विद्युत मंत्रालय
MINISTRY OF
POWER

सत्यमेव जयते

METHODOLOGICAL TOOL

BM-T-003

Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation

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Publication Date: 27 March 2025

Version 1.0

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1. Introduction

1. The methodological tool is developed to provide consistent procedures among the ICM methodologies to calculate baseline, project and/or leakage emissions due to electricity consumption and to monitor the amount of electricity generated by the project power plant.

2. Scope & Applicability

2.1. Scope

2. This tool provides procedures to estimate the baseline, project and/or leakage emissions associated with the consumption of electricity, and procedures to monitor the amount of electricity generated by the project power plant.

3. The tool provides options to non-obligated entities to estimate the baseline, project and/or leakage emissions associated with the consumption of electricity by the proposed project activity. These options aim to provide flexibility while ensuring that the estimation of emission reductions is conservative. Some options provide broader estimates of the emission reductions and rely on conservative default values or conservative simplifications, whereas other options provide more accurate estimates but require extensive data monitoring.

4. Depending on their specific scope, methodologies which refer to this tool should:

(a) Specify clearly which sources of project, baseline and leakage electricity consumption should be calculated with this tool; and/or

(b) Provide the procedures to determine the most likely baseline scenario for each source of baseline electricity consumption; and/or

(c) Provide the procedures to determine the most likely baseline scenario for electricity generated and supplied by the project power plant to the grid or consumers; and

(d) Provide the procedures to determine the baseline CO_2 emission factors for the electricity generated and supplied by the project power plant ($EF_{BL,grid,CO2,y}$ and $EF_{BL,facility,CO2,i,y}$).

2.2. Applicability

5. If emissions are calculated for electricity consumption, the tool is only applicable if one out of the following three scenarios applies to the sources of electricity consumption:

(a) Scenario A: Electricity consumption from the grid. The electricity is purchased from the grid only, and either no captive power plant(s) is/are installed at the site of electricity consumption or, if any captive power plant exists on site, it is either not operating or it is not physically able to provide electricity to the electricity consumer;

(b) Scenario B: Electricity consumption from (an) off-grid fossil fuel fired captive power plant(s). One or more fossil fuel fired captive power plants are installed at the site of the electricity consumer and supply the consumer with electricity. The captive power plant(s) is/are not connected to the electricity grid; or

(c) Scenario C: Electricity consumption from the grid and (a) fossil fuel fired captive power plant(s). One or more fossil fuel fired captive power plants operate at the site of the electricity consumer. The captive power plant(s) can provide electricity to the electricity consumer. The captive power plant(s) is/are also connected to the electricity grid. Hence,

the electricity consumer can be provided with electricity from the captive power plant(s) and the grid.

6. This tool can be referred to in methodologies to provide procedures to monitor amount of electricity generated in the project scenario, only if one out of the following three project scenarios applies to the recipient of the electricity generated:

(a) Scenario I: Electricity is supplied to the grid;

(b) Scenario II: Electricity is supplied to consumers/electricity consuming facilities; or

(c) Scenario III: Electricity is supplied to the grid and consumers/electricity consuming facilities.

7. This tool is not applicable in cases where captive renewable power generation technologies are installed to provide electricity in the project activity, in the baseline scenario or to sources of leakage. The tool only accounts for CO_2 emissions.

3. Parameters

8. This tool provides procedures to determine the following parameters:

Table 1. Parameters

Parameter	SI Unit	Description
$PE_{EC,y}$	t CO_2 / yr	Project emissions from electricity consumption in year y
$BE_{EC,y}$	t CO_2 / yr	Baseline emissions from electricity consumption in year y
$LE_{EC,y}$	t CO_2 / yr	Leakage emissions from electricity consumption in year y
$EG_{PJ,grid,y}$	MWh/ yr	Quantity of electricity generated and supplied by the project power plant to the grid in year *y*

4. Methodology: Procedure

4.1. Emission from electricity generation

9. The baseline emissions from electricity generated and supplied by the project power plant to the grid and/or to the consumers ($BE_{EG,y}$) is calculated in the methodology that refers to this tool. This tool aims to provide consistent monitoring provisions to determine the quantity of electricity generated and supplied to the grid and/or consumers/electricity consuming facility (e.g. quantity of electricity generated and supplied by the project power plant to the grid in year y ($EG_{PJ,grid,y}$) or to the consumers/electricity consuming facility i in year y ($EG_{PJ,facility,i,y}$).

4.2. Emissions from electricity consumption

10. Emissions from electricity consumption include CO_2 emissions from the combustion of fossil fuels at any power plants at the site(s) of electricity consumption and, if applicable, at power plants connected physically to the electricity system (grid) from which electricity is consumed.

11. Non-Obligated Entity should document transparently in the ICM-PDD and in monitoring reports which sources of electricity consumption are calculated with this tool and, for each source, which scenario (A, B or C, as described in Section 2.2, paragraph 5 above) applies.

12. In the following, a generic approach to calculate emissions from consumption of electricity is introduced. This approach can be used in all applicable scenarios (A, B or C) as described in Section 2.2, paragraph 6. Then guidance on the determination of the emission factor for electricity generation is provided. Finally, simplified alternative approaches applicable to scenario B and to project and leakage are introduced in Section 4.2.2, paragraph 31.

4.2.1. Generic approach

13. In the generic approach, project, baseline and/or leakage emissions from consumption of electricity are calculated based on the quantity of electricity consumed, an emission factor for electricity generation and a factor to account for transmission losses, as follows:

$$PE_{EC,y} = \Sigma EC_{PJ,j,y} \times EF_{EF,j,y} \times (1+TDL_{j,y})j \quad \text{Equation (1)}$$

$$BE_{EC,y} = \Sigma EC_{BL,k,y} \times EF_{EF,k,y} \times (1+TDL_{k,y})k \quad \text{Equation (2)}$$

$$LE_{EC,y} = \Sigma EC_{LE,l,y} \times EF_{EF,l,y} \times (1+TDL_{l,y})l \quad \text{Equation (3)}$$

Where:
$PE_{EC,y}$= Project emissions from electricity consumption in year y (tCO_2 / yr)
$BE_{EC,y}$= Baseline emissions from electricity consumption in year y (tCO_2 / yr)
$LE_{EC,y}$= Leakage emissions from electricity consumption in year y (tCO_2 / yr)
$EC_{PJ,j,y}$= Quantity of electricity consumed by the project electricity consumption source j in year y (MWh/yr)
$EC_{BL,k,y}$ = Quantity of electricity that would be consumed by the baseline electricity consumer k in year y (MWh/yr)
$EC_{LE,l,y}$ = Net increase in electricity consumption of source l in year y as a result of leakage[1] (MWh/yr)
$EF_{EF,j,y}$ = Emission factor for electricity generation for source j in year y (t CO_2/MWh)
$EF_{EF,k,y}$ =Emission factor for electricity generation for source k in year y (t CO_2/MWh)
$EF_{EF,l,y}$ =Emission factor for electricity generation for source l in year y (t CO_2/MWh)
$TDL_{j,y}$=Average technical transmission and distribution losses for providing electricity to source j in year y
$TDL_{k,y}$=Average technical transmission and distribution losses for providing electricity to source k in year y
$TDL_{l,y}$=Average technical transmission and distribution losses for providing electricity to source l in year y
j=Sources of electricity consumption in the project
k=Sources of electricity consumption in the baseline
l=Leakage sources of electricity consumption

[1] A net increase of electricity consumption outside the project boundary as a result of the ICM project activity should be reflected in a positive value for $EC_{LE,l,y}$. If electricity consumption decreases as a result of the ICM project activity, $EC_{LE,l,y}$ should be assumed as zero.

4.2.1.1. Determination of the emission factor for electricity generation ($EF_{EL,j/k/l,y}$)

14. The determination of the emission factors for electricity generation ($EF_{EL,j/k/l,y}$) in the project scenario depends on which scenario (A, B or C), as described in Section 3.2, paragraph 6 that applies to the source of electricity consumption that would be displaced in the baseline by electricity generated in the project:

4.2.1.1.1. Scenario A: Electricity consumption from the grid

15. Calculate the combined margin emission factor of the applicable electricity system, using the procedures in the latest version of the CO2 Baseline Database published by the CEA ($EF_{EL,j/k/l,y} = EF_{grid,CM,y}$)[2].

4.2.1.1.2. Scenario B: Electricity consumption from an off-grid captive power plant

16. In this case, non-obligated entity may choose among the following options:

17. Option B1: The emission factor for electricity generation is determined based on the CO_2 emissions from fuel combustion and the electricity generation in the captive power plant(s) installed at the site of the electricity consumption source. In case of plants that co-generate heat and power (cogeneration plants), non-obligated entity may:

    (a) Ignore, as a conservative assumption, the heat generation, if:

        (i) The source of electricity consumption is a project or leakage electricity consumption source but not a baseline electricity consumption source; or

        (ii) Electricity generated by the captive power plant is consumed by one or several project electricity consumption sources and one or several baseline electricity consumption sources; and, the electricity consumption by the project electricity consumption sources connected to the power plant is greater than the electricity consumption of the baseline electricity consumption sources connected to that power plant;

    (b) Allocate the emissions of the captive power plant to heat and power, by assuming that without cogeneration the heat would be generated in a boiler, using the same type of fossil fuel(s) that are used in the captive power plant. Note that this option requires determining the heat generation of the captive power plant(s).

18. In case where none of the captive power plants is a cogeneration plant or where the heat generation is ignored (subject to the conditions outlined above), the emission factor of the captive power plant(s) is calculated as follows:

$$EF_{EL,j/k/l,y} = \frac{\sum_n \sum_i FC_{n,i,t} * NCV_{i,t} * EF_{CO2,i,t}}{\sum_n EG_{n,t}} \qquad \text{Equation (4)}$$

Where:

[2] https://cea.nic.in/cdm-co2-baseline-database/?lang=en

$EF_{EL,j/k/l,y}$ =Emission factor for electricity generation for source j, k or l in year y (tCO_2/MWh)

$FC_{n,i,t}$=Quantity of fossil fuel type i fired in the captive power plant n in the time period t (mass or volume unit)

$NCV_{i,t}$=Average net calorific value of fossil fuel type i used in the period t (GJ / mass or volume unit)

$EF_{CO2,i,t}$=Average CO_2 emission factor of fossil fuel type i used in the period t (tCO_2 / GJ)

$EG_{n,t}$=Quantity of electricity generated in captive power plant n in the time period t (MWh)

i=Fossil fuel types fired in captive power plant n in the time period t

j=Sources of electricity consumption in the project

k=Sources of electricity consumption in the baseline

l=Leakage sources of electricity consumption

n=Fossil fuel fired captive power plants installed at the site of the electricity consumption source j, k or l

t=Time period for which the emission factor for electricity generation is determined (see further guidance below)

19. In other cases, the CO_2 emission factor for electricity generation is calculated by allocating the fuel consumption between electricity and heat generation, as follows:

$$EF_{EL,j/k/l,y=} \frac{\sum_n [\sum_i (FC_{n,i,t} * NCV_{i,t}) - \frac{HG_{n,t}}{\eta_{boiler}}] * EF_{CO2,n,t}}{\sum_n EG_{n,t}} \quad \text{Equation (5)}$$

Where:

$EF_{EL,j/k/l,y}$=Emission factor for electricity generation for source j, k or l in year y (tCO_2/MWh)

$FC_{n,i,t}$=Quantity of fossil fuel type i fired in the captive power plant n in the time period t (mass or volume unit)

$NCV_{i,t}$=Average net calorific value of fossil fuel type i used in the period t (GJ/mass or volume unit)

$HG_{n,t}$=Quantity of heat co-generated in captive power plant n in the time period t (GJ)

η_{boiler}=Efficiency of the boiler in which heat is assumed to be generated in the absence of a cogeneration plant

$EF_{CO2,n,t}$=Average CO_2 emission factor of the fossil fuels fired in the captive power plant n in the time period t (tCO_2 / GJ)

$\Sigma EG_{n,tn}$=Quantity of electricity generated in captive power plant n in the time period t (MWh)

i=Fossil fuel types fired in captive power plant n in the time period t

j=Sources of electricity consumption in the project

k=Sources of electricity consumption in the baseline

l=Leakage sources of electricity consumption

n=Fossil fuel fired captive power plants installed at the site of the electricity consumption source j, k or l

t=Time period for which the emission factor for electricity generation is determined (see further guidance below)

20. The time period t should correspond to:

(a) The monitored period (e.g. the year y) for:

(i) Project and leakage electricity consumption sources;

(ii) Baseline electricity consumption sources if existing or new captive power plant(s) are operated during the monitored period at the site of the baseline or leakage electricity consumption source[3];

(b) The most recent historical three years prior to the implementation of the project activity for baseline electricity consumption sources if no captive power plant is operated during the monitored period at the site of the baseline or leakage electricity consumption source.

21. The average CO_2 emission factor of the fossil fuels fired in the captive power plant n ($EF_{CO2,n,t}$) is determined as follows:

(a) In case of captive power plants that have only used one single fuel type since their start of operation (except small amount of start-up4 fuel), use the CO_2 emission factor of that fuel type ($EFCO_{2,n,t} = EFCO_{2,i}$);

(b) In the case of captive power plants that have used multiple fuel types since their start of operation, choose among the following option[5]:

(i) For baseline electricity consumption, use the fuel type with the lowest CO_2 emission factor ($EFCO_{2,i,t}$) among the fuel types that were used in the period prior to the start of the project activity; the period considered shall be a minimum of one year and a maximum of three years;

(ii) For project electricity consumption, use the fuel type with the highest CO_2 emission factor ($EF_{CO2,i,t}$) among the fuel types that have been used in the period since the start of the project activity until the end of the monitored period in question;

(iii) Nevertheless, if electricity is consumed from the same captive power plant for both the baseline and project (and/or leakage); and the electricity consumption of the project and leakage sources is greater than the electricity consumption of the baseline sources, then the CO_2 emission factor ($EF_{CO2,i,t}$) as per sub-paragraph (b)

[3] In some cases, the captive power plant(s) at the site of a baseline or leakage electricity consumption source may stop their operation after the implementation of the project activity.

[4] If a fuel is defined as a start-up fuel, it should not represent more than three per cent of the total fuel utilized in the process, on energy basis.

[5] These provisions aim to address the following issues:

(ii) shall be used for both. On the other hand, if electricity is consumed from the same captive power plant for both the baseline and project (and/or leakage); and the electricity consumption of the baseline sources is greater than the electricity consumption of the project and/or leakage sources, then the CO_2 emission factor ($EF_{CO2,i,t}$) as per sub-paragraph (b)[6] (i) shall be used for both;

(iv) Calculate an average CO_2 emission factor for the period t, provided that the decision on the fuel mix is outside the control of the project participants (e.g. in the case of leakage electricity consumers or in cases where the fuel mix is fixed through mandatory regulations or determined by a centralized dispatch authority, as follows:

$$EF_{CO2,n,t}=\frac{\sum_i FC_{n,i,t}*NCV_{i,t}*EF_{CO2,i,t}}{\sum_i FC_{n,i,t}*NCV_{i,t}} \quad \text{Equation (6)}$$

Where:

$EFCO_{2,n,t}$	=	Average CO_2 emission factor of the fossil fuels fired in the captive power plant n in the time period t (tCO_2/GJ)
$FC_{n,i,t}$	=	Quantity of fossil fuel type i fired in the captive power plant n in the time period t (mass or volume unit)
$NCV_{i,t}$	=	Average net calorific value of fossil fuel type i used in the period t (GJ / mass or volume unit)
$EF_{CO2,i,t}$	=	CO_2 emission factor of fossil fuel type i used in the time period t (t CO_2 / GJ)
i	=	Fossil fuel types fired in captive power plant n in the time period t
n	=	Fossil fuel fired captive power plants installed at the site of the electricity consumption source j, k or l
t	=	Time period for which the emission factor for electricity generation is determined (see further guidance below)

(v) Calculate the average CO_2 emission factor, as per equation (6) above, for (a) the period of the most recent three years prior to the implementation of the project activity and for (b) the monitored period in question and use the value that is more conservative.

22. The selected approach should be documented in the ICM-PDD and, once selected, not be changed during the crediting period.

23. Option B2: Use the value corresponding to captive power generation as per the latest version of the CO_2 Baseline Database published by the CEA[7].

[6] The provisions aim to avoid the situation that project participants may face perverse incentives to use in their captive power plants fuel types with higher CO_2 emission factors. This may, for example, apply if a project activity saves electricity at a site where a dual fuel captive power plant is operated by the project participants. In this case, the use of a fuel type with a higher emission factor would, without these provisions, result in the issuance of more CCCs.

[7] https://cea.nic.in/cdm-co2-baseline-database/?lang=en

4.2.1.1.3. Scenario C: Electricity consumption from the grid and (a) fossil fuel fired captive power plant(s)

24. Under this scenario, the consumption of electricity in the project, the baseline or as a source of leakage may result in different emission levels, depending on the situation of the project activity. The following three cases can be differentiated:

(a) Case C.I: Grid electricity. The implementation of the project activity only affects the quantity of electricity that is supplied from the grid and not the operation of the captive power plant. This applies, for example:
   (i) If at all times during the monitored period the total electricity demand at the site of the captive power plant(s) is, both with the project activity and in the absence of the project activity, larger than the electricity generation capacity of the captive power plant(s); or
   (ii) If the captive power plant is operated continuously (apart from maintenance) and feeds any excess electricity into the grid, because the revenues for feeding electricity into the grid are above the plant operation costs; or
   (iii) If the captive power plant is centrally dispatched and the dispatch of the captive power plant is thus outside the control of the non-obligated entity;

(b) Case C.II: Electricity from captive power plant(s). The implementation of the project activity is clearly demonstrated to only affect the quantity of electricity that is generated in the captive power plant(s) and does not affect the quantity of electricity supplied from the grid. This applies, for example, in the following situation: A fixed quantity of electricity is purchased from the grid due to physical transmission constraints, such as a limited capacity of the transformer that provides electricity to the relevant source. In this situation, case C.II would apply if the total electricity demand at the site of the captive power plant(s) is at all times during the monitored period, both with the project activity and in the absence of the project activity, larger than the quantity of the electricity that can physically be supplied by the grid;

(c) Case C.III: Electricity from both the grid and captive power plant(s). The implementation of the project activity may affect both the quantity of electricity that is generated in the captive power plant(s) and the quantity of electricity supplied from the grid. This applies, for example:
   (i) If the captive power plant(s) is/are not operating continuously; or
   (ii) If grid electricity is purchased during a part of the monitored period; or
   (iii) If electricity from the captive power plant is fed into the grid during a part of the monitored period.

25. Non-obligated entity should document in the ICM-PDD and in monitoring reports which case applies, justify why the case applies and provide the relevant evidence. The ACVA should carefully evaluate the case. In the case of doubts, case C.III should be identified, as a conservative approach.

26. Where case C.I has been identified, the guidance for scenario A above should be applied (use option A1 or option A2). Where case C.II has been identified, the guidance for scenario B above should be applied (use option B1 or B2). Where case C.III has been identified, as a conservative simple approach, the emission factor for electricity generation should be the more conservative value between the emission factor determined as per guidance for scenario A and B, respectively. This means that the more conservative value should be chosen between a) the result of applying either option A1 or A2 and b) the result of applying either option B1 or B2.

4.3. Data and parameters not monitored

Data / Parameter table 1.

Data/Parameter	$PP_{CP,j}$ and $PP_{CP,l}$
Data Unit	MW
Description	Rated capacity of the captive power plant(s) that provide the project or leakage consumption source(s) l or j with electricity
Source of Data	Name plate capacity of the captive power plant, manufacturer's specifications or catalogue references
Value to be applied	-
Measurement Procedure (if any)	-
QA/QC Procedures	-
Any Comment	In case of uncertainty a conservative value should be chosen

4.4. Monitoring Methodology Procedure

4.4.1. Monitoring Procedures

27. Describe and specify in the ICM-PDD all monitoring procedures, including the type of measurement instrumentation used, the responsibilities for monitoring and QA/QC procedures that will be applied. Where the methodology provides different options (e.g. use of default values or on-site measurements), specify which option will be used. Meters should be installed, maintained and calibrated according to equipment manufacturer instructions and be in line with national standards, or, if these are not available, international standards (e.g. IEC, ISO).

28. All data collected as part of monitoring should be archived electronically and be kept at least for 2 years after the end of the last crediting period. 100% of the data should be monitored if not indicated differently in the comments in the tables below.

4.4.2. Data and parameters monitored

Data / Parameter table 2.

Data/Parameter	$EF_{grid,CM,y}$
Data Unit	tCO_2/MWh
Description	Combined margin emission factor for the grid in year y
Source of Data	Combined margin emission factor, as per the latest version of the CO2 Baseline Database published by the Central Electricity Authority, India. https://cea.nic.in/cdm-co2-baseline-database/?lang=en
Measurement Procedure (if any)	NA
Monitoring Frequency	Annual
QA/QC Procedures	-
Any Comment	-

Data / Parameter table 3.

Data/Parameter	TDLj,y and TDLk,y and TDLl,y
Data Unit	-
Description	Average technical transmission and distribution losses for providing electricity to source j, k or l in year y
Source of Data	In case of scenario B and scenario C, case C.II, assume TDLj/k/l,y = 0 as a simplification. In case of other scenarios (scenario A and scenario C, cases C.I and C.III), choose one of the following options: 1. Use annual average value based on the most recent data available within the host country; 2. Use as default values of 20% for: (a) project or leakage electricity consumption sources; (b) baseline electricity consumption sources if the electricity consumption by all project and leakage electricity consumption sources to which scenario A or scenario C (cases C.I or C.III) applies is larger than the electricity consumption of all baseline electricity consumption sources to which scenario A or scenario C (cases C.I or C.III) applies; 3. Use as default values of 3% for: (a) baseline electricity consumption sources; (b) project and leakage electricity consumption sources if the electricity consumption by all project and leakage electricity consumption sources to which scenario A or scenario C (cases C.I or C.III) applies is smaller than the electricity consumption of all baseline electricity consumption sources to which scenario A or scenario C (cases C.I or C.III) applies
Measurement Procedure (if any)	For (a): TDLj/k/l,y should be estimated for the distribution and transmission networks of the electricity grid of the same voltage as the connection where the proposed ICM project activity is connected to. The technical distribution losses should not contain other types of grid losses (e.g. commercial losses/theft). The distribution losses can either be calculated by the project participants or be based on references from utilities, network operators or other official documentation
Monitoring Frequency	Annually. In the absence of data from the relevant year, most recent figures should be used, but not older than 5 years
QA/QC Procedures	-
Any Comment	-

Data / Parameter table 4.

Data/Parameter	$FC_{n,i,t}$
Data Unit	Mass or () volume unit at reference conditions[8] per year (in m^3, ton or l)
Description	Quantity of fossil fuel type i fired in the captive power plant n in the time period t
Source of Data	Annual data during the crediting period: Onsite measurements Historical data: Historical records / onsite measurements
Measurement Procedure (if any)	Use either mass or volume meters. In cases where fuel is supplied from small daily tanks, rulers can be used to determine mass or volume of the fuel consumed, with the following conditions: The ruler gauge must be part of the daily tank and calibrated at least once a year and have a book of control for recording the measurements (on a daily basis or per shift); Accessories such as transducers, sonar and piezoelectronic devices are accepted if they are properly calibrated with the ruler gauge and receiving a maintenance per supplier specifications;

[8] Reference conditions are defined as 0 oC (273.15 K, 32ºF) and 1 atm (101.325 kN/m2, 101.325 kPa, 14.69 psia, 29.92 in Hg, 760 torr).

	In case of daily tanks with pre-heaters for heavy oil, the calibration will be made with the system at typical operational conditions
Monitoring Frequency	Continuously, aggregated at least annually
QA/QC Procedures	The consistency of metered fuel consumption quantities should be cross-checked with an annual energy balance that is based on purchased quantities and stock changes.
Any Comment	Only applicable if option B1 is used.

Data / Parameter table 5.

Data/Parameter	$EG_{n,t}$
Data Unit	MWh
Description	Quantity of electricity generated in captive power plant n in the time period t
Source of Data	Onsite measurements
Measurement Procedure (if any)	Use electricity meters
Monitoring Frequency	Continuously, aggregated at least annually
QA/QC Procedures	Cross check measurement results with records for sold electricity where relevant
Any Comment	Only applicable if option B1 is used

Data / Parameter table 6.

Data/Parameter	$HG_{n,t}$
Data Unit	GJ
Description	Quantity of heat co-generated in captive power plant n in the period t
Source of Data	Onsite measurements
Measurement Procedure (if any)	Heat generation is determined as the difference of the enthalpy of the steam or hot water generated minus the enthalpy of the feed-water and any condensate return. The respective enthalpies should be determined based on the mass (or volume) flows, the temperatures and, in case of superheated steam, the pressure. Steam tables or appropriate thermodynamic equations may be used to calculate the enthalpy as a function of temperature and pressure.
Monitoring Frequency	Continuously, aggregated at least annually
QA/QC Procedures	Cross check measurement results with records for sold heat and the other energy measurements where relevant.
Any Comment	Only applicable if option B1 is used and if heat generation is not ignored (subject to the conditions outlined above)

Data / Parameter table 7.

Data/Parameter	$\eta_{boiler,y}$
Data Unit	-
Description	Efficiency of the boiler in which heat is assumed to be generated in the absence of a cogeneration plant
Source of Data	Choose among the following options: (a) Measurement of the efficiency in the case that a heat-only boiler is installed and in operation at the site of the captive power plant(s) (b) Assume a default value of 100% in case of a project or leakage emission source and 60% in case of a baseline emission source

Measurement Procedure (if any)	(a) Use national or international standards to determine the boiler efficiency (b) Not applicable
Monitoring Frequency	(a) Once at the start of the project activity (b) Not applicable
QA/QC Procedures	-
Any Comment	Only applicable to option B1 and in cases where CO_2 emissions from cogeneration are allocated to heat and power

Data / Parameter table 8.

Data/Parameter	$NCV_{i,t}$
Data Unit	GJ / mass or volume unit
Description	Average net calorific value of fossil fuel type i used in the period t
Source of Data	The following data sources may be used if the relevant conditions apply:

Data source	Conditions for using the data source
(a) Values provided by the fuel supplier in invoices	This is the preferred source
(b) Measurements by the project participants	If (a) is not available
(c) Regional or national default values	If (a) is not available. These sources can only be used for liquid fuels and should be based on well documented, reliable sources (such as national energy balances).
(d) IPCC default values at the upper or lower limit – whatever is more conservative – of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories	If (a) is not available

Measurement Procedure (if any)	For (a) and (b): Measurements should be undertaken in line with national or international fuel standards.

Monitoring Frequency	For (a) and (b): The NCV should be obtained for each fuel delivery, from which weighted average values for the period t should be calculated
	For (c): Review appropriateness of the values annually
	For (d): Any future revision of the IPCC Guidelines should be taken into account

QA/QC Procedures	Verify if the values under (a), (b) and (c) are within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines. If the values fall out this range collect additional information from the testing laboratory to justify the outcome or conduct additional measurements. The laboratories in a), b) or c) should have ISO17025 accreditation or justify that they can comply with similar quality standards.
Any Comment	Only applicable if option B1 is used

Data / Parameter table 9.

Data/Parameter	$EF_{CO2,i,t}$
Data Unit	tCO_2 / GJ

<table>
<tr><td>Description</td><td>CO_2 emission factor of fossil fuel type i used in the period t</td></tr>
<tr><td>Source of Data</td><td>The following data sources may be used if the relevant conditions apply:
<table>
<tr><td>Data source</td><td>Conditions for using the data source</td></tr>
<tr><td>(a) Values provided by the fuel supplier in invoices</td><td>This is the preferred source</td></tr>
<tr><td>(b) Measurements by the project participants</td><td>If (a) is not available</td></tr>
<tr><td>(c) Regional or national default values</td><td>If (a) is not available.
These sources can only be used for liquid fuels and should be based on well documented, reliable sources (such as national energy balances).</td></tr>
<tr><td>(d) IPCC default values at the upper or lower limit – whatever is more conservative – of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories</td><td>If (a) is not available</td></tr>
</table></td></tr>
<tr><td>Measurement Procedure (if any)</td><td>For (a) and (b): Measurements should be undertaken in line with national or international fuel standards.
For a): If the fuel supplier does provide the NCV value and the CO_2 emission factor on the invoice and these two values are based on measurements for this specific fuel, this CO_2 factor should be used. If another source for the CO_2 emission factor is used or no CO_2 emission factor is provided, options (b), (c) or (d) should be used.</td></tr>
<tr><td>Monitoring Frequency</td><td>For a) and b): The CO_2 emission factor should be obtained for each fuel delivery, from which weighted average values for the period t should be calculated
For (c): Review appropriateness of the values annually
For (d): Any future revision of the IPCC Guidelines should be taken into account</td></tr>
<tr><td>QA/QC Procedures</td><td>-</td></tr>
<tr><td>Any Comment</td><td>Only applicable if option B1 is used</td></tr>
</table>

Data / Parameter table 10.

Data/Parameter	$EC_{PJ,j,y}$; $EC_{LE,l,y}$
Data Unit	MWh/yr
Description	Quantity of electricity consumed by the project electricity consumption source j in year y Net increase in electricity consumption of source l in year y as a result of leakage
Source of Data	Direct measurement or calculated based on measurements from more than one electricity meters
Measurement Procedure (if any)	Use electricity meters installed at the electricity consumption sources.
Monitoring Frequency	Continuous measurement and at least monthly recording

QA/QC Procedures	In cases where electricity meters are regulated (e.g. the electricity is supplied by the electric grid – scenario A), the electricity meter will be subject to regular maintenance and testing in accordance with the stipulation of the meter supplier and/or as per the requirements set by the grid operators or national requirements. The calibration of meters, including the frequency of calibration, should be done in accordance with national standards or requirements set by the meter supplier or requirements set by the grid operators. The accuracy class of the meters should be in accordance with the stipulation of the meter supplier and/or as per the requirements set by the grid operators or national requirements. In cases where electricity meters are not regulated (e.g. the electricity is supplied by captive power plants – Scenario B), the electricity meter will be subject to regular maintenance and testing in accordance with the stipulation of the meter supplier or national requirements. The calibration of meters, including the frequency of calibration, should be done in accordance with national standards or requirements set by the meter supplier. The accuracy class of the meters should be in accordance with the stipulation of the meter supplier or national requirements. If these standards are not available, and meter supplier does not specify, calibrate the meters every 3 years and use the meters with at least 0.5 accuracy class (e.g. a meter with 0.2 accuracy class is more accurate and thus it is accepted).
Any Comment	The non-obligated entity do not need to apply for post registration changes in the following situations and the change shall be described in the subsequent monitoring report and verification report: (a) Changing the type of meter during the monitoring period, for example from analogue to electrical or vice-versa as long as the meters comply with the accuracy class mentioned above. (b) Changing the accuracy class of meter from lower accuracy class to higher accuracy class. (c) Changing the calibration frequency of meter within the range stipulated in the national standards or requirements set by the meter supplier or requirements set by the grid operators. (d) Changing meter type from check meter to bi-directional meter. The non-obligated entity may choose not to monitor this parameter for a period of time if the emission factors associated to the electricity consumed are zero or close to zero. In doing so, the ACVA shall validate that the total emissions (project and leakage) do not cross the materiality threshold. In case of missing data due to meter failure or other reasons for a certain period of time, the following options to estimate electricity consumption may be applied: (a) A conservative value based on rated capacity and full operational hours (8760 hours); or (b) Estimation of electricity consumption as highest daily value among the daily monitored values multiplied by the number of days' data were missing. This is option is applicable for missing data of up to 7 consecutive days within three consecutive months; or (c) Highest value for the same calendar period of the previous years among recorded values; or

	(d) a value of a representative sample of the first batch[9] of project devices. In other words, it may be assumed that the electricity consumption measured in a representative sample of the first batch of project devices apply to all subsequent batches. Options (c) and (d) are only applicable to project activities, where end users of the subsystems or measures are households/communities/small and medium enterprises (SMEs), provided the gap period does not exceed 30 consecutive days within six consecutive months.

Data / Parameter table 11.

Data/Parameter	$EC_{BL,k,y}$
Data Unit	MWh/yr
Description	Quantity of electricity that would be consumed by the baseline electricity consumption source k in year y
Source of Data	Direct measurement or calculated based on measurements from more than one electricity meters
Measurement Procedure (if any)	Use electricity meters installed at the electricity consumption sources.
Monitoring Frequency	Continuous measurement and at least monthly recording
QA/QC Procedures	In cases where electricity meters are regulated (e.g. in case the electricity is supplied by the electric grid – scenario A), the electricity meter will be subject to regular maintenance and testing in accordance with the stipulation of the meter supplier and/or as per the requirements set by the grid operators or national requirements. The calibration of meters, including the frequency of calibration, should be done in accordance with national standards or requirements set by the meter supplier or requirements set by the grid operators. The accuracy class of the meters should be in accordance with the stipulation of the meter supplier and/or as per the requirements set by the grid operators or national requirements. In cases where electricity meters are not regulated (e.g. the electricity is supplied by captive power plants – Scenario B), the electricity meter will be subject to regular maintenance and testing in accordance with the stipulation of the meter supplier or national requirements. The calibration of meters, including the frequency of calibration, should be done in accordance with national standards or requirements set by the meter supplier. The accuracy class of the meters should be in accordance with the stipulation of the meter supplier or national requirements. If these standards are not available, and meter supplier does not specify, calibrate the meters every 3 years and use the meters with at least 0.5 accuracy class (e.g. a meter with 0.2 accuracy class is more accurate and thus it is accepted).
Any Comment	The non-obligated entity do not need to apply for post registration changes in the following situations and the change shall be described in the subsequent monitoring report and verification report: (a) Changing the type of meter during the monitoring period, for example from analogue to electrical or vice-versa as long as the meters comply with the accuracy class mentioned above.

[9] Batch is defined as the population of the devices of the same type commissioned at a certain calendar year. To establish the date of commissioning, the non-obligated entity may opt to group the devices in "batches" and the latest date of commissioning of a device within the batch shall be used as the date of commissioning for the entire batch.

	(b) Changing the accuracy class of meter from lower accuracy class to higher accuracy class. (c) Changing the calibration frequency of meter within the range stipulated in the national standards or requirements set by the meter supplier or requirements set by the grid operators. (d) Changing meter type from check meter to bi-directional meter.

Data / Parameter table 12.

Data/Parameter	$EG_{PJ,grid,y}$ or $EG_{PJ,facility,l,y}$
Data Unit	MWh/yr
Description	Quantity of electricity generated and supplied by the project power plant to the grid in year y Quantity of electricity generated and supplied by the project power plant to the consumers/electricity consuming facility i in year y
Source of Data	Direct measurement or calculated based on measurements from more than one electricity meters
Measurement Procedure (if any)	Use electricity meters installed at the grid interface for electricity export to grid and for supply to captive consumers use electricity meters installed at the entrance of the electricity consuming facility. In case of grid and net electricity generation: This parameter should be either monitored using bi-directional energy meter or calculated as difference between (a) the quantity of electricity supplied by the project plant/unit to the grid; and (b) the quantity of electricity the project plant/unit from the grid. If it is calculated, then the following parameters shall be measured: (a) The quantity of electricity supplied by the project plant/unit to the grid; and (b) The quantity of electricity delivered to the project plant/unit from the grid
Monitoring Frequency	Continuous measurement and at least monthly recording
QA/QC Procedures	In cases where electricity meters are regulated (e.g. the electricity is supplied to the electric grid), the electricity meter will be subject to regular maintenance and testing in accordance with the stipulation of the meter supplier and/or as per the requirements set by the grid operators or national requirements. The calibration of meters, including the frequency of calibration, should be done in accordance with national standards or requirements set by the meter supplier or requirements set by the grid operators. The accuracy class of the meters should be in accordance with the stipulation of the meter supplier and/or as per the requirements set by the grid operators or national requirements. In cases where electricity meters are not regulated (e.g. the electricity is supplied to captive users), the electricity meter will be subject to regular maintenance and testing in accordance with the stipulation of the meter supplier or national requirements. The calibration of meters, including the frequency of calibration, should be done in accordance with national standards or requirements set by the meter supplier. The accuracy class of the meters should be in accordance with the stipulation of the meter supplier or national requirements. If these standards are not available, calibrate the meters every 3 years and use the meters with at least 0.5 accuracy class (e.g. meter with 0.2 accuracy class is more accurate and thus it is accepted). The electricity generation (gross or net) shall be cross-checked with records of electricity sale (e.g. sales receipt).

Any Comment	The non-obligated entity do not need to apply for post registration changes in the following situations and the change shall be described in the subsequent monitoring report and verification report: (a) Changing the type of meter during the monitoring period, for example from analogue to electrical or vice-versa as long as the meters comply with the accuracy class mentioned above; (b) Changing the accuracy class of meter from lower accuracy class to higher accuracy class; (c) Changing the calibration frequency of meter within the range stipulated in the national standards or requirements set by the meter supplier or requirements set by the grid operators; (d) Apportioning of the electricity generated and supplied by the project power plant based on a common monitoring meter after: (e) ACVA has verified that the apportioning is done by a third party (example: the electricity supplier to the grid). (f) ACVA has verified that the apportioning is cross-checked with the sales receipt; (g) The apportioning and method used is highlighted in the subsequent monitoring report and verification report; (h) Changing meter type from check meter to bi-directional meter. In case of missing data due to meter failure or other reasons, one of the following options to estimate electricity generation may be applied: (i) the conservative value as zero; (j) The lowest daily value among the daily monitored values from the current crediting period multiplied by the number of days with missing data; (k) The energy input to the equipment determined by the fossil fuel consumed, adjusted by efficiency. Efficiency of the equipment in this case shall be determined using the 'Methodological tool: Determining the baseline efficiency of thermal or electric energy generation systems'. (l) For solar PV, installed capacity of the power plant adjusted by availability factor. (m) As a value of a representative sample of the first batch[10] of project devices. Estimation of electricity generation can only be applied if it is demonstrated that the power generating equipment is operational during the missing data period[11]. (a) Missing data period shall not exceed seven consecutive days within three consecutive months except where end users of the subsystems or measures are households/communities/small and medium enterprises (SMEs), 30 consecutive days within six consecutive months are allowed for project activities.

[10] Batch is defined as the population of the devices of the same type commissioned at a certain calendar year. To establish the date of commissioning, the project participant may opt to group the devices in "batches" and the latest date of commissioning of a device within the batch shall be used as the date of commissioning for the entire batch.

[11] This can be done through, for example, records in an automated monitoring system and snapshots of a webcam

Revision/Changes in the Document

Version	*Date*	*Description*
1.0	27 March 2025	Initial Adoption