JCM Proposed Methodology Form

Cover sheet of the Proposed Methodology Form

Form for submitting the proposed methodology

Host Country	Vietnam
Name of the methodology proponents submitting this form	Hibiya Engineering, Ltd. Mitsubishi UFJ Morgan Stanley Securities Co., Ltd.
Sectoral scope(s) to which the Proposed Methodology applies	3. Energy demand
Title of the proposed methodology, and version number	Improving the energy efficiency of commercial buildings by utilization of high efficiency equipment, Version 01.0
List of documents to be attached to this form (please check):	☐The attached draft JCM-PDD: ☒Additional information
Date of completion	27/11/2014

History of the proposed methodology

Version	Date	Contents revised
01.0	27/11/2014	First edition

A. Title of the methodology

Improving the energy efficiency of commercial buildings by utilization of high efficiency equipment, Version 01.0

B. Terms and definitions

Terms	Definitions
High efficiency equipment	Building facility equipment listed in Table 1 of the eligibility criterion 1.
Reference equipment	Equipment whose output is replaced/substituted by the project.
Coefficient of Performance (COP)	For the purpose of this methodology, COP is defined as a ratio of heat supplied to the amount of energy consumed by a chiller or heat pump, and it is defined by using following formula: COP = Q/W Where: Q: Amount of heat supplied by a chiller or a heat pump W: Electric power consumed by a chiller or a heat pump

C. Summary of the methodology

Items	Summary
GHG emission reduction measures	Reduction of electricity and fossil fuel consumed by existing facilities is achieved by replacing or substituting these facilities with high efficiency equipment defined in Table 1 of the eligibility criterion 1.
Calculation of reference emissions	Reference emissions are calculated by multiplying electricity and fossil fuel consumption of the project by the ratio of efficiency of reference and project equipment, and emission factors of electricity and fossil fuel. For the installation of high efficiency lighting, reference

	emissions are calculated using rated electricity consumption of the lighting multiplied by operation hours.
Calculation of project emissions	Project emissions are calculated based on monitored electricity and fossil fuel consumption in the project.
Monitoring parameters	Electricity and fossil fuel consumption of the high efficiency equipment Operating hours of the high efficiency equipment and auxiliary equipment, where applicable

D. Eligibility criteria

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

<table>
<tr><td>Criterion 1</td><td>The project involves implementation of one or more energy efficiency measures categorized in Table 1 by using high efficiency equipment at an existing facility.

Projects involving installation of high efficiency lighting need to be coupled with another energy saving measure(s) in order to be eligible under this methodology.

High efficiency equipment introduced by the project replaces the existing equipment or substitutes the output of the existing equipment, and it is included in the applicable technologies as shown in Table 1:

Table 1 Applicable Technologies
<table>
<tr><td>No</td><td>Energy efficiency measures</td><td>Applicable technologies and their criteria</td></tr>
<tr><td>1</td><td>Energy efficiency improvement by reducing fossil fuel consumption</td><td>High efficiency boiler with the following features:
- Energy efficiency is greater or equal to 93% (e.g. small once -through boiler);
- Equipped with automatic unit number control device; and
- Individual performance test report is provided.</td></tr>
<tr><td>2</td><td>Fuel switch to electricity</td><td>Heat recovery heat pump which generates both cooling and heating energy (temperature of hot water ≥80°C) and uses non-HFC refrigerant with zero Ozone Depletion Potential (ODP)</td></tr>
<tr><td>3</td><td>Installation of high efficiency lighting</td><td>LED lighting</td></tr>
</table>
</td></tr>
<tr><td>Criterion 2</td><td>If the existing equipment is a chiller containing CFCs, HFCs, or HCFCs and is removed due to the project, a plan to prevent release of refrigerant used for the existing chiller into the atmosphere is prepared. Execution of the prevention plan</td></tr>
</table>

	is checked at the time of verification, in order to confirm that the refrigerant used for the existing chiller is not released to the air.
Criterion 3	High efficiency equipment in the project guarantees a better performance than the reference equipment for a minimum of one year. The performance level can be confirmed by comparing the efficiency or rated electricity consumption between the high efficiency equipment and the reference equipment, with an evidence of either a manufacturer's performance guarantee or energy saving company's (ESCO) energy saving guarantee of high efficiency equipment. Where such evidence is not available for the reference equipment, high efficiency equipment in the project guarantees a better performance than the default efficiency values provided in the methodology.

E. Emission Sources and GHG types

Reference emissions	
Emission sources	GHG types
Fossil fuel consumption by the reference equipment	CO_2
Electricity consumption by the reference equipment	CO_2
Project emissions	
Emission sources	GHG types
Fossil fuel consumption by the high efficiency equipment or the equipment	CO_2
Electricity consumption by the high efficiency equipment	CO_2
Electricity consumption by the auxiliary equipment for the high efficiency equipment	CO_2

F. Establishment and calculation of reference emissions

F.1. Establishment of reference emissions

Reference emissions are calculated by multiplying electricity ($EC_{REF,i,p}$) and fossil fuel ($FC_{REF,i,p}$) consumption of the project by the ratio of efficiency of reference and project equipment, and emission factors of electricity and fossil fuel. Individual electricity and fossil fuel consumption are derived from monitored fuel and electricity consumption by the high

efficiency equipment. Below are typical examples of reference equipment replaced or substituted by high efficiency equipment.

	Energy efficiency measures	Project equipment	Typical examples of reference equipment
1	Energy efficiency improvement by reducing fossil fuel consumption	High efficiency boiler	Boiler
2	Fuel switch to electricity	Heat recovery heat pump	Boiler Chiller
3	Installation of high efficiency lighting	LED lighting	Halogen Fluorescent

The methodology ensures net emission reductions by the followings:

1) Adopting conservative default efficiency values for calculation of reference emissions

- Boilers: applying CDM default efficiency for new boilers;
- Chillers: design efficiency of models sold by dominant manufacturers in the chiller market in Vietnam

2) Implementation of multiple measures

Among the three measures introduced in this methodology, one measure (installation of high efficiency lighting) may have a possibility where the calculation result will not demonstrate net emission reductions due to the way the equation is formulated. In order to ensure the net emission reductions, the methodology requires to implement together with other energy efficiency measure(s) stated in table 1 under the eligibility criteria.

F.2. Calculation of reference emissions

Reference emissions are calculated by the following equation:

$$RE_p = \frac{\sum_i EC_{REF,i,p}}{1{,}000} \times EF_{CO2,ELEC} + \sum_i \sum_j \left(FC_{REF,i,j,p} \times EF_{CO2,j} \right) \quad (1)$$

Where

RE_p	Reference emissions during the period p [tCO_2/p]
$EC_{REF,i,p}$	Electricity consumed during the period p by reference equipment corresponding to measure i introduced in the project [kWh/p]
$EF_{CO2,ELEC}$	CO_2 emission factor of electricity consumed [tCO_2/MWh]

$FC_{REF,i,j,p}$	Fossil fuel j consumed during the period *p* by reference equipment, corresponding to measure *i* introduced in the project [L/p].
$EF_{CO2,j}$	CO_2 emission factor of fossil fuel *j* [tCO_2/L]
i	Type of measure
j	Type of fossil fuel

Measure 1: High efficiency boiler

$$FC_{REF,1,p} = \sum_i FC_{PJ1,i,p} \times \frac{\eta_{PJ1,i}}{\eta_{REF1,i}} \quad (2)$$

Where

$FC_{REF,1,p}$	Total fossil fuel that would have been consumed during the period *p* by the reference equipment, replaced/substituted by the high efficiency equipment introduced in the project categorized as measure 1 [L/p]
$FC_{PJ1,i,p}$	Fossil fuel consumed during the period *p* by the high efficiency equipment *i* introduced in the project categorized as measure 1 [L/p]
$\eta_{PJ1,i}$	Energy efficiency of the equipment *i* introduced in the project. [dimensionless]
$\eta_{REF1,i}$	Energy efficiency of the reference equipment, replaced/substituted by the equipment *i* introduced in the project. [dimensionless]

Measure 2: Heat recovery heat pump

$$FC_{REF,2,p} = \sum_i \frac{EC_{PJ2,i,p}}{ECR_i} \times H_i \times DC_i \quad (3)$$

$$EC_{REF,2,p} = \sum_i \frac{EC_{PJ2,i,p}}{ECR_i} \times \frac{CH_i}{COP_i} \quad (4)$$

Where

$FC_{REF,2,p}$	Total fossil fuel that would have been consumed during the period *p* by the reference equipment, replaced/substituted by the high efficiency equipment in the project categorized as measure 2 [L/p]
$EC_{PJ2,i,p}$	Electricity consumed during the period *p* by the high efficiency equipment *i* in the project categorized as measure 2 [kWh/p]
ECR_i	Rated electricity consumption of the high efficiency equipment *i* introduced in the project [kW]
H_i	Rated heating capacity of the high efficiency equipment *i* in the project [kW]
DC_i	Unit fuel consumption rate of the reference equipment that are replaced/substituted

by the equipment *i* in the project (L/kWh)

$EC_{REF,2,p}$ Total electricity that would have been consumed during the period *p* by the reference equipment, replaced/substituted by the high efficiency equipment introduced in the project categorized as measure 2 [kWh/p]

CH_i Rated cooling capacity of the high efficiency equipment *i* introduced in the project [kW]

COP_i Efficiency of reference cooling equipment replaced/substituted by the equipment *i* introduced in the project. [dimensionless]

Measure 3: LED lighting

$$EC_{REF,3,p} = \sum_i ECR_{REF3,i} \times t_{i,p} \quad (5)$$

Where

$EC_{REF,3,p}$ Total electricity that would have been consumed during the period *p* by the reference equipment, replaced/substituted by the high efficiency equipment introduced in the project categorized as measure 3 [kWh/p]

$ECR_{REF3,i}$ Rated electricity consumption of the reference equipment *i*, replaced by the high efficiency equipment *i* in the project categorized as measure 3 [kW]

$t_{i,p}$ Operating hours of the high efficiency equipment *i* during the period *p* in the project categorized as measure 3 [hr/p]

G. Calculation of project emissions

Project emissions are calculated as a sum of emissions from electricity (EC_{PJ}) and fossil fuel (FC_{PJ}) consumption in the project. The emission from electricity consumption is calculated by multiplying electricity consumed by the project ($EC_{PJ,i,p}$) by the CO_2 emission factor of electricity ($EF_{CO2,ELEC}$). The emission from fuel consumption is calculated by multiplying fuel consumed by the project ($FC_{PJ,i,j,p}$) by the emission factor of the fuel ($EF_{CO2,j}$).

$$PE_p = \frac{\sum_i EC_{PJ,i,p}}{1{,}000} \times EF_{CO2,ELEC} + \sum_i \sum_j \left(FC_{PJ,i,j,p} \times EF_{CO2,j} \right) \quad (6)$$

Where

PE_p Project emissions during the period *p* [tCO_2/p]

$EC_{PJ,i,p}$ Total electricity consumed by the high efficiency equipment by measure *i* introduced in the project during the period *p* [kWh/p]

$EF_{CO2,ELEC}$	CO_2 emission factor of the electricity consumed [tCO_2/MWh]
$FC_{PJ,i,j,p}$	Total fossil fuel *j* consumed by the high efficiency equipment by measure *i* introduced in the project during the period *p* [L/p]
$EF_{CO2,j}$	CO_2 emission factor of fossil fuel *j* [tCO_2/L]
i	Type of measure
j	Type of fossil fuel

Measure 1: High efficiency boiler

$$FC_{PJ,1,p} = \sum_i FC_{PJ1,i,p} \quad (7)$$

Where

$FC_{PJ,1,p}$	Total fossil fuel consumed during the period *p* by the high efficiency equipment introduced in the project categorized as measure 1 [L/p]
$FC_{PJ1,i,p}$	Fossil fuel consumed during the period *p* by the high efficiency equipment *i* introduced in the project categorized as measure 1 [L/p]

Measure 2: Heat recovery heat pump

$$EC_{PJ,2,p} = \sum_i \left(EC_{PJ2,i,p} + ECA_i \times t_p\right) \quad (8)$$

Where

$EC_{PJ,2,p}$	Total electricity consumed during the period *p* by the high efficiency equipment introduced in the project categorized as measure 2 [kWh/p]
$EC_{PJ2,i,p}$	Electricity consumed during the period *p* by the high efficiency equipment *i* introduced in the project categorized as measure 2 [kWh/p]
ECA_i	Capacity of auxiliary electric equipment that is installed due to the implementation of the high efficiency equipment *i* [kW]
t_p	Operating hours of auxiliary electric equipment during the period *p* [hr/p]

Measure 3: LED lighting

$$EC_{PJ,3,p} = \sum_i \left(EC_{PJ3,i} \times t_{i,p}\right) \quad (9)$$

Where

$EC_{PJ,3,p}$	Total electricity consumed during the period *p* by the high efficiency equipment introduced in the project categorized as measure 3 [kWh/p]
$EC_{PJ3,i}$	Rated electricity consumption of the high efficiency equipment *i* in the project categorized as measure 3 [kW]
$t_{i,p}$	Operating hours of the high efficiency equipment *i* introduced in the

project during the period *p* categorized as measure 3 [hr/p]

H. Calculation of emissions reductions

Emission reduction is calculated by the following equation.

$$ER_p = RE_p - PE_p \quad (10)$$

Where

ER_p	Emission reduction during the period *p* [tCO_2/p]
RE_p	Reference emission during the period *p* [tCO_2/p]
PE_p	Project emission 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
$\eta_{PJ1,i}$	Energy efficiency of the equipment *i* introduced in the project	Rated/provided by the technology supplier
$\eta_{REF1,i}$	Energy efficiency of the reference equipment replaced/substituted by the equipment *i* introduced in the project	Default values in the methodology
ECR_i	Rated electricity consumption of the high efficiency equipment *i* introduced in the project	Rated/provided by the technology supplier
H_i	Rated heating capacity of the high efficiency equipment *i* introduced in the project	Rated/provided by the technology supplier
DC_i	Unit fuel consumption rate of the reference equipment replaced/ substituted by the equipment *i* introduced in the project	Rated/provided by the technology supplier
CH_i	Rated cooling capacity of the high efficiency equipment *i* introduced in the project	Rated/provided by the technology supplier
COP_i	Efficiency of the reference equipment replaced/substituted by the equipment *i* introduced in the project	Default values in the methodology
$ECR_{REF3,i}$	Rated electricity consumption of the reference equipment (lighting) *i* replaced by the high efficiency	Rated/provided by the technology supplier or

	equipment *i* in the project categorized as measure 3	checked by the indication on the lighting *i*
ECA_i	Capacity of auxiliary electric equipment that is installed due to the implementation of the high efficiency equipment *i*	Rated/provided by the technology supplier
$EC_{PJ3,i}$	Rated electricity consumption of the high efficiency lighting *i* in the project categorized as measure 3	Rated/provided by the technology supplier
$EF_{CO2,ELEC}$	CO_2 emission factor of the electricity consumed When captive power generation is not available at the project site, then the most recent Vietnamese national grid emission factor [EF_{grid}] available at the time of validation is applied as [$EF_{CO2,ELEC}$] and fixed for the monitoring period thereafter. When captive power generation is available at the project site, then [$EF_{CO2,ELEC}$] is conservatively selected as below and fixed for the monitoring period thereafter: $EF_{CO2,ELEC}$ = min (EF_{grid}, $EF_{captive}$) $EF_{captive}$ = 0.8 tCO_2/MWh* *The most recent emission factor available from CDM approved small scale methodology AMS-I.A at the time of validation is applied.	[EF_{grid}] Ministry of Natural Resources and Environment (MONRE), Vietnamese DNA for CDM unless otherwise instructed by the Joint Committee. [$EF_{captive}$] CDM approved small scale methodology: AMS-I.A
$EF_{CO2,j}$	CO_2 emission factor of fossil fuel *j*	IPCC or international organization's default values, or derived using country specific or project specific data.