**Joint Crediting Mechanism Approved Methodology KH_AM001**

**"Installation of LED street lighting system with wireless network control"**

## A. Title of the methodology

Installation of LED street lighting system with wireless network control, Version 01.0

## B. Terms and definitions

| Terms | Definitions |
|---|---|
| Wireless network control | Operation of a network of equipment without any kind of cables where data are exchanged through the use of radio wave. It consists of nodes that collect information from individual equipment and gateways that act as the central collecting points and communicate data with a wider network. |
| LED lamp | A lighting device utilizing light-emitting diode (LED), which is a semiconductor device that emits visible light when an electric current passes through it. |
| HID lamp | An electric discharge lamp in which the light-producing arc is stabilized by wall temperature and the arc has a bulb wall loading in excess of 3 watts per square centimetre. HID lamps include groups of lamps known as high pressure mercury, metal halide and high pressure sodium lamps. [Source: International Electrotechnical Vocabulary (IEV) 845-07-19] |
| Luminaire efficiency | Luminaire efficiency is the capacity of light flux per watt. |

## C. Summary of the methodology

| Items | Summary |
|---|---|
| *GHG emission reduction measures* | The street lighting system that introduces LED lamps and lighting control devices with utilization of wireless network is installed on streets to save electricity consumption. |

| | |
|---|---|
| *Calculation of reference emissions* | Reference emissions are calculated as emissions from consumption of grid electricity by lighting system utilizing HID lamps for providing the same service level as in the project. |
| *Calculation of project emissions* | Project emissions are calculated as the emissions from consumption of grid electricity by LED street lighting system with wireless network control installed under the project. |
| *Monitoring parameters* | 1. Total operating hours of project lighting system $i$ during the period $p$ (hrs/p)<br>2. Total amount of electricity consumed in the project lighting system $i$ during the period $p$ (Wh/p) |

## D. Eligibility criteria

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

| | |
|---|---|
| Criterion 1 | The project installs LED street lighting system utilizing wireless network control, which is connected to an electricity grid system. |
| Criterion 2 | All lighting equipment in one lighting system has the same specifications. |
| Criterion 3 | Wireless network technology enables controlling of the volume of lighting. |

## E. Emission Sources and GHG types

| Reference emissions | |
|---|---|
| Emission sources | GHG types |
| Grid electricity consumption by the HID street lighting system. | $CO_2$ |
| Project emissions | |
| Emission sources | GHG types |
| Grid electricity consumption by the LED street lighting system with wireless network control. | $CO_2$ |

## F. Establishment and calculation of reference emissions

### F.1. Establishment of reference emissions

Reference emissions are calculated on the basis of the rated power consumption of project street lighting systems, ratio of luminaire efficiency of project/reference lighting, operating hours of

reference lighting systems and $CO_2$ emission factor of the electricity systems to which the lighting systems are connected.

In order to ensure net emission reductions, a conservative default value is established for luminaire efficiency of reference lighting system taking into account the highest luminaire efficiency out of high pressure sodium lamps used on major arterial roads of Japan.

**F.2. Calculation of reference emissions**

Reference emissions are calculated in line with the following equation. The operating hours are assumed to be the same as the project.

$$RE_p = \sum_i P_i \times \left( \eta_{PJ,i} \div \eta_{RE} \right) \times PO_{i,p} \times EF_{grid} \times 10^{-6} \tag{1}$$

| | |
|---|---|
| $RE_p$ | Reference emissions during the period $p$ (tCO$_2$/p) |
| $P_i$ | Rated power consumption of a lighting equipment used in the project lighting system $i$ (W) |
| $\eta_{PJ,i}$ | Luminaire efficiency of a lighting equipment used in the project lighting system $i$ (lm/W) |
| $\eta_{RE}$ | Luminaire efficiency of the reference lighting system (lm/W) |
| $PO_{i,p}$ | Total operating hours of project lighting system $i$ during the period $p$ (hrs/p) |
| $EF_{grid}$ | Grid emission factor of Cambodian grid (tCO$_2$/MWh) |
| $i$ | Identification number of the lighting system |

## G. Calculation of project emissions

Project emissions are calculated in line with the following equation.

$$PE_p = \sum_i PEC_{i,p} \times EF_{grid} \times 10^{-6} \tag{2}$$

| | |
|---|---|
| $PE_p$ | Project emissions during the period $p$ (tCO$_2$/p) |

| | |
|---|---|
| $PEC_{i,p}$ | Total amount of electricity consumed in the project lighting system $i$ during the period $p$ (Wh/p) |
| $EF_{grid}$ | Grid emission factor of Cambodian grid (tCO$_2$/MWh) |
| $i$ | Identification number of the lighting system |

## H. Calculation of emissions reductions

$$ER_p = RE_p - PE_p \qquad (3)$$

| | |
|---|---|
| $ER_p$ | Emissions reduction 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 |
|---|---|---|
| $P_i$ | Rated power consumption of a lighting equipment used in the project lighting system $i$ (W) | Information by manufacturer |
| $\eta_{PJ,i}$ | Luminaire efficiency of a lighting equipment used in the project lighting system $i$ (lm/W). | Information by manufacturer |
| $\eta_{RE}$ | Luminaire efficiency of the reference lighting system (lm/W). A default value (62 lm/W) based on the HPS lamp with the highest efficiency meeting Japan's highway lighting standards for major arterial roads (HPS NH220). | The rated lamp efficiency is based on the specifications of HPS NH220 and is adjusted by the loss by equipment based on the evaluation by NH220's manufacturer and the power factor based on Japan Industrial Standard (JIS C 8109). |

| $EF_{grid}$ | Grid emission factor of Cambodian grid (tCO$_2$/MWh) | The most recent published value by the Ministry of Environment of Cambodia at the time of validation. |
|---|---|---|

History of the document

| Version | Date | Contents revised |
|---|---|---|
| 01.0 | 26 April 2016 | JC2, Annex 7<br>Initial approval. |
| | | |
| | | |