11. Energy / Thermal Power Generation/Fuel Efficiency Improvement

1. Typical Project Outline

· Construction of high efficient thermal power generation plants.

· Improvement of existing thermal power plants (replacement of existing facilities, introduction of combine cycle facilities).

2. Applicability

(1) Construction of a high efficient thermal power plant comparing to the most common thermal power plants in the host countries.

(2) Replacement of existing facilities with high efficient facilities in existing thermal power plants.

(3) Not applicable for introduction of co-generation.

3. Methodology of Emission Reduction Calculation

The emission reduction from the project activity is determined as the differences between the GHG emission of baseline scenario (facilities with low efficiency) and project scenario (facilities with high efficiency)[1].

Details of sources of each data in the following formulae are provided in "4. Data and Parameters for the Estimation".

$$ER_y = BE_y - PE_y$$

ER_y : Emission reduction through the project in year y (t-CO_2e/y)

BE_y : GHG emission from the baseline scenario in year y (t-CO_2e/y)

PE_y : GHG emission from the project scenario in year y (t-CO_2e/y)

(1) Calculation of Baseline Emission

Baseline GHG emission is calculated based on the amount of power generated by the project and specific fuel consumption of baseline facilities.

For the case of capacity increase at the new power plant, GHG emissions are calculated by dividing into two types; GHG emissions at the capacity increase before the project is implemented and GHG emissions corresponding to the increased capacity. The GHG emissions corresponding to the increased capacity is considered as emissions from the plant when using the most popular technology in the country where the project is implemented, and is calculated using the following formula.

(i) When the capacity of the power plant does not increase compared to the baseline scenario.

$$BE_y = EG_{PJ,y} \times GE_{BL} \times NCV_i \times EF_{fuel,i} \div 10^6$$

$EG_{PJ,y}$: Amount of electricity generated by the project in year y (MWh/y)

GE_{BL} : Specific fuel consumption of baseline facilities (t/MWh)

NCV_i : Net caloric value of the fuel i used for power generation (TJ/Gg = TJ/kt)

$EF_{fuel,i}$: CO_2 emission factor of the fuel i used for power generation (kg-CO_2/TJ)

(ii) When the capacity of the power plant increases compared to the baseline scenario.

Baseline emissions are calculated in the same way as (i) above until the power generation in the baseline scenario is implemented,

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[1] The target year shall be a representative year under average operation or an annual average of multiple years.

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and more than that, using the most popular power generation efficiency.

$$BE_y = \left\{ (EG_{PJ,y} - EG_{BL}) \times \frac{\eta_{BL}}{\eta_{BL,country}} + EG_{BL} \right\} \times GE_{BL} \times NCV_i \times EF_{fuel,i} \div 10^6$$

EG_{BL} : Amount of electricity generated in the baseline scenario (MWh/y)

η_{BL} : Power generation efficiency in the baseline scenario (%)

$\eta_{BL,country}$: Power generation efficiency of the most popular facilities in the country where the project is implemented (%)

(2) Calculation of Project Emission

Project emission is calculated based on the consumption of fuel for power generation in the project and CO_2 emission factor of the fuel used for power generation.

$$PE_y = FC_{PJ,i,y} \times NCV_i \times EF_{fuel,i} \div 10^6$$

$FC_{PJ,i,y}$: Consumption of the fuel i used for power generation in the project (t/y)

4. Data and Parameters for the Estimation

Data	Description	Data Sources	
		For baseline emission calculation	For project emission calculation
$EG_{PJ,y}$	Amount of electricity generated by the project in year y (MWh/y)	A planned value	N/A
EG_{BL}	Amount of electricity generated in the baseline scenario (MWh/y)	A planned value	N/A
GE_{BL}	Specific fuel consumption of baseline facilities (t/MWh)	From the following sources in the order of priority i) A value from the actual performance of existing typical old power plants or the target power plant ii) A value from the specification of the target power plant facilities	N/A
$FC_{PJ,i,y}$	Consumption of the fuel i used for power generation in the project (t/y)	N/A	A planned value
$EF_{fuel,i}$	CO_2 emission factor of the fuel i used for power generation (kg-CO_2/TJ)	An IPCC default value (Table 2, Appendix) If there is no default value applied or if there is another appropriate value, that value may be used.	
NCV_i	Net caloric value of the fuel i used for power generation (TJ/Gg = TJ/kt)	An IPCC default value (Table 1, Appendix) If there is no default value applied or if there is another appropriate value, that value may be used.	
η_{BL}	Power generation efficiency in the baseline scenario (%)	A monitored value	N/A
$\eta_{BL,country}$	Power generation efficiency of the most popular facilities in the country where the project is implemented (%)	Survey results in the country of the project implementation. If there is no energy efficiency data, set η_{BL} / $\eta_{BL,\,country}$ = 0. *	N/A

（※）If there is no data on the power generation efficiency of the most popular plants in the country, the GHG emission reduction of the capacity increase is regarded as zero from the viewpoint of conservative calculation of the GHG emission reduction.

5. Others

(1) Project Boundary

The physical boundary for measuring GHG emissions includes power generation facilities where project activity is implemented.

(2) Leakage

There are probably indirect emissions that potentially lead to leakage due to activities such as product manufacturing or transport of materials. However, the kind of emission is temporary and negligible compare to the project scale. Therefore, it can be ignored.

(3) Comparison with existing CDM methodologies

There are CDM methodologies such as AM0061 (Methodology for rehabilitation and/or energy efficiency improvement in existing power plants, Version 2.1), AM0062 (Energy efficiency improvements of a power plant through retrofitting turbines, Version 2.0), ACM0013 (Construction and operation of new grid connected fossil fuel fired power plants using a less GHG intensive technology, Version 05) and AMS-II.B. (Supply side energy efficiency improvements-generation, Version 09) can be references for development of the methodology.

The logic of emission reduction calculation in the methodology is almost the same as that of the ACM001. However, this methodology tries to apply straightforward parameters and default values as more as possible such as specific fuel consumption for simplicity and transparency. Moreover, there is no limitation for the emission reduction in the methodology like the CDM methodologies did.

(4) CH_4 and N_2O

Since methane (CH_4) and nitrous oxide (N_2O) do not have a significant impact on emission reductions by the project, they were not considered for simplification.

(5) Revision history

Version	Year/Month	Revisions
2.0	March 2014	• Amended baseline emission calculation to use CO_2 emission factor of power generation before the project and amount of electricity generated by the project
3.0	September 2019	• Added a calculation method for capacity/output increase • Prioritized the use of default values • Added instructions not to consider CH_4 and N_2O emissions
4.0	March 2023	• In the description of the calculation method and necessary data of baseline emissions, the words "before project implementation" was revised to use "the baseline scenario". The baseline scenario is the scenario that would have occurred in the absence of the project, such as continuation of the pre-project conditions. • Deleted the column "Ex-post" in "4. Data and Parameters Estimated and Need Monitoring":

		current version of Climate-FIT aims to quantify GHG emission reductions in the "planning phase").
5.0	March 2024	• No revision.