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TYPE III – OTHER PROJECT ACTIVITIES

Project participants shall apply the general guidelines to SSC CDM methodologies, ~~information on additionality (~~attachment A to appendix B~~)~~ provided at <http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html> *mutatis mutandis*.

III.AR. Substituting fossil fuel based lighting with LED/CFL lighting systems

Technology/measure

1. This category comprises activities that replace portable fossil fuel based lamps (e.g. wick-based kerosene lanterns) with battery-charged LED or CFL[1] based lighting systems[2] in residential and/or non-residential applications (e.g. ambient lights, task lights, portable lights).

2. This methodology is applicable only to project lamps whose batteries are charged using one of the following options:[3]

(a) Charged by a renewable energy system included as part of the Project Lamp (e.g. a photovoltaic system~~s~~ or mechanical system~~s~~ such as a hand crank ~~wind battery~~ charger~~s~~);

(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.

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

- 5,000 hours for Option 1, paragraph 11;
- 10,000 hours for Option 2, paragraph 12.

Rated average life is the life certified by the manufacturer or responsible vendor as being the time at which the lamp's initial light output will decline by no more than 30%. In addition, the manufacturer shall certify that the project lamp's battery charging circuit efficiency, at the time of purchase, is at least 50%.

[1] Light Emitting Diode or Compact Fluorescent Lamps.

[2] An LED or CFL based lighting system is defined as one or more individual LED or CFL lamps connected to a single rechargeable battery system~~, such~~ These systems may be portable or fixed ~~permanently installed, e.g. hard-wired~~. 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~~, must have a configuration of diodes with a minimum illumination of 20 lux.~~

[3] Project Lamps may be charged by any of the listed options, however each individual Project Lamp shall be charged by only one of the charging options (~~e.g.~~for example,10,000 project lamps ~~are~~ may be charged by PV ~~solar~~ systems and 10,000 ~~are~~ may be charged by a grid, but none of the Lamps ~~are~~ may be charged by both a grid and a PV ~~solar~~ system).

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III.AR. Substituting fuel based lighting with LED lighting systems (cont)

4. Project Lamps shall have a warranty of a minimum of one year ~~warranty~~. At a minimum, the warranty shall cover free replacement or repair of any failed lamps, batteries and where applicable solar panels.

5. 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 20 lumens or illuminance of 25 lux over an area ≥0.1 m^2 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 20% for Option 1 (paragraph 11) or 15% for Option 2 (paragraph 12);

(b) **Run Time and Battery Capacity:** Daily Burn Time (DBT)[4] shall meet the following requirements:

(i) DBT shall be equal to or greater than 3.5 hours;

(ii) For charging option 2(a) the Autonomous Time of the Project Lamps shall meet the following requirements:

– For Option 1, paragraph 11, the Autonomous Time shall be equal to or greater than 150% than the DBT of the Project Lamps;

– For Option 2, paragraph 12, the Autonomous Time shall be equal to or greater than 150% of the DBT of the Project Lamps;

(iii) For charging options 2(b) and 2(c) the Autonomous Time of the Project Lamps shall meet the following requirements:

– For Option 1, paragraph 11, the Autonomous Time shall be equal to or greater than 200% of the DBT of the Project Lamps;

– For Option 2, paragraph 12, the Autonomous Time shall be equal to or greater than 200% of the DBT of the Project Lamps;

(iv) For charging with solar PV under option 2(a) the Solar Run Time for the Project Lamp in each month of the year (as determined per paragraph 7(g)) shall be greater than or equal to the DBT;

(v) For charging option per 2(b) or 2(c), the Project Lamp shall be fully charged after eight hours of charging.

6. The project design document shall explain the proposed ~~method of~~ distribution method of the project lamps. It shall also explain how the proposed project activity will:

(a) Ensure that the replaced baseline lamps are ~~only~~ those that directly consume~~ing~~ 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;

[4] Definitions of terms are included in Annex 1.

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III.AR. Substituting fuel based lighting with LED lighting systems (cont)

(b) 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. ~~or others~~) claims credit for Emission Reductions for the project lamps. At a minimum, project lamps shall be marked as CDM project lamps;

(c) Ensure compliance with prevailing regulations pertaining to the use and disposal of batteries.

7. The project design document shall include the minimum requirements for the design specifications of project lamps ~~such as~~ 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), and rated capacity of the batteries (in Ampere Hours);

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

(f) Autonomous Time and Daily Burn Time;

(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. ~~Where applicable (with solar energy charging systems) maximum, minimum and average monthly Solar Fraction values during the year;~~

~~(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) ~~Where applicable grid charging time;~~

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

8. The project activity shall restrict the number of project lamps distributed through the project activity to no more than five per household ~~(for residential applications)~~ or per business location (e.g. for commercial applications such as shops).

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

Indicative simplified baseline and monitoring methodologies
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III.AR. Substituting fuel based lighting with LED lighting systems (cont)

Boundary

10. The project boundary ~~is the physical, geographical site where each project lamp is utilized. In addition,~~ 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.

Lamp Effective Useful Life[5]

11. **Option 1:** Project Lamps are assumed to operate for two years after ~~project lamp~~ distribution to end-users. Therefore, under this option, emission reductions ~~can~~ may only be claimed for two years.

12. **Option 2:** Project Lamps are assumed to operate for up to seven years after ~~project lamp~~ distribution to end-users, and thus emission reductions can be claimed for up to seven years per project lamp, ~~if and~~ if all of the following conditions ~~for the project lamps~~ are met.

(a) At a minimum, ~~LED~~ Project Lamps must be certified by their manufacturer to have a useful life of 10,000 hours. Within this time span, the relative luminous flux shall not ~~reduce~~ decrease by more than 30% 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 ~~10~~ 15% during the 2,000 hours of continuous operation. As per the principles indicated in ~~paragraph 4 of~~ AMS-II.J "Demand-side activities for efficient lighting technologies", if the average life value is not available *ex ante*, it shall be made available for verification.

$$\phi_{Vrel} = \phi_v(t)/\phi_v(t_0) \quad \textbf{(1)}$$

[5] 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.

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III.AR. Substituting fuel based lighting with LED lighting systems (cont)

Where:

ϕ_{Vrel} Relative luminous flux after time t (shall be =>~~90~~ 85% after 2,000 hrs and =>70% after 10,000 hrs)

$\phi_v(t_0)$ Initial luminous flux

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

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

~~(c) Following criteria are satisfied with regard to the design specifications of the project lamps:[6]~~

~~(i) An illumination level of 20 lx for task and portable lights and 4 lx@1m for ambient lights;[7]~~

~~(ii) For charging option per 2 (b) or 2 (c), the Daily Burn Time (DBT) shall be equal to autonomous time after eight hours of charging;~~

~~(iii) For charging option 2 (a) with solar PV panel as the charging source, the minimum Solar Fraction achieved on a monthly basis during the year shall be 100%;~~

~~(iv) The battery capacity will be such that Autonomous Time of the Project Lamps shall be a minimum of 150% of DBT;~~

~~(v) With regard to dust and water tightness a minimum protection of IP41 is achieved in accordance to IEC 60529 or an equivalent national standard.~~

(c) With regard to physical ingress and water protection, the Project Lamps shall achieve a minimum level of protection, based on the type of lamp, in accordance with IEC 60529, or an equivalent national standard, or the approved norms indicated in Annex 1.

(i) For lamps with integrated solar modules or solar modules with a cable length less than 3 meters, the Ingress Protection (IP) class of the lamp shall be 43 or greater; or alternatively the lamp shall be protected from an equivalent level of environmental exposure.

(ii) For lamps with integrated energy storage (i.e., battery) and external solar modules with cable lengths greater than 3 meters, the IP class of the lamp shall be 41 or greater; or alternatively the lamp shall be protected from an equivalent level of environmental exposure.

~~[6] Based on Bopp, et al. (2009), see annex I for full citation.~~

~~[7] Minimum Illuminance (EVmin) for task lights and portable lights shall be EVmin ≥ 20 lx at one A4 sheet of writing paper (0.06 m^2). For ambient lights EVmin ≥ 4 lx at α ≥ 90°, r = 1m.~~

(iii) For lamps with separate energy storage, light points, and external solar modules with cable lengths greater than 3 meters, the IP class of the storage base unit and light points shall be 21 or greater; or alternatively the lamp shall be protected from an equivalent level of environmental exposure.

(d) Conditions ~~11 (a), 11 c (i) to 11 c(v)~~ 12(a) and 12(c) are confirmed by a third-party testing organization based on sample tests[8] of project lamps using applicable national standards where such are available, or alternatively, the standards or test protocols indicated in Annex 1 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, e.g. ISO/IEC 17025. If the testing results are not available *ex ante*, they shall be made available at project ~~for~~ verification;

(e) Project lamps shall be~~, in addition to the standard lamp specifications,~~ marked for clear, unique identification ~~with the project activity~~ to associate them with each unique CDM project.

Baseline Emissions

13. This methodology provides for a default annual baseline emissions factor for the project lamps ~~distributed to end-users~~. The following assumptions are made about the equivalent baseline lighting system:

~~(a) Fuel use rate (liters/hour): 0.025 liters/hour;~~

~~(b) Utilization rate (hours/day): 3.5 hours per day;~~

~~(c) Utilization (days/year): 365 days per year;~~

~~(d) Fuel emissions factor: 2.4 kgCO2/liter;~~

~~(e) Leakage factor: 1.0;~~

~~(f) Number of fuel-based lamps replaced per project lamp: 1.0;~~

~~(g) Net-to-Gross factor: 1.0.~~

$$DV = FUR \times O \times U \times EF / 1000 \times LF \times n \times NTG \quad \textbf{(2)}$$

Where:

DV	Lamp Emission Factor (default is 0.08 tCO_2e per project lamp)
FUR	Fuel use rate (0.025 liters/hour)
O	Utilization rate (3.5 hours/day)

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

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III.AR. Substituting fuel based lighting with LED lighting systems (cont)

U	Annual utilization (365 days/year)
EF	Fuel emissions factor (2.4 kgCO2/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)

14. Baseline emissions are calculated per equation (~~2~~3).

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

Where:

BE_y	Baseline Emissions per project lamp in year *y* (tCO_2e)
~~*DV*~~	~~Default Emissions Factor (0.08 tCO_2e per project lamp calculated using values indicated in paragraph 12)~~
GF_y	Grid Factor in year *y*, • Equal to 1.0 when charging option defined in paragraph 2(a) is used[9] • 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) • 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 ~~o~~for a three or five years average (fraction))

15. Alternative values for parameters in equation 2 to result in a different value for DV ~~paragraph 13~~ (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 non governmental organizations or the project proponent to collect reliable and comprehensive data).

[9] Based on ~~Combined with~~ the demonstration that fossil fuel is the predominant practice for lighting as per paragraph 6(a), it is assumed all baseline emissions are from the consumption of fossil fuel burning for lighting.

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III.AR. Substituting fuel based lighting with LED lighting systems (cont)

Project Emissions

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

(a) Paragraph 2 (a); or

(b) Paragraph 2 (b) if the minigrid or distributed generation system is entirely powered by renewable energy generation unit(s).

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

(a) Paragraph 2 (c); or

(b) Paragraph 2 (b) if the minigrid or distributed generation system is not entirely powered by renewable energy generation unit(s).

18. Project emissions per ~~LED~~Project Lamp are calculated as:

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

Where:

$PE_{y,i,j}$	Average project Emissions in year y (tCO_2e) per Project Lamp
i	Type of Project Lamp
j	Type of charging mechanism as per paragraph 2
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, ~~take~~ use a value of 365
H	Hours of operation of project lamps per day (DBT), ~~take~~ use a value of 3.5 hours
$EF_{CO2,ELEC,y}$	Grid Emission Factor in year y calculated in accordance with the provisions in AMS-I.D "Grid connected renewable electricity generation" or AMS-I.F "Renewable electricity generation for captive use and mini-grid" depending on the charging mechanism j (tCO_2/MWh)
TD_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/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% 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

Emissions reduction

19. Annual emission reductions are calculated as:

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

Where:

ER_y	Emission reductions in year y (tCO_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. Assumed to equal to 100% for years 1, 2 and 3. Equal to value determined per paragraph 21, for years 4, 5, 6 and 7[10]

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

Monitoring

20. Monitoring includes: (i) Recording of project lamp distribution data; and (ii) Where Option 2, paragraph 12 is chosen *ex post* monitoring surveys to determine percentage of project lamps distributed to end users that are operating and in service in year y.

21. 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 ~~supply~~);[11]

(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 12.

22. For project lamps that will claim emission reductions for up to seven years, *ex post* monitoring surveys to determine percentage of project lamps[12] distributed to end users that are

[10] The years refer to the operational years of project lamps (e.g. for project lamps distributed ~~deployed~~ 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).

[11] Or a conservative estimation thereof based on distribution records.

operating and in service will be conducted during the third year of the crediting period. Only project lamps with a~~n original~~ unique project marking (per paragraphs 12(e) or 25) 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.

23. 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% confidence interval and the 10% 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.

Project activity under a Programme of Activities

24. If monitoring is required, per paragraphs 20-23, 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 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.

25. For Option 2, paragraph 12, Project lamps shall be marked for clear, unique identification to associate them with each unique CPA.

[12] If project lamps are distributed with different charging methods, per paragraph 2 (a), 2 (b) and/or 2 (c), then the percentage operating in year 3 should be determined per each category of charging method, see equation 5.

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III.AR. Substituting fuel based lighting with LED lighting systems (cont)

Annex I

DEFINITIONS

Daily Burn Time (DBT): ~~The~~ 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 5(a). ~~A default value of 3.5 hours is used in this methodology.~~ DBT is expressed in hours.

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 5(a) to the point in time where the light output reaches 70% of its initial brightness ~~such that it can not provide adequate illumination~~ or where ~~until~~ 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.

Solar Run Time (SRT): Operational time in a mode that is bright enough to satisfy the light output requirements stipulated in paragraph 5(a) from a day of solar charging under standard solar day conditions. Although a "standard solar day" can be defined as 5 kWh/m^2 incident radiation, actual SRT depends on geography, weather, shading, and user behavior. Thus, if regional solar datea are available, such data shall be used to calculate SRT instead of the 5 kWh/m^2 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.

Ambient lights. Lights used to either fully or partly illuminate a room.

Task lights. Lights used to illuminate a defined working area.

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.

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 includes:

(a) "Lighting Africa Quality Test Method" (the most recent version of this document should be used; the document is available at http://lightingafrica.org/lighting-africa-quality-test-method-la-qtm)

(b) PVGAP PVRS 5/5A, batteries;

(c) IEC 61951, NiMH batteries;

(d) IEC 61960, Li-ion batteries;

(e) CIE 127, LEDs;

(f) PVGAP PVRS 11A, Solar lights;

(g) IEC 62124 PV stand-alone systems, design verification and others.

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III.AR. Substituting fuel based lighting with LED lighting systems (cont)

History of the document

Version	Date	Nature of revision
02	EB 65, Annex # 25 November 2011	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.
01	EB 58, Annex 19 26 November 2010	Initial adoption.
Decision Class: Regulatory **Document Type**: Standard **Business Function**: Methodology		