CLEAN DEVELOPMENT MECHANISM

CDM-MP92-A06

Draft Small-scale Methodology

AMS-III.AR.: Substituting fossil fuel-based lighting with ~~LED/CFL~~ more efficient lighting systems

Version ~~08~~09

Sectoral scope(s): 01

United Nations
Framework Convention on
Climate Change

COVER NOTE

1. Procedural background

1. The Executive Board of the clean development mechanism (CDM) (hereinafter referred to as the Board), at its 116th meeting, requested the MP to review and, if needed, revise the methodologies listed below to clarify eligible energy efficient lighting technologies. In addition, the Board requested the MP to further assess the eligibility of different compact fluorescent lamps technologies as project technologies (e.g. considering the additionality aspects and environmental impacts of disposal) and propose limitations where deemed necessary.

   (a) "AM0046: Distribution of efficient light bulbs to households";

   (b) "AM0113: Distribution of compact fluorescent lamps (CFL) and light-emitting diode (LED) lamps to households";

   (c) "AMS-II.C.: Demand-side energy efficiency activities for specific technologies";

   (d) "AMS-II.J.: Demand-side activities for efficient lighting technologies";

   (e) "AMS-III.AR.: Substituting fossil fuel-based lighting with LED/CFL lighting systems".

2. Purpose

2. The purpose is to revise the methodologies to address the mandate from the Board.

3. Key issues and proposed solutions

3. The following changes are proposed to the methodologies listed in paragraph 1 above:

   (a) Removing references to the types of technologies eligible for project lamps, i.e. compact fluorescent lamps (CFLs) and light emitting diode (LED), and replacing by efficient systems or efficient lamps;

   (b) Including a requirement stating that the PDD shall ensure that project lamps will be managed properly at the end of its lifetime in line with national regulations or standards to prevent harm to the environment and to public health.

4. To ensure that only efficient lamps are eligible as project lamps, the proposed revision makes the methodology applicable only to project lamps with a luminous efficacy of no less than 70 Lumen/Watt.[1]

4. Impacts

5. The revision of this methodology, if approved, will ensure that only high efficient project lamps that do not have the potential to harm the environment or public health are eligible as project lamps.

5. Subsequent work and timelines

6. The MP, at its 92nd meeting, agreed to seek public inputs on the draft revised methodology. Inputs received, if any, will be discussed with the MP and forwarded to the Board for its consideration together with this document. No further work is envisaged.

6. Recommendations to the Board

7. The MP recommends that the Board adopt this draft methodology, to be made effective at the time of the Board's approval.

[1] CLASP and PricewaterhouseCoopers Private Limited (PwC). 2020. *Indonesia Lighting Market Study and Policy Analysis – Final Report*. Available at https://www.clasp.ngo/wp-content/uploads/2021/01/Indonesia-Lighting-Market-Study-and-Policy-Analysis.pdf, accessed on 30 August 2023. Figure 52 illustrates the performance (in lumen/W) of different types of lamps per outputs (lumen) for different types of lamps (LED, CFL, Halogen, Incandescent) gathered from different countries (Australia, China, Indonesia, Korea and Singapore) and compare these performances with Minimum Energy Performance Standards (MEPS) from South Africa, European Union and China. A threshold of 70 lumen/W is proposed since it covers lamps with a high performance. As a consequence, most CFL lamps and all incandescent and halogen lamps are not eligible under this methodology.

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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)	Activities that replace portable fossil fuel-based lamps (e.g. wick-based kerosene lanterns) with battery-charged ~~LED or CFL based~~more efficient lighting systems in residential and/or non-residential applications (e.g. ambient lights, task lights, portable lights)
Type of GHG emissions mitigation action	Renewable energy and Energy efficiency: Displacement of more-GHG-intensive service (lighting)

2. Scope, applicability, and entry into force

2.1. Scope

2. This category comprises activities that replace portable fossil fuel-based lamps (e.g. wick-based kerosene lanterns) with battery-charged ~~light-emitting diode (LED) or compact fluorescent lamps (CFL)-based~~ more efficient lighting systems in residential and/or non-residential applications (e.g. ambient lights, task lights, portable lights).

2.2. Applicability

3. This methodology is applicable only to project lamps whose batteries are charged using the following options:

(a) Charged by a renewable energy system included as part of the project lamp (e.g. a photovoltaic system or mechanical system such as a hand crank charger);

(b) Charged by a standalone distributed generation system (e.g. a diesel generator set) or a mini-grid, i.e. that is not connected to a national or regional grid;

(c) Charged by a grid that is connected to regional/national grid;

(d) Charged by a combination of the methods described in options (a), (b) or (c) above.

4. At a minimum, project lamps shall be certified by their manufacturer to have a rated average operational life of at least:

(a) 5,000 hours for Option 1, paragraph 19;

(b) 10,000 hours for Option 2, paragraph 20.

5. The rated average life is the period of time certified by the manufacturer or responsible vendor over which the lamp's initial light output will decline by no more than 30 per cent. In addition, for project lamps charged using the options from paragraphs 3(c) or 3(d), if a grid that is connected to regional/national grid is one of the sources used to charge the project lamps, the manufacturer shall certify that the battery-charging-circuit efficiency of the project lamps, at the time of the purchase, is at least 50 per cent. For project lamps charged under the options indicated in paragraph 3(b) or 3(d), if a mini-grid is one of the

sources used to charge the project lamps and the mini-grid or distributed generation system is not entirely powered by renewable energy generation unit(s), the manufacturer shall certify that the project lamp's battery charging circuit efficiency, at the time of purchase, is at least 50 per cent.

6. Project lamps shall meet warranty requirements of the Lighting Global Minimum Quality Standard. The project lamps shall have a warranty of a minimum of one year from the time the end-user takes ownership or begins using the lamp. At a minimum, the warranty shall cover free replacement or repair of any failed lamps, batteries, and where applicable solar panels. The warranty shall be clearly communicated and supported through the supply chain and available to end-users of the project lamps during the warranty period. In a situation where the project lamps are distributed through intermediaries, the one-year warranty shall commence from the time that the project lamps are distributed to end-users. The full warranty terms shall be available in writing, in a regionally appropriate language and included with each unit.

7. Project lamps shall meet or exceed the following minimum performance characteristics, which should be proven by third-party test results:

   (a) **Light Output** - luminous flux of 25 lumens or illuminance of 50 lux over an area ≥0.1 m2 when suspended at a distance of 0.75 meters or self-supported. The light output over a 2,000 hour lumen maintenance test should not decline by more than 15%;

   (b) **Luminous efficacy** – no less than 70 lumen/Watt;[2]

   (c) **Run Time and Battery Capacity** - Daily Burn Time (DBT) shall meet the following requirements:

      (i) DBT shall be equal to or greater than 4 hours;

      (ii) For charging Option 3(a) with solar PV, the DBT is defined by the Solar Run Time for the project lamp (as determined per paragraph 9(g));

      (iii) For other technologies in Option 3(a), the DBT is defined based on typical expected patterns of use;

      (iv) For charging Options 3(b) and 3(c):

         a. The maximum claimed DBT shall be less than or equal to the typical capabilities of the regional or local energy system at delivering reliable power sufficient for recharging;

[2] CLASP and PricewaterhouseCoopers Private Limited (PwC). 2020. *Indonesia Lighting Market Study and Policy Analysis – Final Report*. Available at https://www.clasp.ngo/wp-content/uploads/2021/01/Indonesia-Lighting-Market-Study-and-Policy-Analysis.pdf, accessed on 30 August 2023. Figure 52 illustrates the performance (in lumen/W) of different types of lamps per outputs (lumen) for different types of lamps (LED, CFL, Halogen, Incandescent) gathered from different countries (Australia, China, Indonesia, Korea and Singapore) and compare these performances with Minimum Energy Performance Standards (MEPS) from South Africa, European Union and China. A threshold of 70 lumen/W is proposed since it covers lamps with a high performance. As a consequence, most CFL lamps and all incandescent and halogen lamps are not eligible under this methodology.

b. The autonomous (full battery) run-time of the project lamps shall be equal to or greater than 200 per cent of the DBT of the project lamps;

c. The project lamp shall be fully recharged from a discharged state after eight hours of charging.

8. The project design document (PDD) shall explain the proposed distribution method of the project lamps. It shall also explain how the proposed project activity shall:

(a) Ensure that the replaced baseline lamps are those that directly consume fossil fuel. This can be done through documentation of the common practice of fuel usage for lighting in the project region (e.g. based on representative sample surveys, official data or peer reviewed literature) that demonstrates that fossil fuel is a commonly used fuel for lighting;

(b) Encourage the consumers, targeted by the project activity, to use the project lamps and discourage hoarding;

(c) Eliminate potential double counting of emission reductions that could occur, for example, if more than one entity (e.g. lamp manufacturers, suppliers of solar and/or battery equipment, etc.) claims credit for emission reductions for the project lamps. At a minimum, project lamps shall be marked as CDM project lamps;

(d) Ensure compliance with prevailing regulations pertaining to the use and disposal of batteries;

(e) Ensure that project lamps are handled properly at the end of their lifetime in line with national regulations or standards to prevent harm to the environment and to public health.

9. The PDD shall include the minimum requirements for the design specifications of project lamps including the following specifications:

(a) Lamp wattage (in Watts) and luminous flux output (in lumens);

(b) Rated lamp life (in hours);

(c) Where applicable, the type and rated capacity of the renewable energy equipment used for battery-charging (in Watts);

(d) Type (e.g. NiMH, Lead-Acid, Li-ion, Lithium-iron-phosphate, etc.), nominal voltage, and rated capacity of the batteries (in Ampere hours);

(e) Type of charge controller (e.g. active or passive);

(f) Autonomous time and DBT;

(g) Solar Run Times(s) (SRT) for products with solar energy charging systems. If regional solar data are available, the maximum, minimum and average estimated SRT values for each month of a typical year shall be provided. If regional solar data are not available, the standard solar day (5 kWh/m^2) shall be used to estimate SRT;

(h) Where applicable, the amount of time to fully charge the product using mechanical means or a centralized charging system (e.g. the national grid);

(i) Physical protection against environmental factors (e.g. rain, heat, insect ingress).

10. The number of project lamps distributed or sold to each household is restricted to six (at maximum).

11. Measures are limited to those that result in emissions reductions of less than or equal to 60 kt CO_2 equivalent annually.

2.3. Entry into force

12. The date of entry into force is the date of the publication of the EB ~~115~~ XX meeting report on ~~8 September 2022~~DD Month YYYY.

2.4. Applicability of sectoral scopes

13. For validation and verification of CDM projects and programme of activities by a designated operational entity (DOE) using this methodology, application of sectoral scope 01 is mandatory.

3. Normative references

14. Project participants shall apply the "Guideline: General guidelines for SSC CDM methodologies", "TOOL21: Demonstration of additionality of small-scale project activities" (hereinafter referred to as TOOL21) and "TOOL19: Demonstration of additionality of microscale project activities" (hereinafter referred to as TOOL19).

15. This methodology also refers to the latest approved versions of the following approved tools and standard:

(a) "TOOL07: Tool to Calculate the Emission factor for an electricity system" (hereinafter referred to as TOOL07);

(b) "TOOL33: Default values for common parameters" (hereinafter referred as TOOL33);

(c) "Standard: sampling and surveys for CDM project activities and programme of activities".

4. Definitions

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

17. For the purposes of this methodology the following definitions shall apply:

~~(a) **LED or CFL based lighting system** - is defined as one or more individual LED or CFL lamps connected to a single rechargeable battery system. These systems may be portable or fixed. LED lamps may consist of one or more diodes. For the purposes of this methodology, a single LED or CFL based lighting system is referred to as the 'project lamp' throughout this document;~~

(b) **Ambient lights** - Lights used to either fully or partly illuminate a room;

(c) **Autonomous Time or Autonomous Run Time (AT)** - time measured from switching on the light in a mode that is bright enough to satisfy the light output

requirements stipulated in paragraph 7(a) to the point in time where the light output reaches 70 per cent of its initial brightness or where low voltage triggers battery cut-off, whichever is earlier. The test must be performed with a fully charged battery. AT indicates maximum possible burn time or run time and is also known as battery autonomy. AT is expressed in hours;

(d) **Daily Burn Time (DBT)** - total number of hours per day that the lighting system must provide light that is bright enough to satisfy the light output requirements stipulated in paragraph 7(a). DBT is expressed in hours;

(e) **Global quality standards** - "Lighting Global Minimum Quality Standards" (the most recent version of this document should be used; the document is available at <http://www.lightingglobal.org);

(f) **Main test procedures and framework description -** IEC/TS 62257-9-5 "Recommendations for small renewable energy and hybrid systems for rural electrification - Part 9-5: Integrated system - Selection of stand-alone lighting kits for rural electrification";

(g) **Norms, specifications and test procedures** - Existing test procedures and specifications for project lamps or other off-grid lighting systems, batteries, charge controllers and solar modules included;

(h) **Portable lamps** - Portable lamps have self-contained energy sources, are easily transported by hand, and are not permanently connected via piping to a central energy source;

(i) **Solar Run Time (SRT)** - operational time in a mode that is bright enough to satisfy the light output requirements stipulated in paragraph 7(a) from a day of solar charging under standard solar day conditions. Although a "standard solar day" can be defined as 5 kWh/m2 incident radiation, actual SRT depends on geography, weather, shading, and user behaviour. Thus, if regional solar data are available, such data shall be used to calculate SRT instead of the 5 kWh/m2 value. SRT may be computed using simulation software or it can be computed using the method indicated in the test procedure included below. SRT is expressed as a number of hours of operation;

(j) **Task lights** - Lights used to illuminate a defined working area.

5. Baseline methodology

5.1. Project boundary

18. The project boundary includes the project lamps as well as the charging systems, as follows:

(a) If the project lamps are charged by a renewable energy system, then the project boundary includes the physical, geographical site of the renewable energy system;

(b) If the project lamps are charged by a mini-grid or a distributed generation system, then the project boundary includes the physical, geographical site of the mini-grid or distributed generation system;

(c) If the project lamps are charged by a regional or national grid, then the project boundary includes the physical, geographical site of the regional/national grid;

(d) If the project lamps are charged by a combination of the above sources, the project boundary includes the boundaries of the individual sources.

5.1.1. Lamp effective useful life[3]

5.1.1.1. Option 1

19. Project lamps are assumed to operate for two years after distribution to end-users. Therefore, under this option, emission reductions may only be claimed for two years.

5.1.1.2. Option 2

20. Project lamps are assumed to operate for up to seven years after distribution to end-users, and thus emission reductions can be claimed for up to seven years per project lamp, if all the following conditions are met:

(a) Unless specified otherwise in this document, the currently-applicable requirements to meet the Lighting Global Minimum Quality Standards at the time of project application shall be met by project lamps based on IEC/TS 62257-9-5 and IEC 60529, or an equivalent national standard, or the approved norms indicated in paragraph 17(g);

(b) At a minimum, project lamps must be certified by their manufacturer to have a useful operational life of 10,000 hours[4]. Within this time span, the relative luminous flux shall not decrease by more than 30 per cent as per equation (1). Such claims shall be confirmed by a third-party testing organization using an applicable standard and testing protocol. As an alternative to long-term measurement of light output over the full lifetime of the lamp, a shortened measurement period of 2,000 hours may be chosen. If a 2,000-hour test period is used, the relative luminous flux shall not decrease by more than 15 per cent during the 2,000 hours of continuous operation. If the average life value is not available ex ante, it shall be made available for verification.

$$\emptyset_{Vrel} = \emptyset_v(t) \div \emptyset_v(t_0)$$ Equation (1)

Where:

ϕ_{Vrel} = Relative luminous flux after time *t* (shall be => 85% after 2,000 hrs and =>70% after 10,000 hrs)

[3] The crediting period of the project activity is distinct from the lamp effective useful life and the standard fixed or renewable period for CDM projects should be used. Project lamps may be distributed during multiple years as long as the elapsed life of lamps can be unambiguously tracked to ensure that emission reductions are not credited beyond two years (for Option 1) or seven years (for Option 2) for any given project lamp. In addition, both Options 1 and 2 may be used in a single project activity, but the option selected for each lamp must be specified before the distribution of the lamp.

[4] Alternative useful lifetimes can be proposed by project participants or CMEs through a submission of a request for revision of the methodology, following the latest version of the procedure "Development, revision and clarification of baseline and monitoring methodologies and methodological tools".

$\phi_v(t)$ = Luminous flux after time *t*

$\phi_v(t_0)$ = Initial luminous flux

(c) The project lamps use a replaceable, rechargeable battery. In addition, there must be documented measures in place to ensure that lamp owners have access to replacement batteries of comparable quality;

(d) With regard to physical ingress and water protection, mechanical durability, and the quality of workmanship the project lamps shall achieve a minimum level of protection, based on the type of lamp, in accordance with Lighting Global Minimum Quality Standards, IEC/TS 62257-9-5 and IEC 60529, or an equivalent national standard, or the approved norms indicated in paragraph 17;

(e) Compliance with the technical requirements in paragraph 20~~19~~ are confirmed by a third-party testing organization based on appropriately sampled (random or market-selected) tests[5] of project lamps using applicable national standards where such are available, or alternatively, the standards or test protocols indicated in paragraph 17 of this methodology may be used. The laboratory conducting and certifying the tests shall comply with the requirements of a relevant national or international standard such as ISO/IEC 17025. If the testing results are not available ex ante, they shall be made available at project verification;

(f) Project lamps shall be marked for clear, unique identification to associate them with each unique CDM project.[6] The method to meet this requirement includes, but is not limited to, the following:

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

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

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

[5] The size of the sample and method of sample procurement shall be in line with the chosen testing standard.

[6] 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/LED~~efficient light bulbs distribution 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.

5.2. Additionality

21. Additionality is demonstrated using one of the options below:

5.2.1. Option 1 (positive list)

22. Demonstrate ex ante that the market penetration of each of the project lamp technologies is equal to or less than 2.5 per cent of the technologies providing similar services to end-users using the data **based on annual sales of units**, or **1.5 per cent** using the data **based on the stock of units**, in the applicable geographic area in order to be considered as automatically additional. The applicable geographical area should be the entire host country. If the project participants opt to limit the applicable geographical area to a specific geographical area (such as province, region, etc.) within the host country, then they shall provide justification on the essential distinction between the identified specific geographical area and rest of the host country.

23. The market penetration shall be determined using one of the following options:

    (a) Official statistics or reports, relevant industry association reports or peer-reviewed literature;

    (b) Results of a sampling survey conducted by project participants or a third party as per the latest version of "Standard: sampling and surveys for CDM project activities and programme of activities" covering technologies/measures providing similar services as the project technology/measure.

24. If the market penetration is determined using the data based on annual sales of units, the most recent three years' data available at the time of submission of the CDM-PDD or CDM-CPA-DD for validation/inclusion shall be used. This period is considered necessary to capture variations of the sales data from year to year. Exceptionally, historical sales data covering less than three years, but a minimum of one year may be used with due justifications (e.g. demonstrated unavailability of data despite the efforts made).

25. To determine the market penetration using the data based on the stock of units, the most recent data available at the time of submission of the CDM-PDD or CDM-CPA-DD for validation/inclusion, shall be used, and the data vintage used shall not include data older than two years prior to: (a) the start date of the CDM project activity; or (b) the start of validation/inclusion, whichever is earlier.

5.2.2. Option 2

26. Demonstrate additionality applying the TOOL21.

5.2.3. Option 3

27. Demonstrate additionality applying TOOL19.

5.3. Baseline emissions

28. This methodology provides a default annual baseline emissions factor for the project lamps. The following assumptions are made about the equivalent baseline lighting system:

$$DV = FUR \times O \times U \times EF \div 1000 \times LF \times n \times NTG \quad \text{Equation (2)}$$

Where:

DV	=	Lamp Emission Factor (default is 0.092 t CO_2e per project lamp per year)
FUR	=	Fuel use rate (0.03 liters/hour)
O	=	Utilization rate (3.5 hours/day)
U	=	Annual utilization (365 days/year)
EF	=	Fuel emissions factor (2.4 kgCO_2/liter)
LF	=	Leakage factor (1.0)
n	=	Number of fuel-based lamps replaced per project lamp (1.0)
NTG	=	Net-to-gross adjustment factor (1.0)

29. Baseline emissions are calculated as follows:

$$BE_y = DV \times GF_y \times DB_y \quad \text{Equation (3)}$$

Where:

BE_y	=	Baseline emissions per project lamp in year *y* (t CO_2e)
GF_y	=	Grid Factor in year *y*, • Equal to 1.0 when charging option defined in paragraph 3(a) is used;[7] • Equal to 1.0 if the project activity is for off-grid households/communities those which does not have grid access or less than 12 hours grid availability per day on an annual average basis; • Otherwise it is equal to 1.0 minus the fraction of time grid is available to the target households and communities/users in the region of project activity
DB_y	=	Dynamic Baseline Factor (change in baseline fuel, fuel use rate, and/or utilization during crediting period) in year *y*. Calculated as either: Option 1: default of 1.0 in the absence of relevant information; Option 2: value of 1.0+*FFg* where *FFg* is the documented national growth rate of kerosene fuel use in lighting from the preceding years (use the most recent available data for three or five years average (fraction))

30. Alternative values for parameters in equation (2) to result in a different value for DV (e.g. fuel use rate, utilization rate) can only be used if adequate research/monitoring and documentation is provided by the project proponent (e.g. strategic surveys and research conducted by national or local organizations, initiatives by international organizations or

[7] Based on the demonstration that fossil fuel is the predominant practice for lighting as per paragraph 8(a), it is assumed all baseline emissions are from the consumption of fossil fuel burning for lighting.

non-governmental organizations or the project proponent to collect reliable and comprehensive data).

5.4. Project emissions

31. There are no project emissions (PE_y = 0) if the project lamp charging mechanism utilized is as defined in:

    (a) Paragraph 3(a); or

    (b) Paragraph 3(b) if the mini-grid or distributed generation system is entirely powered by renewable energy generation unit(s).

32. There are project emissions if the project lamp charging mechanism utilized is as defined in:

    (a) Paragraph 3(c); or

    (b) Paragraph 3(b) if the mini-grid or distributed generation system is not entirely powered by renewable energy generation unit(s); or

    (c) Paragraph 3(d) if the mini grid or distributed generation system is not entirely powered by renewable energy units or the regional or national grid is connected to one or more fossil fuel powered units.

33. Project emissions per project lamp are calculated as:

$$PE_{y,i,j} = W_i \times EF_{CO2,ELEC,y,j} \times \left(1 \div Eff_{i,j}\right) \times (D \times H) \times \left(1 + TDL_y\right) \times 10^{-6} \quad \text{Equation (4)}$$

Where:

$PE_{y,i,j}$	=	Average project emissions in year *y* (t CO_2e) per project lamp
i	=	Type of project lamp
j	=	Type of charging mechanism as per paragraph 3
W_i	=	Wattage of project lamps distributed to end users, of type *i* (Watts)
$Eff_{i,j}$	=	Battery charging efficiency of lamps distributed to end users, as documented by lamp manufacturer, of type *i* for charging type *j*
D	=	Days of operation of project lamps per year, use a value of 365
H	=	Hours of operation of project lamps per day (DBT), use a value of 3.5 hours
$EF_{CO2,ELEC,y,j}$	=	CO_2 emission factor of the source supplying electricity to charge the project lamp's batteries in year *y* (tCO_2/MWh). Refer to the "Data / Parameter table 1" in section 6.1 for details on how this parameter is determined based on the different charging sources *j*
TDL_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.

5.5. Emissions reduction

34. Annual emission reductions are calculated as follows:

$$ER_y = \sum_{i,j} N_{i,j} \times \left(BE_{y,i} - PE_{y,i,j}\right) \times \left(OF_{y,i,j}\right) \quad \text{Equation (5)}$$

Where:

ER_y	=	Emission reductions in year *y* (t CO_2e)
$N_{i,j}$	=	Number of project lamps distributed to end users of type *i* with charging method *j*
$OF_{y,i,j}$	=	Percentage of project lamps distributed to end users that are operating and in service in year *y*, for each lamp type *i* and charging method *j.*

35. The emission reductions shall be considered from the date of distribution of the project lamps to end-users.

6. Monitoring methodology

36. Monitoring includes:

(a) Recording of project lamp distribution data; and

(b) Where Option 2, paragraph 20 is chosen, ex post monitoring surveys to determine the percentage of project lamps distributed to end-users that are operating and in service in year *y*.

37. During project activity implementation, the following data are to be recorded:

(a) Number of project lamps distributed to end-users under the project activity, identified by the type of project lamps (lamp wattage, battery type, charging method, the date of distribution);[8]

(b) Data to unambiguously identify each recipient of a project lamp, for all the project lamps distributed that will claim emission reductions for up to seven years, as per Option 2, paragraph 20.

[8] Or a conservative estimation thereof based on distribution records. In the case of project activities that do not involve direct distribution of project lamps to end-users, but instead involve distribution of project lamps through intermediaries, the average number of days between the date on which project lamps are delivered to intermediaries and the date on which the project lamps are distributed from the intermediaries to end-users can be determined using either survey methods or by using a default value of 120 days. The survey methods may either be of a census of intermediaries (if the number of intermediaries is equal to less than 50) or using sampling methods in accordance with the "Standard for sampling and surveys for CDM project activities and programme of activities*".* However, the date of delivery of project lamps to all intermediaries shall be directly recorded with no recourse to sampling.

38. For project lamps that will claim emission reductions for up to seven years, ex post monitoring surveys to determine percentage of project lamps[9] distributed to end users that are operating and in service shall be conducted during the third year of the crediting period. While the percentage of project lamps that are operating and in service can be assumed to equal 100 per cent in year 1, 2, and 3, the result of ex post monitoring survey undertaken during the third year shall be used in years 4, 5, 6 and 7[10], as per paragraph 36.

39. Only project lamps with a unique project marking (per paragraphs 20(f) or 41) can be counted as operating and in service. While project lamps replaced as part of a regular maintenance or warranty program can be counted as operating, project lamps cannot be replaced as part of the survey process and then counted as operating. The above ex post monitoring sampling surveys shall be conducted for each batch of project lamps. Alternatively, the result of a sampling survey of the first batch may be used as a proxy to subsequent batches (e.g. the operating rate in year 4 for the project lamps installed in year 1 could be used for the operating rate in year 5 for the project lamps installed in year 2).

40. The following survey principles shall be followed for activities related to determining number of project lamps in service and operating under the project:

    (a) The sampling size is determined by minimum 90 per cent confidence interval and the 10 per cent maximum error margin; the size of the sample shall be no less than 100;

    (b) Sampling must be statistically robust and relevant, i.e. the survey has a random distribution and is representative of the target population (size, location);

    (c) The method to select respondents for interviews is random;

    (d) The survey is conducted by site visits;

    (e) Only persons over age 12 are interviewed;

    (f) The PDD must contain the design details of the survey.

6.1. Parameters for monitoring during the crediting period

Data / Parameter table 1.

Data / Parameter:	$EF_{CO2,ELEC,y,j}$
Data unit:	t CO_2e/MWh
Description:	CO_2 emission factor of the source supplying electricity to charge the project lamp's batteries in year *y*

[9] If project lamps are distributed with different charging methods, per paragraph 3(a), 3(b), 3(c) and 3(d) then the percentage operating in year 3 should be determined per each category of charging method, see equation (5).

[10] The years refer to the operational years of project lamps (e.g. for project lamps distributed in year 3 of the crediting period years 1, 2 and 3 relate to the years 3, 4 and 5 of the crediting period and so forth).

Measurement procedures (if any):	(a) If the battery is entirely charged by a renewable energy system included as part of the project lamp (option from paragraph 3(a)), this parameter does not need to be monitored and a value 0 tCO_2/MWh shall be applied; (b) If the battery is charged by a standalone distributed generation system (e.g. a diesel generator set) or a mini-grid (option form paragraph 3(b)), the monitoring shall follow the procedures described in TOOL33; (c) If the battery is charged by a grid that is connected to regional/national grid (option from paragraph 3(c)), the monitoring shall follow the procedures described under the applicable version of TOOL07; (d) If the battery is charged by a combination of methods described in paragraphs 3(a), 3(b) or 3(c), this parameter can be determined based on the weighted average electricity consumed from the different sources, and the monitoring shall follow the provisions from (a), (b) or (c) above. As an alternative to measuring the electricity from each source separately, the following conservative values may be used: • A fixed conservative value of 1.3 tCO_2/MWh shall be applied if the battery is charged by a combination of methods described in paragraphs 3(a) and 3(c); • A fixed conservative value of 2.4 tCO_2/MWh shall be applied for all other recharging combinations
Monitoring frequency:	Annual monitoring to confirm that the sources supplying electricity to the project lamps have not changed
Any comment:	-

Data / Parameter table 2.

Data / Parameter:	TDL_y
Data unit:	Fraction
Description:	Average annual technical grid losses (transmission and distribution) during year *y* for the grid serving the locations where the devices are installed
Measurement procedures (if any):	This value shall not include non-technical losses such as commercial losses (e.g. theft/pilferage). 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. 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 10 per cent shall be used for average annual technical grid losses, if no recent data are available or the data cannot be regarded as accurate and reliable
Monitoring frequency:	Annual
Any comment:	-

Data / Parameter table 3.

Data / Parameter:	**-**
Data unit:	Fraction
Description:	The percentage of project lamps distributed to end users that are operating and in service
Measurement procedures (if any):	Follow the procedures in paragraph ~~37~~38 and 39~~38~~
Monitoring frequency:	Follow the procedures in paragraph ~~37~~38 and 39~~38~~
Any comment:	-

Data / Parameter table 4.

Data / Parameter:	GF_y
Data unit:	Fraction
Description:	Grid Factor in year *y*
Measurement procedures (if any):	(a) Equal to 1.0 when charging option defined in paragraph 3(a) is used; (b) Equal to 1.0 if the project activity is for off-grid households/communities (defined as no grid access or less than 12 hours grid availability per day on an annual average basis); (c) Otherwise it is equal to 1.0 minus (the fraction of time grid is available to the target households and communities/users in the region of project activity)
Monitoring frequency:	Annual
Any comment:	-

Data / Parameter table 5.

Data / Parameter:	DB_y
Data unit:	Fraction
Description:	Dynamic baseline factor (change in baseline fuel, fuel use rate, and/or utilization during crediting period) in year *y*
Measurement procedures (if any):	Calculated as either: Option 1: default of 1.0 in the absence of relevant information; Option 2: value of 1.0+*FFg* where *FFg* is the documented national growth rate of kerosene fuel use in lighting from the preceding years (use the most recent available data for a three or five years average (fraction))
Monitoring frequency:	Annual
Any comment:	-

6.2. Project activity under a programme of activities

41. If monitoring is required, per paragraphs 36 - 40, to determine the percentage of project lamps distributed to end-users that are operating and in service, such monitoring will take

place in the third year of the crediting period of each CPA and the results shall be used for operational years 4, 5, 6 and 7 of the project lamps of that CPA.

42. For Option 2, paragraph 20, project lamps shall be marked for clear, unique identification to associate them with each unique CPA.

43. The option in paragraph 38 which allows the use of the results of the sampling surveys of the first batch as a proxy to subsequent batches should only be applied to the same CPA to which the first batch belongs.

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Document information

Version	*Date*	*Description*
09.0	17 October 2023	MP 92, Annex 6 To be considered by the Board at EB 120. A call for public input will be issued for this draft document. Any input will be discussed with the MP and forwarded to the Board for consideration. The revisions include inter alia: • Removing reference to CFL and LED lamps to make the methodology technologically neutral; • Inclusion of requirement in the PDD to check the management of project lamps at the end of its lifetime.
08.0	8 September 2022	EB 115, Annex 13 Revision to: • Introduce reference to “TOOL33: Default values for common parameters”; • Make minor editorial improvements; • Remove reference to “AMS-I.F.: Renewable electricity generation for captive use and mini-grid”; and • Ensure the consistency in definitions of market penetration metrics and thresholds.
07.0	5 October 2020	EB107, Annex 3 Revision to include options for charging the batteries of project lamps through more than one source.
06.0	31 August 2018	EB 100, Annex 13 Revision to include simplified provision for automatic additionality (if market penetration is less than or equal to 5 percent).

Version	*Date*	*Description*
05.0	28 November 2014	EB 81, Annex 31 Revision to: • Further clarity in unique marking requirement for the project/PoA; • Simplification of emission reductions calculation (in particular, extrapolation of monitoring results of the first batch of installed compact fluorescent lamps (CFLs)/light-emitting diode (LEDs) to the whole project); • Revision of the minimum quality standards for lighting products.
04.0	23 November 2012	EB 70, Annex 4 Revision to: • Remove the restriction of number of lamps to be distributed per household while a new provision has been introduced to address efforts to encourage lamp use and discourage hoarding.
03.0	20 July 2012	EB 68, Annex 20 Revision to: • Account for suppressed demand in accordance with the suppressed demand guidelines; • Exclude the battery certification requirement for systems charged by renewable energy sources; • Allow the use of survey method or a default value of 120 days to estimate the date of distribution of project lamps; • Provide clarity on the warranty requirements.
02	25 November 2011	EB 65, Annex 26 To include: • Specifications to ensure high quality, high performance lighting products are distributed under the project (e.g. lumen testing, IP class); and • Expand the applicability to include CFLs, including modifying the title.
01	26 November 2010	EB 58, Annex 19 Initial adoption.

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