

T-VER-P-METH-01-06

Using Battery System to Store Excess Renewable Energy from Normal Operations

Version 01

Scope: 01 - Energy industries

Effective from July 23, 2026

1. Methodology Title	Using Battery System to Store Excess Renewable Energy from Normal Operations
2. Project Type	Renewable energy or fossil fuel replacement
3. Scope	01 - Energy industries
4. Project Outline	Outline project activities focus on the deployment and operation of a Battery Energy Storage System (BESS) to store surplus renewable energy. Stored energy shall be utilized for national grid injection, internal self-consumption, and/or direct power delivery under a Private Power Purchase Agreement (Private PPA).
5. Applicability	This methodology applies to project activities involving the installation and operation of a BESS to store surplus renewable energy under either of the following conditions: ● Greenfield : Installation of a newly constructed BESS. ● Replacement / Upgrade : Installation of a new BESS to replace an existing system.
6. Project Conditions	1. Regulatory Compliance: The BESS and its associated installation shall strictly comply with all applicable local, national, and environmental laws and regulations. 2. Standards & Monitoring: The BESS system design and installation shall conform to recognized national and international standards, including Thai Industrial Standards (TIS), National Fire Protection Association (NFPA), International Electrotechnical Commission (IEC), FM Global Standards, and European Standards (EN). Furthermore, the facility must be equipped with certified measurements and data-recording devices to continuously track electricity charge and discharge cycles. 3. Energy Accounting & Segregation: Electricity supplied to the national grid or consumed internally under project activities must originate exclusively from energy stored within the BESS. Electricity charged into and discharged from different generation sources must be monitored, recorded, and reported separately. 4. Environmental Management: Any lead-acid BESS deployed must be fully recyclable through accredited recycling pathways.

	5. Integrated Renewable Installations: Where a BESS is co-located with a non-common practice renewable powerplant (e.g., wind or hydropower), the corresponding methodologies approved for that primary technology shall be applied in conjunction with this framework. (See the details in note) 6. Additionality: Project activities must demonstrate clear additionality beyond normal practices, complying fully with the criteria established by TGO. 7. Baseline Scenario: Energy will only be accounted for electricity stored in the BESS at any given time from surplus renewable energy production after consumption at any given time. The amounts of electricity produced, consumed, and stored must be shown simultaneously. 8. Grid Charging Allowance: Electricity charged into the BESS from the national grid or non-renewable facilities shall not exceed 2.0% of the total electricity charged to the BESS during any given monitoring period. If non-renewable charging exceeds this 2.0% threshold, the project developer shall forfeit eligibility to certify GHG emission reduction for that entire monitoring period. 9. Thermal Management & Refrigerants: Refrigerants deployed in the BESS thermal management system (if applicable) must strictly exclude Chlorofluorocarbons (CFCs) and Hydrochlorofluorocarbons (HCFCs). Furthermore, any alternative refrigerant used shall not possess a Global Warming Potential (GWP) exceeding 1,924 (based on standard R410a values in accordance with IPCC AR5 guidelines). 10. Fire Suppression Systems: Fire suppression media (if applicable) must strictly exclude CFCs and HCFCs, with a maximum allowable GWP threshold of 3,170 (based on HFC-125 values referred to IPCC AR5). Fire safety and suppression installations must conform strictly to applicable national and international industrial standards, including NFPA, Underwriters Laboratories (UL), IEC, FM Global, or European Standards (EN).
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	11. Waste Management : Project owners and project developers must demonstrate safety, compliance, and environmentally sound decommissioning, recycling, or disposal procedures for damaged or end-of-life BESS components. Decommissioned or replaced systems shall not be reused or re-registered to certify GHG emission reductions under other project activities.
7. Project Starting Date	The date on which the project developer (employer) and the contractor jointly signed the contract for the procurement and installation of the BESS to be developed as a T-VER project.
8. Definition	Renewable Energy refers to a type of alternative energy, which is derived from sources that can be replenished and reused. Under this methodology, renewable energy sources include solar, wind, and hydropower.
	Installation of a new BESS (Greenfield) refers to the installation of a new BESS within the premises of an existing renewable power plant, or the installation of a new BESS together with the construction of a new renewable power plant.
	Replacement of BESS refers to investment in replacing an existing BESS with a new one within the premises of an existing renewable power plant, whereby the new data unit capacity shall not be lower than the existing one.
	National Grid refers to Thailand's electricity generation and distribution network operated by EGAT (Electricity Generating Authority of Thailand), PEA (Provincial Electricity Authority), and MEA (Metropolitan Electricity Authority).
	Battery Energy Storage System (BESS) refers to a rechargeable energy storage system consisting of batteries, battery chargers, controllers, power conditioning systems, and associated electrical equipment, designed to store electricity generated from renewable power plants.

Note	1) In the case of installing a new BESS together with the construction of a new renewable powerplant (e.g., wind or hydropower), the project developer shall apply the relevant methodologies T-VER-P-METH-01-01 or T-VER-P-METH-01-02 to account the amount of emission reductions. The calculation shall consider both the electricity supplied to the grid and/or consumed internally and/or sold under a Private PPA without passing through the BESS, together with the electricity discharged from the BESS for grid supply and/or internal consumption. 2) Non-renewable power plants refer to those using fossil fuel combustion and hydrogen produced from fossil sources.
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Details of the T-VER methodology for Using Battery System to Store Excess Renewable Energy from Normal Operations

1. Emission reduction activities

Table 1: Sources and Types of Greenhouse Gases

GHG Emissions	Sources of GHG	Types of GHG	Description of Activities Associated with GHG Emissions
Baseline Emissions	Electricity generation from fossil fuel power plants in the national grid	CO ₂	Combustion of fossil fuels for electricity generation, which is replaced by surplus renewable electricity produced and stored as surplus in the BESS.
Project Emissions	Battery Energy Storage System (BESS)	CO ₂	Purchase of electricity from the grid for BESS auxiliary systems.
			Combustion of fossil fuels for electricity generation to supply BESS auxiliary systems.
Leakage Emissions	Transportation of BESS for maintenance/repair or recycling	CO ₂	Combustion of fossil fuels by vehicles for BESS transportation for maintenance/repair or recycling.
			Use of electricity by vehicles for BESS transportation for maintenance/repair or recycling.

2. Applicability and Scope of Project

The project activity shall consist of deploying a Battery Energy Storage System (BESS) designed exclusively to store surplus electricity generated from solar renewable energy sources at the time of generation. The stored electricity shall be dispatched for injection into the national grid, internal self-consumption, and/or direct sale under a Private Power Purchase Agreement (Private PPA).

The spatial and technical project boundary encompasses the solar renewable energy generation facility, the BESS, and all associated auxiliary and monitoring infrastructure. This includes, but is not limited to, data acquisition and recording units, thermal management and cooling systems for heat dissipation, and gas ventilation systems serving the BESS enclosure.

3. Additionality

The project developers must demonstrate additionality beyond normal practice by applying the “Criteria for Demonstration of Additionality under Premium Thailand Voluntary Emission Reduction (Premium T-VER) Program” as prescribed by TGO.

4. Baseline Scenario

When considering the determination of baseline emission with below business as usual (Below BAU), in accordance with the Guideline for the Development of Premium T-VER Methodology (Version 02). The baseline scenario of the project shall take into account for emissions from fossil fuel combustion for electricity generation of powerplants in the national grid, which are replaced by the surplus electricity discharged from the BESS under the project. The electricity may be supplied to the national grid and/or internally consumed and/or sale under a Private PPA. The baseline emission of the project shall consider Best Available Technology (BAT), the Ambitious Benchmark approach, or the use of existing actual or historical emissions for the first year of baseline emission. A Downward Adjusted Baseline method shall be applied baseline emission of subsequent years onwards during the crediting period. Details are as follows.

4.1 Case of New Green field BESS Installation

In year 1, the baseline emission shall consider greenhouse gas emissions from natural gas combustion for electricity generation of powerplants in the national grid, which are replaced by the electricity discharged from the BESS under the project for supply to the national grid and/or internal consumption and/or sale under a Private PPA. The baseline emission is determined using Ambitious Benchmark Approaches. From year 2 onwards during the crediting period, the Downward Adjusted Baseline method shall be applied.

4.2 Case of New BESS Installation as Replacement

In year 1, the baseline emission shall consider greenhouse gas emissions from natural gas combustion for electricity generation of powerplant in the national grid, which are replaced by the electricity discharged from the BESS under the project for supply to the national grid and/or internal consumption and/or sale under a Private PPA. The baseline emission is determined and adjusted using existing actual or historical emissions, while from year 2 onwards during the crediting period, the Downward Adjusted Baseline method shall be applied.

5. Baseline Emissions

Baseline emissions comprise the methodology for calculating baseline emissions, the calculation of greenhouse gas emissions adjustment from the baseline, and the calculation of greenhouse gas emissions under normal operations, with details as follows.

5.1 Equation for Calculating Baseline Emissions

Baseline emissions are calculated based on the electricity discharged from the BESS under the project for supply to the grid and/or internal consumption and/or sale under a Private PPA, together with the emission factor for electricity generation/consumption. The calculation can be expressed as follows:

$$BE_y = ES_{PJ,y} \times EF_{Elec,y} \quad \text{Equation (1)}$$

Where

BE_y = Baseline Emissions in year y (tCO₂/year)

$ES_{PJ,y}$ = Electricity discharged from the BESS under the project in year y for supply to the grid and/or internal consumption and/or sale under a Private PPA in year y (MWh/year)

$EF_{Elec,y}$ = Emission factor for electricity generation/consumption in year y (tCO₂/MWh)

5.2 Baseline emissions for year 1

5.2.1 Case of New Greenfield BESS Installation

The project developer shall calculate baseline emissions for the case of new BESS installation according to the following steps.

- 1) For year 1 of the crediting period, the calculation shall apply the Best Available Technology or Ambitious Benchmark Approach using equation (1).
- 2) For year 2 onwards of the crediting period, the calculation shall apply the Adjusted Downwards approach as specified in Section 5.3.

5.2.2 Case of New BESS Installation as Replacement

The project developer shall calculate baseline greenhouse gas emissions for the case of new BESS installation as a replacement, by applying the Adjusted Downward approach, which

considers the minimum value between the adjusted baseline and the baseline adjusted for uncertainty, according to the following steps.

$$BE_{adj,y1} = \min (BE_{adj,min,y1} : BE_{adj,UNC,y1}) \quad \text{Equation (2)}$$

Where

$$BE_{adj,min,y1} = BE_{y1} - 0.1 \times (BE_{y1} - PE_{y1}) \quad \text{Equation (3)}$$

$$BE_{adj,UNC,y1} = BE_{y1} \times (1 - UNC_{BE,y1}) \quad \text{Equation (4)}$$

$BE_{adj,y1}$	=	Adjusted Baseline emissions in year 1 of the crediting period (tCO ₂ e/year)
$BE_{adj,min,y1}$	=	Minimum adjusted baseline emissions in year 1 of the crediting period (tCO ₂ e/year)
$BE_{adj,UNC,y1}$	=	Adjusted Baseline emissions for uncertainty in year 1 of the crediting period (tCO ₂ e/year)
BE_{y1}	=	Baseline emissions in year 1 of the crediting period (tCO ₂ e/year)
PE_{y1}	=	Project emissions in year 1 of the crediting period (tCO ₂ e/year)
$UNC_{BE,y1}$	=	Uncertainty value of greenhouse gas emissions at the lower bound of the 95% confidence interval compared to the mean baseline emissions (unadjusted) in year 1 of the crediting period (% represented as a value between 0–1).

1) Baseline emissions in year 1 of the crediting period (BE_{y1})

$$BE_{y1} = ES_{y1} \times EF_{Elec,y1} \quad \text{Equation (5)}$$

Where

BE_{y1}	=	Baseline emissions in year 1 of the crediting period (tCO ₂ e/year)
ES_{y1}	=	Electricity discharged from the BESS under the project in year 1 for supply to the grid and/or internal consumption and/or sale under a Private PPA (MWh/year)
$EF_{Elec,y1}$	=	Emission factor for electricity generation/consumption in year y (tCO ₂ /MWh)

2) Uncertainty value of greenhouse gas emissions at the lower bound of the 95% confidence interval compared to the mean baseline emissions (unadjusted) in year 1 of the crediting period (UNC_{BEy1})

Uncertainty value of greenhouse gas emissions at the lower bound of the 95% confidence interval compared to the mean baseline emissions (unadjusted) in year 1 of the crediting period, shall be calculated using the latest version of T-VER-P-TOOL-02-06 'Tool to Uncertainty Analysis for the Equation Calculating Greenhouse Gas Emission Reductions,' with details as follows.

Calculation of combined uncertainty from multiplication or division

The calculation of uncertainty from multiplication or division can be performed as follows:

$$UNC_{total} = \sqrt{UNC_1^2 + \dots + UNC_i^2 + \dots + UNC_n^2}$$

Equation (6)

Where

UNC_{total} = The percentage uncertainty in the product of the quantities

UNC_i = The percentage uncertainties associated with each of the quantities

Calculation of combined uncertainty from addition or subtraction

Calculation of combined uncertainty from addition or subtraction can be performed as follows:

$$UNC_{total} = \sqrt{\frac{(UNC_1 * x_1)^2 + \dots + (UNC_i * x_i)^2 + \dots + (UNC_n * x_n)^2}{|x_1 + x_i + \dots + x_n|}}$$

Equation (7)

Where

UNC_{total} = The percentage uncertainty in the sum of the quantities

UNC_i = The percentage uncertainties associated with them.

x_i = The uncertain quantities associated with them.

5.3 Adjusted Downwards for baseline emissions from year 2 onwards

5.3.1 Adjusted Downwards for baseline emissions: DA_{y1}

The calculation of the Adjusted Downwards value to be applied for determining the baseline from year 2 onwards shall consider the maximum value between the two results, as expressed in the following equation.

$$DA_{y1} = \text{MAX} \begin{cases} 0.1 \times (BE_{y1} - PE_{y1}) \\ BE_{y1} \times UNC_{BE,y1} \end{cases} \quad \text{Equation (8)}$$

Where

- DA_{y1} = Adjusted Downwards value for baseline emissions in year 1 (tCO₂e/year)
- BE_{y1} = Baseline emissions in year 1 of the crediting period (tCO₂e/year)
- PE_{y1} = Project emissions in year 1 of the crediting period (tCO₂e/year)
- $UNC_{BE,y1}$ = Uncertainty value of greenhouse gas emissions at the lower bound of the 95% confidence interval compared to the mean baseline emissions (unadjusted) in year 1 of the crediting period (% represented as a value between 0–1).

5.3.2 Emissions under business-as-usual operations and the principle of conservativeness. ($BAU_{cons,y}$)

Emissions under business-as-usual operations and the principle of conservativeness shall be determined by considering the minimum value between the lowest adjusted baseline and the uncertainty-adjusted baseline, according to the following steps.

$$BAU_{cons,y} = \min (BAU_{cons,min,y} : BAU_{cons,UNC,y}) \quad \text{Equation (9)}$$

Where

$$BAU_{cons,min,y} = BAU_y - 0.1 \times (BAU_y - PE_y) \quad \text{Equation (10)}$$

$$BAU_{cons,UNC,y} = BAU_y \times (1 - UNC_{BAU,y}) \quad \text{Equation (11)}$$

- $BAU_{cons,min,y}$ = Emissions under business as usual operations and the principle of conservativeness in year y (tCO₂e/year)
- $BAU_{cons,UNC,y}$ = Emissions under business-as-usual operations, incorporating the principle of conservativeness and uncertainty, in year y. (tCO₂e/year)
- BAU_y = Emissions under business-as-usual operations in year y. (tCO₂e/year)
- PE_y = Project emissions in year y of the crediting period (tCO₂e/year)
- $UNC_{BAU,y}$ = Uncertainty value of greenhouse gas emissions at the lower bound of the 95% confidence interval, compared to the mean business-as-usual (unadjusted) emissions in year y of the crediting period

(% represented as a value between 0–1).

1) Emissions under business as usual operations (BAU_y)

The calculation of emissions under business-as-usual operations shall be based on the electricity discharged from the BESS under the project for supply to the grid and/or internal consumption and/or sale under a Private PPA, together with the emission factor for electricity generation/consumption under business-as-usual operations, with details as follows.

$$BAU_y = ES_{PJ,y} \times EF_{Elec,BAU,y} \quad \text{Equation (12)}$$

Where

- BAU_y = Emissions under business as usual operations in year y (tCO₂/year)
- ES_{PJ,y} = Electricity discharged from the BESS under the project in year y for supply to the grid and/or internal consumption and/or sale under a Private PPA in year y (MWh/year)
- EF_{Elec,BAU,y} = Emission factor for electricity generation/consumption under business as usual operations in year y (tCO₂/MWh)

2) Uncertainty value of greenhouse gas emissions at the lower bound of the 95% confidence interval, compared to the mean business-as-usual (unadjusted) emissions in year y of the crediting period (UNC_{BAU,y})

Uncertainty value of greenhouse gas emissions at the lower bound of the 95% confidence interval, compared to the mean business as usual (unadjusted) emissions in year y of the crediting period shall be calculated using the latest version of T-VER-P-TOOL-02-06 'Tool to Uncertainty Analysis for the Equation Calculating Greenhouse Gas Emission Reductions,' with details provided in equation (6) and equation (7).

5.3.3 Adjusted baseline value for year y (from Year 2 onwards), BE_{adj,y}.

The calculation of the adjusted baseline value for year y (from Year 2 onwards) can be performed as follows:

$$BE_{adj,y} = BE_y - (DA_{y1} + BE_{y1} \times 0.01 \times (y - y_1)) \quad \text{Equation (13)}$$

Where

- BE_y = Baseline emissions in year y (tCO₂e/year)
- BE_{y1} = Baseline emissions in year 1 of the crediting period (tCO₂e/year)

DA_{y1} = Adjusted Downwards value for baseline emissions in year 1 (tCO₂e/year)
 y = Year y
 y_1 = Year 1

Consider comparing the values of $BE_{adj,y}$ and $BAU_{cons,y}$ calculated from Section 5.3.2, and proceed according to the following conditions:

- If $BE_{adj,y} < BAU_{cons,y}$, then use $BE_{adj,y}$.
- If $BE_{adj,y} > BAU_{cons,y}$, recalculate $BE_{adj,y}$ according to Section 5.3.3 by adding a constant adjustment so that $BE_{adj,y}$ becomes lower than $BAU_{cons,y}$.

Accordingly, repeat the procedures in Sections 5.3.2 and 5.3.3 for the calculation of baseline values for years 3, 4, and 5, until the completion of the carbon crediting period.

6. Project Emissions

The calculation of project emissions shall be based on the emissions resulting from electricity consumption from the grid or from the use of fossil fuels for electricity generation by generators for the BESS system under the project, with details as follows.

$$PE_y = PE_{EC,y} + PE_{FF,y} \quad \text{Equation (14)}$$

Where

PE_y = Project emissions in year y (tCO₂/year)
 $PE_{EC,y}$ = Project emissions from electricity consumption in year y (tCO₂/year)
 $PE_{FF,y}$ = Project emissions from fossil fuel use for electricity generation by generators in year y (tCO₂/year)

6.1 Project emissions from electricity consumption ($PE_{EC,y}$)

Project emissions from fossil fuel use for electricity generation by generators can be calculated based on the amount of electricity consumed, the emission factor of electricity generation, and transmission losses in the grid, as follows.

$$PE_{EC,y} = EC_{BESS,y} \times EF_{Elec,y} \times (1 + TD_L) \times 10^{-3} \quad \text{Equation (15)}$$

Where

$PE_{EC,y}$ = Project emissions from electricity consumption in year y (tCO₂/year)

$EC_{BESS,y}$ = Electricity consumption from the grid in the project activity in year y (kWh/year)
 $EF_{Elec,y}$ = Emission factor for electricity generation/consumption in year y (tCO₂/MWh)
 TDL_y = Proportion of electricity transmission losses in the grid for electricity supply in year y

6.2 Project emissions from fossil fuel use for electricity generation by generators ($PE_{FF,y}$)

Emissions from fossil fuel use shall be calculated using the latest version of T-VER-P-TOOL-02-01, Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion.

7. Leakage Emission

The calculation of leakage emission shall take into account the emissions from fossil fuel combustion or electricity use for vehicles transporting the BESS for maintenance/repair or recycling, as follows.

$$LE_y = LE_{TR,BESS,y} \quad \text{Equation (16)}$$

Where

LE_y = Leakage Emission in year y (tCO₂e/year)
 $LE_{TR,BESS,y}$ = Leakage emission from fossil fuel combustion or electricity use for vehicles transporting the BESS for maintenance/recycling in year y (tCO₂/year)

7.1 Leakage emission from fossil fuel combustion or electricity use for vehicles transporting the BESS for maintenance/recycling ($LE_{TR,BESS,y}$)

Leakage emission from fossil fuel combustion or electricity use for vehicles transporting the BESS for maintenance/recycling can be performed as follows:

$$LE_{TR,BESS,y} = LE_{TR,FF,y} + LE_{TR,EC,y} \quad \text{Equation (17)}$$

Where

$LE_{TR,BESS,y}$ = Leakage emission from fossil fuel combustion or electricity use for vehicles transporting the BESS for maintenance/recycling in year y (tCO₂/year)
 $LE_{TR,FF,y}$ = Leakage emission from fossil fuel combustion for vehicles transporting the BESS for maintenance/recycling in year y. (tCO₂/year)
 $LE_{TR,EC,y}$ = Leakage emission from electricity use for vehicles transporting the BESS for maintenance/recycling in year y (tCO₂/year)

7.1.1 Leakage emission from fossil fuel combustion for vehicles transporting the BESS for maintenance/recycling ($LE_{TR,FF,y}$)

Leakage emission from fossil fuel combustion for vehicles transporting the BESS for maintenance/recycling can be performed as follows:

$$LE_{TR,FF,y} = \sum D_y \times Q_y \times EF_{CO_2,i} \times 10^{-6} \quad \text{Equation (18)}$$

Where

- $LE_{TR,FF,y}$ = Leakage emission from fossil fuel combustion for vehicles transporting the BESS for maintenance/recycling in year y. (tCO₂/year)
- D_y = Round-trip distance between the origin and destination of BESS transportation for maintenance/recycling in year y (km)
- Q_y = Quantity of BESS transported for maintenance/recycling in year y (t BESS)
- $EF_{CO_2,i}$ = Emission factor from fossil fuel type i for transporting the BESS for maintenance/recycling (gCO₂/tkm)
- i = Type of fossil fuel

7.1.2 Leakage emission from electricity use for vehicles transporting the BESS for maintenance/recycling ($LE_{TR,EC,y}$)

Leakage emission from electricity use for vehicles transporting the BESS for maintenance/recycling can be performed as follows:

$$LE_{TR,EC,y} = EC_{TR,BESS,y} \times EF_{Elec,y} \times (1 + TDL_y) \times 10^{-3} \quad \text{Equation (19)}$$

Where

- $LE_{TR,EC,y}$ = Leakage emission from electricity use for vehicles transporting the BESS for maintenance/recycling in year y (tCO₂/year)
- $EC_{TR,BESS,y}$ = Electricity consumption for vehicles transporting the BESS for maintenance/recycling outside the project boundary in year y. (kWh/year)
- $EF_{Elec,y}$ = Emission factor for electricity generation/consumption in year y (tCO₂/MWh)
- TDL_y = Proportion of electricity transmission losses in the grid for electricity supply in year y

8. Emission Reductions

Emission reductions can be calculated as follows.

$$ER_y = BE_y - PE_y - LE_y \quad \text{Equation (20)}$$

Where

ER_y = Emission reductions in year y (tCO₂e/year)

BE_y = Baseline emissions in year y (tCO₂e/year)

PE_y = Project emissions in year y (tCO₂e/year)

LE_y = Leakage emissions in year y (tCO₂e/year)

8.1 The calculation of emission reductions from the adjusted baseline during the crediting period.

The calculation of emission reductions from the adjusted baseline during the crediting period can be calculated as follows.

$$ER_y = BE_{adj,y} - PE_y - LE_y \quad \text{Equation (21)}$$

Where

ER_y = Emission reductions in year y (tCO₂e/year)

$BE_{adj,y}$ = Baseline emissions adjustment in year y of the crediting period (tCO₂e/year)

PE_y = Project emissions in year y (tCO₂e/year)

LE_y = Leakage emissions in year y (tCO₂e/year)

9. Monitoring Plan

9.1 Monitoring procedure

1) The project developer shall describe and specify the monitoring steps for project activity data or verification of all measurement results in the project proposal document, including the type of measuring instruments used, the responsible personnel for monitoring and data verification, instrument calibration (if applicable), and the procedures for quality assurance and quality control. In cases where alternative methods are available, such as using default values or on-site measurements, the project developer must indicate which option will be applied. Furthermore, the installation, maintenance, and calibration of measuring instruments shall be carried out in

accordance with the manufacturer's instructions and in compliance with national or international standards, such as IEC and ISO, and as specified in Table 9.2.

2) All data collected as part of the monitoring of greenhouse gas emission reductions shall be stored in electronic file format and retained for a period consistent with the guidelines specified by TGO or in accordance with the organization's quality system, but not less than the period required by TGO. The data shall also be verified for accuracy in line with the monitoring methods specified for the data/parameters to be monitored, as indicated in Table 9.2.

9.2 Data and parameters monitored

Data/parameter	$EF_{Elec,y}$	
Description	Emission factor for electricity generation/consumption in year y	
Data unit	tCO ₂ /MWh	
Equations referred	(1) (15) and (19)	
Purpose of data	☐ Baseline emission ☐ Project emission ☐ Leakage emission	
Monitoring frequency	Once per year	
Measurement methods and procedures	Reference shall be made to the emission factor report for electricity generation/use (Emission Factor) for projects and greenhouse gas reduction activities as announced by TGO, under the following conditions. <u>For the preparation of the project proposal document</u> The latest $EF_{Elec,y}$ value announced by TGO shall be used. <u>For the monitoring of greenhouse gas emission reductions</u> The $EF_{Elec,y}$ value announced by TGO for the calendar year corresponding to the crediting period shall be used. In cases where the $EF_{Elec,y}$ value for that calendar year has not yet been announced by TGO, the latest $EF_{Elec,y}$ value announced by TGO shall be applied for that year.	
Entity/person responsible for the measurement	TGO	
Measuring instrument	Type of instrument	-
	Accuracy class	-
	Calibration requirements	-
	Location	-
QA/QC procedures	-	
Treatment of uncertainties	1.02%	
Additional comment	-	

Data/parameter	$EF_{Elec,BAU,y}$	
Description	Emission factor for electricity generation/consumption under business as usual operations in year y	
Data unit	tCO ₂ /MWh	
Equations referred	(12)	
Purpose of data	☒ Baseline emission ☐ Project emission ☐ Leakage emission	
Monitoring frequency	Once per year	
Measurement methods and procedures	Reference shall be made to the emission factor report for electricity generation/use (Emission Factor) for projects and greenhouse gas reduction activities as announced by TGO, under the following conditions. ● Emission factor for electricity generation from renewable energy, for BESS electricity supplied to the grid. ● Emission factor for electricity consumption, for BESS electricity used internally and/or sold directly to electricity consumers under direct power purchase arrangements. Under the following conditions <u>For the preparation of the project proposal document</u> The latest value announced by TGO shall be used. <u>For the monitoring of greenhouse gas emission reductions</u> The value announced by TGO for the calendar year corresponding to the crediting period shall be used. In cases where the value for that calendar year has not yet been announced by TGO, the latest value announced by TGO shall be applied for that year.	
Entity/person responsible for the measurement	TGO	
Measuring instrument	Type of instrument	-
	Accuracy class	-
	Calibration requirements	-
	Location	-
QA/QC procedures	-	
Treatment of uncertainties	0.82%	
Additional comment	-	

Data/parameter	$ES_{PJ,y}$
Description	Electricity discharged from the BESS under the project in year y for supply to the grid and/or internal consumption and/or sale under a Private PPA in year y

Data unit	MWh/year	
Equations referred	(1) and (12)	
Purpose of data	☒ Baseline emission ☐ Project emission ☐ Leakage emission	
Monitoring frequency	Record data every 15 minutes	
Measurement methods and procedures	Measurement using a bidirectional kWh meter	
Entity/person responsible for the measurement	Project developer	
Measuring instrument	Type of instrument	Bidirectional kWh meter
	Accuracy class	1) Electricity meters under regulatory supervision shall comply with the requirements of the meter supplier and/or the requirements specified by the transmission system operator, or national requirements. 2) Electricity meters not under regulatory supervision shall comply with the requirements of the meter supplier or national requirements. In cases where no applicable standard exists and the meter supplier has not specified requirements, the meter shall be calibrated every three years and shall have an accuracy class of at least 0.5.
	Calibration requirements	1) Electricity meters under regulatory supervision shall comply with national standards, or the requirements specified by the meter supplier, or those specified by the transmission system operator. 2) Electricity meters not under regulatory supervision shall comply with national standards or the requirements specified by the meter supplier.
	Location	1) In the case of electricity supplied to the grid, measuring instruments shall be installed at the point of interconnection with the grid. 2) In the case of electricity supplied to specific consumers, measuring instruments shall be installed at the entrance of the electricity consumption location.
QA/QC procedures	-	
Treatment of uncertainties	Uncertainty values shall be referenced from the measuring instruments.	
Additional comment	-	

Data/parameter	$EC_{BESS,y}$	
Description	Electricity consumption from the grid in the project activity in year y	
Data unit	kWh/year	
Equations referred	(15)	
Purpose of data	☐ Baseline emission ☒ Project emission ☐ Leakage emission	
Monitoring frequency	Record data every 15 minutes	
Measurement methods and procedures	Measurement using a bidirectional kWh meter	
Entity/person responsible for the measurement	Project developer	
Measuring instrument	Type of instrument	Bidirectional kWh meter
	Accuracy class	1) Electricity meters under regulatory supervision shall comply with the requirements of the meter supplier and/or the requirements specified by the transmission system operator, or national requirements. 2) Electricity meters not under regulatory supervision shall comply with the requirements of the meter supplier or national requirements. In cases where no applicable standard exists and the meter supplier has not specified requirements, the meter shall be calibrated every three years and shall have an accuracy class of at least 0.5.
	Calibration requirements	1) Electricity meters under regulatory supervision shall comply with national standards, or the requirements specified by the meter supplier, or those specified by the transmission system operator. 2) Electricity meters not under regulatory supervision shall comply with national standards or the requirements specified by the meter supplier.
	Location	Measuring instruments shall be installed at the interconnection point with the electricity grid."
QA/QC procedures	-	
Treatment of uncertainties	Uncertainty values shall be referenced from the measuring instruments.	
Additional comment	-	

Data/parameter	$EC_{TR,BESS,y}$
Description	Electricity consumption for vehicles transporting the BESS

	for maintenance/recycling outside the project boundary in year y.	
Data unit	kWh/year	
Equations referred	(19)	
Purpose of data	☐ Baseline emission ☐ Project emission ☒ Leakage emission	
Monitoring frequency	Electricity consumption shall be recorded at least on a monthly basis.	
Measurement methods and procedures	Measurement using a bidirectional kWh meter	
Entity/person responsible for the measurement	Project developer	
Measuring instrument	Type of instrument	Bidirectional kWh meter
	Accuracy class	1) Electricity meters under regulatory supervision shall comply with the requirements of the meter supplier and/or the requirements specified by the transmission system operator, or national requirements. 2) Electricity meters not under regulatory supervision shall comply with the requirements of the meter supplier or national requirements. In cases where no applicable standard exists and the meter supplier has not specified requirements, the meter shall be calibrated every three years and shall have an accuracy class of at least 0.5.
	Calibration requirements	1) Electricity meters under regulatory supervision shall comply with national standards, or the requirements specified by the meter supplier, or those specified by the transmission system operator. 2) Electricity meters not under regulatory supervision shall comply with national standards or the requirements specified by the meter supplier.
	Location	Measuring instruments shall be installed at the entrance of the charging station.
QA/QC procedures	-	
Treatment of uncertainties	Uncertainty values shall be referenced from the measuring instruments.	
Additional comment	-	

Data/parameter	TDL _y
Description	Proportion of electricity transmission losses in the grid for electricity supply in year y

Data unit	-		
Equations referred	(15) and (19)		
Purpose of data	☐ Baseline emission ☒ Project emission ☒ Leakage emission		
Monitoring frequency	■ If Option 1 is chosen, the project developer shall monitor the value annually throughout the monitoring of greenhouse gas emission reductions. ■ If Option 2 is chosen, the project developer shall apply this value consistently throughout the monitoring of greenhouse gas emission reductions.		
Measurement methods and procedures	Option 1: Report measurement results in cases where data on the amount of electricity supplied by the producer and the amount of electricity received by the consumer are available. Option 2: Use the latest value announced by TGO (equal to 0.0596), which is referenced from the Thailand Energy Balance Report 2023 by the Department of Alternative Energy Development and Efficiency. For rural low-voltage grids, a value of 0.2 shall be used.		
Entity/person responsible for the measurement	In the case of Option 1, the project developer shall be the reporting entity. In the case of Option 2, TGO shall be the reporting entity.		
Measuring instrument	Type of instrument	-	
	Accuracy class	-	
	Calibration requirements	-	
	Location	-	
QA/QC procedures	-		
Treatment of uncertainties	-		
Additional comment	In cases where the measurement results differ significantly from previous measurements or other relevant data sources, additional measurements shall be conducted.		

Data/parameter	D_y
Description	Round-trip distance between the origin and destination of BESS transportation for maintenance/recycling in year y
Data unit	km
Equations referred	(18)
Purpose of data	☐ Baseline emission ☐ Project emission ☒ Leakage emission
Monitoring frequency	Continuous monitoring and recording at least on a monthly basis.

Measurement methods and procedures	Record the distance from the project.	
Entity/person responsible for the measurement	Project developer	
Measuring instrument	Type of instrument	-
	Accuracy class	-
	Calibration requirements	-
	Location	-
QA/QC procedures	-	
Treatment of uncertainties	-	
Additional comment	-	

Data/parameter	Q_y	
Description	Quantity of BESS transported for maintenance/recycling in year y	
Data unit	ton	
Equations referred	(18)	
Purpose of data	☐ Baseline emission ☐ Project emission ☒ Leakage emission	
Monitoring frequency	Continuous monitoring and recording at least on a monthly basis.	
Measurement methods and procedures	Record the weight from the project.	
Entity/person responsible for the measurement	Project developer	
Measuring instrument	Type of instrument	-
	Accuracy class	-
	Calibration requirements	-
	Location	-
QA/QC procedures	-	
Treatment of uncertainties	-	
Additional comment	-	

9.3 Data and parameters not monitored

Data/parameter	$EF_{CO_2,i}$
Description	Emission factor from fossil fuel type i for transporting the BESS for maintenance/recycling
Data unit	gCO_2/tkm
Equations referred	(18)
Purpose of data	☐ Baseline emission ☐ Project emission ☒ Leakage emission
Value(s) applied	-
Source of Data	☐ Measured ☒ Other sources
Measurement methods and procedures	The following values shall be applied: 1) In the case of transportation by small vehicles, use 245 (gCO_2/tkm) 2) In the case of transportation by large vehicles, use 129 (gCO_2/tkm)
Treatment of uncertainties	-
Additional comment	-

10. References

- 1) Clean Development Mechanism (CDM): ACM0002: Grid-connected electricity generation from renewable sources. Version 22.
- 2) Article 6.4 Mechanism: A6.4-AMM-001 Flaring or use of landfill gas.

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Version	Amendment	Entry into force	Description
01	-	23 July 2026	Initial issue