ARTICLE 6.4 MECHANISM

A6.4-MEP010-A01

Draft Methodological tool

Emissions from electricity generation and/or consumption

Version 01.0

United Nations
Framework Convention on
Climate Change

COVER NOTE

1. Procedural background

1. The Supervisory Body of the Article 6.4 mechanism, at its fifteenth meeting, approved its workplan for 2025 for the Methodological Expert Panel (MEP) and requested the MEP to continue working on the revision of CDM methodologies / methodological tools / Standard / Guidelines, including the "Tool to calculate emission factor for an electricity system" (hereinafter referred as "CDM TOOL07") and "Tool for Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (hereinafter referred as "CDM TOOL05").

2. Purpose

2. The purpose of this new methodological tool is to provide different options for activity participants to estimate baseline, project and leakage emissions associated with the generation and consumption of electricity under a proposed Article 6.4 activity.

3. Key issues and proposed solutions

3.1. Scope of the tool

3. The proposed methodological tool is developed based on the CDM TOOL05 and CDM TOOL07. The MEP proposes to merge these tools, considering that the determination of the emission factor for the electricity system is a critical component in estimating emissions associated with electricity generation and/or consumption.

4. The proposed methodological tool also broadens the scope of the merged tools. Whereas the CDM TOOL05 was limited to determining emissions from electricity consumption, the proposed methodological tool also includes provisions for determining emissions from electricity generation.

5. The MEP also notes that the core methodological approaches of the CDM TOOL07 were developed under different circumstances and need to be updated to reflect recent developments. The CDM TOOL07 had also been primarily developed for the purpose of determining baseline emissions and did not include conservative approaches for determining project or leakage emissions.

6. For these reasons, the revisions introduce a number of enhancements to the existing CDM tools, including:

   (a) Revisions to align the methodological approaches with the "Standard: Setting the baseline in mechanism methodologies" (A6.4-STAN-METH-004, hereinafter referred as "baseline standard"),[1] such as by providing for a systematic consideration of uncertainty;

   (b) Amendments to allow the emission factor for an electricity system to be also used for determining project and leakage emissions, and not only baseline emissions;

[1] See https://unfccc.int/sites/default/files/resource/A6.4-STAN-METH-004.pdf.

(c) Revisions to reflect the increasing contribution of intermittent renewable power generation (e.g., solar and wind) in many electricity systems;

(d) Revisions to some provisions of the CDM tools to address identified shortcomings, such as issues with data vintage when determining the emission factor based on historical data;

(e) Inclusion of more options for activity participants to select simplified and conservative default values.

7. The table below provides a summary of key differences in the applicability conditions between the CDM tools and the proposed methodological tool.

Table 1. Comparison of key applicability conditions between the CDM tools and the proposed methodological tool

CDM Tools		**Proposed methodological tool**
CDM TOOL05	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	This methodological tool provides different options for activity participants to estimate baseline, project and leakage emissions associated with the generation and consumption of electricity under a proposed Article 6.4 activity. These options aim to provide flexibility to activity participants, while ensuring that the estimation of emission reductions is conservative. This methodological tool also provides approaches and options to determine the respective emission factors for electricity generation and/or consumption in the baseline scenario and/or the project scenario
CDM TOOL07	This tool may be applied to estimate the operating margin(OM) emission factor, the build margin (BM) emission factor and/or the combined margin (CM) emission factor when calculating baseline emissions for a project activity that substitutes grid electricity that is where a project activity supplies electricity to a grid or a project activity that results in savings of electricity that would have been provided by the grid (e.g. demand-side energy efficiency projects)	

3.2. General approach

8. The proposed methodological tool provides a stepwise approach to determine emissions from electricity generation and/or consumption, as follows:

(a) Step 1: Identify the relevant electricity generation and/or consumption source in relation to the Article 6.4 activity;

(b) Step 2: Determine for each electricity generation or consumption source *s* whether the electricity is consumed from or fed into an electricity system or whether it is consumed from or avoids power generation by captive power plant(s);

(c) Step 3: Identify the relevant electricity system(s), where applicable;

(d) Step 4: Determine whether applying a higher or a lower value for the emissions from electricity generation or consumption is more conservative;

(e) Step 5: Determine the amount of electricity generation and/or consumption;

(f) Step 6: Determine which emission factor is applicable;

(g) Step 7: Determine the emission factor of the electricity system, where applicable;

(h) Step 8: Determine the emission factor for electricity sourced from captive fossil fuel power plants, where applicable;

(i) Step 9: Determine the transmission and distribution losses from the electricity system, where applicable;

(j) Step 10: Determine the emissions from electricity generation and/or consumption.

3.2.1. Determination of applicable scenarios

9. Step 2 defines the following three scenarios and requires activity participants to identify which of the scenario applies:

(a) Scenario A: The electricity is consumed from or fed into the electricity system only;

(b) Scenario B: The electricity is consumed from or avoids power generation by a fossil-fuel fired captive power plant only; or

(c) Scenario C: A combination of scenario A and B, i.e., the electricity is consumed from or fed into the electricity system and consumed from or avoids power generation by a fossil-fuel fired captive power plant.

10. Other potential scenarios, such as power generation by a renewable captive power plant, are not yet applicable under this version of the tool. However, some of the procedures and requirements of this proposed methodological tool already address such scenarios. Some other parts of the tool may need further revision to make the tool applicable to such scenarios. This may be further addressed in future revisions to this tool.

11. Under Scenario A, the emission factor of the project electricity system shall apply. Accordingly, the relevant electricity system shall be identified in Step 3, unless conservative default values are used to determine the emission factor, in which case assessing the boundary of the electricity system is unnecessary.

12. Under Scenario B, the emission factor of the captive power plant shall apply.

13. Under Scenario C, the emission factor may be determined either separately for captive electricity generation and electricity generation in the electricity system, based on the specific configuration of the project, or by applying the more conservative value between these emission factors.

14. Lastly, the proposed tool does not yet include provisions for integrating off-grid power plants in the calculation of the emission factor for the electricity system. The MEP proposes that this issue be addressed in future revisions to the methodological tool or through bottom-up methodology submissions.

3.2.2. Ensuring conservativeness while providing flexibility

15. To ensure conservativeness in determining emissions associated with electricity generation and consumption, the proposed methodological tool defines two distinct cases:

(a) Case 1 refers to situations where a higher emission factor is more conservative; and

(b) Case 2 refers to situations where a lower emission factor is more conservative.

16. Throughout the tool, these two cases are considered and differentiated to ensure that emission factors and baseline, project or leakage emissions are determined in a conservative manner.

17. To provide flexibility to activity participants, the tool also provides different calculation options and corresponding default values for determining both the quantity of electricity generation or consumption and the emission factor under each case.

3.2.3. Determination of the emission factor of the project electricity system

18. The proposed methodological tool provides options to either calculate the emission factor of the project electricity system or to use simplified conservative default values for the emission factor. Different default values are provided in the tool, taking into account the share of the renewable and nuclear energy sources in the project electricity system.

19. Where the emission factor of the electricity system is calculated, a “Combined Margin” (CM) emission factor is determined, in line with CDM TOOL07, as the weighted average of the OM and the BM.

20. The proposed methodological tool draws upon the four methods for determining the OM emission factor in CDM TOOL 07: Dispatch Data OM, simple OM, simple adjusted OM, and average OM. The proposed tool refines and simplifies the approaches from the CDM, and specifies applicability conditions for each method, noting that TOOL07 was only intended for determining baseline emissions and that intermittent power generation played a smaller role when TOOL07 was developed.

21. The table below provides a summary of key differences between the CDM TOOL07 and the proposed methodological tool with regard to the conditions for using the OM method.

Table 2. Comparison of the conditions for using the different OM methods between the CDM TOOL 07 and the proposed methodological tool

CDM Tool		**Proposed methodological tool**	
Dispatch data analysis OM	Hourly data from each power plant on power generation and fuel type and fuel consumption is available	Dispatch data OM	In addition to the CDM tool: Power units in the electricity system are dispatched in a certain order
Simple OM	Low cost/must run (LCMR) share <50% in recent 5 years; or an average load by LCMR < average Lowest annual system load (LASL) over three years	Simple OM	For Case 1: No conditions
Simple adjusted OM	LCMR share > 50% in recent 5 years, and an average load by LCMR > an average LASL over three years	Simple adjusted OM	This method includes two options: • Option 1: No conditions

CDM Tool		Proposed methodological tool	
			• Option 2: Only applicable to non-intermittent electricity generation sources and electricity consumption sources not depending on intermittent generation
Average OM	Annual aggregated data from the grid on power generation, fuel type and fuel consumption is available	Average OM	Only applicable to Case 2 and to non-intermittent electricity generation sources and electricity consumption sources not depending on intermittent generation

22. The dispatch data method is based on hourly dispatch data and is considered the most accurate approach as it estimates the real-time impact of the Article 6.4 activity.

23. For the simple OM method, "must-run" power units in the project electricity system are excluded from the emission factor calculation, assuming that their operation is unlikely to be affected by the Article 6.4 activity. The proposed methodological tool provides criteria for identifying must-run power units and considers most type of renewable power units to be must-run units. This approach leads to a relatively higher calculated emission factor compared to that if all plants are considered, as it includes more carbon-intensive electricity generation sources. Therefore, the tool stipulates that the simple OM method is applicable without conditions for Case 1, where using a higher emission factor value represents the conservative approach. For Case 2, if a high penetration of renewable energy results in situations where during a material number of hours only renewable power and any nuclear power units serve the electricity system, the electricity associated with the Article 6.4 activity may effectively displace renewable generation. In such instances, the simple OM method is not applicable under Case 2 and the simple adjusted OM may be used instead.

24. The simple adjusted OM is a variation of simple OM method. It requires determining when the electricity system operates solely based on renewable, nuclear, and/or storage power units. During these times, the OM emission factor is assumed to be zero. The tool provides two options for calculating the simple adjusted OM emission factor:

    (a) Under Option 1, electricity generation or consumption data of the Article 6.4 activity, as well as information on whether the project electricity system is operating solely on renewable, nuclear energy and/or storage power units, is determined on an hourly basis. This option may always be applied, without any conditions. This is because the hourly information allows reflecting at what times the Article 6.4 activity affects fossil fuel power generation and at which times not;

    (b) Under Option 2, all information is determined on an annual basis, including the fraction of time during which the electricity system is operating solely on renewable, nuclear energy and/or storage power units. This option is not applicable to intermittent electricity generation sources and electricity consumption sources depending on intermittent generation, as defined in the proposed methodological tool.

25. The average OM emission factor is calculated as the average emission intensity of all power plants operating in the electricity system. This approach includes all renewable and

nuclear power generation and thus leads to a relatively low emission factor. It can therefore only be applied under Case 2 in which a lower emission factor is more conservative. Moreover, this method may not be conservative for intermittent electricity generation sources and electricity consumption sources depending on intermittent generation, as it based on annual information. Therefore, this method only applies to non-intermittent electricity generation sources and electricity consumption sources not depending on intermittent generation.

26. The emission factors derived from the simple OM, simple adjusted OM, and average OM methods can be determined either ex ante for a crediting period or be updated ex post during monitoring. A discount shall be applied where historical data is used to account for the trend of increasing renewable energy penetration in the electricity system, which generally leads to a decrease in the OM emission factor over time.

27. The table below provides a summary of key differences with regard to the OM method between the CDM TOOL07 and the proposed methodological tool.

Table 3. Comparison of the methodological approaches to determine the OM emission factor between the CDM TOOL07 and the proposed methodological tool

CDM Tool		**Proposed methodological tool**	
Dispatch data analysis OM	Determined as the generation-weighted average CO_2 emission of power units dispatched at the margin in hour *h* within the electricity system	Dispatch data OM	As under the CDM tool
Simple OM	Determined as the generation-weighted average CO_2 emissions per unit net electricity generation of all generating power plants serving the system, not including LCMR power plants/units	Simple OM	As under the CDM, with a refined definition of must-run power units
Simple adjusted OM	Determined as a variation of the simple OM by considering the fraction of time when LCMR power units are operating at the margin	Simple adjusted OM	Determined as a variation of the simple OM, with an adjustment for those periods in which the electricity system operates solely based on renewable, nuclear, and/or storage power units
Average OM	Determined as the average emission rate of all power plants serving the grid	Average OM	As under the CDM

28. The build margin (BM) emission factor is calculated as the weighted average emission intensity of the new power units that have been most recently built within the electricity system. The proposed methodological tool refines the approach from the CDM TOOL07. For the first crediting period, it allows activity participants to choose between two reference periods for identifying these power units: the "concurrent" reference period, which reflects the time when the Article 6.4 is implemented, and a "historical" reference period. Where historical data is used, a discount applies to account for the increasing share of

renewables that are built over time in many electricity systems. In that case, the emission factor should also be updated when the necessary data becomes available to use the "concurrent" reference period. The table below provides a comparison between the data vintage and updates of BM between the CDM TOOL07 and the proposed methodological tool.

Table 4. Comparison of requirements on data vintage and updates of the BM emission factor between the CDM TOOL 07 and the proposed methodological tool

CDM TOOL 07	Proposed methodological tool
For the first crediting period: • Ex ante option: based on the most recent information available at the time of CDM-PDD submission to the DOE for validation; • Ex post option: Updated annually based on the information of those units built up to the year of registration of the project activity or, up to the latest year for which information is available. For the second crediting period, based on the most recent information available at the time of submission of the request for renewal of the crediting period to the DOE. For the third crediting period, use the build margin emission factor calculated for the second crediting period	For the first crediting period, update the BM emission factor annually. Further, if the historical period is applied, update the reference period once the necessary data to calculate the emission factor for the "concurrent" reference period becomes available. For the second and third crediting periods, the BM emission factor shall be determined for the concurrent reference period once ex ante and not be updated annually

29. The value for weighting of the OM and BM emission factor in calculating the CM emission factor is higher compared with the CDM TOOL07, accounting for the growing trend of renewable energy penetration in electricity systems.

3.2.4. Determination of the emission factor of the captive power plant

30. The proposed methodological tool provides two options for calculating the emission factor: based on actual emission factor of the captive power plant and based on simplified, conservative default values.

31. The activity participant may calculate the emission factor based on the fossil fuel consumed and the electricity generated by the captive power plant.

3.2.5. Determination of transmission and distribution losses

32. If data is available, the activity participant may determine the transmission and distribution losses based on local data of the project electricity system. In principle, only physical losses shall be considered as transmission and distribution losses, while noting that for some electricity systems there may also be non-physical losses such as electricity pilferage. Such losses shall only be considered if their inclusion leads to a conservative estimate of the emission reductions.

33. Additionally, the proposed methodological tool also provides default values for transmission and distribution losses for both Case 1 and Case 2, based on the voltage level at which electricity is consumed.

3.2.6. Determination of uncertainty

34. The uncertainty of emissions or emission factors shall be determined following the guidance of Volume 1, Chapter 3 of the 2019 Refinement of the 2006 IPCC Guidelines. For some methods or assumptions, the uncertainty is specified in the tool.

35. For some parameters, the tool provides conservative default values. When these conservative default values are used, no further consideration of uncertainty is required. In other instances, default values provided in the tool represent a mean estimate, with the indication of an uncertainty range. In these cases, the indicated uncertainty shall be considered in the quantification of the overall uncertainty.

4. Impacts

36. The proposed methodological tool provides requirements and procedures for activity participants and methodology proponents to determine the emissions associated with electricity generation and/or consumption.

5. Subsequent work and timelines

37. The MEP agreed to seek public inputs from stakeholders on this draft version of the proposed tool. The MEP will consider the stakeholders' inputs received and recommend a revised draft tool for recommendation of approval by the Supervisory Body.

38. The MEP will conduct further analysis regarding certain parameters that are not yet specified in the draft methodological tool, based on a review of relevant literature and historical data from different electricity systems. This includes default values and uncertainty ranges. These values are marked with a placeholder [X] in the relevant sections. The MEP also specifically seeks feedback from stakeholders on these values.

6. Recommendations to the Supervisory Body

39. Not applicable (Document is published for a call for public inputs).

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1. Introduction

1.1. Scope

1. This methodological tool provides options for activity participants to estimate baseline, project and leakage emissions associated with the generation and consumption of electricity under a proposed Article 6.4 activity. These options aim to provide flexibility to activity participants, while ensuring that the estimation of emission reductions is conservative. Some options rely on conservative default factors or conservative simplifications, whereas other options require more data to produce estimates.

2. This methodological tool establishes requirements to determine the parameters provided the table below. The tool includes procedures to determine for each parameter the mean value (noting that the mean value includes some degree of conservativeness due to the use of conservative default values or conservative assumptions) and the upper and the lower bound of the uncertainty for the value at 95% confidence level.

Table 1. Parameters determined

Parameter	SI Unit	Description
$BE_{EG,y}$	t CO_2e/year	Baseline emissions from electricity generation in year *y*
$BE_{EC,y}$	t CO_2e/year	Baseline emissions from electricity consumption in year *y*
$PE_{EG,y}$	t CO_2e/year	Project emissions from electricity generation in year *y*
$PE_{EC,y}$	t CO_2e/year	Project emissions from electricity consumption in year *y*
$LE_{EG,PJ,y}$	t CO_2e/year	Leakage emissions from electricity generation in the project scenario in year *y*
$LE_{EG,BL,y}$	t CO_2e/year	Leakage emissions from electricity generation in the baseline scenario in year *y*
$LE_{EC,PJ,y}$	t CO_2e/year	Leakage emissions from electricity consumption in the project scenario in year *y*
$LE_{EC,BL,y}$	t CO_2e/year	Leakage emissions from electricity consumption in the baseline scenario in year *y*
$EF_{EG/C,BL,s,y}$	t CO_2e/MWh	Emission factor for electricity generation or consumption by electricity generation or consumption source *s* in the baseline scenario (Case 2) in year *y*
$EF_{EG/C,PJ,s,y}$	t CO_2e/MWh	Emission factor for electricity generation or consumption by electricity generation or consumption source *s* in the project scenario (Case 1) in year *y*
$EF_{EG/C,BL,s,h}$	t CO_2e/MWh	Emission factor for electricity generation or consumption by electricity generation or consumption source *s* in the baseline scenario (Case 2) in hour *h*
$EF_{EG/C,PJ,s,h}$	t CO_2e/MWh	Emission factor for electricity generation or consumption by electricity generation or consumption source *s* in the project scenario (Case 1) in hour *h*

1.2. Entry into force and validity

3. This methodological tool enters into force on DD/MM/YYYY.

4. This methodological tool remains valid for five years, i.e., until DD/MM/YYYY, unless an earlier date applies if the methodological tool is revised or withdrawn in accordance with the "Procedure: Development, revision and clarification of methodologies and methodological tools" (A6.4-PROC-METH-001).[1]

2. Definitions

2.1. General terms

5. The following general terms are applied to this methodological tool:

   (a) "**Shall**" is used to indicate requirements that must be followed;

   (b) "**Should**" is used to indicate that, among several options, one course of action is recommended as particularly suitable;

   (c) "**May**" is used to indicate what is permitted.

2.2. Methodological terms and definitions

6. The following methodological terms and definitions are applied to this methodological tool:

   (a) **Connected electricity system:** An electricity system that is connected by transmission lines to the project electricity system;

   (b) **Dispatch area:** An electricity system or a part of the electricity system controlled by a dispatch centre. An electricity system could be controlled by several dispatch centres that are organized as layered dispatch areas or by a single dispatch centre. An example of a layered dispatch area is where regional dispatch centres are required to comply with orders of a higher-level dispatch centre (e.g., a national or transboundary dispatch centre);

   (c) **Dispatch centre:** An entity responsible for keeping the electricity system synchronized within its dispatch area. The dispatch centre's responsibilities include scheduling generation and dispatching electricity from power plants to customers and, where applicable, to the connected electricity system(s);

   (d) **Electricity consumption source:** Electric equipment (e.g., pumps, electric motors, blowers, etc.) and/or electric appliances that consume electricity from an electricity system and/or from captive power plant(s)/unit(s);

   (e) **Electricity consumption source depending on intermittent generation:** An electricity consumption source where the pattern of electricity consumption from the electricity system or a third party depends on the availability of intermittent electricity supply[2];

[1] See https://unfccc.int/sites/default/files/resource/A6.4-PROC-METH-001.pdf.

[2] For example, this may apply to a facility that purchases electricity from a specific wind power plant through a dedicated electricity line and therefore draws a high-power load from the electricity system during periods of low wind power availability.

(f) **Electricity generation source:** Power plant(s)/unit(s) that are connected to an electricity system or operate as captive power plant(s)/unit(s)) in the baseline or in the project scenarios;

(g) **Intermittent electricity generation source:** A renewable energy power plant/unit where the pattern of electricity generation depends on natural, uncontrollable, and variable inputs such as sunlight, wind, tides, or wave action. This typically applies to wind, solar, tidal and wave power plants, etc.;

(h) **Must-run power plant/unit:** A power plant/unit dispatched independently of the daily or seasonal electricity consumption load and the operation of intermittent electricity generation sources in the electricity system (e.g., because the plant has low marginal electricity generation costs);

(i) **Net electricity generation:** The difference between the total quantity of electricity generated by a power plant/unit and the auxiliary electricity consumption (also known as parasitic load) of the power plant/unit (e.g., for pumps, fans, control systems, etc.);

(j) **Non-intermittent electricity generation source:** An electricity generation source where electricity generation can be ramped up or down by the operators of the power plant, regardless of external conditions, such as sunlight, wind, or wave action;

(k) **Power plant/unit:** A facility that generates electric power. Several power units at one site comprise one power plant, whereas a power unit is characterized by the fact that it can operate independently from other power units at the same site. Where several identical power units (i.e., with the same capacity, age and efficiency) are installed at one site, they may be considered as one single power unit;

(l) **Project electricity system:** The spatial extent of the power plants and electricity end-users that are physically connected through transmission and distribution lines with the Article 6.4 activity (e.g., a renewable power plant or the consumers that are either being served with or saving electricity) and that are covered by either a single or a layered dispatch area;

(m) **Top-level dispatch centre:** The dispatch centre that is at the highest level within a layered dispatch area or the single dispatch centre in a situation without a layered dispatch area;

(n) **Transmission and distribution losses:** The fraction of electrical energy lost during the transmission and distribution of electricity from power plants to end-users.

7. Further definitions from the “Article 6.4 Glossary of Terms”, once adopted by the Supervisory Body, shall also apply to this methodological tool.

3. Applicability

8. This methodological tool may be used by mechanism methodologies related to emission reductions.

9. This methodological tool is applicable to Article 6.4 activities where it is referred to in the applied mechanism methodology.

10. This version of the methodological tool applies only to Article 6.4 activities undertaken at the project level and may be amended in the future to cover activities at other scales (e.g., programmes of activities, policies, sectoral approaches) once the standards for the development of mechanism methodologies (e.g., the "Standard: Setting the baseline in mechanism methodologies" (A6.4-STAN-METH-004)[3]) have been revised to incorporate other scales.

11. This methodological tool may be used to determine baseline, project and leakage emissions from:

    (a) The generation of electricity that is supplied to an electricity system or to captive consumers which may or may not be connected to an electricity system; and/or

    (b) The consumption of electricity from an electricity system or from captive fossil fuel power plant(s)/unit(s).

12. This methodological tool also provides approaches and options to determine the respective emission factors for electricity generation and/or consumption in the baseline scenario and/or the project scenario.

13. This version of the methodological tool is not applicable for estimating:

    (a) Project emissions from captive renewable power plants;

    (b) Upstream emissions associated with electricity generation/consumption;

    (c) Greenhouse gas (GHG) emissions other than CO_2.

14. Mechanism methodologies intending to use this methodological tool shall include a reference to this tool within the mechanism methodology and shall specify:

    (a) Which sources of baseline, project and leakage emissions from which electricity generation or consumption source "*s*" are to be calculated with this methodological tool;[4]

    (b) How the amount of electricity generated or consumed is determined for each relevant electricity generation or consumption source *s*;

    (c) Whether any specific options provided in this methodological tool shall be applied by activity participants;

    (d) Which scenarios (A, B or C, as specified in section 5.2 below) applies to each electricity generation or consumption source *s* or how activity participants shall determine which of these scenarios applies; and

    (e) How the uncertainty of the emission factor, the quantification of the amount of electricity generated or consumed, and the transmission and distribution losses shall be considered in the emission reduction calculation.

[3] See https://unfccc.int/sites/default/files/resource/A6.4-STAN-METH-004.pdf.

[4] For example, in the case of a landfill gas utilization project, one electricity generation source *s* may the power generation equipment utilizing the landfill gas, while electricity consumption sources may include equipment to operate the landfill gas capture system and other auxiliary equipment.

15. Where the mechanism methodology referring to this methodological tool specifies approaches that differ from those described in this methodological tool, the requirements contained in the mechanism methodology shall take precedence.

4. Normative and informative references

16. The following normative document is indispensable for the application of this methodological tool. The most recent version of the documents listed shall apply:

    (a) Intergovernmental Panel on Climate Change (2019). 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.[5]

5. Methodological approaches

17. Activity participants shall determine emissions from electricity consumption and/or generation through the following steps:

    (a) **Step 1:** Identify all relevant electricity generation and consumption source *s* in relation to the Article 6.4 activity (section 5.1 below);

    (b) **Step 2:** Determine for each electricity generation or consumption source *s* whether the electricity is consumed from or fed into an electricity system or whether it is consumed from or avoids power generation by captive power plant(s) (section 5.2 below);

    (c) **Step 3:** Identify the relevant electricity system(s), where applicable (section 5.3 below);

    (d) **Step 4:** Determine whether applying a higher or a lower value for the emissions from electricity generation or consumption is more conservative (section 5.4 below);

    (e) **Step 5:** Determine the amount of electricity generation or consumption (section 5.5 below);

    (f) **Step 6:** Determine which emission factor is applicable (section 5.6 below);

    (g) **Step 7:** Determine the emission factor of the electricity system, where applicable (section 5.7 below);

    (h) **Step 8:** Determine the emission factor for electricity sourced from captive fossil fuel power plants, where applicable (section 5.8 below);

    (i) **Step 9:** Determine the transmission and distribution losses from the electricity system, where applicable (section 5.9 below);

    (j) **Step 10:** Determine the emissions from electricity generation and/or consumption (section 5.10 below).

[5] See https://www.ipcc-nggip.iges.or.jp/public/2019rf/index.html.

5.1. Step 1: Identify all relevant electricity generation and consumption sources s in relation to the Article 6.4 activity

18. Activity participants shall identify all electricity generation and consumption sources *s* in relation to the Article 6.4 activity, in accordance with the methodology referring to this methodological tool. This may include electricity generation and consumption sources that occur in the project scenario and/or in the baseline scenario. It may also include any electricity generation and consumption sources classified as leakage sources where these are considered as per the mechanism methodology referring to this methodological tool. Note that any net "positive leakage" shall not be accounted for, as per the provisions in the standard "Addressing leakage in mechanism methodologies" (A6.4-STAN-METH-005, hereinafter referred as "leakage standard").[6]

19. For each identified electricity generation or consumption source *s*, activity participants shall in the project design document (PDD):

    (a) Assign a unique number to the identified source;

    (b) Describe the electricity generation or consumption source and its location;

    (c) Classify an electricity generation source as either intermittent or non-intermittent, and an electricity consumption source as either depending or not depending on intermittent electricity supply;

    (d) Specify how electricity generation or consumption is quantified for that source;

    (e) Specify whether the electricity generation or consumption source occurs in the project scenario, in the baseline scenario, or in both, including in relation to any leakage sources.

5.2. Step 2: Determine for each electricity generation or consumption source *s* whether the electricity is consumed from or fed into an electricity system or whether it is consumed from or avoids power generation by captive power plant(s)

20. Activity participants shall identify for each electricity generation or consumption source *s*, as identified in section 5.1 above, which of the following scenarios applies:

    (a) **Scenario A:** The electricity is consumed from or fed into an electricity system only;

    (b) **Scenario B:** The electricity is consumed from or avoids power generation by a fossil-fuel fired captive power plant only; or

    (c) **Scenario C:** A combination of scenario A and B, i.e., the electricity is consumed from or fed into an electricity system and consumed from or avoids power generation by a fossil-fuel fired captive power plant.

21. Scenario A applies where:

    (a) The electricity generation or consumption source is only connected to an electricity system and not to any captive power plant; or

[6] See https://unfccc.int/sites/default/files/resource/A6.4-STAN-METH-005.pdf.

(b) The electricity generation or consumption source is connected to both an electricity system and a captive power plant; however, the implementation of the Article 6.4 activity only affects the quantity of electricity that is consumed from or fed into the electricity system 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 larger than the electricity generation capacity of the captive power plant(s) both in the project scenario and the baseline scenario; or

(ii) If the captive power plant is operated continuously (apart from maintenance) and feeds any excess electricity into the electricity system, because the revenues for feeding electricity into the electricity system 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 activity participants.

22. Scenario B applies where:

(a) The electricity generation or consumption source is only connected to a captive power plant and not to an electricity system; or

(b) The implementation of the Article 6.4 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 consumed from or fed into the electricity system. This applies, for example:

(i) If a fixed quantity of electricity is purchased from the electricity system due to physical transmission constraints, such as a limited capacity of the transformer that provides electricity to the relevant source; or

(ii) If, at all times during the monitored period, the total electricity demand at the site of the captive power plant(s) is larger than the quantity of the electricity that can physically be supplied by the electricity system both in the project scenario and in the baseline scenario.

23. Scenario C applies to all other cases where the electricity generation or consumption source is connected to both an electricity system and a captive power plant.

24. Activity participants shall document in the PDD and in monitoring reports which scenario applies, justify why the scenario applies and provide relevant evidence. Scenario C shall be identified, as a conservative approach, if it is not possible to clearly classify the circumstances as Scenario A or Scenario B.

5.3. Step 3: Identify the relevant electricity system(s)

25. This step is only applicable where:

(a) Scenario A or Scenario C applies; and

(b) Option A (Calculate the combined margin emission factor of the electricity system) in section 5.7.1 below is applied.

26. Activity participants shall delineate the project electricity system and any connected electricity system(s) and document the geographical [extent] [boundary] of the project electricity system and any connected electricity system transparently.

27. An electricity system (i.e., the project electricity system or any connected electricity systems) shall be delineated as follows:

    (a) Where available, use the delineation of electricity systems published by the DNA of the host country or by a group of the DNAs covering the host country. In case a delineation is provided by a group of DNAs, the same delineation should be used by all activity participants applying this methodological tool in these countries;

    (b) Where a delineation by the DNA is not available, determine the delineation of electricity systems as follows:

        (i) Identify the dispatch areas covered by the respective dispatch centres;

        (ii) Identify all dispatch areas. Where a dispatch area is controlled by more than one dispatch centre (i.e., a layered dispatch area), the higher-level area shall be considered as the top-level dispatch area;[7]

        (iii) Assess whether any transmission constraints exist between the top-level dispatch areas identified in subparagraph (ii) above;

        (iv) Identify the relevant electricity system as the area covered by all top-level dispatch centres which do not have transmission constraints among them.

28. The assessment of whether transmission constraints exist between two top-level dispatch centres shall be conducted for a defined period. If the delineation of electricity systems is published by the DNA of the host country, or by a group of the DNAs covering the host country, the assessment shall be conducted following an update from the DNA. Otherwise, the assessment shall be conducted at the renewal of the crediting period based on the data in the most recent year.

29. It is determined that there are no transmission constraints if any one of the following criteria is met:

    (a) In case of electricity systems with spot markets for electricity: the difference in electricity prices (without transmission and distribution costs) between the two top-level dispatch centres is less than five per cent during at least 90 per cent of the hours during the assessment period; or

    (b) The transmission line(s) between the two top-level dispatch centres are operated at 75 per cent or less of their rated capacity during 90 per cent or more of the hours during the assessment period. This shall be determined as follows:

        (i) Determine the maximum load capacity of the transmission lines between the two top-level dispatch centres based on official information (e.g., from the operator of the system). If more than one transmission line is operated

[7] For example, where regional cross-boundary dispatch centres are required to comply with dispatch orders of a national dispatch centre, the area controlled by the national dispatch centre shall be used to delineate the project electricity system.

between the two top-level dispatch centres, the total load capacity of the transmission lines shall apply; and

(ii) Determine the operated load of the transmission lines between the two top-level dispatch centre in each hour and check whether they are operated at 75 per cent or less of their rated capacity during that hour; and

(iii) If the cumulative hours in which the conditions in sub-paragraph (ii) are met account for no more than 10% of the hours within the assessment period, it is determined that no transmission constraint exists.[8]

(c) The transmission capacity of the transmission line(s) between the two independent dispatch centres is more than 10 per cent of the installed power generation capacity the independent dispatch centres which is smaller.

30. In addition, in cases involving an international interconnection (i.e., transmission lines between different countries), it shall be further confirmed that there are no legal restrictions for international electricity exchange to determine that there are no transmission constraints.

31. For the purpose of this methodological tool, the reference system is the project electricity system. Hence electricity transfers from a connected electricity systems to the project electricity system are defined as electricity imports while electricity transfers from the project electricity system to connected electricity systems are defined as electricity exports.

5.4. Step 4: Determine whether applying a higher or a lower value for the emissions from electricity generation or consumption is more conservative

32. This step serves to determine whether applying a higher or a lower value for the emissions from electricity generation or consumption represents the more conservative approach. Towards this end, this tool defines two different cases:

(a) **Case 1:** This refers to situations in which a higher value for the emissions from electricity generation or consumption is more conservative. This case applies to determining the parameters $PE_{EG,y}$, $PE_{EC,y}$, $LE_{EG,PJ,y}$ and $LE_{EC,PJ,y}$ in Table 1 in section 1.1 above;[9]

(b) **Case 2:** This refers to situations in which a lower value for the emissions from electricity generation or consumption is more conservative. This case applies to determining the parameters $BE_{EG,y}$, $BE_{EC,y}$, $LE_{EG,BL,y}$ and $LE_{EC,BL,y}$ in Table 1 in section 1.1 above.[10]

[8] For example, if two transmission lines are operated between two independent dispatch centres, and each has a maximum load capacity of 100 MW, then count the number of hours during which the total operating capacity of these two lines is higher than 150 MW. If the number of hours exceeds 876 for an even year and 878 for a leap year, it shall be considered that no transmission constraints exist between the two independent dispatch centres in that year.

[9] For example, Case 1 may be applied to determine the project emissions from the electricity consumption to operate a landfill gas recovery system or the project emissions from the electricity generation by an on-site generator.

[10] For example, Case 2 may be applied to determine the baseline emissions from the electricity generation under a projects that recovers landfill gas for electricity generation.

33. Activity participants shall determine and justify, for each electricity generation or consumption source *s*, whether Case 1 or Case 2 applies. This determination shall be based on the specific circumstances of the Article 6.4 activity and its corresponding baseline.

34. Where an Article 6.4 activity covers multiple electricity generation and/or consumption sources, the net total electricity generation and/or consumption from all sources may be netted for each hour covered by the monitoring period. Where Case 1 applies to some hours covered by a monitoring period and Case 2 applies to the remaining hours of the same monitoring period, activity participants shall apply the corresponding emission factor for the respective hours.[11] Alternatively, activity participants may determine the emissions separately for each electricity generation and/or consumption source *s*, by applying the corresponding emission factor to each source *s*, depending on whether Case 1 or 2 and whether Scenarios A, B or C apply to the respective source *s*.

35. Where either Case 1 or Case 2 applies to all electricity generation and consumption source *s* and throughout the time covered by a monitoring period of the Article 6.4 activity, activity participants shall identify the relevant case and apply it consistently in the determination of the emission factor. This approach may also be applied where one of the two cases makes up less than [1 per cent] [X per cent] of the amount of electricity generation and/or consumption compared to the other case.[12]

5.5. Step 5: Determine the amount of electricity generation or consumption

36. Activity participants shall specify in the PDD how the amount of electricity generated or consumed shall be determined for each electricity generation or consumption source *s* identified in Step 1. The period for aggregating the amount of electricity generation or consumption shall align with the period used to determine the emission factor, as specified in Sections 5.7 and 5.8 below.

37. The electricity generated or consumed shall be either directly monitored by activity participants as per the provisions of section 6 below or be determined using any of the simplified and conservative options provided in paragraphs 38 and 39 below. These simplified approaches may be applied to the entire monitoring period, or to any specific interval during which data is missing.

38. For Case 1, activity participants may apply the following conservative approaches:

    (a) For electricity generation:

        (i) Identify the nominal capacity (in MW) of the respective power plant/unit;

        (ii) Multiply the nominal capacity by the actual operating hours of the power plant or by 8,760 hours/year.

    (b) For electricity consumption:

        (i) Identify the rated power or capacity of the electricity consumption source *s*;

[11] This may, for example, apply to an activity capturing landfill gas which may feed electricity into the electricity system when power is generated but consumes electricity from the electricity system when it only flares landfill gas.

[12] This may, for example, apply to a wind power generation plant which may consume comparatively small amounts of electricity during times when no power is generated.

(ii) Determine the electricity consumed by the electricity consumption source *s* as the product between (i) the rated power or capacity of the electricity consumption source and (ii) the actual operating hours of the electricity generation or consumption source *s* or 8,760 hours/year.

39. For Case 2, apply a conservative value of zero to the electricity generation or consumption of the respective source *s*.

5.6. Step 6. Determine which emission factor is applicable

40. The determination of the emission factor for an electricity generation or consumption source *s* depends on which of the three Scenarios (A, B or C) and which of the two Cases (Case 1 or Case 2) apply for that source.

41. Where **Scenario A** applies, the emission factor shall be determined as the emission factor of the electricity system to which the Article 6.4 activity is connected, under Case 1 and Case 2 respectively, applying the procedure set out in section 5.7 below.

42. Where **Scenario B** applies, the emission factor shall be determined as the emission factor of the captive power plant, under Case 1 and Case 2 respectively, applying the procedure set out in section 5.8 below.

43. Where **Scenario C** applies, the emission factor shall be determined by:

(a) Applying the respective emission factor for Scenario A or B separately if the amount of electricity consumed or delivered under each scenario is available (i.e., apply the emission factor the electricity system to the amount identified for Scenario A and apply the emission factor from captive power plant(s) to the amount identified for Scenario B);

(b) Applying a conservative approach as follows:

(i) For Case 1, use the higher value between the emission factor of the electricity system and the emission factor of the captive power plant;

(ii) For Case 2, use the lower value between the emission factor of the electricity system and the emission factor of the captive power plant.

5.7. Step 7: Determine the emission factor of the electricity system, where applicable

44. This step is applicable if Step 6 confirmed that the emission factor of the electricity system shall be used.

45. Activity participants shall determine the emission factor of the electricity system by choosing one of the following two options and document their choice in the PDD:

(a) **Option A:** Calculate the combined margin emission factor of the electricity system, as set out in section 5.7.1 below; or

(b) **Option B:** Use a conservative default emission factor, as set out in section 5.7.2 below.

5.7.1. Option A: Calculate the combined margin emission factor of the electricity system

46. The emission factor of the electricity system shall be determined as the "combined margin" (CM) emission factor, which is the result of a weighted average of two emission factors pertaining to the electricity system: the "operating margin" (OM) emission factor, and the "build margin" (BM) emission factor. The OM emission factor aims to represent the emissions intensity of existing power plants whose electricity generation is affected by the Article 6.4 activity. The BM emission factor aims to represent the average emissions intensity of new power plants that would be likely be built in the absence of the Article 6.4 activity.

47. For both cases (Case 1 and Case 2), the emission factor of the electricity system shall be determined based on the following steps:

    (a) Sub-step a: Determination of the OM emission factor ($EF_{OM,y}$);

    (b) Sub-step b: Determination of the BM emission factor ($EF_{BM,y}$);

    (c) Sub-step c: Determination of the CM emission factor ($EF_{CM,y}$).

5.7.1.1. General requirements applicable to different sub-steps

5.7.1.1.1. Consideration of power plants or units

48. For simplicity, the subsequent sections only refer to power units. Whether power units or power plants shall be considered in the calculation depends on the operational roles of the power units at the site of the power plant. Power units should be considered separately in the calculation if any features that are relevant for the calculation differ among them, such as their fuel type, efficiency or must-run status (e.g., if the power plant includes a mix of must-run and non-must-run units). Otherwise, several power units may be aggregated into one power plant and considered together in the calculation.

5.7.1.1.2. Treatment of electricity imports and exports

49. Any net electricity imports from a connected electricity system to the project electricity system during the relevant period shall be treated as a power unit *p* supplying electricity to the electricity system. The emission factor for such net electricity imports shall be determined for the period (e.g., hour *h* for the dispatch data OM, or relevant period *t* for other methods) using one of the following options:

    (a) Determine the emission factor for the exporting electricity system as the combined margin emission factor of the electricity system as per this section (section 5.7.1);

    (b) Use the conservative default emission factors in section 5.7.2 below for the exporting electricity system;

    (c) If the amount of net electricity imports is smaller than [5 per cent] [x per cent] of the electricity generation in the project electricity system in the relevant period, use one of the following options:

        (i) The average OM emission factor of the exporting electricity system, determined as described in section 5.7.1.2.4 below, if the conditions for this method as described in paragraph 87 below apply to the exporting electricity system;

(ii) The simple OM emission factor of the exporting electricity system, determined as described in section 5.7.1.2.2 below, if the conditions for this method, as described in paragraph 70 below, apply to the exporting electricity system; or

(iii) The simple adjusted operating margin emission factor of the exporting electricity system, determined as described in section 5.7.1.2.3 below, if the conditions for this method, as described in para 81 below, apply to the exporting electricity system.

50. Any net electricity exports from the project electricity system to a connected electricity system shall not be accounted for in the application of this tool.

5.7.1.1.3. General requirements for determining CO_2 emission factors of power units

51. This section sets out how activity participants shall determine the CO_2 emission factors of power units *p*. The section applies to calculating both the BM and the OM emission factor.

52. The CO_2 emission factor of each power unit *p* ($EF_{EL,p,t}$) shall be determined as follows:

(a) **Option 1:** If for a power unit *p* data on fuel consumption and net electricity generation is available, the emission factor shall be determined as follows:

$$EF_{EL,p,t} = \frac{\sum_i FC_{i,p,t} \times NCV_{i,t} \times EF_{CO2,i,t}}{EG_{p,t}} \quad \text{Equation (1)}$$

Where:

$EF_{EL,p,t}$	n factor of power unit *p* in period *t* (t CO_2/MWh)
$FC_{i,p,t}$	el type *i* consumed by power unit *p* in period *t* ume unit)
$NCV_{i,t}$	alue (energy content) of fuel type *i* in period *t* volume unit)
$EF_{CO2,i,t}$	n factor of fuel type *i* in period *t* (t CO_2/GJ)
$EG_{p,t}$	of electricity generated and delivered to the electricity system by power unit *p* in period *t* (MWh)
p	ower units serving the electricity system in year *y* as per the method used for determining the OM or BM emission factor
i	combusted in power unit *p* in *period t*
t	period used for determining the emission factor

(b) **Option 2:** If for a power unit *p* only data on electricity generation and the fuel types used is available, the emission factor shall be determined based on the CO_2 emission factor of the fuel type used and the efficiency of the power unit, as follows:

$$EF_{EL,p,t} = \frac{EF_{CO2,p,i,t} \times 3.6}{\eta_{p,t}} \quad \text{Equation (2)}$$

Where:

$EF_{EL,p,t}$	=	CO_2 emission factor of power unit *p* in period *t* (t CO_2/MWh)
$EF_{CO2,p,i,t}$	=	Average CO_2 emission factor of fuel type *i* used in power unit *p* in period *t* (t CO_2/GJ)
$\eta_{p,t}$	=	Average net energy conversion efficiency of power unit *p* in period *t* (ratio)
p	=	All relevant power units serving the electricity system in period *t* as per the method used for determining the OM or BM emission factor
t	=	The relevant period used for determining the emission factor

(c) **Option 3:** As a simple and conservative approach, if for a power unit *p* only data on the fuel type and electricity generation is available, the default values in the table below shall be used for the emission factor ($EF_{EL,p,t}$).

Table 2. Default values for the emission factor of power units[13]

Fuel type	Case 1	Case 2
Coal	1.3 t CO_2/MWh	0.7 t CO_2/MWh
Oil	0.9 t CO_2/MWh	0.54 t CO_2/MWh
Natural gas	0.7 t CO_2/MWh	0.3 t CO_2/MWh

53. Where biomass or biomass-derived fuels are consumed by a power unit *p*, use for Case 1 the higher value within a plausible range of emission factors, assuming that the biomass is not renewable, and use for Case 2 an emission factor of zero.

54. Where hydrogen or hydrogen-derived fuels are consumed by a power unit *p*, use for Case 1 the higher value within a plausible range of emission factors, assuming that the hydrogen would be produced from fossil fuels without carbon capture and storage, and use for Case 2 an emission factor of zero.

55. Where several fuel types are consumed by a power unit *p* and the data for option 1 is not available, use the fuel type with the highest emission factor for Case 1 and the fuel type with the lowest emission factor for Case 2.

5.7.1.2. Sub step a: Determination of the OM emission factor

56. The OM emission factor ($EF_{OM,t}$) shall be determined based on one of the following methods:

(a) Dispatch data OM, as described in section 5.7.1.2.1 below;

(b) Simple OM, as described in section 5.7.1.2.2 below;

(c) Simple adjusted OM, as described in section 5.7.1.2.3 below; or

(d) Average OM, as described in section 5.7.1.2.4 below.

[13] The values in the table were calculated based on the higher and the lower estimates of the efficiency of power plants and CO_2 emission factors of the relevant fuel types. The CO_2 emission factors were taken from the 2006 IPCC Guidelines for national GHG inventories. The efficiencies of power plants were collected from various sources, including manufacturer information for the upper end of the efficiency.

57. The table below summarizes the conditions under which each method may be used. It also specifies the uncertainty that is deemed to be associated with each method. This uncertainty shall be used when determining the overall uncertainty of the emission factor for the electricity system. For all methods, the necessary data to apply the method must be available.

Table 3. Applicability conditions (other than data availability) and associated uncertainty for different methods to determine the OM emission factor

Method	Applicability conditions	Associated method uncertainty (per cent)
Dispatch data OM	• Power units in the electricity system are dispatched in a certain order	±[X]
Simple OM	• For Case 1: No conditions • For Case 2: (i) The electricity system operates for less than [X] [100] hours per year solely based on renewable, nuclear, and/or storage power units or (ii) the share of electricity generation from renewable and nuclear power units is not larger than [X] per cent	±[X]
Simple adjusted OM	This method includes two options: • Option 1: No conditions • Option 2: Only applicable to non-intermittent electricity generation sources and electricity consumption sources not depending on intermittent generation	±[X]
Average OM	• Only applicable to Case 2 and to non-intermittent electricity generation sources and electricity consumption sources not depending on intermittent generation	±[X]

58. Where activity participants choose the simple OM or the simple adjusted OM, they shall determine for each power unit in the electricity system whether it is a must-run power unit. Activity participants shall document the classification for each power unit in the PDD or monitoring report, as applicable, specify the data sources used, and provide an appropriate justification.

59. A power generation unit shall be designated as a must-run power unit if it meets one or more of the following conditions:

(a) Fulfillment of non-power generation obligations: The operation of the power generation unit is determined by obligations that are not related to electricity production (e.g., providing essential heat/steam supply from a cogeneration power unit);

(b) Low marginal electricity generation costs: The power plant or units is a hydro, wind, solar, tidal, or geothermal power generation unit, noting that these units usually have low marginal electricity generation costs;

(c) Power units with a steady operation and constant load: The power unit has been operating in the most recent three years for more than [7,500] [8,000] [X] hours

per year with a constant load, i.e., with variations in the load of no more than ±5 per cent, except for maintenance intervals.

60. Power units registered as Article 6.4 projects or component projects, or registered under other carbon crediting programs, shall be included in the cohort of power units that is used to calculate the operating margin under the respective method.

5.7.1.2.1. Method (a): Dispatch data OM

61. The dispatch data OM emission factor ($EF_{OM,DD,t}$) is determined based on the power units in the electricity system that are actually dispatched at the margin during each hour *h* where the Article 6.4 activity is displacing electricity in, or consuming electricity from, the electricity system. This means that the dispatch data OM emission factor shall always be determined ex post for the respective monitoring period.

62. The dispatch data OM emission factor may be applied for both Case 1 and Case 2. It may also be applied to any type of electricity generation or consumption source (including to intermittent and non-intermittent electricity generation sources and electricity consumption sources depending or not depending on intermittent generation). However, it may only be applied if power units in the electricity system are dispatched in a certain order[14] and the data on the dispatch order is available. This usually applies where:

(a) The electricity system has an established spot market; or

(b) Power units are centrally dispatched by a dispatch centre.

63. Activity participants shall document and justify in the PDD or monitoring report, as applicable, that the conditions in paragraph 61 above are fulfilled and which data sources are used to demonstrate this.

64. The dispatch data OM emission factor ($EF_{OM,DD,h}$) shall be calculated for each hour *h* of a period *t* (e.g., the monitoring period), using one of the following approaches:

(a) Based on hourly fuel consumption data (if available), as follows:

$$EF_{OM,DD,h} = \frac{\sum_{i,p} FC_{i,p,h} \times NCV_{i,t} \times EF_{CO2,i,t}}{\sum_{p} EG_{p,h}}$$ Equation (3)

Where:

$EF_{OM,DD,h}$	=	Dispatch data OM emission factor during hour *h* within period *t* (t CO_2/MWh)
$FC_{i,p,h}$	=	Amount of fuel type *i* consumed by power unit *p* in hour *h* (Mass or volume unit)
$NCV_{i,t}$	=	Net calorific value (energy content) of fuel type *i* in period *t* (GJ/mass or volume unit)
$EF_{CO2,i,t}$	=	CO_2 emission factor of fuel type *i* in period *t* (t CO_2/GJ)

[14] The order is usually based on increasing marginal costs of electricity generation; however, other considerations may also play a role, such as the available of water for irrigation purposes in the case of hydro power plants.

$EG_{p,h}$	=	Net electricity generated and delivered by power unit *p* to the electricity system in hour *h* (MWh)
p	=	Power units in the electricity system that operate within the top of the dispatch order in hour *h* (as defined below)
i	=	Fuel types combusted in power unit *p* in period *t*
h	=	Hours in period *t* in which the Article 6.4 activity is displacing electricity in, or consuming electricity from, the electricity system
t	=	Period for which emissions from displacing electricity in, or consuming electricity from, the electricity system are quantified

(b) Based on the net electricity generation of each power unit *p* and a CO_2 emission factor for each power unit *p*, as follows:

$$EF_{OM,DD,h} = \frac{\sum_p EG_{p,h} \times EF_{EL,p,t}}{\sum_p EG_{p,h}}$$ Equation (4)

Where:

$EF_{OM,DD,h}$	=	Dispatch data OM emission factor during hour *h* within period *t* (t CO_2/MWh)
$EG_{p,h}$	=	Net electricity generated and delivered by power unit *p* to the electricity system in hour *h* (MWh)
$EF_{EL,p,t}$	=	CO_2 emission factor of power unit *p* in period *t* (t CO_2/MWh)
p	=	Power units in the electricity system that operate within the top of the dispatch order in hour *h* (as defined below)
h	=	Hours in period *t* in which the Article 6.4 activity is displacing electricity in, or consuming electricity from, the electricity system
t	=	Period for which emissions from displacing electricity in, or consuming electricity from, the electricity system are quantified

65. The CO_2 emission factor of the power units *p* ($EF_{EL,p,t}$) shall be determined as per the provisions in section 5.7.1.1.3 above.

66. To determine the set of power units *p*, obtain from the respective dispatch centre:

(a) The electricity system dispatch order of operation for each power unit of the electricity system including power units from which electricity is imported; and

(b) The amount of power (MWh) that is dispatched from all power units connected to the electricity system during each hour *h* that the project activity is displacing/consuming electricity.

67. At each hour *h*, stack each power unit's electricity generation using the dispatch order. The group of power units *p* in the margin includes the units in the top *x* per cent of the total amount of electricity dispatched in the hour *h* (i.e., the power units that are dispatched last within the dispatch order).

68. The percentage of x shall be equal to the greater of either:

(a) 10 per cent (if 10 per cent falls on part of the generation of a unit, the generation of that unit is fully included in the calculation); or

(b) The quantity of electricity displaced/consumed by the Article 6.4 activity during hour *h* divided by the total electricity generation by all power units in the electricity system during that hour *h*.

5.7.1.2.2. Method (b): Simple OM

69. The simple OM emission factor ($EF_{OM,simple,y}$) is determined as the generation-weighted average CO_2 emission factor per unit of net electricity generation from all power units in the electricity system that are not classified as must-run power units.

70. The simple OM emission factor shall only be applied where the necessary data is available. It may be applied to any type of electricity generation or consumption source (including to intermittent and non-intermittent electricity generation sources and electricity consumption sources depending or not depending on intermittent generation). In addition, the following conditions apply for Case 1 and Case 2:

(a) For Case 1, no further conditions apply.

(b) For Case 2, the simple OM shall only be applied if:

(i) The electricity system operates for less than [X] [100] hours per year solely based on renewable, nuclear, and/or storage power units; or

(ii) The share of electricity generation from renewable and nuclear power units in the relevant period *t* is not larger than [X per cent].

71. Activity participants shall document and justify with appropriate evidence in the PDD or monitoring report, as applicable, that the conditions in paragraph 70 above are fulfilled.[15]

72. The simple OM emission factor shall be determined as an annual emission factor for each calendar year of the crediting period. Activity participants shall use one of the following two options to determine the simple OM emission factor:

(a) **Ex ante option:** The emission factor is determined once for the crediting period, thus no monitoring and recalculation of the emission factor is required during the crediting period. Activity participants shall calculate a three-year generation-weighted average emission factor, based on the most recent data available at the time of submission of the PDD to the DOE for validation;

(b) **Ex post option:** The emission factor is updated ex post during monitoring for each calendar year y of the crediting period. Activity participants shall specify in the PDD whether they determine the emission factor based on data from the calendar year y of the crediting period or based on data from a historical calendar year *v*. Where a historical year *v* is chosen, activity participants shall use a fixed time difference between the year *y* and the year *v* throughout the crediting period and specify this time difference in the PDD and not change it during the crediting

[15] For instance, this may include power generation curves or operational statistics for the project electricity system released by regulatory agencies or system operators.

period.[16] The time difference shall be as recent as possible, taking into account when the necessary data usually becomes available.[17]

73. The simple OM shall be calculated using one of the following two approaches:

(a) **Approach A**: Based on the net electricity generation of each power unit and a CO_2 emission factor for each power unit; or

(b) **Approach B**: Based on the total net electricity generation of all power units serving the electricity system and the fuel types and total fuel consumption of power units in the electricity system. Option B can only be used if:

(i) The necessary data for Approach A is not available; and

(ii) Only nuclear and renewable power generation are considered as must-run power units and the quantity of electricity supplied to electricity system by these power units is known.

74. Under **Approach A**, the simple OM emission factor shall be calculated based on the net electricity generation of each power unit and an emission factor for each power unit, not including must-run power units, as follows:

$$EF_{OM,simple,t} = \frac{\sum_p EG_{p,t} \times EF_{EL,p,t}}{\sum_p EG_{p,t}} \quad \text{Equation (5)}$$

Where:

$EF_{OM,simple,t}$	=	Simple operating margin CO_2 emission factor in period *t* (t CO_2/MWh)
$EG_{p,t}$	=	Net quantity of electricity generated and delivered to the electricity system by power unit *p* in period *t* (MWh)
$EF_{EL,p,t}$	=	CO_2 emission factor of power unit *p* in period *t* (t CO_2/MWh)
p	=	Power units delivering electricity to the electricity system in period *t* except for must-run power units
t	=	Relevant period: under the ex ante option the most recent three historical calendar years for which data is available at the time of submission of the PDD to the DOE for validation; under the ex post option, the calendar year y of the crediting period or the historical year v

75. The CO_2 emission factor of the power units *p* ($EF_{EL,p,t}$) shall be determined as per the provisions in section 5.7.1.1.3 above.

76. Under **Approach B**, the simple OM emission factor shall be calculated based on the net electricity supplied to the electricity system by all power units serving the system, not including must-run power units, and based on the fuel type(s) and total fuel consumption of the electricity system, as follows:

[16] For example, the emission factor for 2025 may be calculated based on data from 2023, the emission factor for 2026 based on data from 2024, and so on.

[17] For example, if the annual data required to calculate the emission factor for year y is usually only available later than six months after the end of year y, the historical year v may correspond to year y-1. If the data is usually only available 18 months after the end of year y, the historical year *v* may correspond to year *y*-2.

$$EF_{OM,simple,t} = \frac{\sum_i FC_{i,t} \times NCV_{i,t} \times EF_{CO2,i,t}}{EG_t}$$ Equation (6)

Where:

$EF_{OM,simple,t}$	=	Simple operating margin CO_2 emission factor in period *t* (t CO_2/MWh)
$FC_{i,t}$	=	Amount of fuel type *i* consumed in the electricity system in period *t* (mass or volume unit)
$NCV_{i,t}$	=	Net calorific value (energy content) of fuel type *i* in period *t* (GJ/mass or volume unit)
$EF_{CO2,i,t}$	=	CO_2 emission factor of fuel type *i* in period *t* (t CO_2/GJ)
EG_t	=	Net electricity generated and delivered to the electricity by all power units serving the system, not including must-run power units, in period *t* (MWh)
i	=	All fuel types combusted in power sources in the project electricity system in period *t*
t	=	Relevant period: under the ex ante option the most recent three historical calendar years for which data is available at the time of submission of the PDD to the DOE for validation; under the ex post option, the calendar year y of the crediting period or the historical year v

77. Where data from the calendar year *y* of the crediting period is used, the resulting emission factor from equations (5) and (6) shall be used as the emission factor for the respective calendar year y (i.e., $EF_{OM,simple,y} = EF_{OM,simple,t}$).

78. Where data is used from a year that is prior to the year *y* of the crediting period for which emission reductions are determined, the simple OM emission factor derived from historical data is adjusted to account for the data vintage, noting that in many electricity systems the average emissions intensity of existing power units declines over time due to an increasing share of renewable energy power units, the use of more efficient power units and the use of less GHG-intensive fuels, as follows:

$$EF_{OM,simple,y} = EF_{OM,simple,t} \times [1 - F_{OM} \times (y - t)]$$ Equation (7)

Where:

$EF_{OM,simple,y}$	=	Simple operating margin CO_2 emission factor in year *y* (t CO_2/MWh)
$EF_{OM,simple,t}$	=	Simple operating margin CO_2 emission factor in period *t* (t CO_2/MWh)
F_{OM}	=	Factor to account for the likely annual decrease of the OM emission factor over time
y	=	Calendar year of the crediting period for which emission reductions are determined
t	=	Period for which the simple OM emission factor is calculated: under the ex post option, the historical year v; under the ex ante option, the central calendar year of the three year period used to the calculate the emission factor

79. For Case 1, a value of zero shall apply to the parameter F_{OM}, as a simplified and reasonably conservative approach. For Case 2, a value of [X] shall be applied.

Note: the MEP intends to conduct further analysis on the value to be used for F_{OM}.

5.7.1.2.3. Method (c): Simple adjusted OM

80. The simple adjusted OM emission factor ($EF_{OM,adj,t}$) is a variation of the simple OM, with an adjustment for those periods in which the electricity system operates solely based on renewable, nuclear, and/or storage power units.

81. The simple adjusted OM emission factor may only be applied where the necessary data is available. It may be applied to both Case 1 and Case 2 and to any type of electricity generation or consumption source (including to intermittent and non-intermittent electricity generation sources and electricity consumption sources depending or not depending on intermittent generation).

82. This methodological tool provides two options to calculate the simple adjusted OM emission factor:

(a) **Option 1:** Based on (i) hourly data on the electricity generation or consumption from all sources *s*, (ii) hourly data on whether the electricity system operates solely based on renewable, nuclear, and/or storage power units, and (iii) annual data to calculate the simple OM emission factor;

(b) **Option 2:** Based on annual data on electricity generation or consumption from all sources *s* and aggregated information on the number of hours in which the electricity system operates solely based on renewable, nuclear, and/or storage power units.

83. Option 1 may be applied in all situations. Option 2 shall only be applied to non-intermittent electricity generation sources or electricity consumption sources not depending on intermittent generation. Furthermore, Option 1 shall be determined using the ex post option, as described for the simple OM emission factor in section 5.7.1.2.2 above. Option 2 may be determined using either the ex ante option or the ex post option, as described for the simple OM emission factor in section 5.7.1.2.2 above.

84. Under both options, the simple adjusted OM emission factor is determined by making an adjustment to the simple OM emission factor, as follows:

(a) **Option 1:** An emission factor of zero is used for each hour *h* in which the electricity system operates solely based on renewable, nuclear, and/or storage power units. In all other hours *h*, the annual simple OM emission factor is used. This is expressed through the term S_h which shall equal to zero for hours in which the electricity system operates solely based on renewable, nuclear, and/or storage power units and to a value of one for other hours:

$$EF_{OM,adj,h} = S_h \times EF_{OM,simple,y} \quad \text{Equation (8)}$$

(b) **Option 2:** The simple adjusted OM emission factor is determined for the calendar year y, adjusting for the fraction of time in which the electricity system operates solely based on renewable, nuclear, and/or storage power units, as follows:

$$EF_{OM,adj,y} = (1 - \lambda_y) \times EF_{OM,simple,y}$$ Equation (9)

Where:

$EF_{OM,adj,y}$	=	Simple adjusted operating margin CO_2 emission factor in year *y* (t CO_2/MWh)
S_h	=	Binary parameters for whether during hour *h* the electricity system operates solely based on renewable, nuclear, and/or storage power units (in this case $S_h = 0$, otherwise $S_h = 1$)
$EF_{OM,simple,y}$	=	Simple operating margin CO_2 emission factor in year *y* (t CO_2/MWh)
λ_y	=	The fraction of time when the electricity system operates solely based on renewable, nuclear, and/or storage power units in year y
y	=	Calendar year of the crediting period for which emission reductions are determined

85. The parameters S_h and λ_y shall be determined differently, depending on which of the two cases applies, as follows:[18]

(a) Where Case 1 applies, this shall refer to the fraction of time when solely the following type of power units operate: hydro, solar, wind, tidal, wave, geothermal nuclear and hydro or battery storage power units;

(b) Where Case 2 applies, this shall refer to the fraction of time when solely the following type of power units operate: hydro, solar, wind, tidal, wave, geothermal, nuclear, biomass or biomass-derived fuels, hydrogen or hydrogen-derived fuels, and any type of storage power units.

5.7.1.2.4. Method (d): Average OM

86. The average OM emission factor ($EF_{OM,av,y}$) is determined as the generation-weighted average CO_2 emission factor per unit of net electricity generation from all power units in the electricity system.

87. The average OM method shall only be applied where the necessary data is available. Moreover, it shall only be applied:

(a) To non-intermittent electricity generation sources and electricity consumption sources not depending on intermittent generation; and

(b) Where Case 2 applies.

88. The average OM emission factor ($EF_{OM,av,y}$) shall be calculated as the generation-weighted average emission factor of all power units serving the electricity system, using

[18] This differentiation is preliminary. Further work may be conducted on this matter, pending the development of other methodological tools under the Article 6.4 mechanism. Biomass may stem from renewable or non-renewable resources. As a conservative and simplified approach, in this version of the tool biomass is considered to be non-renewable under Case 1 and renewable under Case 2 a. Similarly, the emissions impact of power generation based on hydrogen depends on how the hydrogen is produced. As a conservative and simplified approach, hydrogen is treated as a fuel associated with emissions under Case 1 and as a zero-emission fuel under Case 2.

the same approaches as for the simple OM, but also including must-run power units in all equations. The emission factor shall be determined as an annual emission factor for each calendar year *y* of the crediting period. As for the simple OM emission factor, the ex ante or the ex post option may be used, and Approach B shall only be used if the necessary data for Approach A is not available. The respective provisions in section 5.7.1.2.2 apply.

5.7.1.3. Sub-step b: Determination of the BM emission factor ($EF_{BM,y}$)

89. The BM emission factor ($EF_{BM,y}$) is determined based on the generation-weighted average emissions intensity of new power units that started supplying electricity to the electricity system in a reference period. Where the necessary data is available, the reference period should reflect the period when the Article 6.4 activity starts operation, which is hereinafter referred to as "concurrent" reference period. Where the relevant data is not yet available at the time of calculating the BM emission factor, a "historical" reference period may be used. In the case of historical reference period, the average emissions intensity of new power units is adjusted to account for the data vintage, noting that in many electricity systems the average emissions intensity of new power units declines over time due to an increasing share of renewable energy power units, the use of more efficient power units and the use of less GHG-intensive fuels.

90. [Activity participants shall include the following power units *p* in the calculation of the BM emission factor:

(a) Where Case 1 applies and the electricity generation source is intermittent or the consumption source is depending on intermittent generation: include only non-intermittent electricity generation sources in the calculation;

(b) In all other situations: include all power units in the calculation.]

91. Activity participants shall determine the reference period to calculate the BM emission factor as follows:

(a) Determine the calendar year in which the Article 6.4 activity started operation, hereinafter referred to as year *x*;

(b) Determine the most recent calendar year for which data is available on new power units that started to supply electricity to the electricity system, hereinafter referred to as year *z*;

(c) Determine an initial three-year reference period, either as concurrent or historical reference period, as follows:

(i) Concurrent reference period: Where $z \geq x+1$, determine the initial reference period as the three-year period covering the calendar year before and after the calendar year of the start of operation of the Article 6.4 activity (i.e., the period covering the calendar years x-1, x and x+1);

(ii) Historical reference period: Where $z < x+1$, determine the initial reference period as the latest three-year period for which data is available (i.e., the period covering the calendar years z-2, z-1 and z).

(d) Identify the total capacity of all power units in the electricity system in MW at the end of the initial three-year reference period, hereinafter referred to as $P_{EL,total}$;

(e) Identify all power units *p* that started to supply electricity to the electricity system in the initial three-year reference period and determine the total power capacity of these units in MW, hereinafter referred to as $P_{EL,refperiod}$;

(f) If at least five power units have been identified in sub-paragraph (e) above and $P_{EL,refperiod} \geq$ [0.05] [0.1] $\times P_{EL,total}$, then use the initial three-year period determined in sub-paragraph (c) as the reference period. Otherwise, use a five-year reference period, either as concurrent or historical reference period, as follows:

(i) Concurrent reference period: Where $z \geq x+2$, determine the reference period as the five-year period covering the two calendar years before and after the start of operation of the Article 6.4 activity (i.e., the period covering the calendar years *x*-2, *x*-1, *x*, *x*+1 and *x*+2);

(ii) Historical reference period: Where $z < x+2$, determine the reference period as the latest five-year period for which data is available (i.e., the period covering the calendar years *z*-4, *z*-3, *z*-2, *z*-1 and *z*).

92. Activity participants shall determine the BM emission factor as the generation-weighted average emission factor (t CO_2/MWh) of all power units *p* during the period *t*, calculated as follows:

(a) For a concurrent reference period:

$$EF_{BM,y} = \frac{\sum_p EG_{p,t} \times EF_{EL,p,t}}{\sum_p EG_{p,t}} \quad \text{Equation (10)}$$

(b) For a historical reference period:

$$EF_{BM,y} = \frac{\sum_p EG_{p,t} \times EF_{EL,p,t}}{\sum_p EG_{p,t}} \times [1 - F_{BM} \times (x - r)] \quad \text{Equation (11)}$$

Where:

$EF_{BM,y}$	=	Build margin CO_2 emission factor in year *y* (t CO_2/MWh)
$EG_{p,t}$	=	Net quantity of electricity generated and delivered to the electricity system by power unit *p* in period *t* (MWh)
$EF_{EL,p,t}$	=	CO_2 emission factor of power unit *p* in period *t* (t CO_2/MWh)
p	=	Power units included in the build margin
y	=	Calendar year of the crediting period for which emission reductions are determined

t	=	Period from the start of the reference period up to the most recent calendar year for which electricity generation data is available[19]
F_{BM}	=	Factor to account for the likely annual decrease of the BM emission factor over time
x	=	Calendar year in which the Article 6.4 activity starts operation
r	=	Central year within the historical reference period (i.e., *z*-1 for a three-year historical reference period and *z*-3 for a five-year historical reference period)

93. For Case 1, a value of zero shall apply to the parameter F_{BM}, as a simplified and reasonably conservative approach. For Case 2, a value of [X] shall be applied.

Note: the MEP intends to conduct further analysis on the value to be used for F_{BM}.

94. Power units registered as Article 6.4 projects or component projects, or registered under other carbon crediting programs, shall be included in the calculation of the BM emission factor. However, capacity additions resulting from retrofits of existing power units shall be excluded.

95. For the first crediting period, the BM emission factor shall be updated for each calendar year as follows:

(a) As long as data to determine the BM emission factor for a concurrent reference period is not yet available, the BM emission factor shall be updated for each calendar year using the same historical reference period and the same set of power units *p*, but updating electricity generation and emission factor data from the power units *p* by extending the period *t* up to the most recent calendar year for which electricity generation data is available;

(b) Once data is available to determine the BM emission factor for a concurrent reference period, the BM emission factor shall be updated, using the concurrent reference period and a new set of power units *p*. In subsequent calendar years, the BM emission factor shall be updated for each calendar year, using the same concurrent reference period and same set of power units *p*, but updating electricity generation and emission factor data from the power units *p* by extending the period *t* up to the most recent calendar year for which electricity generation data is available.

96. For the second and third crediting periods, the BM emission factor shall be determined once ex ante and not be updated annually. It shall be determined for the concurrent reference period and the set of power units *p* identified for that period, as per the provisions in paragraphs 91 above, and using electricity generation data from the power units *p* from the start of the concurrent reference period up to the most recent calendar

[19] For example, the reference period may start on 1 January 2022. If a project determines the emission factor for the year 2029, the most recent available data may be available for 2027. In this case, the period *t* corresponds to the six-year period from 1 January 2022 to 31 December 2027. If a power unit *p* included in the BM calculation started operation on 1 July 2023, the electricity generation data from that power units shall cover the period from 1 July 2023 until 31 December 2027. If another power unit *p* included in calculation started operation on 15 November 2024, the electricity generation data for that power unit shall cover the period from 15 November 2024 until 31 December 2027.

year for which electricity generation data is available at the time of renewal of the crediting period.

97. The CO_2 emission factor of the power units *p* ($EF_{EL,p,t}$) shall be determined as per the provisions in section 5.7.1.1.3 above.

98. For the purpose of quantifying the uncertainty of the BM emission factor, the uncertainty associated with the BM method, in particular the assumption that the Article 6.4 would displace the construction of the same type and composition of power units as those included in the BM, shall be assumed to be ±[X] [5] [10] per cent of the calculated value for the BM emission factor.

5.7.1.4. Sub step c: Determine the CM emission factor ($EF_{CM,y}$ or $EF_{CM,h}$)

99. The CM emissions factor shall be calculated as follows:

$$EF_{CM,t} = EF_{OM,t} \times w_{OM} + EF_{BM,t} \times w_{BM} \quad \text{Equation (12)}$$

Where:

$EF_{CM,t}$	=	Combined margin CO_2 emission factor in period *t* (t CO_2/MWh)
$EF_{OM,t}$	=	Operating margin CO_2 emission factor in period *t* (t CO_2/MWh)
$EF_{BM,t}$	=	Build margin CO_2 emission factor in period *t* (t CO_2/MWh)
w_{OM}	=	Weighting of the operating margin emissions factor (unitless)
w_{BM}	=	Weighting of the build margin emissions factor (unitless)
t	=	Period for which the emission factor of the electricity system is determined (either the calendar year *y* of the crediting period or the hour *h* within the calendar year *y* of the crediting period)[20]

100. The default values in the table below shall be used for w_{OM} and w_{BM}, unless the mechanism methodology referring to this tool specifies other values.

Table 4. Default values for w_{OM} and w_{BM}

Type of electricity generation or consumption source	w_{OM}		w_{BM}	
	Mean	Uncertainty	Mean	Uncertainty
Intermittent electricity generation sources Electricity consumption sources depending on intermittent generation	[0.5]	[X]	[0.5]	[X]

[20] Note that the BM emission factor is always calculated for a calendar year *y* of the crediting period. Where the OM emission factor is determined on an hourly basis, the annual value of the BM emission factor may be applied to each hour *h*.

Type of electricity generation or consumption source	w_{OM}		w_{BM}	
	Mean	Uncertainty	Mean	Uncertainty
Non-intermittent electricity generation sources Electricity consumption sources not depending on intermittent generation	[0.25]	[X]	[0.75]	[X]

Note: The MEP would like to seek comments from stakeholders on the values of weighting in the table above.

101. The values for w_{OM} and w_{BM} shall be fixed for a crediting period.

5.7.2. Option B: Use a conservative default emission factor

102. For Case 1, apply one of the following default emission factors and justify the choice in the PDD:

(a) 0.87 t CO_2e/MWh if there is high confidence that the share of electricity generation from renewable (excluding solar and wind) and nuclear energy in the electricity system exceeds 33% in the period for which the emission factor is determined;[21]

(b) 0.44 t CO_2e/MWh if there is high confidence that the share of electricity generation from renewable (excluding solar and wind) and nuclear energy in the electricity system exceeds 67% in the period for which the emission factor is determined;[22] or

(c) 1.3 t CO_2e/MWh.[23]

103. For Case 2, apply one of the following default emission factors and justify the choice in the PDD:

(a) 0.2 t CO_2e/MWh if there is high confidence that the share of electricity generation from renewable energy (including solar and wind) and nuclear energy in the electricity system is less than 33% in the period for which the emission factor is determined;[24]

(b) 0.1 t CO_2e/MWh if there is high confidence that the share of electricity generation from renewable energy (including solar and wind) and nuclear energy in the electricity systems is less than 67% in the period for which the emission factor is determined;[25] or

[21] Calculated as 1.3 t CO_2/MWh x 2/3.

[22] Calculated as 1.3 t CO_2/MWh x 1/3.

[23] Applying a conservative higher value of the emission intensity of the fossil fuel power plant.

[24] Applying a conservative lower value of the emission intensity of the fossil fuel power plant as 0.3 t CO_2/MWh. Calculated as 0.3 t CO_2/MWh x 2/3.

[25] Calculated as 0.3 t CO_2/MWh x 1/3.

(c) 0.03 t CO_2e/MWh.[26]

104. For determining the emission factor applied under Case 1, the data for identifying the share of electricity generation from renewable (excluding solar and wind) and nuclear energy in the electricity system may be either determined ex ante based on the average data in the most recent three years at the time of submission or ex post for the period t for which the emission factor is determined. For Case 2, the share of renewable and nuclear energy (excluding solar and wind) in the annual electricity generation shall be determined ex post for the period *t* for which the emission factor is determined.

105. Under Option B, uncertainty in relation to the emission factor does not need to be addressed.

5.8. Step 8: Determine the emission factor for electricity sourced from captive fossil fuel power plants, where applicable

106. This step is applicable if Step 6 confirmed that the emission factor for electricity sourced from captive fossil fuel power plants shall be used.

107. Activity participants shall determine the emission factor for electricity sourced from captive fossil fuel power plants by choosing one of the following two options and document their choice in the PDD:

(a) Option A: Calculate the actual emission factor of the captive fossil fuel power plants, as set out in section 5.8.1 below; or

(b) Option B: Use a conservative default emission factor, as set out in section 5.8.2 below.

5.8.1. Option A: Calculate the actual emission factor of the captive fossil fuel power plants

108. 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) identified in Step 2. In the case of plants that co-generate heat and power (cogeneration plants), activity participants may:

(a) Ignore, as a conservative assumption, the heat generation for activities under Case 1; or

(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).

109. In the 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) shall be calculated as follows:

[26] The upstream emissions from solar PV power plant from *Life Cycle Greenhouse Gas Emissions from Concentrating Solar Power,* issued by NREL.

$$EF_{BE/PE/LE,p,t} = \frac{\sum_i FC_{i,p,t} \times NCV_{i,t} \times EF_{CO2,i,t}}{EG_{p,t}}$$ Equation (13)

Where:

$EF_{BE/PE/LE,p,t}$	=	Emission factor of the captive power plant *p* in the period *t* (t CO_2e/MWh)
$FC_{i,p,t}$	=	Quantity of fossil fuel type *i* fired in the captive power plant *p* in the 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_2e/GJ)
$EG_{p,t}$	=	Quantity of electricity generated in captive power plant *p* in the period *t* (MWh)
p	=	Fossil fuel fired captive power plants identified in Step 2
t	=	Period for which the emission factor for electricity generation is determined (see further guidance below)

110. 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:

$$EF_{BE/PE/LE,p,t} = \frac{\left[\sum_i \left(FC_{i,p,t} \times NCV_{i,t}\right) - \frac{HG_{p,t}}{\eta_{boiler}}\right] \times EF_{CO2,p,t}}{EG_{p,t}}$$ Equation (14)

Where:

$EF_{BE/PE/LE,y}$	=	Emission factor of the captive power plant p in the period *t* (t CO_2e/MWh)
$FC_{i,p,t}$	=	Quantity of fossil fuel type *i* fired in the captive power plant *p* in the 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)
$HG_{p,t}$	=	Quantity of heat co-generated in captive power plant *p* in the period *t* (GJ)
η_{boiler}	=	Efficiency of the boiler in which heat is assumed to be generated in the absence of a cogeneration plant
$EF_{CO2,p,t}$	=	Average CO_2 emission factor of the fossil fuels fired in the captive power plant *p* in the period *t* (t CO_2 / GJ)
$EG_{n,t}$	=	Quantity of electricity generated in captive power plant *p* in the period *t* (MWh)
p	=	Fossil fuel fired captive power plants identified in Step 2
t	=	Period for which the emission factor for electricity generation is determined (see further guidance below)

111. The period *t* shall correspond to:

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

(i) Determining project and leakage emissions of electricity consumption source *s*; or

(ii) Determining baseline emissions for the case where existing or new captive power plant(s) are operated at the site of the electricity generation/consumption source *s* during the monitored period.

(b) The most recent historical three years prior to the implementation of the project activity for determining baseline emissions for the case where no captive power plant is operated at the site of the electricity generation/consumption source *s* during the monitored period.

112. The average CO_2 emission factor of the fossil fuels fired in the captive power plant *p* ($EF_{CO2,p,t}$) shall be determined as follows:

(a) In the case of captive power plants that have only used one single fuel type since their start of operation (except for a small amount of start-up fuel), use the CO_2 emission factor of that fuel type ($EF_{CO2,p,t} = EF_{CO2,i}$);

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

(i) For Case 1, 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;

(ii) For Case 2, 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 prior to the start of the project activity. The period considered shall be a minimum of one year and a maximum of three years;

(iii) 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 activity 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:

$$EF_{CO2,p,t} = \frac{\sum_i FC_{i,p,t} \times NCV_{i,t} \times EF_{CO2,i,t}}{\sum_i FC_{p,i,t} \times NCV_{i,t}} \quad \text{Equation (15)}$$

Where:

$EF_{CO2,p,t}$	=	Average CO_2 emission factor of the fossil fuels fired in the captive power plant *p* in the period *t* (t CO_2/GJ)
$FC_{i,p,t}$	=	Quantity of fossil fuel type *i* fired in the captive power plant *p* in the 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 period *t* (t CO_2/GJ)
i	=	Fossil fuel types fired in captive power plant *p* in the period *t*
p	=	Fossil fuel fired captive power plants identified in Step 2

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

(iv) Calculate the average CO_2 emission factor, as per Equation (14) above, for (a) the period of the most recent three years prior to the implementation of the activity and for (b) the monitored period in question, and use the value that is more conservative.

113. The selected approach shall be documented in the PDD and shall not be changed during the crediting period.

114. Under Option A, uncertainty in relation to the emission factor shall be addressed following the requirements in section 5.11 below.

5.8.2. Option B: Use a conservative default emission factor

115. The default values provided in Table 2 above in section 5.7.1.1.3 above shall be applied for each specified type of fossil fuel-based power plant. In cases where multiple fossil fuel types are consumed, or the fuel type cannot be determined, the higher emission factor shall be used for Case 1 and the lower emission factor shall be used for Case 2.

116. Under Option B, uncertainty in relation to the emission factor does not need to be addressed.

5.9. Step 9. Determine the transmission and distribution losses from the electricity system, where applicable

117. This step is only applicable where Scenario A or Scenario C applies and where electricity is consumed from the project electricity system in the Article 6.4 activity scenario and/or the baseline scenario. It is not applicable where electricity is supplied to the project electricity system in the Article 6.4 activity scenario and/or baseline scenario.

118. Activity participants shall determine transmission and distribution losses from the electricity system using one of the following two options:

(a) Option 1: Determine the transmission and distribution losses for the specific situation of the Article 6.4 activity, taking into account the relevant parameters, such as the geographical region and the voltage level at which electricity is consumed from the electricity system, based on transmission and distribution loss data from sources such as electricity wholesale or retail companies. This option may be either applied (i) ex post for the calendar year for which emission reductions are determined, or (ii) ex ante for the crediting period using the average transmission and distribution losses in the most recent three years for which data is available at the time of submission of the PDD to the DOE for validation. For Case 1, the data used may or may not include losses from electricity pilferage. This means that data may be used even if no information is available on whether or not the data includes losses from electricity pilferage. For Case 2, the data shall only be used if it only includes physical losses and not any losses from electricity pilferage; or

(b) Option 2: Apply the appropriate default value from the table below for the transmission and distribution losses, based on the voltage level at which electricity is consumed and depending on whether Case 1 or Case 2 applies.

Table 5. Default transmission and distribution losses for different voltages at which electricity is consumed and depending on which case applies

Voltage level	Case 1	Case 2
High voltage (HV)	[7%]	[4%]
Medium voltage (MV)	[11%]	[6%]
Low voltage (LV)	[17%]	[10%]

5.10. Step 10. Determine the emissions from electricity generation and/or consumption

119. Baseline, project and/or leakage emissions from generation and/or consumption of electricity shall be calculated based on the quantity of electricity generation or consumption, an emission factor for electricity generation or consumption, and a factor to account for transmission and distribution losses.

120. Where electricity generation or consumption and emission factors are determined on an annual basis for each calendar year *y* of the crediting period, the emissions shall be calculated as follows:

$$BE_{EG,y} = \sum_{s} EG_{s,y} \times EF_{EG,BL,s,y}$$ Equation (16)

$$BE_{EC,y} = \sum_{s} EC_{s,y} \times EF_{EC,BL,s,y} \times \frac{1}{1 - F_{TDL,s,y}}$$ Equation (17)

$$PE_{EG,y} = \sum_{s} EG_{s,y} \times EF_{EG,PJ,s,y}$$ Equation (18)

$$PE_{EC,y} = \sum_{s} EC_{s,y} \times EF_{EC,PJ,s,y} \times \frac{1}{1 - F_{TDL,s,y}}$$ Equation (19)

$$LE_{EG,BL,y} = \sum_{s} EG_{s,y} \times EF_{EG,BL,s,y}$$ Equation (20)

$$LE_{EC,BL,y} = \sum_{s} EC_{s,y} \times EF_{EC,PJ,s,y} \times \frac{1}{1 - F_{TDL,s,y}}$$ Equation (21)

$$LE_{EG,PJ,y} = \sum_{s} EG_{s,y} \times EF_{EG,PJ,s,y}$$ Equation (22)

$$LE_{EC,PJ,y} = \sum_{s} EC_{s,y} \times EF_{EC,PJ,s,y} \times \frac{1}{1 - F_{TDL,s,y}}$$ Equation (23)

Where:

$BE_{EG,y}$	=	Baseline emissions from electricity generation in year *y* (t CO_2/year)
$BE_{EC,y}$	=	Baseline emissions from electricity consumption in year *y* (t CO_2/year)
$PE_{EG,y}$	=	Project emissions from electricity generation in year *y* (t CO_2/year)
$PE_{EC,y}$	=	Project emissions from electricity consumption in year *y* (t CO_2/year)
$LE_{EG,BL,y}$	=	Leakage emissions from electricity generation in the baseline scenario in year *y* (t CO_2/year)
$LE_{EC,BL,y}$	=	Leakage emissions from electricity consumption in the baseline scenario in year *y* (t CO_2/year)
$LE_{EG,PJ,y}$	=	Leakage emissions from electricity generation in the project scenario in year *y* (t CO_2/year)
$LE_{EC,PJ,y}$	=	Leakage emissions from electricity consumption in the project scenario in year *y* (t CO_2/year)
$EG_{s,y}$	=	Electricity generation by the electricity generation source *s* in year *y* (MWh/year)
$EC_{s,y}$	=	Electricity consumption by the electricity consumption source *s* in year *y* (MWh/year)
$EF_{EG,BL,s,y}$	=	Emission factor for electricity generation by electricity generation source *s* in the baseline scenario in (Case 2) year *y* (MWh/year)
$EF_{EC,BL,s,y}$	=	Emission factor for electricity consumption by electricity consumption source *s* in the baseline scenario in (Case 2) year *y* (MWh/year)
$EF_{EG,PJ,s,y}$	=	Emission factor for electricity generation by electricity generation source *s* in the project scenario in (Case 1) year *y* (MWh/year)
$EF_{EC,PJ,s,y}$	=	Emission factor for electricity consumption by electricity consumption source *s* in the project scenario in (Case 1) year *y* (MWh/year)
$F_{TDL,s,y}$	=	Factor to account for transmission and distribution losses applicable to electricity generation or consumption source *s* in year *y*
s	=	Relevant electricity generation or consumption sources

121. Where electricity generation or consumption and emission factors are determined for each hour *h* of the calendar year *y* of the crediting period, the emissions shall be calculated as follows:

$$BE_{EG,y} = \sum_{s} \sum_{h} EG_{s,h} \times EF_{EG,BL,s,h}$$ Equation (24)

$$BE_{EC,y} = \sum_{s} \left(\sum_{h} EC_{s,h} \times EF_{EC,BL,s,h} \right) \times \frac{1}{1 - F_{TDL,s,y}}$$ Equation (25)

$$PE_{EG,y} = \sum_{s}\sum_{h} EG_{s,h} \times EF_{EG,PJ,s,h}$$ Equation (26)

$$PE_{EC,y} = \sum_{s}\left(\sum_{h} EC_{s,h} \times EF_{EC,PJ,s,h}\right) \times \frac{1}{1 - F_{TDL,s,y}}$$ Equation (27)

$$LE_{EG,BL,y} = \sum_{s}\sum_{h} EG_{s,h} \times EF_{EG,BL,s,h}$$ Equation (28)

$$LE_{EC,BL,y} = \sum_{s}\left(\sum_{h} EC_{s,h} \times EF_{EC,PJ,s,h}\right) \times \frac{1}{1 - F_{TDL,s,y}}$$ Equation (29)

$$LE_{EG,PJ,y} = \sum_{s}\sum_{h} EG_{s,h} \times EF_{EG,PJ,s,h}$$ Equation (30)

$$LE_{EC,PJ,y} = \sum_{s}\left(\sum_{h} EC_{s,h} \times EF_{EC,PJ,s,h}\right) \times \frac{1}{1 - F_{TDL,s,y}}$$ Equation (31)

Where:

$BE_{EG,y}$	=	Baseline emissions from electricity generated by the Article 6.4 activity in year *y* (tCO_2/MWh)
$BE_{EC,y}$	=	Baseline emissions from electricity consumed by the Article 6.4 activity in year *y* (tCO_2/MWh)
$PE_{EG,y}$	=	Project emissions from electricity generated by the Article 6.4 activity in year *y* (tCO_2/MWh)
$PE_{EC,y}$	=	Project emissions from electricity consumed by the Article 6.4 activity in year *y* (tCO_2/MWh)
$LE_{EG,BL,y}$	=	Leakage emissions from electricity generated in the baseline scenario in year *y* (tCO_2/MWh)
$LE_{EC,BL,y}$	=	Leakage emissions from electricity consumed in the baseline scenario in year *y* (tCO_2/MWh)
$LE_{EG,PJ,y}$	=	Leakage emissions from electricity generated in the baseline scenario in year *y* (tCO_2/MWh)
$LE_{EC,PJ,y}$	=	Leakage emissions from electricity consumed in the baseline scenario in year *y* (tCO_2/MWh)
$EG_{s,h}$	=	Electricity generated by the electricity generation source *s* in hour *h* (MWh/year)
$EC_{s,h}$	=	Electricity consumed by the electricity consumption source *s* in hour *h* (MWh/year)

$EF_{EG,BL,s,h}$	=	Emission factor of the electricity generated by the electricity generation source *s* in the baseline scenario in hour *h* (MWh/year)
$EF_{EC,BL,s,h}$	=	Emission factor of the electricity consumed by the electricity consumption source *s* in the baseline scenario in hour *h* (MWh/year)
$EF_{EG,PJ,s,h}$	=	Emission factor of the electricity generated by the electricity generation source s in the project scenario in hour *h* (MWh/year)
$EF_{EC,PJ,s,h}$	=	Emission factor of the electricity consumed by the electricity consumption source s in the project scenario in hour *h* (MWh/year)
$F_{TDL,s,y}$	=	Factor to account for transmission and distribution losses applicable to the electricity generation and consumption source s in hour *h*
s	=	Relevant electricity generation or consumption sources
h	=	Hour during the year *y*
y	=	Calendar year of the crediting period for which emission reductions are determined

5.11. Uncertainty determination

122. Activity participants shall determine the uncertainty of the emissions or emission factors from electricity generation and/or consumption, unless otherwise specified by the mechanism methodology referring to this tool. The uncertainty shall then be used in the calculation, as specified by the mechanism methodology.

123. The uncertainty shall be determined by considering the uncertainty associated with the methods, assumptions, data and measurements used, following the guidance of Volume 1, Chapter 3 of the 2019 Refinement of the 2006 IPCC Guidelines. The uncertainty shall be expressed as the standard error of the mean and incorporated into the uncertainty calculations as specified by the mechanism methodology. For both Case 1 and Case 2, the upper and the lower bound of the uncertainty at a 95 percent confidence interval shall be specified, respectively.

124. Specifically, the following sources of uncertainty shall be considered in the quantification of uncertainty:

    (a) The uncertainty of input data: This includes the uncertainty associated with measurements or default values (unless the default values explicitly represent conservative default values) used in the calculation. Such data includes:

        (i) The data related to the power units in the electricity system and/or the captive power plants, such as the amount, the net calorific values and the emission factor of the fuel consumed, the electricity generation and the conversion efficiency of the power plant;

        (ii) The data used to determine the transmission and distribution losses, such as the total electricity generation and consumption data within the electricity system; and

        (iii) Measurements of electricity generation and/or consumption by equipment operated under the Article 6.4 activity or in the baseline scenario.

    (b) The uncertainty associated with the method and relevant assumptions (weighing of the OM and BM) in determining the CM emission factor, as specified in this methodological tool. It includes the uncertainties associated with the specific

methods chosen for determining the OM and BM emission factors (dispatch data OM, simple OM, simple adjusted OM, average OM and the BM) as well as the uncertainty related to the weighting used to combine them into the single CM emission factor, as detailed in the corresponding sections above.

125. When applying the conservative default values provided in the tool (i.e., values that are specified to be conservative and for which no uncertainty range is indicated, and any conservative default values based on IPCC data that are determined at the upper or lower bound of the uncertainty range at a 95 per cent confidence interval), no further uncertainty analysis for these specific values is required, i.e., these values shall not be deemed to be associated with uncertainty in the further quantification of the overall emission reductions.

6. Monitoring methodology

126. Some parameters listed below either need to be monitored continuously during the crediting period or need to be calculated only once for the crediting period, depending on the data vintage chosen, following the provisions in the methodological approaches procedure outlined above and the guidance on “measurement and updating frequency” and “additional comments” for the parameter.

127. The calculation of the operating margin and build margin emission factors should be documented electronically in a spreadsheet that should be attached to the PDD and monitoring report as applicable. All the data shall be presented in a manner that enables reproducing of the calculation of the build margin and operating margin emission factors. This should include all data used to calculate the emission factors, including:

(a) The following information for each power plant/unit:

(i) Information to clearly identify the plant;

(ii) The date of commissioning;

(iii) The capacity (MW);

The fuel type(s) used;

(ii) The quantity of net electricity generation in the relevant year(s);

(iii) If applicable: the fuel consumption of each fuel type in the relevant period(s);

(iv) In cases where the simple OM or the simple adjusted OM is used: Information whether the plant/unit is a must-run plant/unit;

(b) Net calorific values used;

(c) CO_2 emission factors used;

(d) Plant efficiencies used;

(e) Identification of the plants included in the build margin and the operating margin during the relevant period(s);

(f) In case the simple operating margin or simple adjusted OM is used: hours when the project electricity system operates solely based on renewable, nuclear, and/or storage power units, as applicable;

(g) In case the dispatch data operating margin is used: for each hour h where the activity is displacing electricity in, or consuming electricity from the electricity system:

(i) The dispatch order of all power plants connected to the electricity system;

(ii) The total electricity generation of the electricity system;

(iii) The quantity of electricity displaced by the Article 6.4 activity;

(iv) Identification of the plants that are in the top of the dispatch and for each plant information on electricity generation and, where hourly fuel consumption data is available, data on the types and quantities of fuels consumed during that hour.

Data / Parameter table 1.

Data/parameter	$EG_{s,y}$; $EG_{s,h}$	
Description	$EG_{s,y}$: Electricity generated by the electricity generation source *s* in year *y* $EG_{s,h}$: Electricity generated by the electricity generation source *s* in hour *h*	
Data unit	$EG_{s,y}$: MWh/year $EG_{s,h}$: MWh/h	
Equations referred		
Purpose of data	☒ Baseline emissions ☒ Project emissions ☒ Leakage emissions	
Measurement and updating frequency	$EG_{s,y}$: Continuous measurement and at least monthly recording $EG_{s,h}$: Continuous measurement and at least hourly recording	
Measurement methods and procedures	Direct measurement or calculated based on measurements from more than one electricity meter	
Entity/person responsible for the measurement	Activity participants	
Measuring instrument(s)	*Type of instrument*	Electricity-meter(s)
	Accuracy class	If electricity-meters are regulated: in accordance with the stipulation of the meter supplier and/or as per the requirements set by the operators of the electricity system or national requirements. If electricity-meters are not regulated: at least 0.5 accuracy class, or in accordance with the stipulation of the meter supplier or national requirements

	Calibration requirements	If electricity-meters are regulated: in accordance with national standards or requirements set by the meter supplier or requirements set by the operators of the electricity system, including the frequency of calibration. If electricity-meters are not regulated: every 3 years or in accordance with national standards or requirements set by the meter supplier, including the frequency of calibration
	Location	Scenario A and C: electricity system interface, where applicable, Scenario B and C: entrance of the electricity consuming facility, where applicable
QA/QC procedures	In cases where electricity meters are regulated (e.g., the electricity is supplied by the electricity system – 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 operators of the electricity system 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 electricity generation (gross or net) shall be cross-checked with records of electricity sale (e.g., sales receipt)	
Treatment of uncertainties	Uncertainties are determined based on the measuring instruments	
Additional comment	If the electricity is exported to the electricity system using a one-way electricity-meter, $EG_{s,y}$ and $EG_{s,h}$ are calculated as the difference between (a) the quantity of electricity supplied by the project plant/unit to the electricity system and (b) the quantity of electricity consumed by the project plant/unit from the electricity system	

Data / Parameter table 2.

Data/parameter	$\boldsymbol{EC_{s,y}}$; $\boldsymbol{EC_{s,h}}$
Description	$\boldsymbol{EC_{s,y}}$**:** Electricity consumed by the electricity consumption source *s* in year *y* $\boldsymbol{EC_{s,h}}$**:** Electricity consumed by the electricity consumption source *s* in hour *h*
Data unit	$\boldsymbol{EC_{s,y}}$**:** MWh/year $\boldsymbol{EC_{s,h}}$**:** MWh/h
Equations referred	
Purpose of data	☒ Baseline emissions ☒ Project emissions ☒ Leakage emissions
Measurement and updating frequency	$\boldsymbol{EC_{s,y}}$**:** Continuous measurement and at least monthly recording $\boldsymbol{EC_{s,h}}$**:** Continuous measurement and at least hourly recording

Measurement methods and procedures	Direct measurement or calculated based on measurements from more than one electricity meter	
Entity/person responsible for the measurement	Activity participants	
Measuring instrument(s)	*Type of instrument*	Electricity-meter(s)
	Accuracy class	If electricity-meters are regulated: in accordance with the stipulation of the meter supplier and/or as per the requirements set by the operators of the electricity system or national requirements. If electricity-meters are not regulated: at least 0.5 accuracy class, or in accordance with the stipulation of the meter supplier or national requirements
	Calibration requirements	If electricity-meters are regulated: in accordance with national standards or requirements set by the meter supplier or requirements set by the operators of the electricity system, including the frequency of calibration. If electricity-meters are not regulated: every 3 years or in accordance with national standards or requirements set by the meter supplier, including the frequency of calibration
	Location	Scenario A and C: electricity system interface, where applicable, Scenario B and C: entrance of the electricity consuming facility, where applicable
QA/QC procedures	In cases where electricity meters are regulated (e.g., the electricity is supplied by the electricity system – 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 operators of the electricity system 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 electricity consumption shall be cross-checked with records of electricity purchased (e.g., purchase receipt)	
Treatment of uncertainties	Uncertainties are determined based on the measuring instruments	
Additional comment	-	

Data / Parameter table 3.

Data/parameter	$\boldsymbol{FC_{i,p,t}}$ **;** $\boldsymbol{FC_{i,p,h}}$
Description	$\boldsymbol{FC_{i,p,t}}$**:** Amount of fuel type *i* consumed by power unit *p* in period *t* $\boldsymbol{FC_{i,p,h}}$**:** Amount of fuel type *i* consumed by power unit *p* in hour *h*

Data unit	$FC_{i,p,t}$: Mass or volume unit at reference conditions[27] in period *t* $FC_{i,p,h}$: Mass or volume unit at reference conditions[27] in hour *h*	
Equations referred		
Purpose of data	☒ Baseline emissions ☒ Project emissions ☒ Leakage emissions	
Measurement and updating frequency	$FC_{i,p,t}$: Continuous measurement and at least monthly recording $FC_{i,p,h}$: Continuous measurement and at least hourly recording	
Measurement methods and procedures	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 reasonable maintenance. In the case of using daily tanks with pre-heaters for heavy oil, the calibration will be made with the system at typical operational conditions	
Entity/person responsible for the measurement	Activity participants	
Measuring instrument(s)	*Type of instrument*	Mass or volume meters, ruler gauge (that is part of daily tanks), transducers, sonar and piezoelectronic devices
	Accuracy class	N/A
	Calibration requirements	Ruler gauge: at least once a year. Transducers, sonar and piezoelectronic devices: calibrated with the ruler gauge and receiving a reasonable maintenance
	Location	N/A
QA/QC procedures	The consistency of metered fuel consumption quantities should be cross-checked by an annual energy balance that is based on purchased quantities and stock changes. Where the purchased fuel invoices can be identified specifically for the Article 6.4 activity, the metered fuel consumption quantities should also be cross-checked with available purchase invoices from the financial record	
Treatment of uncertainties	Uncertainties are determined based on the measuring instruments	
Additional comment	Article 6.4 activities faced with data gaps due to meter failure or other reasons unforeseen, may estimate the quantity of fuel, using one of the following options, provided the gap period does not exceed 30 consecutive days within six consecutive months:	

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

	The purchased fuel/energy invoices/bills, where the purchased fuel can be identified specifically for the Article 6.4 activity. For Article 6.4 activities under Case A or Case C, this parameter needs to be updated at the renewal of the crediting period if activity participants chose to determine OM or BM ex ante

Data / Parameter table 4.

Data/parameter	$NCV_{i,t}$		
Description	Net calorific value of the fuel type *i* in period *t*		
Data unit	GJ/mass unit or GJ/volume unit		
Equations referred			
Purpose of data	☒ Baseline emissions	☒ Project emissions	☒ Leakage emissions
Measurement and updating frequency	Option 1: At every fuel delivery; Option 2: At every fuel delivery; Option 3: Annually; Option 4: Update based on future revisions of the IPCC Guidelines		
Measurement methods and procedures	Option 1: Values provided by the supplier of the fuel (preferred source). The density of the fuel should be obtained for each fuel delivery, from which weighted average annual values should be calculated; Option 2: Measurements by activity participants undertaken in line with national or international fuel standards (if the values provided by the supplier of the fuel are not available). The NCV of the fuel should be obtained for each fuel delivery, from which weighted average annual values should be calculated; Option 3: Regional or national default values (if the values provided by the supplier of the fuel are not available and only for liquid fuels). Values shall be reviewed annually; Option 4: Upper bound for Case 1 and lower bound for Case 2 at a 95 per cent confidence interval from IPCC default values provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2019 Refinement to the 2006 IPCC Guidelines on National GHG Inventories (if the values provided by the supplier of the fuel are not available). Update based on future revisions of the IPCC Guidelines		
Entity/person responsible for the measurement	Activity participants		
Measuring instrument(s)	*Type of instrument*	N/A	
	Accuracy class	N/A	
	Calibration requirements	N/A	
	Location	N/A	
QA/QC procedures	The laboratories in (a) or (b) should have ISO17025 accreditation or justify that they can comply with similar quality standards		

Treatment of uncertainties	Verify if the values under Options 1, 2 and 3 are within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2019 Refinement to the 2006 IPCC Guidelines. If the values fall below this range collect additional information from the testing laboratory to justify the outcome or co006Educt additional measurements – the laboratories in Options 1, 2 and 3 should have ISO17025 accreditation or justify that they can comply with similar quality standards
Additional comment	For Article 6.4 activities under Case A or Case C, this parameter needs to be updated at the renewal of the crediting period if activity participants chose to determine OM or BM ex ante

Data / Parameter table 5.

Data/parameter	$\boldsymbol{EF_{CO2,i,t}}$	
Description	CO_2 emission factor of fuel type *i* in period *t*	
Data unit	t CO_2/GJ	
Equations referred		
Purpose of data	☒ Baseline emissions ☒ Project emissions ☒ Leakage emissions	
Measurement and updating frequency	Option 1: At every fuel delivery; Option 2: At every fuel delivery; Option 3: Annually; Option 4: Update based on future revisions of the IPCC Guidelines	
Measurement methods and procedures	Option 1: Values provided by the supplier of the fuel (preferred source) in line with national or international fuel standards; Option 2: Measurements by activity participants undertaken in line with national or international fuel standards (if the values provided by the supplier of the fuel are not available); Option 3: Regional or national default values (if the values provided by the supplier of the fuel are not available and only for liquid fuels). Values shall be reviewed annually; Option 4: Upper bound for Case 1 and lower bound for Case 2 at a 95 per cent confidence interval from IPCC default values provided in the 2019 Refinement to the 2006 IPCC Guidelines on National GHG Inventories (if the values provided by the supplier of the fuel are not available). Update based on future revisions of the IPCC Guidelines	
Entity/person responsible for the measurement	Activity participants	
Measuring instrument(s)	*Type of instrument*	N/A
	Accuracy class	N/A
	Calibration requirements	N/A
	Location	N/A
QA/QC procedures	N/A	

Treatment of uncertainties	Verify if the values under Options 1, 2 and 3 are within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2019 Refinement to the 2006 IPCC Guidelines. If the values fall below this range collect additional information from the testing laboratory to justify the outcome or conduct additional measurements – the laboratories in Options 1, 2 and 3 should have ISO17025 accreditation or justify that they can comply with similar quality standards
Additional comment	For Option 1, if the fuel supplier of the fuel 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 2, 3 and 4 should be used. The emission factors of CH_4 and N_2O shall be converted to t CO_2e/GJ and added to the emission factor of CO_2 to estimate a total equivalent emission factor in t CO_2e/GJ for the three greenhouse gases. For Article 6.4 activities under Case A or Case C, this parameter needs to be updated at the renewal of the crediting period if activity participants chose to determine OM or BM ex ante

Data / Parameter table 6.

Data/parameter	$\boldsymbol{EG_{p,t}}$; $\boldsymbol{EG_{p,h}}$	
Description	$\boldsymbol{EG_{p,t}}$**:** Net quantity of electricity generated and delivered to the electricity system by the power plant *p* in the period *t* OR Quantity of electricity generated in captive power plant *p* in the period *t* $\boldsymbol{EG_{p,h}}$**:** Net quantity of electricity generated and delivered to the electricity system by the power plant *p* in the hour *h* OR Quantity of electricity generated in captive power plant *p* in hour *h*	
Data unit	$\boldsymbol{EG_{p,t}}$**:** MWh/period *t* $\boldsymbol{EG_{p,h}}$**:** MWh/h	
Equations referred		
Purpose of data	☒ Baseline emissions ☒ Project emissions ☒ Leakage emissions	
Measurement and updating frequency	$\boldsymbol{EG_{p,t}}$**:** Continuous measurement and at least monthly recording $\boldsymbol{EG_{p,h}}$**:** Continuous measurement and at least hourly recording	
Measurement methods and procedures	Direct measurement or calculated based on measurements from more than one electricity meters	
Entity/person responsible for the measurement	Activity participants	
Measuring instrument(s)	*Type of instrument*	Electricity-meter(s)
	Accuracy class	At least 0.5 accuracy class, or in accordance with the stipulation of the meter supplier or national requirements

	Calibration requirements	Every 3 years or in accordance with national standards or requirements set by the meter supplier, including the frequency of calibration
	Location	Entrance of the captive consumer
QA/QC procedures	The electricity meter will be subject to regular maintenance and testing in accordance with the stipulation of the meter supplier or national requirements. The electricity generation (gross or net) shall be cross-checked with records of electricity sale (e.g., sales receipt)	
Treatment of uncertainty	Uncertainties are determined based on the measuring instruments	
Additional comment	For Article 6.4 activities under Case A or Case C, this parameter needs to be updated at the renewal of the crediting period if activity participants chose to determine OM or BM ex ante	

Data / Parameter table 7.

Data/parameter	$HG_{p,t}$		
Description	Quantity of heat co-generated in captive power plant *p* in the period *t*		
Data unit	GJ/period *t*		
Equations referred			
Purpose of data	☒ Baseline emissions	☒ Project emissions	☒ Leakage emissions
Measurement and updating frequency	Continuously, aggregated at least annually		
Measurement methods and procedures	Determined as the difference of the enthalpy of the steam or hot water generated minus the enthalpy of the feedwater 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		
Entity/person responsible for the measurement	Activity participants		
Measuring instrument(s)	*Type of instrument*	N/A	
	Accuracy class	N/A	
	Calibration requirements	N/A	
	Location	N/A	
QA/QC procedures	Cross check measurement results with records for sold heat and the other energy measurements where relevant		
Treatment of uncertainty	Uncertainties are determined based on the measuring instruments		

Additional comment	-

Data / Parameter table 8.

Data/parameter	η_{boiler}	
Description	Efficiency of the boiler in which heat is assumed to be generated in the absence of a captive cogeneration plant	
Data unit	%	
Equations referred		
Purpose of data	☒ Baseline emissions ☒ Project emissions ☒ Leakage emissions	
Measurement and updating frequency	If option (a) below is chosen: Once at the start of the Article 6.4 activity. If option (b) below is chosen: Not applicable	
Measurement methods and procedures	Choose among the following options: Option (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) using national or international standards; Option (b): Assume a default value of 100% for Case 1 and 60% for Case 2	
Entity/person responsible for the measurement	If option (a) below is chosen: activity participants. If option (b) below is chosen: not applicable	
Measuring instrument(s)	*Type of instrument*	N/A
	Accuracy class	N/A
	Calibration requirements	N/A
	Location	N/A
QA/QC procedures	-	
Treatment of uncertainty	If option (a) below is chosen: Uncertainties are determined based on the measuring instruments. If option (b) below is chosen: Not applicable	
Additional comment	-	

Data / Parameter table 9.

Data/parameter	$\eta_{p,t}$
Description	Average net energy conversion efficiency of power unit *p* in the project electricity system in period *t*
Data unit	%
Equations referred	

Purpose of data	☒ Baseline emissions ☒ Project emissions ☒ Leakage emissions	
Measurement and updating frequency	Once for the crediting period	
Measurement methods and procedures	Use either: Documented manufacturer's specifications (if the efficiency of the plant is not significantly increased through retrofits or rehabilitations); or For power plants connected to the electricity system: data from the utility, the dispatch centre or official records if it can be deemed reliable; or [62 per cent] as the default value for Case 1 and [30 per cent] as the default value for Case 2	
Entity/person responsible for the measurement	Activity participants	
Measuring instrument(s)	*Type of instrument*	N/A
	Accuracy class	N/A
	Calibration requirements	N/A
	Location	N/A
QA/QC procedures	N/A	
Treatment of uncertainties	N/A	
Additional comment	-	

Data / Parameter table 10.

Data/parameter	$F_{TDL,s,y}$
Description	Factor to account for transmission and distribution losses applicable to electricity generation or consumption source *s* in year *y*
Data unit	%
Equations referred	
Purpose of data	☒ Baseline emissions ☒ Project emissions ☒ Leakage emissions
Measurement and updating frequency	If Option 1 below is chosen: once at the start of the Article 6.4 activity or annually. If Option 2 below is chosen: N/A
Measurement methods and procedures	Option 1: Data sourced from electricity wholesale or retail companies, including the transmission and distribution losses for different voltage levels; Option 2: Default values provided in the methodological tool

Entity/person responsible for the measurement	Option 1: Electricity wholesale or retail companies Option 2: N/A	
Measuring instrument(s)	*Type of instrument*	N/A
	Accuracy class	N/A
	Calibration requirements	N/A
	Location	N/A
QA/QC procedures	-	
Treatment of uncertainty	Option 1: uncertainties provided by the electricity wholesale or retail companies; Option 2: N/A	
Additional comment	Option 1: for Case 1, the data used may or may not include losses from electricity pilferage; for Case 2, the data shall only be used if it only includes physical losses and not any losses from electricity pilferage	

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Document information

Version	*Date*	*Description*
01.0	10 December 2025	MEP 010, Annex 1. A call for input on this document will be issued following the conclusion of MEP 010 meeting. The input received will be considered by the MEP for the further development of this document at a future meeting.

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