Joint Crediting Mechanism Approved Methodology VN_AM002

"Introduction of room air conditioners equipped with inverters"

A. Title of the methodology

Introduction of room air conditioners equipped with inverters, Version 01.1~~0~~

B. Terms and definitions

Terms	Definitions
Room air conditioner (RAC)	A single split type air conditioner.
Inverter	A device included in RACs and other motor-operated appliances, whose function is to vary the speed of the compressor motor in line with different load demand, for example to enable variable refrigerant flow to optimally regulate the temperature.
Public sector buildings	Buildings owned or administered by national or local government.
Energy efficiency ratio (EER)	The ratio of total cooling capacity to rated input power in specified conditions.
Cooling seasonal performance factor (CSPF)	Energy efficiency of RACs factoring into the seasonal temperature variation. Ratio of the total annual amount of heat that the RAC can remove from the indoor air when operated for cooling active mode to the total annual amount of energy consumed by the equipment during the same period.

C. Summary of the methodology

Items	Summary
GHG emission reduction measures	Energy saving achieved by introduction of RACs equipped with inverters.
Calculation of reference emissions	GHG emissions associated with electricity consumption of reference RACs are calculated based on the monitored electricity consumption of project RACs, the ratio of the energy

	efficiency of reference and project RACs, and the CO_2 emission factor of the electricity consumed by project RACs.
Calculation of project emissions	GHG emissions associated with electricity consumption of project RACs are calculated based on the monitored electricity consumption of project RACs and the CO_2 emission factor of the electricity consumed by project RACs.
Monitoring parameters	Electricity consumption of project RACs Project energy efficiency (CSPF of project RACs) Reference energy efficiency (CSPF of reference RACs)

D. Eligibility criteria

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

Criterion 1	The methodology is applicable to the following types of projects: ・ Installation of inverter RACs to public sector buildings. ・ Replacement of existing non-inverter RACs by inverter RACs in all types of buildings.
Criterion 2	Rated cooling capacity of a project RAC is within the applicable range of the Vietnamese national standard TCVN7831:2012.
Criterion 3	Ozone Depletion Potential (ODP) of the refrigerant used for project RAC is zero.
Criterion 4	Plans to prevent release of refrigerants into the atmosphere at the time of RAC removal are prepared for both project RACs and the existing RACs replaced by the project. In the case of replacing existing RACs by project RACs, execution of the prevention plan is checked at the time of verification, in order to confirm that refrigerant used for the existing RACs removed by the project is not released to the air.

E. Emission Sources and GHG types

Reference emissions	
Emission sources	GHG types
Electricity consumption by reference RACs	CO_2
Project emissions	
Emission sources	GHG types
Electricity consumption by project RACs	CO_2

F. Establishment and calculation of reference emissions

F.1. Establishment of reference emissions

Reference emissions are established as the product of monitored electricity consumption of project RACs, the ratio of the energy efficiency of reference and project RACs, and the CO_2 emission factor of the electricity consumed by project RACs.

The methodology provides following stepwise procedures to set energy efficiency values of the reference and project RACs, ex-post. In the procedures, reference RACs are conservatively set to results in a net reduction of emissions.

Step 1: Determine reference RACs that lead to net emission reduction

Select a reference RAC for each model of project RAC which meets the following conditions:

- Not equipped with inverters.
- Categorized as Grade 4 of the energy efficiency grades by EER as outlined in Table 3 of Vietnamese national standard TCVN7830:2012.
- Cooling capacity of the reference RAC selected for the purpose of calculating reference emissions belongs to the same rated capacity class as the project RAC, based on the three rated capacity classes in Table 3 of TCVN7830:2012.
- Reference RAC is previously unused and is currently available in the market at the time of CSPF determination.

Step 2: Determine CSPF of reference RACs

CSPF values of selected reference RACs by step 1 are determined at a third party testing facility which is equipped with a calorimeter capable of determining CSPF in line with ISO5151, following the testing procedures and conditions outlined in the latest version of Vietnamese National Standard TCVN 7831 at the time of CSPF determination.

Step 3: Determine CSPF of project RACs

CSPF values of each model type of project RACs are determined at a third party testing facility which is equipped with a calorimeter capable of determining CSPF in line with ISO5151, following the testing procedures and conditions outlined in the latest version of Vietnamese National Standard TCVN 7831 at the time of CSPF determination.

Step 4: Select the reference and project energy efficiency (CSPF) values for the project

Among the CSPF values calculated in Step 2 and 3, select the highest value of CSPF determined according to step 2 and the lowest value of CSPF determined according to step 3 to yield the efficiency ratio (η_{PJ} / η_{REF} in equation 1). These values are used as the reference and project CSPF values during the project lifetime. This step ensures that ratio of CSPF values used for the purpose of calculating reference emissions is conservatively derived for the project.

F.2. Calculation of reference emissions

$$RE_p = \sum_{i=1}^{n} EC_{PJ,i,p} \times \left(\frac{\eta_{PJ}}{\eta_{REF}} \right) \times EF_{elec} \qquad (1)$$

Where

RE_p	=	Reference emissions during the period p [tCO_2/p]
$EC_{PJ,i,p}$	=	Electricity consumption by project RACs group i during the period p [MWh/p]
n	=	Number of RACs groups whose aggregate electricity consumption are measured by one electricity meter [dimensionless]
i	=	An index variable that is used to count the number of RACs groups
η_{REF}	=	Highest energy efficiency (CSPF) of reference RACs[1] [dimensionless]
η_{PJ}	=	Lowest energy efficiency (CSPF) of project RACs[2] [dimensionless]
EF_{elec}	=	CO_2 emission factor of electricity consumed [tCO_2/MWh]

[1] CSPF of the reference RAC selected using steps as stipulated in Section F.1.
[2] CSPF of the project RAC selected using steps as stipulated in Section F.1.

G. Calculation of project emissions

$$PE_p = \sum_{i=1}^{n} EC_{PJ,i,p} \times EF_{elec} \quad (2)$$

Where

PE_p	=	Project emissions during the period p [tCO_2/p]
$EC_{PJ,i,p}$	=	Electricity consumption by project RACs group i during the period p [MWh/p]
EF_{elec}	=	CO_2 emission factor of electricity consumed [tCO_2/MWh]

H. Calculation of emissions reductions

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

Where

ER_p	=	Emission 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*

Parameter	Description of data	Source
EF_{elec}	CO_2 emission factor of electricity consumed. When project RACs consume only grid electricity or captive electricity, the project participant applies the CO_2 emission factor respectively. When project RACs 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 time of validation For captive electricity, it is determined based on the following options: a) Calculated from its power generation efficiency ($\eta_{elec,CG}$ [%]) obtained from manufacturer's specification The power generation efficiency based on lower heating value (LHV) of the captive power generation system from the manufacturer's specification is applied; $EF_{elec} = 3.6 \times \frac{100}{\eta_{elec,CG}} \times EF_{fuel,CG}$ b) Calculated from measured data The power generation efficiency calculated from monitored data of the amount of fuel input for power generation ($FC_{PJ,CG,p}$) and the amount	[Grid electricity ~~EF_{grid}~~] Ministry of Natural Resources and Environment of Vietnam (MONRE), Vietnamese DNA for CDM unless otherwise instructed by the Joint Committee. [Captive electricity] For the option a) Specification of the captive power generation system provided by the manufacturer ($\eta_{elec,CG}$ [%]). CO_2 emission factor of the fossil fuel type used in the captive power generation system ($EF_{fuel,CG}$ [tCO_2/GJ]) For the option b) Generated and supplied electricity by the captive power generation system ($EG_{PJ,CG,p}$ [MWh/p]). Fuel amount consumed by the captive power generation system ($FC_{PJ,CG,p}$ [mass or volume/p]). Net calorific value ($NCV_{fuel,CG}$ [GJ/mass or volume]) and CO_2 emission factor ($EF_{fuel,CG}$ [tCO_2/GJ]) of the fuel consumed by the captive power generation system in order of preference: 1) values provided by the fuel

	of electricity generated ($EG_{PJ,CG,p}$) during the monitoring period *p* is applied. The measurement is conducted with the monitoring equipment to which calibration certificate is issued by an entity accredited under national/international standards; $EF_{elec} = FC_{PJ,CG,p} \times NCV_{fuel,CG} \times EF_{fuel,CG} \times \frac{1}{EG_{PJ,CG,p}}$ Where: $NCV_{fuel,CG}$: Net calorific value of fuel consumed by the captive power generation system [GJ/mass or volume] Note: In case the captive electricity generation system meets all of the following conditions, the value in the following table may be applied to EF_{elec} depending on the consumed fuel type. ● The system is non-renewable generation system ● Electricity generation capacity of the system is less than or equal to 15 MW fuel type / Diesel fuel / Natural gas EF_{elec} / 0.8 *1 / 0.46 *2 *1 The most recent value at the time of validation is applied. *2 The value is calculated with the equation in the option a) above. The lower value of default effective CO_2 emission factor for natural gas (0.0543 tCO_2/GJ), and the most efficient value of default efficiency for off-grid gas turbine	supplier; 2) measurement by the project participants; 3) regional or national default values; 4) IPCC default values provided in tables 1.2 and 1.4 of Ch.1 Vol.2 of 2006 IPCC Guidelines on National GHG Inventories. Lower value is applied. [Captive electricity with diesel fuel] CDM approved small scale methodology: AMS-I.A. [Captive electricity with natural gas] 2006 IPCC Guidelines on National GHG Inventories for the source of EF of natural gas. CDM Methodological tool "Determining the baseline efficiency of thermal or electric energy generation systems version02.0" for the default efficiency for off-grid power plants.~~[$EF_{captive}$]~~ ~~CDM approved small scale methodology: AMS-I.A~~

	systems (42%) are applied.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_{elec}] and fixed for the monitoring period thereafter. When captive power generation is available at the project site, then [EF_{elec}] is conservatively selected as below and fixed for the monitoring period thereafter: $EF_{elec} = \min(EF_{grid}, EF_{captive})$ $EF_{captive} = 0.8\ tCO_2/MWh$* *The most recent emission factor available from CDM approved small scale methodology AMS-I.A at the time of validation is applied.	
n	Number of RACs groups whose aggregate electricity consumption are measured by one electricity meter [dimensionless]	The project proponent selects an integer between 1 and 25 in line with the number of RACs groups included in the project.

History of the document

Version	Date	Contents revised
01.1	10 October 2017	JC6 ● Revision of methods to determine CO_2 emission factor for consumed electricity in section I
01.0	14 January 2015	JC3, Annex 3 Initial approval.