CLEAN DEVELOPMENT MECHANISM

TOOL05

Methodological tool

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

Version 03.0

United Nations
Framework Convention on
Climate Change

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1. Introduction

1. The methodological tool is developed to provide consistent procedures among the CDM 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, and entry into force

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 several options to project participants 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 to project participants, while ensuring that the estimation of emission reductions is conservative. Some options provide more rough estimates of the emission reductions and rely on conservative default values or conservative simplifications, whereas other options provide more accurate estimates but require more accurate project or country specific data.

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.

2.3. Entry into force

8. The date of entry into force is the date of the publication of the EB 96 meeting report on 22 September 2017.

3. Normative references

9. This tool refers to the following documents:

(a) “Tool to calculate the emission factor for an electricity system”;

(b) “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion”.

4. Definitions

10. The definitions contained in the Glossary of CDM terms shall apply.

5. Parameters

11. 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*

Parameter	SI Unit	Description
$EG_{PJ,facility,i,y}$	MWh/ yr	Quantity of electricity generated and supplied by the project power plant to the consumers/electricity consuming facility *i* in year y

6. Methodology procedure

6.1. Emissions from electricity generation

12. 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* ($EG_{PJ,facility,i,y}$)).

6.2. Emissions from electricity consumption

13. 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.

14. Project participants should document transparently in the CDM-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.

15. In the following, first 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 5. 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 6.2.2, paragraph 35.

6.2.1. Generic approach

16. 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:

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

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

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

Where:

$PE_{EC,y}$	=	Project emissions from electricity consumption in year *y* (t CO_2 / yr)
$BE_{EC,y}$	=	Baseline emissions from electricity consumption in year *y* (t CO_2 / yr)
$LE_{EC,y}$	=	Leakage emissions from electricity consumption in year *y* (t CO_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

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

17. 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 2.2, paragraph 5 that applies to the source of electricity consumption that would be displaced in the baseline by electricity generated in the project:

6.2.1.1.1. Scenario A: Electricity consumption from the grid

18. In this case, project participants may choose among the following options:

19. Option A1: Calculate the combined margin emission factor of the applicable electricity system, using the procedures in the latest approved version of the “Tool to calculate the emission factor for an electricity system” ($EF_{EL,j/k/l,y} = EF_{grid,CM,y}$).

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

20. Option A2: Use the following conservative default values:

(a) A value of 1.3 t CO_2/MWh if:

(i) Scenario A applies only to project and/or leakage electricity consumption sources but not to baseline electricity consumption sources; or

(ii) Scenario A applies to: both baseline and project (and/or leakage) electricity consumption sources; and the electricity consumption of the project and leakage sources is greater than the electricity consumption of the baseline sources;

(b) A value of 0.4 t CO_2/MWh for electricity grids where hydro power plants constitute less than 50% of total grid generation in 1) average of the five most recent years, or 2) based on long-term averages for hydroelectricity production, and a value of 0.25 t CO_2/MWh for other electricity grids. These values can be used if:

(i) Scenario A applies only to baseline electricity consumption sources but not to project or leakage electricity consumption sources; or

(ii) Scenario A applies to: both baseline and project (and/or leakage) electricity consumption sources; and the electricity consumption of the baseline sources is greater than the electricity consumption of the project and leakage sources.

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

21. In this case, project participants may choose among the following options:

22. 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), project participants 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).

23. 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:

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

Where:

$EF_{EL,j/k/l,y}$	=	Emission factor for electricity generation for source *j*, *k* or *l* in year *y* (t CO_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* (t CO_2 / GJ)
$EG_{n,t}$	=	Quantity of electricity generated in captive power plant *n* in the time period *t* (MWh)
i	=	are the 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)

24. 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:

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

Where:

$EF_{EL,j/k/l,y}$	=	Emission factor for electricity generation for source j, *k* or *l* in year *y* (t CO_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* (t CO_2 / GJ)
$\sum_n EG_{n,t}$	=	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)

25. 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[2];

(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.

26. 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-up[3] fuel), use the CO_2 emission factor of that fuel type ($EF_{CO2,n,t} = EF_{CO2,i}$);

(b) In the case of captive power plants that have used multiple fuel types since their start of operation, choose among the following options[4]:

(i) For baseline electricity consumption, use the fuel type with the lowest CO_2 emission factor ($EF_{CO2,i,t}$) among the fuel types that were used in the period

[2] 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.

[3] 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.

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

(a) The provision avoids that emission reductions can be claimed for changing the fuel mix in the captive power plant. If project participants wish to credit emission reductions from switching the fuel mix in a captive power plant, a fuel switch methodology needs to be applied. The scope of this tool is not to claim emission reductions from fuel switches;

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); <u>and</u> the electricity consumption of the project and leakage sources is <u>greater</u> than the electricity consumption of the baseline sources, then the CO_2 emission factor ($EF_{CO2,i,t}$) as per sub-paragraph (b) (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); <u>and</u> the electricity consumption of the baseline sources is <u>greater</u> 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) (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:

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

Where:

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

(b) 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 CERs.

(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.[5]

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

28. Option B2: Use the following conservative default values:

(a) A value of 1.3 t CO_2/MWh if:

(i) The electricity consumption source is a project or leakage electricity consumption source; or

(ii) The electricity consumption source is a baseline electricity consumption source; <u>and</u> the electricity consumption of all baseline electricity consumptions sources at the site of the captive power plant(s) is <u>less</u> than the electricity consumption of all project electricity consumption sources at the site of the captive power plant(s);

(b) A value of 0.4 t CO_2/MWh if:

(i) The electricity consumption source is a baseline electricity consumption source; or

(ii) The electricity consumption source is a project electricity consumption source <u>and</u> the electricity consumption of all baseline electricity consumptions sources at the site of the captive power plant(s) is <u>greater</u> than the electricity consumption of all project electricity consumption sources at the site of the captive power plant(s).

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

29. 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

[5] The more conservative value is the value that results in the lower overall emission reductions of the project activity. This may imply using the higher or the lower value, depending on the specific configuration of the project activity.

(iii) If the captive power plant is centrally dispatched and the dispatch of the captive power plant is thus outside the control of the project participants;

(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.

30. Project participants should document in the CDM-PDD and in monitoring reports which case applies, justify why the case applies and provide the relevant evidence. The DOE should carefully evaluate the case. In the case of doubts, case C.III should be identified, as a conservative approach.

31. 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[5] 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.

6.2.2. Alternative approaches for project and/or leakage emissions

32. This section provides for alternative approaches to estimate project and/or leakage emissions. The approaches outlined below can be used if:

(a) Scenario B (as described in Section 2.2, paragraph 5) applies to an electricity consumer;

(b) The electricity consumer is a project or leakage source.

33. If these conditions apply, project participants may use the following alternative options to determine project and/or leakage emissions from electricity consumption:

34. Option B3: Project or leakage emissions from consumption of electricity are determined by calculating the CO_2 emissions from all fuel combustion in the captive power plant. These emissions should be calculated using the latest approved version of the “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion”. This option provides an accurate estimate if all the power generated by the captive power plant is consumed by the proposed CDM project activity.

35. Option B4: Project or leakage emissions from consumption of electricity are determined based on the rated capacity of the captive power plant(s), assuming, as a very conservative simplification, an emission factor of 1.3 t CO_2/MWh and an operation of 8,760 hours per year at the rated capacity, as follows:

$$PE_{EC,j,y} = 11{,}400 \times \frac{tCO_2}{MW} \times PP_{CP,j}$$ Equation (7)

$$LE_{EC,l,y} = 11{,}400 \times \frac{tCO_2}{MW} \times PP_{CP,l}$$ Equation (8)

Where:

$PE_{EC,j,y}$	=	Project emissions from electricity consumption by source(s) *j* in year *y* (t CO_2 / yr)
$LE_{EC,l,y}$	=	Leakage emissions from electricity consumption by source(s) *l* in year *y* (t CO_2 / yr)
$PP_{CP,j}$	=	Rated capacity of the captive power plant(s) that provide the project electricity consumption source(s) *j* with electricity (MW)
$PP_{CP,l}$	=	Rated capacity of the captive power plant(s) that provide the leakage electricity consumption source(s) *l* with electricity (MW)
j	=	Project electricity consumption sources that are supplied with power from captive power plant(s) installed at one site
l	=	Leakage electricity consumption sources that are supplied with power from captive power plant(s) installed at one site

Note: Note that this option does not require monitoring any parameters. Note further that this option can be used to cover all project or leakage emissions sources that are supplied with captive power plant(s) installed at one site.

6.3. 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 procedures (if any):	-
QA/QC procedures:	-
Any comment:	In case of uncertainty a conservative value should be chosen

7. Monitoring methodology procedure

7.1. Monitoring procedures

36. Describe and specify in the CDM-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).

37. 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.

7.2. Data and parameters monitored

Data / Parameter table 2.

Data / Parameter:	$EF_{grid,CM,y}$
Data unit:	t CO_2/MWh
Description:	Combined margin emission factor for the grid in year *y*
Source of data:	Calculate the combined margin emission factor, using the procedures in the latest approved version of the “Tool to calculate the emission factor for an electricity system”
Measurement procedures (if any):	As per the “Tool to calculate the emission factor for an electricity system”
Monitoring frequency:	As per the “Tool to calculate the emission factor for an electricity system”
QA/QC procedures:	As per the “Tool to calculate the emission factor for an electricity system”
Any comment:	Only applicable to scenarios A and C (cases C.I and C.III)

Data / Parameter table 3.

Data / Parameter:	$TDL_{j,y}$ **and** $TDL_{k,y}$ **and** $TDL_{l,y}$
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 procedures (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 CDM 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[6] 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

[6] 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).

Measurement procedures (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; • 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 procedures (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 procedures (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 procedures (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.

<table>
<tr><td>Data / Parameter:</td><td>$NCV_{i,t}$</td></tr>
<tr><td>Data unit:</td><td>GJ / mass or volume unit</td></tr>
<tr><td>Description:</td><td>Average net calorific value 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><th>Data source</th><th>Conditions for using the data source</th></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</td><td>If (a) is not available</td></tr>
</table></td></tr>
</table>

	conservative[5] – 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
Measurement procedures (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.

<table>
<tr><td>Data / Parameter:</td><td>$EF_{CO2,i,t}$</td></tr>
<tr><td>Data unit:</td><td>$t\ CO_2$ / GJ</td></tr>
<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><th>Data source</th><th>Conditions for using the data source</th></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[5] – of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter1 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 procedures (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[1]
Source of data:	Direct measurement or calculated based on measurements from more than one electricity meters
Measurement procedures (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 project participants 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 project participants 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 DOE shall validate that the total emissions (project and leakage) do not cross the materiality threshold stipulated by the CDM Executive Board for the applicable CDM project activity. 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[7] 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 or PoAs, 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:	$\boldsymbol{EC_{BL,k,y}}$
Data unit:	MWh/yr
Description:	Quantity of electricity that would be consumed by the baseline electricity consumption source *k* in year *y*

[7] 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.

Source of data:	Direct measurement or calculated based on measurements from more than one electricity meters
Measurement procedures (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 project participants 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.

Data / Parameter table 12.

Data / Parameter:	**$EG_{PJ,grid,y}$ or $EG_{PJ,facility,I,y}$**
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 procedures (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 project participants 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) DOE has verified that the apportioning is done by a third party (example: the electricity supplier to the grid).

	(f) DOE 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. Availability factor for the missing data period shall be calculated by using the provisions from the methodology AMS-III.BL: 'Integrated methodology for electrification of communities. (m) As a value of a representative sample of the first batch[8] 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[9]. (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 or PoAs.

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Document information

Version	*Date*	*Description*
03.0	22 September 2017	EB 96, Annex 5 Revision to provide flexible and objective requirements and best Practice examples for missing data management.

[8] 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.

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

Version	*Date*	*Description*
02.0	27 November 2015	EB 87, Annex 8 Revision to: • Expand the applicability of the tool to cover baseline emissions from electricity generation; • Include monitoring parameters for amount of electricity generation and consumption; • Consolidate and improve the monitoring requirements contained in various methodologies related to amount of electricity generation and consumption; • Simplify the monitoring requirements based on issues identified through PRC analysis, review of methodologies; • Provide flexible and objective requirements for monitoring of amount of electricity generation and consumption; • Include data handling protocol for missing data; • Change document title from “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” to “Methodological tool: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation”.
01.0	16 May 2008	EB 39, Annex 7 Initial adoption.

Decision Class: Regulatory
Document Type: Tool
Business Function: Methodology
Keywords: baseline scenario, electricity generation, energy efficiency, leakage, sampling