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 21.0

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 ~~P~~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.

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

Table 1: Parameters to be monitored *ex post*

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Monitoring point No.	Parameters	Description of data	Estimated Values	Units	Monitoring option	Source of data	Measurement methods and procedures	Monitoring frequency	Other comments
(1)	$EC_{PJ,1,p}$	Power consumption of project air conditioning system 1 during the period *p*	0	MWh/p	Option C	Monitored data	Measuring equipment is installed to measure power consumption of ~~in each~~ air conditioning system. ~~Data accumulated from the equipment is recorded by grocery store staff and double-checked by another staff on a monthly basis, to prevent missing data.~~ 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
(2)	$EC_{PJ,2,p}$	Power consumption of project air conditioning system 2 during the period *p*	0	MWh/p	Option C	Monitored data	Measuring equipment is installed to measure power consumption of ~~in each~~ air conditioning system. ~~Data accumulated from the equipment is recorded by grocery store staff and double-checked by another staff on a monthly basis, to prevent missing data.~~ 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

(3)	$EC_{PJ,3,p}$	Power consumption of project air conditioning system 3 during the period *p*	0	MWh/p	Option C	Monitored data	Measuring equipment is installed to measure power consumption of ~~in each~~ air conditioning system. ~~Data accumulated from the equipment is recorded by grocery store staff and double-checked by another staff on a monthly basis, to prevent missing data.~~ 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
(4)	$EC_{PJ,4,p}$	Power consumption of project air conditioning system 4 during the period *p*	0	MWh/p	Option C	Monitored data	Measuring equipment is installed to measure power consumption of ~~in each~~air conditioning system. ~~Data accumulated from the equipment is recorded by grocery store staff and double-checked by another staff on a monthly basis, to prevent missing data.~~ 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)	(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
$COP_{PJ,1}$	COP of project air conditioning system 1	0.00	-	Specifications of project air conditioning system prepared for the quotation or factory acceptance test data by manufacturer.	n/a
$COP_{PJ,2}$	COP of project air conditioning system 2	0.00	-	Specifications of project air conditioning system prepared for the quotation or factory acceptance test data by manufacturer.	n/a
$COP_{PJ,3}$	COP of project air conditioning system 3	0.00	-	Specifications of project air conditioning system prepared for the quotation or factory acceptance test data by manufacturer.	n/a
$COP_{PJ,4}$	COP of project air conditioning system 4	0.00	-	Specifications of project air conditioning system prepared for the quotation or factory acceptance test data by manufacturer.	n/a
$COP_{RE,1}$	COP of reference air conditioning system 1	4.00	-	Nominal value available on product catalogs, specification documents or websites.	n/a
$COP_{RE,2}$	COP of reference air conditioning system 2	3.59	-	Nominal value available on product catalogs, specification documents or websites.	n/a
$COP_{RE,3}$	COP of reference air conditioning system 3	2.96	-	Nominal value available on product catalogs, specification documents or websites.	n/a
$COP_{RE,4}$	COP of reference air conditioning system 4	2.85	-	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 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*	N/A	0	tCO_2/p	ER_p
2. Selected default values, etc.				
COP of reference air conditioning system 1	N/A	4.00	-	$COP_{RE,1}$
COP of reference air conditioning system 2	N/A	3.59	-	$COP_{RE,2}$
COP of reference air conditioning system 3	N/A	2.96	-	$COP_{RE,3}$
COP of reference air conditioning system 4	N/A	2.85	-	$COP_{RE,4}$
3. Calculations for reference emissions				
Reference emissions during the period *p*	N/A	0	tCO_2/p	RE_p
Power consumption of project air conditioning system 1 during the period *p*	Electricity	0	MWh/p	$EC_{PJ,1,p}$
Power consumption of project air conditioning system 2 during the period *p*	Electricity	0	MWh/p	$EC_{PJ,2,p}$
Power consumption of project air conditioning system 3 during the period *p*	Electricity	0	MWh/p	$EC_{PJ,3,p}$
Power consumption of project air conditioning system 4 during the period *p*	Electricity	0	MWh/p	$EC_{PJ,4,p}$
COP of project air conditioning system 1	N/A	0.00	-	$COP_{PJ,1}$
COP of reference air conditioning system 1	N/A	4.00	-	$COP_{RE,1}$
COP of project air conditioning system 2	N/A	0.00	-	$COP_{PJ,2}$
COP of reference air conditioning system 2	N/A	3.59	-	$COP_{RE,2}$
COP of project air conditioning system 3	N/A	0.00	-	$COP_{PJ,3}$
COP of reference air conditioning system 3	N/A	2.96	-	$COP_{RE,3}$
COP of project air conditioning system 4	N/A	0.00	-	$COP_{PJ,4}$
COP of reference air conditioning system 4	N/A	2.85	-	$COP_{RE,4}$
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*	N/A	0	tCO_2/p	PE_p
Sum of power consumption of project air conditioning system *i* during the period *p*	Electricity	0	MWh/p	$\Sigma EC_{PJ,i,p}$
CO_2 emission factor for consumed electricity	Electricity	0.000	tCO_2/MWh	EF_{elec}

[List of Default Values]

i	Project-specific parameters to be fixed *ex ante*		
1	COP of reference air conditioning system (Cooling capacity 2.5kW < x ≦ 4.1kW)	4.00	-
2	COP of reference air conditioning system (Cooling capacity 4.1kW < x ≦ 5.3kW)	3.59	-
3	COP of reference air conditioning system (Cooling capacity 5.3kW < x ≦ 7.1kW)	2.96	-
4	COP of reference air conditioning system (Cooling capacity 7.1kW < x ≦ 14.2kW)	2.85	-

Monitoring Structure Sheet [Attachment to Project Design Document]

Responsible personnel	Role