Joint Crediting Mechanism Approved Methodology ID_AM020

"Introduction of energy efficient and high color rendering LED downlight/spotlight"

A. Title of the methodology

Introduction of energy efficient and high color rendering LED downlight/spotlight, Version 01.0

B. Terms and definitions

Terms	Definitions
Luminous efficiency	The capacity of light flux per watt, which is calculated with the formula below. Luminous efficiency [lm/W] = Luminous flux [lm] ÷ Rated power consumption [W]
Color rendering index	An index used to quantitatively measure light source's ability to render the true colors of the object compared to a natural light source. The index is measured from 0 to 100, with a perfect 100 indicating that colors under the light source appear the same as they would under natural sunlight.
Downlight/Spotlight	Downlight is downward lighting directly embedded in ceiling. Spotlight is downward lighting attached to ceiling-mounted wiring ducts.

C. Summary of the methodology

Items	Summary
GHG emission reduction measures	This methodology applies to the project that aims for saving energy by introducing Light Emitting Diode (LED) downlight/spotlight in indoor facilities where high performance in color rendering property is required.
Calculation of reference emissions	Reference emissions are GHG emissions from using reference lighting, calculated with power consumption of project lighting, ratio of luminous efficiency of project/reference lighting and

	CO_2 emission factor for consumed electricity.
Calculation of project emissions	Project emissions are GHG emissions from using project lighting, calculated with power consumption of project lighting and CO_2 emission factor for consumed electricity.
Monitoring parameters	● Total power consumption by project lighting and/or opening days of facilities where project lighting is installed

D. Eligibility criteria

This methodology is applicable to projects that satisfy all of the following criteria.

Criterion 1	LED lighting is installed in indoor facilities.
Criterion 2	The installed LED lighting is a downlight or spotlight type LED whose color rendering index stated in catalogs or other information prepared by its manufacturer is equal to or higher than 85, and luminous efficiency is equal to or higher than the corresponding threshold value set in the table below.

Rated power consumption [W]	0≤x<20	20≤x<40	40≤x<60	60≤x<80	x≥80
Threshold luminous efficiency value [lm/W]	77.2	77.6	73.7	76.3	74.8

E. Emission Sources and GHG types

Reference emissions	
Emission sources	GHG types
Power consumption by reference lighting	CO_2
Project emissions	
Emission sources	GHG types
Power consumption by project LED lighting	CO_2

F. Establishment and calculation of reference emissions

F.1. Establishment of reference emissions

Reference emissions are calculated with power consumption of project lighting, ratio of luminous efficiency of project/reference lighting and CO_2 emission factor for consumed electricity.

The luminous efficiency of reference lighting is conservatively set *ex ante* in the following manner to ensure the net emission reductions.

1. In Indonesia, conventional High Intensity Discharge (HID) lighting, fluorescent lighting and Compact Fluorescent Lamp (CFL) are commonly chosen as lighting equipment in indoor facilities. However, LED lighting, which is more efficient than these conventional lighting, is adopted as reference lighting in this methodology for conservativeness.
2. The average luminous efficiency value of LED downlight/spotlight commercially available in the global market is defined as η_{RE} in each rated power consumption range, as described in Section I.

F.2. Calculation of reference emissions

$$RE_p = \sum_{i,j} EC_{PJ,i,j,p} \times \frac{\eta_{PJ,i,j}}{\eta_{RE,i,j}} \times EF_{elec,i}$$

RE_p	:	Reference emissions during the period p [tCO_2/p]
i	:	Identification number of the facility
j	:	Identification number of the group of project lighting of the same model
$EC_{PJ,i,j,p}$	:	Power consumption of project lighting for group j in the facility i during the period p [MWh/p]
$\eta_{PJ,i,j}$	:	Luminous efficiency of project lighting for group j in the facility i [lm/W]
$\eta_{RE,i,j}$	:	Luminous efficiency of reference lighting for group j in the facility i [lm/W]
$EF_{elec,i}$	:	CO_2 emission factor for consumed electricity in the facility i [tCO_2/MWh]

$EC_{PJ,i,j,p}$ is calculated as described below (Option 1 or 2).

- **Option 1.** If total power consumption by project lighting is measured for the facility i,

$$EC_{PJ,i,j,p} = EC_{PJ,i,total,p} \times \frac{P_{PJ,i,j} \times n_{PJ,i,j}}{P_{PJ,i,total}}$$

$$P_{PJ,i,total} = \sum_{j} \left(P_{PJ,i,j} \times n_{PJ,i,j} \right) \ ^{*1}$$

$EC_{PJ,i,total,p}$: Total power consumption by project lighting in the facility i during the period p [MWh/p]

$P_{PJ,i,total}$: Total rated power consumption of project lighting in the facility i [W]

$P_{PJ,i,j}$: Rated power consumption per unit of project lighting for group j in the facility i [W]

$n_{PJ,i,j}$: Number of the unit of project lighting for group j in the facility i

*1 If $EC_{PJ,i,total,p}$ includes power consumption by other lighting than project lighting which meets eligibility criterion 2 above, the rated power consumption of that lighting is included as a part of $P_{PJ,i,total}$.

- **Option 2.** Otherwise,

$$EC_{PJ,i,j,p} = P_{PJ,i,j} \times n_{PJ,i,j} \times 10^{-6} \times h_i \times D_{i,p}$$

h_i : Daily opening hours of the facility i [hour/day]

$D_{i,p}$: Opening days of the facility i during the period p [day/p]

G. Calculation of project emissions

$$PE_p = \sum_{i,j} EC_{PJ,i,j,p} \times EF_{elec,i}$$

PE_p : Project emissions during the period p [tCO_2/p]

$EC_{PJ,i,j,p}$: Power consumption of project lighting for group j in the facility i during the period p [MWh/p]

$EF_{elec,i}$: CO_2 emission factor for consumed electricity in the facility i [tCO_2/MWh]

H. Calculation of emissions reductions

$$ER_p = RE_p - PE_p$$

ER_p : Emission reductions during the period p [tCO_2/p]

RE_p : Reference emissions during the period p [tCO_2/p]

PE_p	:	Project emissions during the period p [tCO_2/p]

I. Data and parameters fixed *ex ante*

The source of each data and parameter fixed *ex ante* is listed as below.

Parameter	Description of data	Source
$EF_{elec,i}$	CO_2 emission factor for consumed electricity in the facility i [tCO_2/MWh]. When project lighting consumes only grid electricity or captive electricity, the project participant applies the CO_2 emission factor respectively. When project lighting may consume both grid electricity and captive electricity, the project participant applies the CO_2 emission factor with lower value. **[CO_2 emission factor]** For grid electricity: The most recent value available from the source stated in this table at the time of validation For captive electricity: 0.8 *[2] [tCO_2/MWh] *[2] The most recent value available from CDM approved small scale methodology AMS-I.A at the time of validation is applied.	**[Grid electricity]** Latest version of "Emission Factors of Electricity Interconnection Systems", National Committee on Clean Development Mechanism (Indonesian DNA for CDM), based on data obtained by Directorate General of Electricity, Ministry of Energy and Mineral Resources, Indonesia, unless otherwise instructed by the Joint Committee. **[Captive electricity]** CDM approved small scale methodology AMS-I.A
$\eta_{PJ,i,j}$	Luminous efficiency of project lighting for group j in the facility i. [lm/W].	Information prepared by manufacturer (e.g. catalogs, specifications, or quotations)
$\eta_{RE,i,j}$	Luminous efficiency of reference lighting for group j in the facility i [lm/W]. The default values for reference luminous efficiency are set in the table below, corresponding to the rated power consumption of project lighting.	Value derived from the result of survey on high color rendering LED downlight /spotlight. The default value should be revised, if necessary, every three years.

	<table><tr><th>Rated power consumption [W]</th><th>Reference luminous efficiency [lm/W]</th></tr><tr><td>0 ≤ x < 20</td><td>77.2</td></tr><tr><td>20 ≤ x < 40</td><td>77.6</td></tr><tr><td>40 ≤ x < 60</td><td>73.7</td></tr><tr><td>60 ≤ x < 80</td><td>76.3</td></tr><tr><td>x ≥ 80</td><td>74.8</td></tr></table>	
$P_{PJ,i,j}$	Rated power consumption per unit of project lighting for group *j* in the facility *i* [W].	Information prepared by manufacturer (e.g. catalogs, specifications, or quotations)
$n_{PJ,i,j}$	Number of the unit of project lighting for group *j* in the facility *i*.	Information prepared by PP (e.g. ledger, inventory or management record etc.)
h_i	Daily opening hours of the facility *i* [hour/day]. When the facility has more than one pattern of opening hours, the shortest one is applied conservatively.	Information on the facility where project lighting is installed.

History of the document

Version	Date	Contents revised
01.0	31 October 2019	JC9, Annex 1 Initial approval.