Joint Crediting Mechanism Approved Methodology ID_AM005

"Installation of LED Lighting for Grocery Store"

A. Title of the methodology

Installation of LED Lighting for Grocery Store, Version 32.0

B. Terms and definitions

Terms	Definitions
Luminous efficiency	Luminous efficiency is the capacity of light flux per watt. The formula to calculate luminous efficiency is as below. Luminous efficiency [lm/W] = Luminous flux [lm] ÷ Rated power consumption [W]

C. Summary of the methodology

Items	Summary
GHG emission reduction measures	This methodology applies to the project that aims for saving energy by introducing LED (Light Emitting Diode) lighting for grocery store in Indonesia.
Calculation of reference emissions	Reference emissions are GHG emissions from using reference lighting, calculated with total 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 total power consumption of project lighting, and CO_2 emission factor for consumed electricity.
Monitoring parameters	Total power consumption of project lighting

D. Eligibility criteria

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

Criterion 1	LED lighting is newly installed or installed to replace existing fluorescent

	lighting for grocery store whose selling area is less than 400 (four hundred) m^2.
Criterion 2	The installed LED lighting is a straight type LED with color temperature between 5,000 and 6,500 K, length between 602.5 and 1,513.0 mm, and luminous efficiency which is higher than the luminous efficiency of reference lighting. ~~of more than 120 lm/W.~~
Criterion 3	A measurement result of the illuminance (lux (lm/m^2)) of the installed LED lighting which is equal or above the minimum value (300 lux) for illuminance of grocery store is obtained. See explanatory note for the measurement method.
Criterion 4	In the case of replacing existing fluorescent lighting with the project LED lighting, mercury contained in existing fluorescent lighting is not released to the environment.

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 total 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, usually fluorescent lighting is chosen when purchasing lighting equipment.
2. The reference luminous efficiency of LED lighting is adopted as LED lighting is more energy efficient than fluorescent lighting.
3. The most efficient value of LED lighting commercially available in Indonesia is

defined as η_{RE}, as described in Section I.

F.2. Calculation of reference emissions

$$RE_p = EC_{PJ,p} \times (\eta_{PJ} \div \eta_{RE}) \times EF_{elec}$$

RE_p : Reference emissions during the period p [tCO_2/p]
$EC_{PJ,p}$: Total power consumption of project lighting during the period p [MWh/p]
η_{PJ} : Luminous efficiency of project lighting [lm/W]
η_{RE} : Luminous efficiency of reference lighting [lm/W]
EF_{elec} : CO_2 emission factor for consumed electricity [tCO_2/MWh]

G. Calculation of project emissions

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

PE_p : Project emissions during the period p [tCO_2/p]
$EC_{PJ,p}$: Total power consumption of project lighting during the period p [MWh/p]
EF_{elec} : CO_2 emission factor for consumed electricity [tCO_2/MWh]

H. Calculation of emissions reductions

$$ER_p = RE_p - PE_p$$

ER_p : Emissions 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.

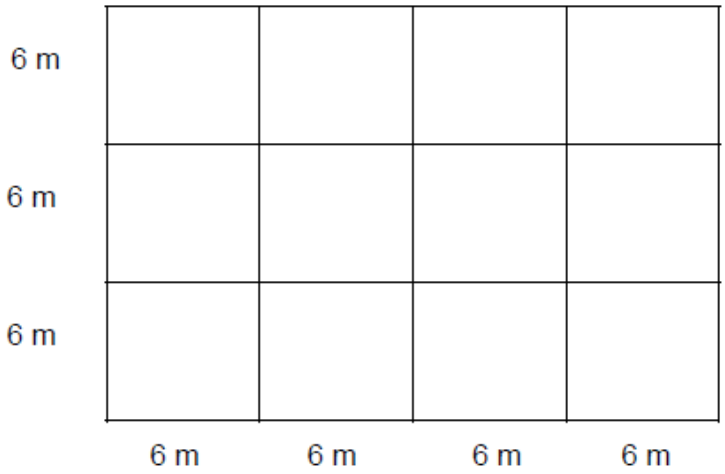
Parameter	Description of Data	Source
EF_{elec}	CO_2 emission factor for consumed electricity. When project lighting consumes only grid electricity or captive electricity, the project	**[Grid electricity]** Updates on Grid Electricity Emission Factors (calculated in

	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* [tCO_2/MWh] *The most recent value available from CDM approved small scale methodology AMS-I.A at the time of validation is applied.	year 2013), National Committee on Clean Development Mechanism, Indonesia, unless otherwise instructed by the Joint Committee. **[Captive electricity]** CDM approved small scale methodology AMS-I.A
η_{PJ}	Luminous efficiency of project lighting. The value prepared by manufacturer is applied. When more than one type of lighting equipment is installed, the luminous efficiency of lowest value amongst the installed equipments is applied.	Specifications of project lighting prepared for the quotation or factory acceptance test data by manufacturer.
η_{RE}	Luminous efficiency of reference lighting. The default value for η_{RE} is set as 131 lm/W. ~~Since LED lighting is limited and can only be found in newly opened grocery stores by international brands, reference emissions are determined under the assumption that commercially available LED lighting in Indonesia is installed in the stores. Top 5 manufacturers of lighting equipment in the country are identified through interview, and based on Criterion 2, LED lighting by one manufacturer meets the specifications. Therefore, luminous efficiency of merchandise by the manufacturer (110 lm/W) is set as η_{RE}.~~	Nominal value available on product catalogs, specification documents or websites. The default value is derived from the result of survey on luminous efficiency of LED from manufacturers that have high market share. The default value should be revised if necessary from survey result which is conducted by JC or project participants ~~every three years~~. The survey should prove the use of clear methodology.

Explanatory note

Measurement method for the illuminance (lux) of the installed LED lighting is as follows.

1. Equipment: Use luxmeter which shows the readings of the measurement in illuminance. Record the model of the luxmeter used for the measurement and its most recent record of the calibration. The accuracy of luxmeter is within ±6%. For each measurement, stable numerical values are obtained.
2. Measurement points: Divide the store horizontally with 6 meter squares or less as shown below and take readings at each point of intersection at the height of 1 meter above the floor.



3. Number of measurement and recording: Conduct and record measurement of illuminance for 3 times at each measurement point. Calculate the average illuminance in each measurement point, as well as average illuminance for all of the measurement points. Use the average illuminance for all of the measurement points for the comparison to the minimum value (300 lux (lm/m^2)) for illuminance of grocery store.
4. Others: At the time of measurement, the door of the grocery store and room lighting is set in line with the normal working condition.

History of the document

Version	Date	Contents revised
03.0	TBD	TBD
02.0	10 November 2015	Electronic decision by the Joint Committee Revision to the description of "Measurement methods and procedures" for the total power consumption of project lighting in the Monitoring Spreadsheet.
01.0	14 May 2015	Electronic decision by the Joint Committee Initial approval.

Monitoring Plan Sheet (Input Sheet) [Attachment to Project Design Document]

Table 1: Parameters to be monitored *ex post*

(a) Monitoring point No.	(b) Parameters	(c) Description of data	(d) Estimated Values	(e) Units	(f) Monitoring option	(g) Source of data	(h) Measurement methods and procedures	(i) Monitoring frequency	(j) Other comments
1	$EC_{PJ,p}$	Total power consumption of project lighting during the period *p*		MWh/p	Option C	Monitored data	Measuring equipment is installed to measure power consumption of LED lighting. Measurement is conducted with any of the following methods: [Method 1: Automated monitoring system] - Measured data is automatically transmitted through internet to the remote server for recording. - Data recorded in the remote server is reported and double-checked by a responsible staff on a monthly basis to prevent missing data. [Method 2: Manual monitoring] - Measured data on monitoring equipment are read and recorded manually by a grocery store staff member and double-checked by another member on a monthly basis, to prevent missing data. In case a calibration certificate issued by an entity accredited under national/international standards is not provided, such measuring equipment is required to be calibrated.	Monthly	n/a

Table 2: Project-specific parameters to be fixed *ex ante*

(a) Parameters	(b) Description of data	(c) Estimated Values	(d) Units	(e) Source of data	(f) Other comments
EF_{elec}	CO_2 emission factor for consumed electricity		tCO_2/MWh	[grid electricity] The most recent value available at the time of validation is applied and fixed for the monitoring period thereafter. The data is sourced from Updates on Grid Electricity Emission Factors (calculated in year 2013), National Committee on Clean Development Mechanism, Indonesia, unless otherwise instructed by the Joint Committee. [captive electricity] CDM approved small scale methodology AMS-I.A	n/a
η_{PJ}	Luminous efficiency of project lighting		lm/W	Specifications of project lighting prepared for the quotation or factory acceptance test data by manufacturer.	n/a
η_{RE}	Luminous efficiency of reference lighting	131.0	lm/W	Nominal value available on product catalogs, specification documents or websites.	n/a

Table3: *Ex-ante* estimation of CO_2 emission reductions

CO_2 emission reductions	Units
0	tCO_2/p

[Monitoring option]

Option A	Based on public data which is measured by entities other than the project participants (Data used: publicly recognized data such as statistical data and specifications)
Option B	Based on the amount of transaction which is measured directly using measuring equipments (Data used: commercial evidence such as invoices)

Option C	Based on the actual measurement using measuring equipments (Data used: measured values)

Monitoring Spreadsheet: JCM_ID_AM005_ver03.0

Reference Number:

Monitoring Plan Sheet (Calculation Process Sheet) [Attachment to Project Design Document]

1. Calculations for emission reductions	Fuel type	Value	Units	Parameter
Emission reductions during the period *p*		0.0	tCO_2/p	ER_p
2. Selected default values, etc.				
Luminous efficiency of reference lighting		131.0	lm/W	η_{RE}
3. Calculations for reference emissions				
Reference emissions during the period *p*		0.0	tCO_2/p	RE_p
Total power consumption of project lighting during the period *p*	Electricity	0.0	MWh/p	$EC_{PJ,p}$
Luminous efficiency of project lighting		0.0	lm/W	η_{PJ}
Luminous efficiency of reference lighting		131.0	lm/W	η_{RE}
CO_2 emission factor for consumed electricity	Electricity	0.000	tCO_2/MWh	EF_{elec}
4. Calculations of the project emissions				
Project emissions during the period *p*		0.0	tCO_2/p	PE_p
Total power consumption of project lighting during the period *p*	Electricity	0.0	MWh/p	$EC_{PJ,p}$
CO_2 emission factor for consumed electricity	Electricity	0.000	tCO_2/MWh	EF_{elec}

[List of Default Values]

Luminous efficiency of reference lighting	131.0	lm/W

Monitoring Structure Sheet [Attachment to Project Design Document]

Responsible personnel	Role

Monitoring Report Sheet (Input Sheet) [For Verification]

Table 1: Parameters monitored *ex post*

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)
Monitoring period	Monitoring point No.	Parameters	Description of data	Monitored Values	Units	Monitoring option	Source of data	Measurement methods and procedures	Monitoring frequency	Other comments
	1	$EC_{PJ,p}$	Total power consumption of project lighting during the period *p*		MWh/p	Option C	Monitored data	Measuring equipment is installed to measure power consumption of LED lighting. Measurement is conducted with any of the following methods: [Method 1: Automated monitoring system] - Measured data is automatically transmitted through internet to the remote server for recording. - Data recorded in the remote server is reported and double-checked by a responsible staff on a monthly basis to prevent missing data. [Method 2: Manual monitoring] - Measured data on monitoring equipment are read and recorded manually by a grocery store staff member and double-checked by another member on a monthly basis, to prevent missing data. In case a calibration certificate issued by an entity accredited under national/international standards is not provided, such measuring equipment is required to be calibrated.	Monthly	n/a

Table 2: Project-specific parameters fixed *ex ante*

(a)	(b)	(c)	(d)	(e)	(f)
Parameters	Description of data	Estimated Values	Units	Source of data	Other comments
EF_{elec}	CO_2 emission factor for consumed electricity	0.000	tCO_2/MWh	[grid electricity] The most recent value available at the time of validation is applied and fixed for the monitoring period thereafter. The data is sourced from Updates on Grid Electricity Emission Factors (calculated in year 2013), National Committee on Clean Development Mechanism, Indonesia, unless otherwise instructed by the Joint Committee. [captive electricity] CDM approved small scale methodology AMS-I.A	n/a
η_{PJ}	Luminous efficiency of project lighting	0.0	lm/W	Specifications of project lighting prepared for the quotation or factory acceptance test data by manufacturer.	n/a
η_{RE}	Luminous efficiency of reference lighting	131.0	lm/W	Nominal value available on product catalogs, specification documents or websites.	n/a

Table3: *Ex-post* calculation of CO_2 emission reductions

Monitoring Period	CO_2 emission reductions	Units
	0	tCO_2/p

[Monitoring option]

Option A	Based on public data which is measured by entities other than the project participants (Data used: publicly recognized data such as statistical data and specifications)
Option B	Based on the amount of transaction which is measured directly using measuring equipments (Data used: commercial evidence such as invoices)

Option C	Based on the actual measurement using measuring equipments (Data used: measured values)

Monitoring Spreadsheet: JCM_ID_AM005_ver03.0

Reference Number:

Monitoring Report Sheet (Calculation Process Sheet) [For Verification]

1. Calculations for emission reductions	Fuel type	Value	Units	Parameter
Emission reductions during the period *p*		0.0	tCO_2/p	ER_p
2. Selected default values, etc.				
Luminous efficiency of reference lighting		131.0	lm/W	η_{RE}
3. Calculations for reference emissions				
Reference emissions during the period *p*		0.0	tCO_2/p	RE_p
Total power consumption of project lighting during the period *p*	Electricity	0.0	MWh/p	$EC_{PJ,p}$
Luminous efficiency of project lighting		0.0	lm/W	η_{PJ}
Luminous efficiency of reference lighting		131.0	lm/W	η_{RE}
CO_2 emission factor for consumed electricity	Electricity	0.000	tCO_2/MWh	EF_{elec}
4. Calculations of the project emissions				
Project emissions during the period *p*		0.0	tCO_2/p	PE_p
Total power consumption of project lighting during the period *p*	Electricity	0.0	MWh/p	$EC_{PJ,p}$
CO_2 emission factor for consumed electricity	Electricity	0.000	tCO_2/MWh	EF_{elec}

[List of Default Values]

Luminous efficiency of reference lighting	131.0	lm/W