Joint Crediting Mechanism Approved Methodology ID_AM008 "Installation of a separate type fridge-freezer showcase by using natural refrigerant for grocery store to reduce air conditioning load inside the store"

A. Title of the methodology

Installation of a separate type fridge-freezer showcase by using natural refrigerant for grocery store to reduce air conditioning load inside the store, version 2.0

B. Terms and definitions

Terms	Definitions	
Separate type fridge-freezer	Refrigeration or freezer system with natural refrigerant of	
showcase	which condensing unit and showcase unit are separated and	
	the condensing unit is located outside the store. The system	
	includes the following:	
	Reach-in type fridge showcase or freezer showcase (a	
	structure to interrupt display room from outside air by	
	glass type door)	
	Open type fridge showcase (a structure to interrupt	
	display room from outside air by air curtain)	
	Walk in type fridge showcase (a structure which people	
	can go in and fill groceries from behind the display	
	shelves)	
Natural refrigerant	Natural refrigerant refers to naturally occurring substances	
	with refrigeration capacity and with zero ozone depletion	
	potential (ODP) (e.g., CO ₂ and NH ₃).	
Built-in type showcase	Refrigeration or freezer system of which condensing unit and	
	showcase unit are built in one unit.	
Coefficient of Performance	Coefficient of Performance (COP) is the cooling capacity per	
(COP)	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.	
Energy efficiency	For the purpose of this methodology, energy efficiency of the	
	fridge-freezer showcase is defined as the rated volume (L)	

divided by the rated electricity consumption (W) or the rated
cooling capacity (W) divided by the rated electricity
consumption (W).

C. Summary of the methodology

Items	Summary
GHG emission reduction	This methodology applies to the project that aims for saving total
measures	energy of in-store showcase and air conditioning system by
	introducing a separate type natural refrigerant fridge-freezer
	showcase for grocery store in Indonesia, which leads to GHG
	emission reductions, through the reduction of air conditioning
	electricity load demand by not releasing waste heat inside the
	store.
Calculation of reference	Reference emissions are GHG emissions from both the reference
emissions	built-in type fridge-freezer showcase and the reference air
	conditioning system.
	[Built-in type fridge-freezer showcase]
	Reference emissions from the reference fridge-freezer showcase
	are calculated with:
	Electricity consumption of the project fridge-freezer
	showcase;
	Energy efficiency of the project fridge-freezer showcase;
	Energy efficiency of the reference fridge-freezer
	showcase; and
	 CO₂ emission factor for consumed electricity.
	[Air conditioning system]
	Reference emissions from the reference air conditioning system
	due to waste heat from the reference fridge-freezer showcase are
	calculated with:
	Electricity consumption of the project fridge-freezer
	showcase;
	Energy efficiency of the project fridge-freezer showcase
	in terms of the cooling capacity;
	Energy efficiency of the project fridge-freezer showcase
	in terms of the volume;

	Energy efficiency of the reference fridge-freezer	
	showcase;	
	COP of the reference air conditioning system; and	
	CO ₂ emission factor for consumed electricity.	
Calculation of project	[Separate type natural refrigerant fridge-freezer showcase]	
emissions	Project emissions are calculated with power consumption of	
	installed separate type natural refrigerant fridge-freezer showcase	
	and CO ₂ emission factor for consumed electricity.	
Monitoring parameters	Electricity consumption of the project fridge showcase	
	Electricity consumption of the project freezer showcase	

D. Eligibility criteria

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

Criterion 1	The project is to install a separate type fridge-freezer showcase by using natural	
	refrigerant or replacing the existing at a grocery store which is equipped with wall	
	mounted type and/or ceiling cassette type air conditioning system and whose	
	selling area is less than 400 (four hundred) m ² .	
Criterion 2	In the case of replacing the existing fridge-freezer showcase with the project	
	fridge-freezer showcase, the existing one is a built-in type showcase.	
Criterion 3	A plan for not releasing refrigerant used for project fridge-freezer showcase is	
	prepared. In the case of replacing the existing fridge-freezer showcase with the	
	project fridge-freezer showcase, a plan is prepared in which refrigerant used in the	
	existing fridge-freezer showcase 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.	

E. Emission Sources and GHG types

Reference emissions	
Emission sources	GHG types
Electricity consumption of the reference fridge showcase	CO_2
Electricity consumption of the reference freezer showcase	CO_2
Electricity consumption of the reference air conditioning system	CO ₂

Project emissions	
Emission sources	GHG types
Electricity consumption of the project fridge showcase	CO_2
Electricity consumption of the project freezer showcase	CO ₂

F. Establishment and calculation of reference emissions

F.1. Establishment of reference emissions

Reference emissions are GHG emissions from electricity consumption by both the reference built-in type fridge-freezer showcase and the reference air conditioning system used for cooling the exhaust heat from the reference fridge showcase.

Net emission reductions in this methodology are achieved by setting default values of "COP of the reference air conditioning system" in a conservative manner, and also achieved by not including "leakage of HFCs from the reference fridge-freezer showcase" when calculating emission reductions.

[COP of the reference air conditioning system]

The default values of COP of the reference air conditioning system are set in line with the approved JCM methodology ID_AM004 Ver1.0.

If the air conditioning system equipped in the project store has higher COP values compared to the table below within the respective cooling capacity range, the COP value of the air conditioning system installed at the project store is used.

If multiple types of air conditioning system with different cooling capacity rage shown in the table below are found in the project site, the highest value of COP is selected and applied to calculate reference emissions in a conservative manner.

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

The default COP values may be revised as to the revision of the approved JCM methodology ID_AM004 to maintain conservativeness.

[Energy efficiency of the reference fridge-freezer showcase]

The default values of rated electricity consumption of the reference fridge and freezer showcase are set *ex ante* in the table below.

The reference fridge showcase

-Reach-in showcase

Range of volume (L)	Energy efficiency (L/W)
z < 900	1.18
900 z < 1,200	1.07
1,200 z	2.24

-Open showcase

Range of volume (L)	Energy efficiency (L/W)
z < 900	0.50
900 z < 1,200	0.65
1,200 z	0.73

The reference freezer showcase

-Reach-in showcase

Range of volume (L)	Energy efficiency (L/W)
z < 900	0.70
900 z < 1,200	0.70
1,200 z	1.01

Correspondence between project fridge-freezer showcase and reference fridge-freezer showcase:

Pattern	Project fridge-freezer showcase	Reference fridge-freezer showcase
1	Reach-in type fridge showcase	Reach-in type fridge showcase
2	Open type fridge showcase	Open type fridge showcase
3	Walk-in type fridge showcase	Reach-in type fridge showcase
4	Reach-in type freezer showcase	Reach-in type freezer showcase

F.2. Calculation of reference emissions

 $RE_p = RE_{fridge,p} + RE_{freezer,p} + RE_{AC,add,fridge,p} + RE_{AC,add,freezer,p}$

 RE_p : Reference emissions during the period p [tCO₂/p]

 $RE_{fridge,p}$: Reference emissions of the fridge showcase during the period p [tCO₂/p]

 $RE_{freezer,p}$: Reference emissions of the freezer showcase during the period p

[tCO₂/p]

RE_{AC,add,fridge,p}: Reference emissions of the air conditioning system caused by the

electricity consumption due to exhaust heat from the reference fridge

showcase during the period p [tCO₂/p]

RE_{AC,add,freezer,p}: Reference emissions of the air conditioning system caused by the

electricity consumption due to exhaust heat from the reference freezer

showcase during the period p [tCO₂/p]

 $RE_{fridge,p} = \sum_{i} \left(EC_{PJ,fridge,i,p} \times \frac{\eta_{PJ,fridge,i}}{\eta_{RE,fridge,i}} \right) \times EF_{elec}$

 $RE_{fridge,p}$: Reference emissions of the fridge showcase during the period p [tCO₂/p]

 $EC_{PJ,fridge,i,p}$: Electricity consumption of the project fridge showcase *i* during the period

p [MWh/p]

 $\eta_{\text{PJ,fridge,i}}$: Energy efficiency of the project fridge showcase *i* in terms of the volume

[L/W]

 $\eta_{\text{RE,fridge,i}}$: Energy efficiency of the reference fridge showcase *i* in terms of the

volume [L/W]

EF_{elec} : CO₂ emission factor for consumed electricity [tCO₂/MWh]

i : Identification number of the fridge showcase [-]

 $RE_{freezer,p} = \sum_{i} \left(EC_{PJ,freezer,j,p} \times \frac{\eta_{PJ,freezer,j}}{\eta_{RE,freezer,j}} \right) \times EF_{elec}$

 $RE_{freezer.p}$: Reference emissions of the freezer showcase during the period p [tCO₂/p]

 $EC_{PI,freezer,j,p}$: Electricity consumption of the project freezer showcase j during the period

p [MWh/p]

 $\eta_{\text{Pl,freezer,j}}$: Energy efficiency of the project freezer showcase j in terms of the volume

[L/W]

 $\eta_{\text{RE,freezer,j}}$: Energy efficiency of the reference freezer showcase j in terms of the

volume [L/W]

EF_{elec} : CO₂ emission factor for consumed electricity [tCO₂/MWh]

i : Identification number of the freezer showcase [-]

RE _{AC,add,fridge,p}	=	EC _{RE,AC,add,fridge,p}	×	EF _{elec}
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$$EC_{RE,AC,add,fridge,p} = \sum_{i} EH_{RE,fridge,i,p} \times \frac{1}{\eta_{RE,AC}}$$

$$EH_{RE,fridge,i,p} = HG_{RE,fridge,i,p} + EC_{RE,fridge,i,p} \label{eq:energy}$$

$$HG_{RE,fridge,i,p} = HG_{PJ,fridge,i,p}$$

$$HG_{PJ,fridge,i,p} = EC_{PJ,fridge,i,p} \times \eta_{PJ,fridge,cap,i}$$

$$EC_{RE,fridge,i,p} = EC_{PJ,fridge,i,p} \times \frac{\eta_{PJ,fridge,i}}{\eta_{RE,fridge,i}}$$

 $RE_{AC,add,fridge,p}$: Reference emissions of the air conditioning system caused by the

electricity consumption due to exhaust heat from the reference fridge

showcase during the period p [tCO₂/p]

EC_{RE,AC,add,fridge,p}: Electricity consumption of the reference air conditioning system due

to exhaust heat from the reference fridge showcase during the period p

[MWh/p]

 EF_{elec} : CO_2 emission factor for consumed electricity [tCO_2/MWh]

 $EH_{RE,fridge,i,p}$: Amount of exhaust heat from the reference fridge showcase i during

the period p [MWh/p]

 $\eta_{\text{RE,AC}}$: COP of the reference air conditioning system [-]

 $HG_{RE,fridge,i,p}$: Amount of cooling energy generated by the reference fridge showcase

i during the period *p* [MWh/p]

 $\mathrm{HG}_{\mathrm{PI,fridge,i,p}}$: Amount of cooling energy generated by the project fridge showcase i

during the period *p* [MWh/p]

 $EC_{RE,fridge,i,p}$: Electricity consumption of the reference fridge showcase i during the

period p [MWh/p]

 $EC_{PI,fridge,i,p}$: Electricity consumption of the project fridge showcase *i* during the

period p [MWh/p]

 $\eta_{\rm PJ,fridge,cap,i}$: Energy efficiency of the project fridge showcase i in terms of the

cooling capacity [W/W]

 $\eta_{\text{Pl,fridge,i}}$: Energy efficiency of the project fridge showcase *i* in terms of the

volume [L/W]

 $\eta_{\text{RE,fridge,i}}$: Energy efficiency of the reference fridge showcase i in terms of the

volume [L/W]

i : Identification number of the fridge showcase [-]

 $RE_{AC,add,freezer,p} = EC_{RE,AC,add,freezer,p} \times EF_{elec}$

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$EC_{RE,AC,add,freezer,p} = \sum EH_{RE,freezer,j,p}$	$\times {\eta_{\text{RE.AC}}}$
-	'/KE,AC

 $EH_{RE,freezer,j,p} = HG_{RE,freezer,j,p} + EC_{REfreezer,j,p}$

 $HG_{RE,freezer,j,p} = HG_{PJ,freezer,j,p}$

 $HG_{PJ,freezer,j,p} = EC_{PJ,freezer,j,p} \times \eta_{PJ,freezer,cap,j}$

 $EC_{RE,freezer,j,p} = EC_{PJ,freezer,j,p} \times \frac{\eta_{PJ,freezer,j}}{\eta_{RE,freezer,j}}$

 $RE_{AC,add,freezer,p}$: Reference emissions of the air conditioning system caused by the

electricity consumption due to exhaust heat from the reference freezer

showcase during the period p [tCO₂/p]

EC_{RE,AC,add,freezer,p}: Electricity consumption of the reference air conditioning system due

to exhaust heat from the reference freezer showcase during the period p

[MWh/p]

EF_{elec} : CO₂ emission factor for consumed electricity [tCO₂/MWh]

 $EH_{RE,freezer,i,p}$: Amount of exhaust heat from the reference freezer showcase j during

the period p [MWh/p]

 $\eta_{\text{RE,AC}}$: COP of the reference air conditioning system [-]

HG_{RE,freezer,i,p}: Amount of cooling energy generated by the reference freezer

showcase j during the period p [MWh/p]

 $\mathrm{HG}_{\mathrm{PI},\mathrm{freezer},\mathrm{j},\mathrm{p}}$: Amount of cooling energy generated by the project freezer showcase j

during the period p [MWh/p]

 $EC_{RE,freezer,j,p}$: Electricity consumption of the reference freezer showcase j during the

period *p* [MWh/p]

 $EC_{PI.freezer,i,p}$: Electricity consumption of the project freezer showcase j during the

period p [MWh/p]

 $\eta_{\text{PJ,freezer,cap,j}}$: Energy efficiency of the project freezer showcase j in terms of the

cooling capacity [W/W]

 $\eta_{\text{PI,freezer,j}}$: Energy efficiency of the project freezer showcase j in terms of the

volume [L/W]

 $\eta_{\text{RE,freezer,j}}$: Energy efficiency of the reference freezer showcase j in terms of the

volume [L/W]

j : Identification number of the freezer showcase [-]

G. Calculation of project emissions

 $PE_p = PE_{fridge,p} + PE_{freezer,p}$

 PE_p : Project emissions during the period p [tCO₂/p]

 $PE_{fridge,p}$: Project emissions of the fridge showcase during the period p [tCO₂/p] $PE_{freezer,p}$: Project emissions of the freezer showcase during the period p [tCO₂/p]

 $PE_{fridge,p} = \sum_{i} (EC_{PJ,fridge,i,p}) \times EF_{elec}$

 $\operatorname{PE}_{\operatorname{fridge,p}}$: Project emissions of the project fridge showcase during the period p

 $[tCO_2/p]$

 $EC_{PI,fridge,i,p}$: Electricity consumption of the project fridge showcase i during the period

p [MWh/p]

 EF_{elec} : CO_2 emission factor for consumed electricity [t CO_2 /MWh]

i : Identification number of the fridge showcase [-]

 $PE_{freezer,p} = \sum_{i} (EC_{PJ,freezer,j,p}) \times EF_{elec}$

 $PE_{freezer,p}$: Project emissions of the project freezer showcase during the period p

 $[tCO_2/p]$

 $\mathrm{EC}_{\mathrm{Pl.freezer,i,p}}$: Electricity consumption of the project freezer showcase j during the period

p [MWh/p]

EF_{elec} : CO₂ emission factor for consumed electricity [tCO₂/MWh]

i : Identification number of the freezer showcase [-]

H. Calculation of emissions reductions

 $ER_{p} = RE_{p} - PE_{p}$

 ER_p : Emissions reductions during the period p [tCO₂/p] RE_p : Reference emissions during the period p [tCO₂/p]

PE_p : Project emissions during the period p [tCO₂/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
	Energy efficiency of the r	eference fridge showcase i	Nominal value
	in terms of the volume.		available on product
			catalogs, specification
	-Reach-in showcase		documents or
	Range of volume (L)	Energy efficiency (L/W)	websites.
	z < 900	1.18	
	900 z < 1,200	1.07	The default values are
	1,200 z	2.24	derived from the result
			of survey on energy
	-Open showcase		efficiency of fridge
$\eta_{ ext{RE,fridge,i}}$	Range of volume (L)	Energy efficiency (L/W)	showcase from
	z < 900	0.50	manufacturers well
	900 z < 1,200	0.65	known in the market.
	1,200 z	0.73	The default values
			should be revised if
	When multiple types of sl	nowcases (Reach-in, Open,	necessary from survey
	and Walk-in) are connected	ed to a condensing unit, the	result which is
	energy efficiency of Reac	h-in showcase above is	conducted by JC or
	selected according to the	total sum of rated cooling	project participants
	capacity (watt) of all show	vcases connected	every three years.
	corresponding to the "Range of volume" in the table.		
	Energy efficiency of the r	eference freezer showcase j	Nominal value
	in terms of the volume.		available on product
			catalogs, specification
$\eta_{ ext{RE,freezer,j}}$	-Reach-in showcase		documents or
	Range of volume (L)	Energy efficiency (L/W)	websites.
	z < 900	0.70	
	900 z < 1,200	0.70	The default values are
	1,200 z	1.01	derived from the result
			of survey on energy
			efficiency of fridge
			showcase from
			manufacturers well

		known in the market.
		The default values
		should be revised if
		necessary from survey
		result which is
		conducted by JC or
		project participants
		every three years.
	Energy efficiency of the project fridge showcase i in	The specifications of
	terms of the cooling capacity.	the project fridge
	The value of rated cooling capacity (watt) and rated	showcase and
	electricity consumption (watt) used in calculation of	condensing unit for
	energy efficiency prepared by manufacturer is	quotation or the
n	applied.	factory acceptance test
$\eta_{ ext{PJ,fridge,cap,i}}$		data by manufacturer.
	When multiple showcases are connected to a	
	condensing unit, the energy efficiency is calculated as	
	a ratio between the total sum of rated cooling capacity	
	(watt) of all showcases connected and the rated	
	electricity consumption (watt) of condensing unit.	
	Energy efficiency of the project fridge showcase <i>i</i> in	The specifications of
	terms of the volume.	the project fridge
	The value of rated volume (liter) and rated electricity	showcase and
	consumption (watt) used in calculation of energy	condensing unit for
	efficiency prepared by manufacturer is applied.	quotation or the
$\eta_{ ext{PJ,fridge,i}}$		factory acceptance test
	When multiple showcases are connected to a	data by manufacturer.
	condensing unit, the energy efficiency is calculated as	
	a ratio between the total sum of rated volume (liter)	
	of all showcases connected and the rated electricity	
	consumption (watt) of condensing unit.	
	Energy efficiency of the project freezer showcase j in	The specifications of
	terms of the cooling capacity.	the project fridge
	The value of rated cooling capacity (watt) and rated	showcase for quotation
$\eta_{ ext{PJ,freezer,cap,i}}$	electricity consumption (watt) used in calculation of	or the factory
	energy efficiency prepared by manufacturer is	acceptance test data by
	applied.	manufacturer.
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	When multiple showcases are connected to a	
	condensing unit, the energy efficiency is calculated as	
	a ratio between the total sum of rated cooling capacity	
	(watt) of all showcases connected and the rated	
	electricity consumption (watt) of condensing unit.	
	Energy efficiency of the project freezer showcase <i>j</i> in	The specifications of
	terms of the volume.	the project fridge
	The value of rated volume (liter) and rated electricity	showcase for quotation
	consumption (watt) used in calculation of energy	or the factory
	efficiency prepared by manufacturer is applied.	acceptance test data by
$\eta_{ ext{PJ,freezer,j}}$		manufacturer.
	When multiple showcases are connected to a	
	condensing unit, the energy efficiency is calculated as	
	a ratio between the total sum of rated volume (liter)	
	of all showcases connected and the rated electricity	
	consumption (watt) of condensing unit.	
	CO ₂ emission factor for consumed electricity.	[Grid electricity]
	When project air conditioning system consumes only	The data is sourced
	grid electricity or captive electricity, the project	from "Emission
	participant applies the CO ₂ emission factor	Factors of Electricity
	respectively.	Interconnection
	When project air conditioning system may consume	Systems", National
	both grid electricity and captive electricity, the project	Committee on Clean
	participant applies the CO ₂ emission factor with	Development
	lower value.	Mechanism
		(Indonesian DNA for
$EF_{ m elec}$	[CO ₂ emission factor]	CDM), based on data
	For grid electricity: The most recent value available	obtained by
	from the source stated in this table at the time of	Directorate General of
	validation	Electricity, Ministry of
	For captive electricity: 0.8* [tCO ₂ /MWh]	Energy and Mineral
	*The most recent value available from CDM	Resources, Indonesia,
	approved small scale methodology AMS-I.A at the	unless otherwise
	time of validation is applied.	instructed by the Joint
		Committee.
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			[Captive electricity]	
		CDM approved small		
		scale methodology		
			AMS-I.A	
	Default COP values of the refer	ence air conditioning	The latest version of	
	system.		approved JCM	
	If multiple types of air conditio	ning system with	methodology	
	different cooling capacity, which	h means different	ID_AM004	
	COP values, are found in the pr	oject site, the highest		
	value of COP is selected.			
	When an air conditioning system	m with higher COP		
	value than that of the reference	COP with		
	corresponding cooling capacity	set in the table is		
	installed at the project site, η_{RE}	E,AC is revised to the		
20	COP value of installed one.			
$\eta_{ ext{RE,AC}}$				
	Default COP ¹ of F	Reference		
	Air Conditioning Sys			
	Cooling Capacity [kW]	Reference COP		
	2.5 < x 4.1	4.00		
	4.1 < x 5.3	3.59		
	5.3 < x 7.1	2.96		
	7.1 < x 14.2	2.85		
	¹ The default COP values may be revised as to the revision			
	of the approved JCM methodology ID_AM004.			

History of the document

Version	Date	Contents revised
02.0	10 November 2015	 Revisions to: Change the description of Criterion 3 in Section D; and Change the description of "Measurement methods and procedures" for the electricity consumption of the project fridge showcases and the project freezer showcases in the Monitoring Spreadsheet.
01.0	18 May 2015	JC4, Annex 3 Initial approval.