Average annual technical grid losses (transmission and distribution) during year *y* for the grid serving the locations where the devices are installed, expressed as a fraction. This value shall not include non-technical losses such as commercial losses (e.g. theft). The average annual technical grid losses shall be determined using recent, accurate and reliable data available for the host country. This value can be determined from recent data published either by a national utility or an official governmental body. The reliability of the data used (e.g. appropriateness, accuracy/uncertainty, especially exclusion of non-technical grid losses) shall be established and documented by the project participant. A default value of 0.1 shall be used for average annual technical grid losses, if no recent data are available or the data cannot be regarded accurate and reliable |
| $Q_{ref,BL}$ | = | Average annual quantity of refrigerant used in the baseline to replace the refrigerant that has leaked (tonnes/year). Only applies to projects that replace equipment containing ODP refrigerants. Values from Chapter 7: Emissions of Fluorinated Substitutes for Ozone Depleting Substances, Volume 3, Industrial Processes and Product Use, 2006 IPCC Guidelines for National Greenhouse Gas Inventories may be used |
| $GWP_{ref,BL}$ | = | Global Warming Potential of the baseline refrigerant ($tCO_2e$/t refrigerant) |

23. An example illustrating the application of Option 1 is provided in the appendix 1 to this methodology.

#### 5.4.1.2. Option 2 – Variable load device(s), regression approach

24. This option is limited to the retrofit of existing equipment and does not apply to Greenfield projects. It applies to baseline equipment for which the rate of energy consumption, demand (kW), varies in response to independent variable(s) such as weather. An example is cooling equipment used to condition an office space where demand changes with outdoor dry bulb and wet bulb temperatures, solar gain and office occupancy. A mathematical function is developed, using regression techniques, to determine baseline

energy consumption as a function of the relevant independent variable(s). The independent variables are measured during the crediting period and used in the regression function to predict baseline energy consumption throughout the crediting period.

25. The baseline emissions under Option 2 are calculated as follows:

$$E_{BL,y} = \sum_i (n_i \times kWh_i)/(1-l_y) \quad \text{Equation (3)}$$

$$BE_y = E_{BL,y} \times EF_{CO2,ELEC,y} + Q_{ref,BL} \times GWP_{ref,BL} \quad \text{Equation (4)}$$

Where:

| | | |
|---|---|---|
| $kWh_i$ | = | Annual average electric energy use for the equipment in group *i*. Based on regression analysis[6] of relevant independent variables that have a physical influence on energy use, for example outside air dry bulb temperature for space cooling applications. Takes for example the form of:<br>*kWh=f(x)+ ε,* where *x* are the independent variable(s) causing the device(s) to use energy and ε is the error term.<br>The data for the analysis must cover a period of 12 continuous months. The data measurement interval will depend on the application but is typically 0.25 to 1.0 hour in length |

26. In order to utilize the regression model to determine emission reductions, the t-test associated with relevant independent variables that have a physical influence on energy use has to be at least 1.645, for a 90% confidence. The regression model must be documented with a complete report indicating at least who completed the regression analyses, when it was completed, key assumptions, how the independent variables were selected and basis for including these variables and rejecting others, the regression results, the survey instrument(s), final sample results, and predicted baseline energy consumption with respect to key variables (e.g. outdoor dry bulb and wet bulb temperatures and office occupancy).

27. An example illustrating the application of Option 2 is provided in the appendix 1 to this methodology.

### 5.4.1.3. Option 3 – Production efficiency/specific energy consumption approach

28. This option does not apply to Greenfield projects. This option is only applicable if the ratio of energy output to energy input for the baseline equipment can be shown to not be variable over the range of outputs experienced during the crediting period.

29. The baseline is calculated by using specific energy consumption per unit of output in the baseline multiplied by the output in project year *y* multiplied by the emission factor for the electricity displaced. This option can only be used where comparable conditions for the output in the baseline and project can be established. For example, in the specific case of

[6] Regression analysis is a statistical method used to establish cause-effect for the investigation of relationships between the variables.

a water pumping system comparable conditions can be established by one of the options below:

(a) Show that average baseline water flow rate (discharge) is within ±10% of the flow rate during the project;[7] or

(b) Choose the nameplate head and discharge specifications of the baseline pump and corresponding power/energy consumption (weighted average values can be used when pumps are operated in parallel) for a conservative estimate of EER.

30. The baseline under Option 3 is calculated as follows:

$$BE_y = E_{BL,y} \times EF_{CO2,ELEC,y} + Q_{ref,BL} \times GWP_{ref,BL}$$ Equation (5)

$$E_{BL,y} = \sum_i \left[ EER_i \times Q_{i,y} / (1 - l_y) \right]$$ Equation (6)

Where:

| | | |
|---|---|---|
| $EER_i$ | = | Specific energy consumption in the baseline (MWh/unit/year) for equipment in group i. EER is calculated as the total annual energy consumed in the baseline divided by the total quantity of annual output of the baseline equipment in the baseline. A group is a collection of devices sharing similar sizes, functions, schedules, outputs or loads.<br>The calculation of EER must be based on data recorded at a fixed interval over a period of at least 12 continuous months. Examples of the recording interval are 15 minute, hourly, daily. EER values must be reported with 10% or higher precision at the 90% confidence level |
| $Q_{i,y}$ | = | Total quantity of output in project year *y* for equipment in group i |

31. An example illustrating the application of Option 3 is provided in the appendix 1 to this methodology.

### 5.4.2. Baseline calculation for project involving fossil fuel savings

32. If the energy displaced is fossil fuel-based, the energy baseline is the existing level of fuel consumption or the amount of fuel that would be used by the technology that would have been implemented otherwise. The emissions baseline is the energy baseline multiplied by an emission factor for the fossil fuel displaced. Reliable local or national data for the emission factor shall be used; IPCC default values should be used only when country or project-specific data are not available.

33. For project activities that improve the energy efficiency through retrofits or replacement of the existing system by a new system, the baseline efficiency can be determined using the relevant provisions from the "Tool to determine baseline efficiency of thermal and electricity systems"[6] where appropriate and applicable.

[7] Use three years historic data. For recent facilities (<3 years) a minimum of one year's data are required.

## 5.5. Project activity emissions

34. Project emissions consist of electricity and/or fossil fuel used in the project equipment, determined as follows.

$$PE_y = EP_{PJ,y} \times EF_{CO2,y} + PE_{ref,y}$$ Equation (7)

Where:

| | | |
|---|---|---|
| $PE_y$ | = | Project emissions in year *y* (tCO2e) |
| $EP_{PJ,y}$ | = | Energy consumption in project activity in year y. This shall be determined ex post based on monitored values |
| $EF_{CO2,y}$ | = | Emission factor for electricity or thermal baseline energy. The emissions associated with grid electricity consumption should be calculated in accordance with the procedures of AMS-I.D. For fossil fuel displaced reliable local or national data for the emission factor shall be used; IPCC default values should be used only when country or project-specific data are not available or difficult to obtain |
| $PE_{ref,y}$ | = | Project emissions from physical leakage of refrigerant from the project equipment in year *y* ($tCO_2e/y$) as determined using equation 10 below |

35. Project energy consumption in the case of project activities that displace grid electricity is determined as follows using the data of the project equipment or system:

$$EP_{PJ,y} = \sum_t \sum_i (n_i \times \rho_i \times o_i)/(1-l_y)$$ Equation (8)

Where:

| | | |
|---|---|---|
| $n_i$ | = | Number of group *i* project devices operating in time interval *t* year *y* |
| $\rho_i$ | = | Electrical power demand (kW) of the group i project devices measured during the time interval *t* in year y |
| $o_i$ | = | Operating hours of group of i project devices in the time interval *t* in year *y*<br><br>Note that $\rho_i$ and $o_i$ may be determined separately or in combination, i.e. as energy consumption. For efficient lighting project activities, default values for the hours of utilization of lamps provided in the section below may be used. |

36. Project emissions from physical leakage of refrigerants are accounted for. All greenhouse gases as defined per Article 1, paragraph 5 of the United Nations Framework Convention on Climate Change (UNFCCC) shall be considered as per the guidance by the Board.[8] $PE_{ref,y}$ is calculated as follows:

$$PE_{ref,y} = (Q_{ref,PJ,y}) \times GWP_{ref,PJ}$$ Equation (9)

[8] Paragraph 17 of report of EB 34.

Where:

| | | |
|---|---|---|
| $PE_{ref,y}$ | = | Project emissions from physical leakage of refrigerant from the project equipment in year *y* ($tCO_2e/y$) |
| $Q_{ref,PJ,y}$ | = | Average annual quantity of refrigerant used in year *y* to replace refrigerant that has leaked in year *y* (tonnes/year). Values from Chapter 7: Emissions of Fluorinated Substitutes for Ozone Depleting Substances, Volume 3, Industrial Processes and Product Use, 2006 IPCC Guidelines for National Greenhouse Gas Inventories may be use |
| $GWP_{ref,PJ}$ | = | Global Warming Potential of the refrigerant that is used in the project equipment ($tCO_2e$/t refrigerant) |

### 5.6. Leakage

37. If the energy efficiency technology is equipment transferred from another activity, leakage is to be considered.

### 5.7. Emission reduction

38. The emission reduction achieved by the project activity shall be determined as the difference between the baseline emissions and the project emissions and leakage.

$$ER_y = (BE_y - PE_y) - LE_y \quad \text{Equation (10)}$$

Where:

| | | |
|---|---|---|
| $ER_y$ | = | Emission reductions in year *y* ($tCO_2e$) |
| $LE_y$ | = | Leakage emissions in year *y* ($tCO_2e$) |

## 6. Monitoring methodology

39. If the equipment installed replaces existing equipment, the number and "power" of a representative sample of the replaced equipment shall be recorded in a way that allows for a physical verification by a designated operational entity (DOE).[9]

40. For projects using Option 1, i.e. if the project equipment installed has a constant current (ampere) characteristic, monitoring shall consist of monitoring either the "power" and "operating hours" or the "energy use" of the equipment installed using an appropriate method. Appropriate methods include:

(a) Recording the "power" of the project equipment installed (e.g. lamp or refrigerator) using nameplate data or bench tests of a sample of the units installed and metering a sample of the units installed for their operating hours using run time meters; or

(b) Metering the "energy use" of an appropriate sample of the project equipment installed.

[9] This shall be monitored while replacement is underway to avoid, for example, 40W lamps being recorded as 100W lamps, greatly inflating the baseline.

41. For any option, for electricity or fossil fuel savings projects, monitoring shall include annual checks of a sample of non-metered systems to ensure that they are still operating.

### 6.1. Specific guidance on monitoring requirements for project activities installing a lighting equipment

42. For project activities installing a lighting equipment, instead of metering a sample of the units as indicated in paragraph 39 (a), a default daily operating hours of 3.5 (hours/day) may be used for residential applications and commercial buildings.

43. For both residential and commercial applications, the CDM-PDD or CDM-PoA-DD/CPA-DD shall explain the proposed method of distribution of project lamps and how collection (e.g. exchanged for project lamps) and destruction[10] of baseline lamps will be conducted and documented. The CDM-PDD or CDM-PoA-DD/CPA-DD shall also explain how the proposed procedures eliminate double counting of emission reductions, for example due to project lamp manufacturers, wholesale providers or others possibly claiming credit for emission reductions from the project lamps.

44. In addition, for residential applications, the following conditions specified in paragraph 44 to 54 shall be met to use the default value.

45. The total light output of a project lamp should be equal to or more than that of the baseline lamp being replaced; light output of the baseline and the project lamp shall be determined in accordance with relevant national or international standard/s. The minimum light output values provided in Table 2 may be used as an alternative option to such standards. If lamp wattage is not provided in Table 2, linearly interpreted value shall be used to determine the minimum light output requirements for example 493 Lumen for a 45 W lamp.

**Table 2. Light output requirements**

| Baseline technology - Incandescent lamp (Watt) | Minimum light output (Lumen) |
|---|---|
| 25 | 230 |
| 40 | 415 |
| 50 | 570 |
| 60 | 715 |
| 75 | 940 |
| 90 | 1,227 |
| 100 | 1,350 |
| 150 | 2,180 |
| 200 | 3,090 |

[10] Proposed method for collection and destruction shall allow for verification. An example method is collection of Incandescent Lamps (ICLs), recording of ICL wattage and destruction in decentralised or centralised locations, and destruction documented via witnessing by local environmental officials or time stamped video records. With recorded documentation of ICL destruction, the destruction can precede verification.

46. The rated average life[11] of each project lamp type shall be known ex ante and reported in the CDM-PDD or CDM-PoA-DD/CPA-DD. Manufacturer specifications shall be used to determine the rated average life. The CDM-PDD or CDM-PoA-DD/CPA-DD shall cite the standard used by the manufacturer.

47. The project lamps utilized under the project activity shall, in addition to the standard lamp specifications,[12] be marked for clear unique identification for the project.[13] The method to meet this requirement includes, but is not limited to, the following:

   (a) Permanent marking of CDM project number and name on each of the project lamps along with other specifications;

   (b) Marking using special codes, for example each project is permanently marked *'for CDM project, not for sale/resale'* followed by project specific marking/labelling;

   (c) Other forms of identification using communication technologies (e.g. GPS, mobile phone networks) or lease/rental payment.

48. The project activity shall be designed to limit undesired secondary market effects (e.g. leakage) and free riders by ensuring that replaced lamps are collected and destroyed. Further project participants are required to undertake at least one of the following actions:

   (a) Directly installing the project lamps;

   (b) Charging at least a minimal price for efficient lighting equipment;

   (c) Restricting the number of lamps per household distributed through the project activity to six.

49. Whether the project lamps are directly installed or not directly installed, the CDM-PDD or CDM-PoA-DD/CPA-DD shall define actions to be taken to encourage the project lamps being installed in locations within the residences where the utilization hours are relatively high, for example common areas. For project lamps not directly installed, these actions can include educating the project lamp recipients of the best uses for project lamps.

50. The households receiving project lamps are connected to a national or regional electricity grid.

[11] See Section 4 for definitions of Rated Average Life.

[12] For example power rating, lumen output, correlated colour temperature, voltage, power factor, frequency.

[13] The requirements on unique marking of project lamps are to ensure that if ex post monitoring survey conducted to confirm that the lamps are still installed and operating is based on sample survey, sample selection is on a random basis to ensure results are unbiased estimates of the parameters and each lamp would have equal chance to qualify as a sample. Besides, the requirements are also to enable identification of the lamps that are distributed only through the specific CDM project activity under consideration, particularly if multiple CFL projects are underway. Furthermore, in the case of programme of activities (PoAs), the requirements are important to avoid double counting within the PoA (the same device belonging to two different CPAs of the same PoA); and to avoid double counting in situations external to the PoA (the same device belonging to two different PoAs). Thus, unique identification of each lamp would avoid double counting as well as allow implementation of unbiased and reliable sample schemes.

51. The assumed baseline scenario is that lighting by the project lamps would have been provided by the lamps collected and replaced by the project activity.

52. For a net-to-gross adjustment factor, a default value of 0.95 shall be multiplied in equation (2) and (8), unless a more appropriate value based on a lighting use survey from the same region and not older than two years is available.

53. Ex post monitoring shall be conducted, using one of the following options:

(a) **Option 1: Use of annually monitored data:** Annual checks of a sample of project lamps should be conducted, and the ex-post monitored data on the number of operating project lamps should be used.

(b) **Option 2: Use of data monitored every three years:**

(i) The Lamp Failure Rate ($LFR_{i,y}$) is the per cent of lamps that have failed during a year. In equation (2) and (8), the number of project/baseline equipment ( $n_i$ ) shall be multiplied by (1- $LFR_{i,y}$). The rated average life is used to calculate the Lamp Failure Rate as follows:

$$LFR_{i,y} = y \times X_i \times \frac{100 - R_i}{100 \times L_i} = \frac{0.5 \times y \times X_i}{L_i}$$ Equation (11)

Where:

| | | |
|---|---|---|
| $LFR_{i,y}$ | = | Lamp Failure Rate for equipment type *i* in year *y* (fraction) |
| $y$ | = | Counter for year |
| $X_i$ | = | Number of operating hours per year for equipment type *i* (hours) |
| $L_i$ | = | Rated Average Life for equipment type *i* (hours) |
| $R_i$ | = | % of lamps of type *i* operating at the end of the rated average life (use a value of 50) |

(ii) First ex post monitoring survey, carried out within the first year after installation of all efficient lighting equipment will provide a value for the number of project lamps placed in service and operating under the project activity. The results of this survey are used to determine the quantity of project lamps ($n_i$) in the emission reduction calculation to determine the ex post Lamp Failure Rate ($LFR_{i,y}$) for use in ex post emission reduction calculations;

(iii) Subsequent ex post monitoring surveys are carried out once every three years[14] to determine the ex post Lamp Failure Rate ($LFR_{i,y}$) for use in ex post emission reduction calculations until such time as CERs are being requested;

(iv) The above ex post monitoring sampling surveys to determine Lamp Failure Rate ($LFR_{i,y}$) shall be conducted for each batch of project lamps.

[14] For example assuming a rated lifetime of 10,000 hours and annual hours of operation of 1,278, since the first ex post monitoring survey is done first year after installation of all efficient lighting equipment, the subsequent surveys take place every three years.

Alternatively, the result of a sampling survey of the first batch may be used as a proxy to subsequent batches (e.g. the Lamp Failure Rate in year 4 for the project lamps installed in year 1 could be used for the Lamp Failure Rate in year 5 for the project lamps installed in year 2);

(v) The surveys will consist of identifying project lamps, marked per paragraph 46, that are installed and operating. Only project lamps with an original marking can be counted as installed. While project lamps replaced as part of a regular maintenance or warranty program can be counted as operating, cannot be replaced as part of this monitoring survey process and counted as operating for the purposes of determining $n_i$.

54. Changes to Lamp Failure Rate ($LFR_{i,y}$) and treatment of differences between Rated Average Life and Average Life: The modifications shall be made using the following methods:

(a) Calculated $LFR_{i,y}$ values in equation (11) shall be used during the period when ex post monitoring surveys are not conducted.

(b) However, when ex post monitoring surveys are conducted (i.e. year 1, 4, 7,.), actual failure rates determined through the survey shall be used instead of the calculated $LFR_{i,y}$ values in equation (11);

(c) For subsequent years beginning from the first calculation year after completion of the ex-post monitoring survey, *a* new value for $L_i$ shall be determined using equation (11) and newly calculated values of $LFR_{i,y}$ shall be used. The adjustment of $L_i$ and $LFR_{i,y}$ should be repeated every time when ex post monitoring surveys are conducted.[15]

55. Monitoring includes: (i) recording of lamp distribution data; and (ii) ex post monitoring surveys as defined in paragraph 52, 53 (a), (b) (i)-(v):

(a) During project activity implementation, the following data are to be recorded:

(i) Number of pieces of new equipment distributed under the project activity, identified by the type of equipment and the date of supply;

(ii) The number and power of the replaced devices;

(iii) Data to unambiguously identify the recipient of the new equipment distributed under the project activity;

(b) The emission reductions are calculated ex ante and adjusted ex post following the monitoring surveys, as described under paragraphs above.

56. For projects using Option 2, i.e. if the project equipment has variable load characteristics, monitoring shall consist of metering the "energy use" of an appropriate sample of the

[15] For example, when the Rated Average Life $L_i$ value is 6,000, ex-ante $LFR_{i,y}$ value for year 1 is calculated as 10.6 per cent using equation (11). In case, ex post monitored $LFR_{i,y}$ value for year 1 is 11 per cent, then a new value for $L_i$ will be determined using equation (11) using the ex post $LFR_{i,y}$ of 11 per cent. The newly calculated $L_i$ value will be 5,807. With this new $L_i$ value, new ex ante values for $LFR_{i,y}$ for year 2 onwards will be calculated, i.e. 22 per cent in year 2, 33 per cent in year 3 and so on. If the second survey is to be done in year 4, the same exercise is repeated.

equipment installed. Monitoring shall also include annual checks of a sample of non-metered systems to ensure that they are still operating.

57. For projects using Option 3, output and the energy consumption are metered. For example, in the case of pumping systems, monitoring of the project activity shall consist of metering the pumping energy use, hourly or daily discharge ($m^3$ per day or hour) and the total delivery head (m).

58. When sampling is employed, the “Standard on sampling and surveys for CDM project activities and PoA” shall be followed.

## 6.2. Project activity under a programme of activities

59. The following conditions apply for use of this methodology in a project activity under a programme of activities:

(a) In case the project activity involves the replacement of equipment, and the leakage effect of the use of the replaced equipment in another activity is neglected, because the replaced equipment is scrapped, an independent monitoring of scrapping of replaced equipment needs to be implemented. The monitoring should include a check on whether the number of project activity equipment distributed by the project and the number of scrapped equipment correspond with each other. For this purpose, scrapped equipment should be stored until such correspondence has been checked. The scrapping of replaced equipment should be documented and independently verified. In the specific case of lighting efficiency projects the guidance provided in paragraph 42 and footnote 10 may be applied to meet these requirements.

# Appendix. Examples of projects applying various options of the methodology

## 1. Example project using Option 1

1. An example is irrigation pumping where water is drawn from an aquifer with a constant depth. The pumps are constant volume. Hours of operation vary seasonally and annually depending on rainfall patterns. The measure is to replace existing pump motors with premium efficiency units. Monitoring data collected monthly over a one-year period of the rate of energy consumption (kW) demonstrates a constant load condition; 90% of records are ± 10% of their mean. Short-term monitoring is conducted for the period of six hours and the data are used to establish the baseline demand. Operating hours of the efficient motors are recorded during the crediting period.

## 2. Example project using Option 2

2. Consider a project at a school facility where space cooling in the baseline case is provided by a distributed population of packaged rooftop units. The project will replace the rooftop units with chilled water supplied from a central chiller plant and new air handler units. The project proponent will build a baseline model using regression analysis to predict annual kWh use. For this simple example all the rooftop units are the same size and a single regression model can represent all units. The independent variables driving kWh use are outside air dry bulb temperatures and building occupancy. The equation below is the general form of the regression equation determining kWh demand for each unit:

$$kWh_i = \sum_k (b + x_1 \times (OAT - T_{cp})_+ \times occ + x_2 \times (OAT - T_{cp})_+ \times unocc)_k \quad \text{Equation (12)}$$

Where:

| | | |
|---|---|---|
| $k$ | = | The k$^{th}$ hour of the cooling season |
| $b$ | = | Regression coefficient |
| $x_1$ | = | Regression coefficient when the school is in session |
| $OAT$ | = | Average daily outside air dry bulb temperature |
| $T_{cp}$ | = | Change point temperature, the outside dry bulb temperature at which cooling is no longer required |
| $x_2$ | = | Regression coefficient when school is not in session |
| $occ$ | = | Occupancy value; 1 = school in session, 0 = school not in session |
| $unocc$ | = | Unoccupied value; 1 = school not in session, 0 = school in session |

3. Hourly data of OAT and energy (kWh) use for a sample of rooftop units were collected for 12 months. The collection period captured temperatures under peak design conditions and the lower end of the expected cooling range. The collection period also covered holidays when school was not in session. Daily average kWh use per rooftop unit was regressed against daily average OAT using a change-point regression analysis routine. Daily averages were used instead of hourly values because the resulting model gave a

better fit to the data. Average daily temperatures were developed for all days for the cooling season where the school was located. Using the coefficients and change point temperature developed by the regression analysis, kWh use was predicted for the year for a single rooftop unit using equation (12) above. $E_{BL,y}$ was calculated using equation (3).

## 3. Example project using Option 3

4. Consider an energy efficiency improvement of a water pumping station. The purpose of this project is to reduce the energy required for the water delivery service from the pumping station. The plant maintains accurate production records including volume of water output per day and sets up a monitoring programme to record monthly energy use. The EER is calculated based on data recorded at an hourly interval over a period of at least 12 continuous months. EER values are reported with 10% precision at the 90% confidence level. The $E_{bl,y}$ is determined for each credit year using equation (6).

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### Document information*

| *Version* | *Date* | *Description* |
|---|---|---|
| 15.0 | 13 May 2016 | EB 89, Annex 5<br>Revision to introduce the use of conservative values under certain conditions. |
| 14.0 | 20 July 2012 | EB 68, Annex 21<br>Revision to expand the methodology to cover the replacement of multiple chillers and elaborate a procedure to calculate energy savings for equipment having constant and variable loads. |
| 13.0 | 17 July 2009 | EB 48, Annex 16<br>To clarify the consideration of increased output over the historic average and boundary definition, and to add an option to use specific energy consumption for the baseline emission calculations. |
| 12.0 | 28 May 2009 | EB 47, Annex 22<br>Elimination of baseline penetration calculations and cross effect calculations. |
| 11.0 | 28 November 2008 | EB 44, Annex 20<br>The revisions clarify the consideration of capacity increase of the project equipment, electricity transmission and distribution (T&D) losses in the baseline and cross effects of lighting and heating. With regard to equipment containing refrigerants, the revisions clarify the calculations of direct emissions from refrigerants. |

* This document, together with the ‘General Guidance’ and all other approved SSC methodologies, was part of a single document entitled: Appendix B of the Simplified Modalities and Procedures for Small-Scale CDM project activities until version 07.

| *Version* | *Date* | *Description* |
|---|---|---|
| 10.0 | 02 August 2008 | EB 41, Annex 17<br>Additional guidance on baseline selection for new facilities and for capacity increase due to retrofit; consideration of electricity transmission and distribution losses; guidance on treatment of direct emissions from refrigerants where relevant. |
| 09.0 | 27 July 2007 | EB 33, Annex 26<br>Revision of the approved small-scale methodology AMS-II.C to allow for its application under a programme of activities (PoA) |
| 08.0 | 15 December 2006 | EB 28, Annex 29<br>The threshold of small-scale Type II methodologies was increased from 15 GWh to 60 GWh. The consideration of transmission and distribution losses in the baseline estimation was removed. |

Decision Class: Regulatory
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**History of the document: Appendix B of the Simplified Modalities and Procedures for Small-Scale CDM project activities**

Appendix B of the Simplified Modalities and Procedures for Small-Scale CDM project activities contained both the General Guidance and Approved Methodologies until version 07. After version 07 the document was divided into separate documents: 'General Guidance' and separate approved small-scale methodologies (AMS).

| *Version* | *Date* | *Description* |
|---|---|---|
| 07.0 | 25 November 2005 | EB 22, Para. 59<br>References to "non-renewable biomass" in Appendix B deleted. |
| 06.0 | 20 September 2005 | EB 21, Annex 22<br>Guidance on consideration of non-renewable biomass in Type I methodologies, thermal equivalence of Type II GWhe limits included. |
| 05.0 | 25 February 2005 | EB 18, Annex 6<br>Guidance on 'capacity addition' and 'cofiring' in Type I methodologies and monitoring of methane in AMS-III.D included. |
| 04.0 | 22 October 2004 | EB 16, Annex 2<br>AMS-II.F was adopted; leakage due to equipment transfer was included in all Type I and Type II methodologies. |
| 03.0 | 30 June 2004 | EB 14, Annex 2<br>New methodology AMS-III.E was adopted. |
| 02.0 | 28 November 2003 | EB 12, Annex 2 |

| *Version* | *Date* | *Description* |
|---|---|---|
| 01.0 | 21 January 2003 | Definition of build margin included in AMS-I.D, minor revisions to AMS-I.A, AMS-III.D, AMS-II.E.<br>EB 7, Annex 6<br>Initial adoption. The Board at its seventh meeting noted the adoption by the Conference of the Parties (COP), by its decision 21/CP.8, of simplified modalities and procedures for small-scale CDM project activities (SSC M&P). |

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