Joint Crediting Mechanism Approved Methodology ID_AM004

"Installation of Inverter-Type Air Conditioning System for Cooling for Grocery Store"

A. Title of the methodology

Installation of Inverter-Type Air Conditioning System for Cooling for Grocery Store, Version 2.0

B. Terms and definitions

Terms	Definitions
Inverter-type air conditioning system	Inverter-type air conditioning system is a type of air conditioning system which contains inverter, an apparatus to control the speed of the compressor motor in order to maintain the ambient temperature. While the compressor in a non-inverter-type air conditioning system can only either operates in maximum capacity or stops entirely, the compressor in an inverter-type air conditioning system operates at adjustable speeds.
Coefficient of Performance (COP)	Coefficient of Performance (COP) is the cooling capacity per rated power consumption of the air conditioning system. The values of cooling capacity and rated power consumption are defined under specific temperature stated in ISO 5151:2010.
Cooling capacity	Cooling capacity is the ability of air conditioning system to remove heat, calculated with amount of heat removed per unit time at specific temperature.

C. Summary of the methodology

Items	Summary
GHG emission reduction measures	This methodology applies to the project that aims for saving energy by introducing inverter-type air conditioning system for cooling for grocery store in Indonesia.

Calculation of reference emissions	Reference emissions are GHG emissions from using reference air conditioning system, calculated with power consumption of project air conditioning system, ratio of COPs of project/reference air conditioning system, and CO_2 emission factor for consumed electricity.
Calculation of project emissions	Project emissions are GHG emissions from using project air conditioning system, calculated with power consumption of installed inverter-type air conditioning system, and CO_2 emission factor for consumed electricity.
Monitoring parameters	Power consumption of project air conditioning system

D. Eligibility criteria

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

Criterion 1	Single split inverter-type air conditioning system[1] is newly installed or installed to replace existing air conditioning system for grocery store whose selling area is less than 400 (four hundred) m^2.
Criterion 2	The installed air conditioning system is wall mounted type and/or ceiling cassette type, and has a COP value higher than that of the value indicated in the table below.
Criterion 3	Ozone Depletion Potential (ODP) of the refrigerant used for the installed air conditioning system is 0 (zero).
Criterion 4	A plan for not releasing refrigerant used for project air conditioning system is prepared. In the case of replacing the existing air conditioning system with the project air conditioning system, a plan is prepared in which refrigerant used for the existing air conditioning system is not released to the air e.g. re-use of the refrigerant. Execution of the prevention plan is checked at the time of verification, in order to confirm that refrigerant used for the existing one replaced by the project is not released to the air.

Cooling Capacity [kW]	Reference COP
$2.5 < x \leqq 4.1$	4.00
$4.1 < x \leqq 5.3$	3.59
$5.3 < x \leqq 7.1$	2.96
$7.1 < x \leqq 14.2$	2.85

[1] Under the single split system, one indoor unit is connected to one outdoor unit.

E. Emission Sources and GHG types

Reference emissions	
Emission sources	GHG types
Power consumption by reference air conditioning system	CO_2
Project emissions	
Emission sources	GHG types
Power consumption by project air conditioning system	CO_2

F. Establishment and calculation of reference emissions

F.1. Establishment of reference emissions

Reference emissions are calculated with power consumption of project air conditioning system, ratio of COPs of project/reference air conditioning system, and CO_2 emission factor for electricity consumed.

The COP of reference air conditioning system is conservatively set *ex ante* in the following manner to ensure the net emission reductions.

1. The COP value tends to decrease as the cooling capacity increases.
2. The reference COP, at a certain cooling capacity, is set at a maximum value in the respective cooling capacity range.
3. The maximum values of COP in the respective cooling capacity ranges are defined as COP_{RE}.

F.2. Calculation of reference emissions

$$\mathbf{RE_p} = \sum_{\mathbf{i}} \left\{ \mathbf{EC_{PJ,i,p}} \times \left(\mathbf{COP_{PJ,i}} \div \mathbf{COP_{RE,i}} \right) \right\} \times \mathbf{EF_{elec}}$$

RE_p	: Reference emissions during the period p [tCO_2/p]
$EC_{PJ,i,p}$	: Power consumption of project air conditioning system i during the period p [MWh/p]
$COP_{PJ,i}$	: COP of project air conditioning system i [-]
$COP_{RE,i}$	: COP of reference air conditioning system i [-]
EF_{elec}	: CO_2 emission factor for consumed electricity [tCO_2/MWh]
i	: Type of air conditioning system [-]

G. Calculation of project emissions

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

PE_p	: Project emissions during the period p [tCO_2/p]
$EC_{PJ,i,p}$	: Power consumption of project air conditioning system i during the period p [MWh/p]
EF_{elec}	: CO_2 emission factor for consumed electricity [tCO_2/MWh]
i	: Type of air conditioning system [-]

H. Calculation of emissions reductions

$$\boldsymbol{ER_p = RE_p - PE_p}$$

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 air conditioning system consumes only grid electricity or captive electricity, the project participant applies the CO_2 emission factor respectively. When project air conditioning system 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	**[Grid electricity]** 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

<table>
<tr><td></td><td>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.</td><td></td></tr>
<tr><td>$COP_{RE,i}$</td><td>COP of reference air conditioning system i, as indicated in Table 2. The values of cooling capacity and rated power consumption used in the calculation of COP are obtained from product catalogs, specification documents or website of major manufacturers in Indonesia.

Table 2 : COP for Reference Air Conditioning System ($COP_{RE,i}$)<table><tr><th>i</th><th>Cooling capacity [kW]</th><th>Reference COP</th></tr><tr><td>1</td><td>2.5kW<x≦4.1kW</td><td>4.00</td></tr><tr><td>2</td><td>4.1kW<x≦5.3kW</td><td>3.59</td></tr><tr><td>3</td><td>5.3kW<x≦7.1kW</td><td>2.96</td></tr><tr><td>4</td><td>7.1kW<x≦14.2kW</td><td>2.85</td></tr></table></td><td>Nominal value available on product catalogs, specification documents or websites.

The default values are derived from the result of survey on COP of air conditioning system from manufacturers that have high market share. The default values 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.</td></tr>
<tr><td>$COP_{PJ,i}$</td><td>COP of project air conditioning system i. The value of cooling capacity and rated power consumption used in the calculation of COP prepared by manufacturer is applied.</td><td>Specifications of project air conditioning system for the quotation or factory acceptance test data by manufacturer.</td></tr>
</table>

History of the document

Version	Date	Contents revised
02.0	10 November 2015	Electronic decision by the Joint Committee Revisions to: ● Change the description of Criterion 4 in Section D; and ● Change the description of “Measurement methods and procedures” for the power consumption of project air

		conditioning system in the Monitoring Spreadsheet.
01.0	30 October 2014	JC3, Annex 5 Initial approval.