T-VER-P-METH-01-02

Renewable Electricity Generation for Independent Power Supply

Version 01

Scope: 03 - Energy demand

Entry into force on 1 March 2023

Thailand Greenhouse Gas Management Organization (Public Organization) (TGO)

1. Methodology Title	Renewable Electricity Generation for Independent Power Supply
2. Project Type	Renewable energy or alternative energy substituted to fossil fuel
3. Scope	03 – Energy Demand
4. Project Outline	Emission reduction by electricity generation from renewable sources for internal usage or community mini-grid including Private Power Purchase Agreement (private PPA).
5. Applicability	Projects with primary objective are to produce electricity from renewable sources for internal usage or supplying to community mini grid and private PPA including the following activities: 1) Greenfield power plant establishment 2) Rehabilitation of an existing power plant 3) Replacement of an existing power plant

6. Project Conditions	1. Activities include replacements of electricity production from fossil fuels with renewable sources for
	
	• Internal use in organizations, households, or communities with:
	  ○ Connected to the national grid (On-Grid) without selling contract to the national grid or
	  ○ Off-Grid
	• Supplying to mini-grids with:
	  ○ Connected to the national grid (On-Grid) without selling contract to the national grid or
	  ○ Off-Grid
	• Private PPA
	2. Electricity production from one or combination of any types of renewable sources.
	3. Main equipment and machinery that have been used from other places are not eligible for project activities.
	4. Proof of Additionality under TGO T-VER additionality criteria.

7. Project Starting Date	The date is that the project owner (client) and the contractor have signed to construct the project of greenhouse gas emission reduction which will be developed to the T-VER project.

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8. Definition	**Renewable Energy** refers to a type of alternative energy produced from renewable resources such as solar, wind, hydro, biomass etc.
	Mini-grid refers to a small electrical system not connected to the national electricity grid.
	Greenfield power plant - a new renewable energy power plant that is constructed and operated at a site where no renewable energy power plant was operated prior to the implementation of the project activity;
	Rehabilitation of an existing power plant means investment to restore the existing power generation system or power plant. But cannot be used due to severe damage or destruction due to natural disasters which may lead to optimization or power generation capacity, power generation system or power plant without installing additional power generation systems. This does not include regular maintenance.
	Replacement of an existing power plant means investment to replace the power generation system in the power plant to replace the existing system. The new production unit has a production capacity not lower than before.
	National Grid means the electricity generation and distribution network in Thailand operated by Electricity Generating Authority of Thailand (EGAT), Provincial Electricity Authority (PEA) and Metropolitan Electricity Authority (MEA).
	Private PPA means private power purchasing agreement and refers contract to buy and sell electricity between private entities.
	Biomass residue means waste material from harvesting or processing agricultural commodities such as rice husks, sugarcane residue, rice straw, corncobs, etc., or wood and wood chips. that can be used to produce fuel

Details of T-VER methodology for
Renewable Electricity Generation for Independent Power Supply

1. Greenhouse gas emission reduction activities used in the calculations

Table 1. Sources and types of greenhouse gases

Greenhouse gas emission	Source	Greenhouse Gas	Details of activities that emit greenhouse gas
Baseline Emission	Electric power generation of the national grid	CO_2	The burning of fossil fuels to generate electricity of the country's electric power generation structure. which is replaced by electricity generated from renewable energy and sold into the electricity grid, including MEA, PEA, EGAT
Project Emission	Energy use within the project plant	CO_2	Purchasing electricity from the National Grid
			The use of fossil fuels such as backup generators, biomass loaders, etc.
	The use of biomass and biomass residue	CO_2, CH_4	• cultivation of biomass in a dedicated plantation • transportation of biomass • processing of biomass • transportation of biomass residues (if any) • processing of biomass residues (if any)
Leakage	Areas that have been converted to dedicated plantations/use of biomass residue	CO_2, CH_4	• the shift of pre-project activities resulting from the cultivation of biomass in a dedicated plantation • diversion of biomass residues from other applications • processing of biomass residues • transportation of biomass residues

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2. Scope of Project

The nature of the activity must be a project that has activities to produce electricity from renewable energy such as solar energy, wind energy, hydropower, and biomass energy, etc. It is the production of electricity for own use at the household or community level in the form of a mini-grid or private PPA that may connect the national grid (On-Grid) or not connected to the electricity grid (Off-Grid) without power purchasing by the national grid. However, more than one technology can be used together to produce electricity.

Project scope is electricity generation system from renewable energy of the project including various activities related to the electricity generation of the project.

There are characteristics of activities that fall into the additional scope. The details are as follows.

1) Project activities with the installation of new power generation units (Greenfield) that include power generation units that use renewable energy and fossil fuels, such as generating electricity from wind power coupled with diesel. Only electricity generation units that use renewable energy will be considered.

2) Electric power generation using cogeneration systems cannot use this method.

3) Projects related to capacity increase cannot use this methodology.

4) Project activities with improvements, rehabilitation, or replacement of the power generation system to replace the old ones. This method can be used.

5) In the case of project activities that are generating electricity from gas from landfills Biogas from decomposing organic matter from waste and biogas from wastewater treatment to reduce greenhouse gas emissions by avoiding methane emissions by reusing them, use the methodology. Another for calculation and activities that use methane to produce electricity for distribution to the electricity grid to use the methodology of T-VER-P-METH-01-01

3. Additionality

The project must undergo further proof of operation from normal operations. (Additionality) by using the "Guidelines to prove operations in addition to normal operations. (Additionality) under the Thailand Voluntary Emission Reduction Program (T-VER)" as prescribed by the TGO.

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4. Baseline Scenario

Considering the guidelines for determining the baseline data based on the concept of Below Business as Usual (Below BAU), the baseline data for greenhouse gas emissions from the purchase of electricity from the national grid or generating electricity by generators that are replaced by production using renewable energy. Renewable electricity generation in both cases will consider the baseline greenhouse gas emissions from using natural gas as fuel for electricity generation.

5. Baseline Emission

Baseline emission considers only carbon dioxide (CO_2) emissions from home-use electric power generation at the household or community level in the form of a mini-grid that may be connected to the grid (on-grid). Connect to the power grid (Off-Grid) without being sold into the power grid. or not sold as a Private PPA, where Baseline emissions are calculated based on the technology's fossil fuel consumption to produce the same energy as in the absence of project activities. can be calculated as follows

5.1 In the case of generating electricity from renewable energy to replace the purchase from the electricity grid

Baseline emission calculation is to multiply the amount of electricity generated by the project for self-use by the GHG emissions from the electricity generation for the grid.

$$BE_y \quad = \quad E_{BL,y} \ x \ EF_{Elec,y} \qquad\qquad \text{Equation (1)}$$

Where

BE_y = Baseline emissions in year y (tCO_2/year) (tCO_2/year)

$E_{BL,y}$ = Amount of electricity generated for self-use from project implementation in year y (kWh/year)

$EF_{Elec,y}$ = Emission factor for electricity generation/consumption in year y (tCO_2/MWh)

Electricity generation from renewable energy of communities/industrial factories/organizations that are connected to the electricity grid without being sold into the grid or not being distributed in the form of Private PPA. You can choose to calculate the amount of electricity produced. for use by yourself from the project implementation ($E_{BL,y}$) in 2 cases as follows:

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Option 1: based on the electricity consumption of the households/user

$$E_{BL,y} = \sum_i \sum_c \left(n_{c,i} \times EC_{c,i,y}\right)/(1 - TDL)$$ Equation (2)

Where

c	=	Type of consumer (e.g. households, community health centres, schools, grain milling, water pumping, irrigation, etc.) covered by the project activity
i	=	Type of renewable electricity generation unit(s) implemented by the project activity
$n_{c,i}$	=	Number of consumers type c supplied with renewable electricity generation unit(s) type i
$EC_{c,i,y}$	=	Electricity consumption by user type c supplied with unit type i in year (kWh)
TDL	=	Average technical transmission and distribution losses for providing electricity to source j in year y

Option 2: based on the annual electricity generation by the project activity

$$E_{BL,y} = \sum_i EG_{i,y}/(1 - TDL)$$ Equation (3)

Where

i	=	Renewable energy electricity generation technologies units type i implemented as part of by the project activity
$EG_{i,y}$	=	Electricity generation by the project activity unit(s) type i in year y (kWh)
TDL	=	Average technical transmission and distribution losses for providing electricity to source j in year y

5.2 The case of generating electricity from renewable energy to replace the production itself using fossil fuels

Baseline emission calculations based on estimation of fossil fuel consumption trends based on historical fuel consumption data.

$$BE_y = \sum_j EG_{i,y} \times (SFC_{BL} \times 10^{-3}) \times NCV_j \times EF_{CO2,NG}$$ Equation (4)

Where

BE_y	=	Baseline emissions in year y (tCO$_2$)
$EG_{i,y}$	=	The amount of electricity produced by the activity unit of the type i project in year y (kWh)
SFC_{BL}	=	Specific fossil fuel consumption value for electricity generation using a baseline generator (unit/MWh)
NCV_j	=	Net calorific value of fuel type j (GJ per mass or volume unit)
$EF_{CO2,NG}$	=	CO$_2$ emissions factor of natural gas (tCO$_2$ /GJ) equal to 56,100 tCO$_2$/GJ
j	=	Fuel type used for combustion

6. Project Emission

6.1 Electricity generation from renewable energy such as solar, wind, wave, tidal and water.

For electricity generation activities from renewable energy such as solar, wind, wave, tidal and water, the greenhouse gas emissions from project implementation, or PE$_y$, will be zero. Except for projects that use fossil fuels, calculations are made using T-VER-P-TOOL-02-01 "Calculating Greenhouse Gas Emissions from the Burning of Fossil Fuels from Project Emission or Leakage Emission", latest edition.

6.2 Electricity generation from Biomass

In the case of project activities that produce electricity from biomass or biomass residue Greenhouse gas emissions from project implementation, T-VER-P-TOOL-02-02 "Calculation of Greenhouse Gas Emissions from Project Operations and Out-of-Project for Biomass" in the latest edition is applied for the activities below.

1) Cultivation of biomass in a dedicated plantation

2) Transportation of biomass

3) Processing of biomass

4) Transportation of biomass residues (if any)

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5) Processing of biomass residues (if any)

7. Leakage Emission

7.1 In the case of electricity generation from renewable energy from hydro, solar, wind, tidal and tidal energy

Not Applicable

7.2 In the case of electricity generation from Biomass

For the generation of electricity from biomass and/or biomass residue project developers must estimate greenhouse gas emissions outside the project boundaries using the computational tool of the project "T-VER-P-TOOL-02-02". The latest edition of the "Calculation of Greenhouse Gas Emissions from Project Emission or Leakage Emission for Biomass" without considering the source of greenhouse gas emissions. The project developer must specify the appropriate justification in the project proposal document.

8. Emission Reduction

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y \hspace{4cm} \text{Equation (5)}$$

Where

ER_y = Emission reductions in year y (tCO$_2$e/year)

BE_y = Baseline emissions in year y (tCO$_2$e/year)

PE_y = Project emissions in year y (tCO$_2$e/year)

LE_y = Leakage emissions in year y (tCO$_2$e/year)

9. Monitoring Plan

9.1 Monitoring methodology

1) The project developer explains and specifies the steps for monitoring the project activity data (Activity data) or verify all measurement results in the project proposal document.

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including the type of measuring instruments used Person responsible for monitoring results and verifying information Calibration of measuring instruments (if any) and procedures for warranty and quality control Where methods have different options, such as using default values or on-site measurements The project developer must specify which option to use. In addition, the installation, maintenance, and calibration of measuring instruments should be carried out in accordance with the instructions of the equipment manufacturer and in accordance with national standards, or international standards such as IEC and ISO.

All data collected as part of the greenhouse gas emission reduction monitoring. The data should be stored in electronic file format and the retention period is in accordance with the guidelines set by the Administrative Organization or the organization's quality system. However, the period of time must not be less than that specified by the TGO. In addition, the project developer must follow the follow-up methods specified in the follow-up parameters specified in Table 9.2.

9.2 Data and parameters monitored

Parameter	$EF_{Elec,y}$
Data unit	tCO_2/MWh
Description	Emission factor for electricity generation/consumption in year y
Source of data	Report on greenhouse gas emissions (Emission Factor) from electricity generation/consumption for projects and activities of greenhouse gas reduction published by TGO.
Measurement	**For the preparation of project design documents** Use the latest $EF_{Elec,y}$ published by TGO **For carbon credit issuance** Use the $EF_{Elec,y}$ values announced by TGO according to the year of the carbon credit issuance. However, in the case that the year of the carbon credit issuance does not have $EF_{Elec,y}$ values published by TGO, use the latest $EF_{Elec,y}$ values published by TGO in that year instead.

Parameter	$EC_{i,y}$
Data unit	kWh
Description	Electricity consumption by user type c supplied with unit type i in year (kWh)
Source of data	Plant records

Measurement procedures	The average individual electricity consumption shall be determined as either: a) Average annual individual energy consumption observed in the closest grid electricity systems among grid connected consumers belonging to the same type c; or b) Monitored electricity consumption by individual users type c supplied with unit type i
Monitoring frequency	Option 1 is continuously monitored. and monthly recording Option 2 is continuously monitored. Save at least hourly and monthly.
Any comment	It is recommended to use option 1.

Parameter	$EG_{i,y}$
Data unit	kWh
Description	Electricity generation by the project activity unit(s) type i in year y (kWh)
Source of data	Plant records
Measurement procedures	Measured using a calibrated meter.
Monitoring frequency	continuous monitoring by recording at least hourly and monthly
Any comment	-

Parameter	TDL
Data unit	-
Description	Average technical transmission and distribution losses for providing electricity to source j in year y
Source of data	Option 1 Measurement Report In the case of information on the amount of electricity released from the producer and the amount of electricity received by the consumer Option 2 uses a Default Value of 0.03 (3%).
Measurement procedures	1) If using Option 1, the project developer will have to monitor the value every year throughout the monitoring of greenhouse gas emissions reductions. 2) If using Option 2, the project developer must use this value throughout the monitoring of greenhouse gas emissions reductions.
Monitoring frequency	Defined once in the first year of the credit period.
Any comment	If the measurement results differ from previous measurements or other sources that are significantly related make additional measurements.

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9.3 Data and parameters not monitored

Parameter	NCV_j
Data unit	GJ/mass or unit of volume
Description	The net calorific value of type j fossil fuel used for electric power generation using a generator in the base emission.
Source of data:	Option 1 The net calorific value of fossil fuels stated in the invoice from the fuel supplier. Option 2 from the measurement Option 3 Thailand Energy Statistics Report Department of Alternative Energy Development and Efficiency Ministry of Energy Option 4 Reference values from the IPCC table 1.2 in chapter 1 of the 2006 IPCC Guidelines on National GHG Inventories Vol. 2 (Energy).
Value to be applied	-

Parameter	SFC_{BL}
Data unit	unit/MWh
Description	Specific fossil fuel consumption values for electricity generation using baseline generators
Source of data:	Option 1 based on actual measurements Option 2 from the manufacturer's information of the device.
Value to be applied	-

Parameter	$EF_{CO2,NG}$
Data unit	tCO_2/GJ
Description	CO_2 emissions factor of natural gas
Source of data	Table 1.4 2006 IPCC Guidelines for National GHG Inventories
Value to be applied	56,100

10. References

Clean Development Mechanism (CDM)

1) AMS-I.A: Electricity generation by the user. Version 18
2) AMS-I.F: Renewable electricity generation for captive use and mini-grid. Version 04
3) ACM0002: Consolidated baseline methodology for grid-connected electricity generation from renewable sources. Version 20
4) TOOL16: Project emissions from cultivation of biomass. Version 05

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	Document information T-VER-P-METH-01-02	

Version	Amendment	Entry into force	Description
01	-	1 March 2023	- Change document code from TVER-METH-01-02 Version 01. - Add the definition of project starting date. - Change the sign and the meaning for parameter of $EF_{grid,y}$ and revise the data sources.
01	-	24 August 2022	Initial adoption.

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