ARTICLE 6.4 MECHANISM

A6.4-AMM-001

Mechanism Methodology

Flaring or use of landfill gas

Version 01.0

Sectoral scope(s): 01 and 13

United Nations
Framework Convention on
Climate Change

TABLE OF CONTENTS **Page**

1. Introduction

1.1. Scope

1. This mechanism methodology applies to Article 6.4 activities[1] that capture landfill gas (LFG) from a solid waste disposal site (SWDS) and (a) flare it, and/or (b) use it to produce energy (i.e., power or heat), and/or (c) use it to supply consumers through a natural gas distribution network, dedicated pipeline or trucks.[2] GHGs are reduced as a result of methane destruction and, where applicable, displacement of a more GHG intensive energy source.

1.2. Entry into force and validity

2. This mechanism methodology enters into force on 30 October 2025.

3. This mechanism methodology remains valid for five years, until 29 October 2030, unless an earlier date applies if the mechanism methodology is revised or withdrawn in accordance with the “Procedure: Development, revision and clarification of methodologies and methodological tools” (A6.4-PROC-METH-001).[3]

1.3. Applicability of sectoral scopes

4. Designated operational entities validating and verifying Article 6.4 activities that use this mechanism methodology shall apply sectoral scopes 1 and 13.

2. Definitions

2.1. General terms

5. The following general terms are applied to this mechanism methodology:

   (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.

[1] The Methodological Exper Panel (MEP) notes that the mechanism methodology applies only to Article 6.4 projects and will be amended in the future to cover activities at other scales (e.g., programmes of activities, policies, sectoral approaches) once the adopted standards for the development of mechanism methodologies (e.g., additionality standard, baseline-setting standard) are revised to incorporate other scales.

[2] Under this methodology, “trucks” mean container trucks that transport LFG or biomethane, whether pressurized or liquefied.

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

2.2. Methodological terms and definitions

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

(a) **Aged solid waste disposal site (SWDS) cell:** A SWDS cell containing waste which has been in the SWDS for more than twenty years;

(b) **Backup flaring:** The destruction of the LFG in a flare that occurs when the associated utilization equipment (e.g., engine, boiler, biogas processing facility) is non-operational due to maintenance or failure, or when the volume of LFG captured exceeds the capacity of the utilization equipment. Backup flaring only occurs in activities that include a utilization component;

(c) **Biogas processing facility:** A facility which processes and upgrades the LFG collected from a SWDS, through a process that removes the CO_2 and other contaminants present in the LFG, and compresses and/or liquefies the LFG with the purpose of supplying upgraded biomethane to end-users;

(d) **Biomethane:** A near-pure source of methane produced by processing and upgrading the LFG in a biogas processing facility;

(e) **Continuous brick kiln:** A brick kiln where bricks are loaded continuously into the kiln, rather than in batches. Continuous brick kilns are distinguished as either moving ware kilns or moving fire annular kilns. Moving ware kilns include tunnel and vertical shaft kilns. Moving fire annular kilns use Hoffmann, Bull's trench and Zig-zag technologies;

(f) **Existing LFG capture system**: A LFG capture system, as defined above that has been in operation at any time in the last year prior to the start of operation of the Article 6.4 activity;

(g) **Features**: Areas in the solid waste disposal site from which emissions are higher than typical emissions within their constituent SWDS cell (hotspots) and are differentiated as such;

(h) **Intermittent brick kiln:** A brick kiln where bricks are loaded into the kiln and fired in batches. Types include Clamp, Scotch and Scove technologies;

(i) **Immature SWDS cell**: A SWDS cell containing waste which has been in the SWDS for less than five years;

(j) **Landfill gas (LFG)**: The biogas generated by decomposition of waste in a SWDS. LFG is mainly composed of methane, carbon dioxide, and small fractions of ammonia and hydrogen sulphide;

(k) **Legal requirements:** Laws, statutes, regulations, court orders, decrees, consent agreements[4], executive orders, permitting conditions or any other legally binding mandates;

(l) **LFG capture system**: A system to capture LFG. The system may be passive, active, or a combination of both active and passive components. Passive systems

[4] For example, agreements between parties, such as between a private sector entity and a government, to take an action in exchange for avoiding court action.

capture LFG by means of natural pressure, concentration, and density gradients. Active systems use mechanical equipment to capture LFG by providing pressure gradients. Captured LFG can be vented, flared or used;

(m) **Mature SWDS cell:** A SWDS cell containing waste which has been in the SWDS between five and twenty years;

(n) **Operational time:** The total time that a piece of equipment has been operating, expressed in years or hours of operation since its first commissioning;

(o) **Primary Flaring:** The destruction of LFG in a flare when the Article 6.4 activity does not include any utilization component, or flaring that exceeds the allowable threshold for backup flaring in a utilization activity;

(p) **Reference conditions**: Conditions are defined as 0ºC (273.15 K, 32ºF) and 1 atm (101.325 kN/m^2, 101.325 kPa, 14.69 psia, 29.92 in Hg, 760 torr);

(q) **Remaining lifetime:** The time for which a piece of existing equipment can continue to operate before it has to be replaced or discarded for technical reasons, such as the age of the equipment, safety reasons, or deteriorated performance. The remaining lifetime is expressed in years or hours of operation;

(r) **Solid waste**: Material that is unwanted and insoluble (including gases or liquids in cans or containers). Hazardous waste is not included in the definition of solid waste;

(s) **Solid waste disposal site (SWDS)**: Designated areas intended as the final storage place for solid waste;

(t) **Solid waste disposal site (SWDS) cell:** a specific, contiguous area within a solid waste disposal site;

(u) **Technical lifetime:** The total time over which a piece of equipment is designed to operate, expressed in years or hours of operation since its first commissioning.

7. Further definitions from the Article 6.4 Glossary of Terms, once adopted by the Supervisory Body, shall also apply to this mechanism methodology.

3. Normative and informative references

8. This mechanism methodology is based on elements from version 19.0 of the Clean Development Mechanism (CDM) methodology “ACM0001: Flaring or use of landfill gas”.

9. The following normative documents are indispensable for the application of this mechanism methodology:

(a) “A6.4-AMT-001: Common practice analysis” (hereinafter referred as “common practice tool”);

(b) “A6.4-AMT-002: Investment analysis” (hereinafter referred as “investment analysis tool”);

(c) “A6.4-AMT-003: Emissions from solid waste disposal sites” (hereinafter referred as “solid waste tool”);

(d) "A6.4-AMT-004: Project emissions from flaring" (hereinafter referred as "flaring tool");

(e) "A6.4-AMT-005: Mass flow of a greenhouse gas in a gaseous stream" (hereinafter referred as "mass flow tool");

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

(g) Intergovernmental Panel on Climate Change (2006). *2006 IPCC Guidelines for National Greenhouse Gas Inventories*.[6]

10. The following informative document provide supporting information that may assist in the application of this mechanism methodology:

(a) Vatopoulos, K., Andrews, D., Carlsson, J., Papaioannou, I. & Zubi, G., 2012. *Study on the state of play of energy efficiency of heat and electricity production technologies*. Luxembourg: Publications Office of the European Union. EUR 25406 EN. Available at: https://doi.org/10.2790/57624;

(b) Rogers, E. M. *Diffusion of Innovations*. 5th ed. New York: Free Press, 2003.

4. Applicability

11. The mechanism methodology is applicable to Article 6.4 activities that involve:

(a) The installation of a new LFG capture system in an existing or new (greenfield) SWDS where no LFG capture system was installed prior to the implementation of the Article 6.4 activity (except for legal or contractual requirements) or would be installed in the absence of the Article 6.4 activity; or

(b) Upgrading an existing (active or passive) LFG capture system to increase the recovery rate, where the captured LFG prior to the implementation of the Article 6.4 activity was flared and not used, and:

(i) The amount of LFG captured by the existing system is collected and measured separately from the upgrade implemented as part of the Article 6.4 activity; or

(ii) The efficiency of the existing system is not impacted by the upgrade implemented as part of the Article 6.4 activity, and historical data on the amount of LFG captured and flared is available (if such historical data is not available, no A6.4 ERs can be claimed).

12. The mechanism methodology is only applicable to activities that meet the requirements of paragraph 11 above and that collect the LFG under the Article 6.4 activity exclusively for one or more of the following applications:

(a) Flaring;

(b) Generating electricity;

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

[6] See https://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html.

(c) Generating heat in a boiler, air heater or kiln (brick firing only) or glass melting furnace;

(d) Supplying the biomethane produced from the LFG to consumers through a natural gas distribution network;

(e) Supplying the LFG or the biomethane produced from the LFG to consumers via trucks;

(f) Supplying the LFG or the biomethane produced from the LFG to consumers through a dedicated pipeline.

13. The mechanism methodology is only applicable if the project does not reduce the amount of organic waste that would be recycled in the absence of the Article 6.4 activity.

14. The mechanism methodology is only applicable for the following baseline scenarios:

(a) For the methane contained in the LFG component (hereafter referred to as “methane component”):

(i) For Article 6.4 activities developed in an existing SWDS, the most plausible baseline scenario is that the methane contained in the LFG generated in the SWDS would be either released to the atmosphere or captured and destroyed through flaring to comply with legal or contractual requirements, to address safety and odour concerns, or for other reasons;

(ii) For Article 6.4 activities implemented in a greenfield SWDS, the most plausible baseline scenario, as identified based on the best-available technology (BAT) approach, is that the methane contained in the LFG generated in the SWDS would be either released to the atmosphere or captured and destroyed through flaring to comply with legal or contractual requirements, to address safety and odour concerns, or for other reasons.[7]

(b) For the electricity generation component:

(i) If the electricity generated by the Article 6.4 activity is supplied to the grid, the most plausible baseline scenario is the same amount of electricity is generated from other power plants connected to the same electric grid;

(ii) If the electricity generated by the Article 6.4 activity replaces the electricity generated in an existing captive fossil fuel fired power plant located within the project boundary, the most plausible baseline scenario is the continued operation of the existing captive fossil fuel fired power plant located using the same fuel;

(iii) If the electricity generated by the Article 6.4 activity replaces the electricity generated in a new captive fossil fuel fired power plant located within the project boundary, the baseline scenario is determined based on the best available technology approach.

[7] If the identified baseline based on the best available technology results in another baseline scenario, activity participants may request a revision to the methodology through the latest version of the “Procedure: Development, revision and clarification of methodologies and methodological tools” (A6.4-PROC-METH-001).

(c) For the heat generation component:

(i) If the heat generated by the Article 6.4 activity is replacing heat generated in existing equipment located within the project boundary (e.g., a boiler, air heater, glass melting furnace or brick kiln), the most plausible baseline scenario is the continued generation of heat in the existing equipment using the same fuel;

(ii) If the heat generated by the Article 6.4 activity is replacing heat generated in new equipment located within the project boundary (e.g., a boiler, air heater, glass melting furnace or kiln), the baseline scenario is determined based on the best available technology approach.

(d) For the supply of LFG or biomethane to consumers through trucks or dedicated pipeline, or the supply of biomethane through natural gas dedicated network (hereinafter referred to as "supply of LFG or biomethane to consumers component"), the most plausible baseline scenario is the consumption of natural gas from an existing natural gas network.

15. If the Article 6.4 activity involves heat generation and results in existing heat generation equipment being replaced as per paragraph 14(c)(i) above, then activity participants shall demonstrate that:

(a) The existing heat generation equipment that is replaced is scrapped, and provide evidence of the scrapping to the DOE performing the validation or at first verification; or

(b) The existing heat generation equipment is used outside of the activity boundary and has a higher efficiency than any equipment it may replace. Evidence of the efficiency of the replaced heat generation equipment outside of the activity boundary shall be provided to the DOE performing the validation. If activity participants cannot demonstrate that a higher efficiency equipment is replacing a lower efficiency equipment, then the mechanism methodology is not applicable.

16. This mechanism methodology is only applicable as a standalone methodology and cannot be applied in combination with other methodologies.[8]

17. This mechanism methodology is not applicable if the management of the SWDS in the Article 6.4 activity scenario is changed in a manner that increases methane generation compared to the situation prior to the implementation of the Article 6.4 activity (for example by recirculating the leachate in the project scenario which was not done in the baseline), unless the change is implemented due to legal requirements. At the validation and at each verification, the DOE shall assess whether any changes in the design or management of the SWDS have been implemented and review any applicable legal requirements (e.g., changes to the maximum allowable emission limit for VOCs).

[8] Activity participants may submit a request for revision of the methodology following the "Procedure: Development, revision and clarification of methodologies and methodological tools" (A6.4-PROC-METH-001, available at https://unfccc.int/sites/default/files/resource/A6.4-PROC-METH-001.pdf) to allow the this methodology to be applied in combination with other approved methodologies.

18. The above provisions shall be demonstrated as follows:

    (a) The provisions in paragraphs 11, 12, 14 and 16 be demonstrated in the Project Design Document (PDD) and be assessed at the initial validation;

    (b) The provisions in paragraphs 13 and 17 above shall be demonstrated in each monitoring report and be assessed at each verification;

    (c) The provisions in paragraph 15 may be demonstrated in the PDD and assessed at the validation or demonstrated in the first monitoring report and assessed at the first verification.

19. The applicability conditions included in the methodological tools referred to in paragraph 9 above also apply.

5. Project boundary

20. The project boundary shall include the site where the LFG is captured and, as applicable:

    (a) Sites where the LFG is flared or used (e.g., flare, power plant, boiler, air heater, glass melting furnace, kiln, natural gas distribution network, dedicated pipeline or biogas processing facility);

    (b) Captive power plant(s) (including emergency diesel generators) or power generation sources connected to the grid, which are supplying electricity to the Article 6.4 activity;

    (c) Captive power plant(s) (including emergency diesel generators) or power generation sources connected to the grid, which are supplying electricity in the baseline scenario that is displaced by electricity generated by captured LFG in the project scenario;

    (d) Heat generation equipment or sources which are supplying heat in the baseline scenario that is displaced by heat generated by captured LFG in the project scenario; and

    (e) The transportation equipment of the LFG or biomethane from the biogas processing facility to consumers;

    (f) Consumers of the LFG or biomethane.

21. The project boundary of the Article 6.4 activity is defined by the emission sources illustrated in the figure and listed in the table below. Note that the table also specifies the circumstances under which some emission sources are included or excluded.

Figure 1. Project boundary

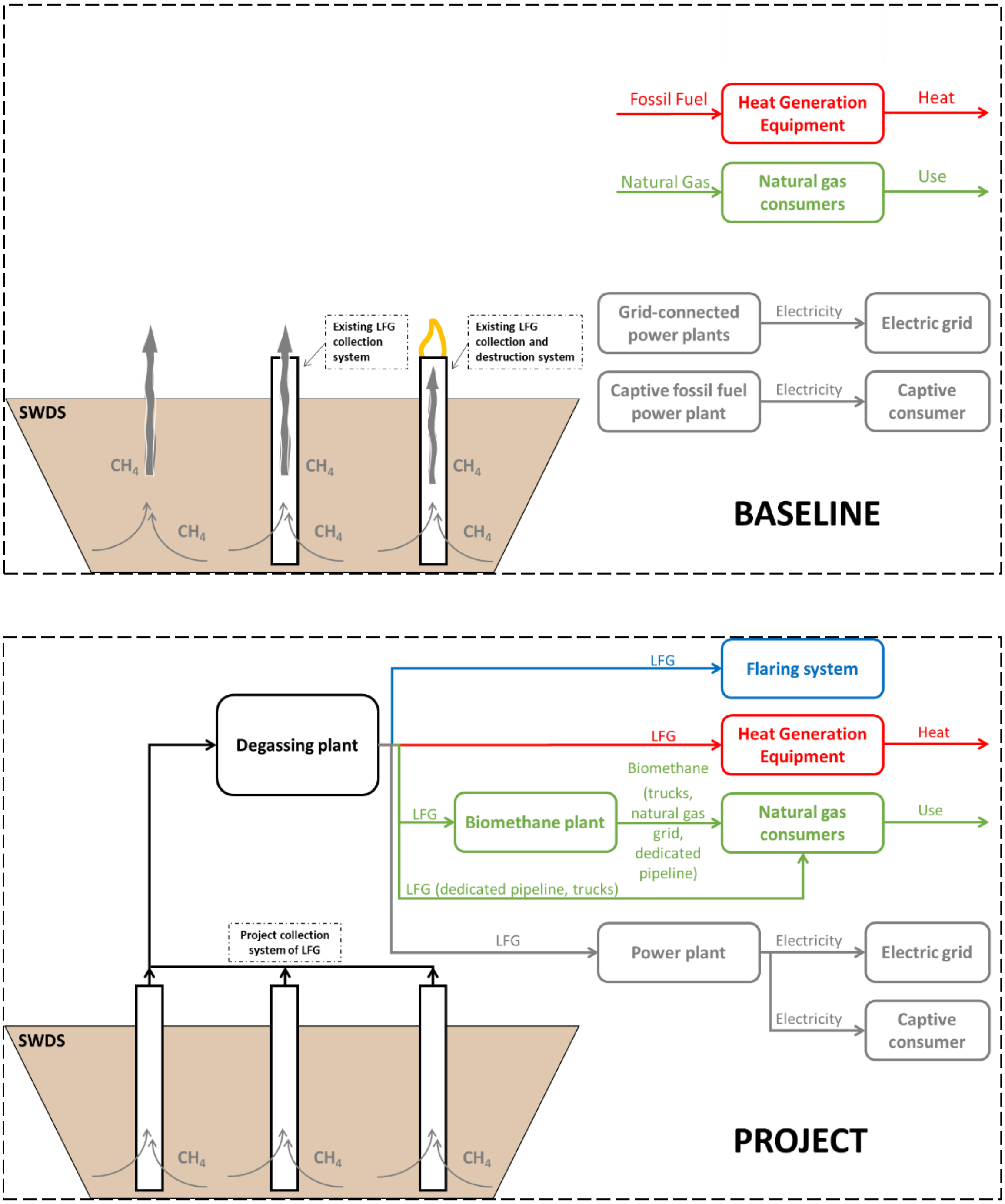

Table 1. Emissions sources included in or excluded from the project boundary

	Source	GHG	Included?	Controlled / Related to / Affected by?	Justification / Explanation
BASELINE SCENARIO	Emissions from decomposition of waste in the SWDS (venting or flaring)	CO_2	No		Not accounted for since the CO_2 is also released in the Article 6.4 activity scenario
		CH_4	Yes	Controlled	Major emission source
		N_2O	No		Emissions are small compared to CH_4 emissions from SWDS and exclusion is conservative
	Emissions from electricity generation by power plants connected to the electric grid or captive power plant(s) displaced by the Article 6.4 activity	CO_2	Yes	Affected by	Major emission source if the project involves the generation of electricity using LFG
		CH_4	No		Excluded for simplification and conservativeness
		N_2O	No		Excluded for simplification and conservativeness
	Emissions from heat generation displaced by Article 6.4 Activity	CO_2	Yes	Related to	Major emission source if the project involves the generation of heat using LFG
		CH_4	No		Excluded for simplification and conservativeness
		N_2O	No		Excluded for simplification and conservativeness
	Emissions from the use of natural gas by consumers	CO_2	Yes	Related to	Major emission source if the project involves the supply of biomethane or LFG to consumers
		CH_4	No		Excluded for simplification and conservativeness
		N_2O	No		Excluded for simplification and conservativeness
ARTICLE 6.4 ACTIVITY SCENARIO	Emissions from on-site fossil fuel consumption for purposes other than electricity generation	CO_2	Yes	Controlled	Significant emission source if fossil fuels are consumed to operate the project
		CH_4	Yes	Controlled	Accounted for in the emission factor for equivalent CO_2 emissions
		N_2O	Yes	Controlled	Accounted for in the emission factor for equivalent CO_2 emissions
	Emissions from on-site electricity consumption	CO_2	Yes	Controlled	Significant emission source if electricity is consumed to operate the project
		CH_4	No		Excluded for simplification
		N_2O	No		Excluded for simplification

	Source	**GHG**	**Included?**	**Controlled / Related to / Affected by?**	**Justification / Explanation**
	Emissions from flaring of LFG	CO_2	No		Not accounted (biogenic)
		CH_4	Yes	Controlled	Significant emission source
		N_2O	No		Excluded for simplification
	Emissions from distribution of biomethane using trucks or through the natural gas distribution network	CO_2	Yes	Controlled Related to	"Controlled" emission source from the consumption of fuel by trucks; "Related to" emission source from the use of biomethane by consumers
		CH_4	Yes	Controlled Related to	"Controlled" emission source from the consumption of fuel by trucks; "Related to" emission source from the use of biomethane by consumers
		N_2O	No		Excluded for simplification
	Emissions from distribution of biomethane or LFG to consumers using dedicated pipelines	CO_2	Yes	Controlled	Significant emission source
		CH_4	Yes	Controlled	Significant emission source
		N_2O	No		Excluded for simplification
LEAKAGE	Upstream emissions	CO_2	Yes	Affected by	Included in LCA analysis
		CH_4	Yes	Affected by	Included in an LCA analysis
		N_2O	Yes	Affected by	Included in an LCA analysis

22. Activity participants shall include in the PDD the location of the Article 6.4 activity in the form of Keyhole Markup Language (KML) files or similar formats as one or more polygon(s), by specifying the coordinates of the geographic boundary using a known coordinate system or any other established method.

6. Demonstration of additionality

23. To demonstrate additionality, activity participants shall apply:

(a) A regulatory analysis (section 6.1 below);

(b) A lock-in analysis (section 6.2 below);

(c) An investment analysis (section 6.3.1 below); and

(d) A common practice analysis (section 6.3.2 below).

24. The proposed Article 6.4 activity shall only be considered additional if all four analyses are concluded positively.

6.1. Regulatory analysis

25. Activity participants shall demonstrate and justify, based on a review of legal requirements on environmental and waste management applicable to the host country and the proposed Article 6.4 activity, that the emission reductions resulting from the Article 6.4 activity would not occur as a result of any of these legal requirements (unless the law or regulation refers to or formally integrates the mechanism as an instrument for implementation)[9] by confirming that these legal requirements do not:

(a) Explicitly require SWDSs to install an LFG capturing and flaring system, or an LFG capturing and utilization system;

(b) Include requirements for the treatment of waste in SWDSs which can only be achieved by either collecting and flaring LFG or collecting and utilizing the LFG for energy purposes;

(c) Prohibit the use of specific waste treatment technologies (e.g., incineration) and mandate the collection, flaring and/or utilization of the LFG for energy as part of a waste treatment technology or practice;

(d) Establish a support scheme that:

(i) Is designed to achieve a quantitative target for methane destruction in SWDSs;

(ii) Is applicable to the collection of LFG and its destruction in flares and/or use; and;

(iii) Would likely result in the same amount of emission reductions if the Article 6.4 activity was not implemented.

26. If one or more of the legal requirements listed in paragraph 25 applies to the Article 6.4 activity, then A6.4ERs cannot be claimed for emission reductions that result from meeting any such legal requirement(s). However, A6.4ERs may be claimed with respect to any emission reductions that are achieved in excess of legal requirement(s).

27. Activity participants shall update the regulatory analysis annually to reflect any changes in legal requirements and update the parameter $F_{CH4,BL,y}$ as per section 7.3.2.1.3 below accordingly.

6.2. Avoidance of locking-in the level of emissions

28. Article 6.4 activities implemented at closed SWDSs and Article 6.4 activities implemented at new SWDSs, and otherwise eligible under this mechanism methodology, are deemed to not have a lock-in risk. This assessment is based on the following considerations: in the case of closed SWDSs, no more waste is added to the landfill and the implementation of the activity does not prolong the lifetime for which emissions occur but rather reduces them. In the case of Article 6.4 activities implemented at new SWDSs, the mechanism methodology requires determining the best available technology as the baseline, where the lowest emission technology is selected among those that are economically viable. This

[9] For example, if the regulations explicitly mention that utilizing the Article 6.4 and its generated revenues are to be used as incentives to achieve the emission reductions in a specific sector.

requirement prevents the Article 6.4 activity from implementing a technology that is not among the lowest emissions technologies that are available.

29. For SWDS that are not yet closed, activity participants shall conservatively demonstrate in the PDD, based on credible evidence and validated by the DOE at the renewal of each crediting period, that the revenues from A6.4 ERs will not prolong the reliance on landfilling practices to treat the solid waste by justifying that implementation of the Article 6.4 activity and the associated revenues do not create or exacerbate barriers to the implementation of alternative, lower-emission waste management practices necessary to achieve the host country’s national or sub-national strategies, NDCs, and LT-LEDS (if available) regarding the long-term transition of the waste sector, including targets for waste diversion, recycling, and composting in the relevant geographical area.

30. The mechanism methodology includes provisions to the downward adjustment in section 7.4 that strongly encourage the adoption of landfill gas utilization instead of landfill gas flaring over time. This encourages ambition and contributes to reducing the lock-in risk associated with Article 6.4 activities involving LFG flaring in existing and new SWDSs under this mechanism methodology. Moreover, this mechanism methodology mandates an investment comparison analysis for Article 6.4 activities involving LFG flaring in cases where alternative scenarios generate revenues (i.e., energy recovery scenarios). This ensures that Article 6.4 activities involving LFG flaring will not prevent the implementation of lower-emission technologies that are financially attractive, which contributes to reducing lock-in risks.

6.3. Investment analysis and common practice analysis

6.3.1. Investment analysis

31. Under this mechanism methodology, investment analysis shall be conducted by activity participants following the provisions of the investment analysis tool.

32. In applying the tool, activity participants shall:

(a) Identify realistic and credible alternative scenarios to the proposed Article 6.4 activity, which shall include, but not be limited to, the following:

(i) For the capture and destruction of the LFG:

a. LFG1: The Article 6.4 activity is implemented without being registered under the Article 6.4 mechanism (i.e., capture and flaring or use of LFG);

b. LFG2: Atmospheric release of the LFG in a managed or unmanaged SWDS;

c. LFG3: Capture of LFG in a managed SWDS and destruction through flaring to comply with regulations or contractual requirements, to address safety and odour concerns, or for other reasons;

d. LFG4: LFG generation is partially avoided because part of the organic fraction of the solid waste is recycled and not disposed in the SWDS;

e. LFG5: LFG generation is partially avoided because part of the organic fraction of the solid waste is treated aerobically and not disposed in the SWDS;

f. LFG6: LFG generation is partially avoided because part of the organic fraction of the solid waste is incinerated and not disposed in the SWDS.

(ii) For the electricity generation:

a. E1: Electricity generation from LFG, undertaken without being registered under the Article 6.4 mechanism;

b. E2: Electricity generation in existing or new renewable or fossil fuel based captive power plant(s);

c. E3: Electricity generation in existing and/or new grid-connected power plants.

(iii) For the heat generation:

a. H1: Heat generation from LFG, undertaken without being registered under the Article 6.4 mechanism;

b. H2: Heat generation in existing or new fossil fuel fired cogeneration plant(s);

c. H3: Heat generation in existing or new renewable based cogeneration plant(s);

d. H4: Heat generation in existing or new fossil fuel-based boiler(s), air heater(s), glass melting furnace(s) or kiln(s);

e. H5: Heat generation in existing or new renewable energy-based boiler(s), air heater(s), glass melting furnace(s) or kiln(s);

f. H6: Any other source, such as district heat; and

g. H7: Other heat generation technologies (e.g., heat pumps or solar energy).

(iv) For the supply of LFG or biomethane to consumers, the baseline is assumed to be the supply with natural gas.

(b) Use the investment comparison analysis or, if the only alternative to the proposed Article 6.4 activity is the continuation of the current situation prior to the implementation of the Article 6.4 activity, use the benchmark analysis;

(c) Use the net present value (NPV) as financial indicator where the investment comparison analysis is applied and choose an appropriate indicator where the benchmark analysis is applied, such as internal rate of return (IRR) or NPV;

(d) Assume that the Article 6.4 activity could be implemented by either the activity participants or other entities, unless activity participants can demonstrate that in the specific context of the proposed Article 6.4 activity that it can only be implemented by the activity participants and not by any other entities.

33. In conducting the sensitivity analysis, apply a variation of at least +/- 10 per cent to the input values which constitute more than 20 per cent of the total costs or total revenues.

6.3.2. Common practice analysis

34. When conducting the common practice analysis, the following activities are defined as possible Article 6.4 project activities:

(a) Activity 1: LFG capture and flaring;

(b) Activity 2: LFG capture and use for electricity generation;

(c) Activity 3: LFG capture and use for heat generation;

(d) Activity 4: LFG capture, supply of LFG or biomethane to consumers;

(e) Activity 5: Any combination of Activities 2 to 4 above.

35. Activity participants shall assess common practice by applying the common practice tool. The following specific guidance shall be followed when applying the different steps in the tool:

(a) **Specification of the approach for common practice analysis:** Approach A, which is based on identification of existing ‘comparable activities’ and differentiation between ‘similar’ and ‘different’ activities, shall be used for the common practice analysis;

(b) **Specification of the indicator of common practice:** a count-based indicator of common practice shall be used in the analysis, based on, for example, the number of SWDSs or the number of incineration plants;

(c) **Sample basis to be used in the analysis:** a stock-based approach shall be used in the common practice analysis, considering all operational SWDSs at the time of the common practice analysis;

(d) **Identification of the applicable geographical area:** the applicable geographical area is the host country. If the applicable geographical area is different than the geographical reference area used to determine the baseline geographical reference area, this should be justified;

(e) **Relevance of scale or capacity in the common practice analysis:** the capacity or scale of the different activity types shall be considered relevant for the common practice analysis. The scale of output for the SWDS and the output capacity of the technologies involved in the different types of activities are:

(i) Activity 1: the capacity does not apply;

(ii) Activities 2, 3, 4, and 5: +/- 50 per cent of the daily waste received by the SWDS.

(f) **Identifying comparable activities:** activities shall be considered comparable to the Article 6.4 activity if they treat a comparable type of waste (e.g., municipal waste) as the proposed Article 6.4 activity, whether they use the same or different technologies (e.g., landfilling, composting, incineration, recycling, etc.).

(g) **Distinguishing between similar and different activities:** the differentiation between similar and different activities is based on the type of measure (LFG destruction and/or energy recovery) applied in the geographical area. Therefore, similar activities under this mechanism methodology shall be identified as follows:

(i) For Activity 1: managed SWDSs with a passive or active LFG collection system and methane destruction and/or energy recovery (e.g., flaring, electricity generation, heat generation, supply of LFG or biomethane to consumers);

(ii) For Activities 2, 3 and 4: managed SWDSs with a passive or active LFG collection system and energy recovery (e.g., electricity generation, heat generation, supply of LFG or biomethane to consumers; but not flaring).

(h) **Determining the common practice threshold (F_{max}):** the common practice factor thresholds to be applied under this mechanism methodology are 16 per cent[10] for Article 6.4 activities located in non-LDCs/SIDS, and 20 per cent for Article 6.4 activities located in LDCs/SIDS.

36. The Article 6.4 activity is only additional if it is demonstrated that:

(a) Emission reductions or net removals resulting from an Article 6.4 activity would not occur as a result of the legal requirements, per section 6.1 above; and

(b) The Article 6.4 activity is not financially viable, per section 6.3.1 above; and

(c) The Article 6.4 activity is not common practice, per section 6.3.2 above.

7. Baseline scenario

7.1. Identification of components and sub-components of the Article 6.4 activity

37. The determination of the baseline scenario and baseline emissions is conducted separately for different components of the Article 6.4 activity. In this mechanism methodology, the following components and sub-components are differentiated:

(a) **Methane component:** This refers to the baseline methane emissions from the SWDS;

(b) **Electricity generation component:** This applies to Article 6.4 activities that involve electricity generation and refers to baseline emissions from electricity generation, differentiating between the following sub-components:

(i) The Article 6.4 activity supplies electricity to the grid;

(ii) The Article 6.4 activity replaces electricity that would be generated in existing captive fossil fuel fired power plants;

(iii) The Article 6.4 activity replaces electricity that would be generated in new captive fossil fuel fired power plants.

[10] Value proposed based on the threshold of moving from early adopters to early majority as identified in the Roger diffusion curve (Rogers, 2003).

(c) **Heat generation component:** This applies to Article 6.4 activities that involve heat generation and refers to baseline emissions from heat generation, differentiating between the following sub-components:

(i) The Article 6.4 activity replaces heat that would be generated in an existing piece of equipment;

(ii) The Article 6.4 activity replaces heat that would be generated in a new piece of equipment.

(d) **Supply of LFG or biomethane to consumers component:** This applies to Article 6.4 activities that supply LFG or biomethane produced from the LFG to consumers, differentiating between the following sub-components:

(i) The Article 6.4 activity supplies biomethane produced from the LFG to consumers through a natural gas distribution network;

(ii) The Article 6.4 activity supplies the LFG, or the biomethane produced from the LFG to consumers via trucks;

(iii) The Article 6.4 activity supplies the LFG, or the biomethane produced from the LFG to consumers through a dedicated pipeline.

38. Activity participants shall specify in the PDD which components and sub-components apply to their project. Note that the methane component applies to all Article 6.4 activities using this mechanism methodology, while the other components or sub-components may or may not apply. Further note that Article 6.4 activities may involve different combination of components or sub-components.

7.2. Selection of the baseline approaches from paragraph 36 of the rules, modalities and procedures

39. The selected approach to determine the baseline for the different possible components of Article 6.4 activities eligible under the mechanism methodology are:

(a) For the methane component:

(i) For Article 6.4 activities developed in existing SWDSs, the baseline is determined through existing actual or historical emissions (paragraph 36(iii) of the RMPs) because data from existing SWDS is strongly heterogeneous and emissions are highly activity- or site-specific (e.g., SWDSs located in humid regions tend to have higher methane generation rates when compared with SWDSs located in dry regions);

(ii) For Article 6.4 activities developed in new SWDSs, the baseline is determined based on the best available technology that represents an economically feasible and environmentally sound course of action (paragraph 36(i) of the RMPs) because the activity (treatment of solid waste in a new SWDS) using alternative technologies for waste treatment (such as waste incineration, composting, pyrolysis, gasification, etc.) provides reasonably homogeneous outputs (i.e., waste treated) for the same pool of users (i.e., the population served by the SWDS).

(b) For the electricity generation component:

(i) If the electricity generated by the Article 6.4 activity is supplied to the grid, the baseline is determined through existing actual or historical emissions (paragraph 36(iii) of the RMPs);

(ii) If the electricity generated by the Article 6.4 activity replaces the electricity generated in an existing captive fossil fuel fired power plants, the baseline is determined through existing actual or historical emissions (paragraph 36(iii) of the RMPs). The approach shall apply until the end of the remaining lifetime[11] of the baseline equipment;

(iii) After the end of the remaining lifetime of the baseline equipment, or if the electricity generated by the Article 6.4 activities replaces the electricity generated in new captive fossil fuel fired power plants, the baseline is determined through the best available technology that represents an economically feasible and environmentally sound course of action (paragraph 36(i) of the RMPs).

(c) For the heat generation component:

(i) If the heat generated from the LFG or the biomethane is replacing heat generated in existing piece of equipment, the baseline is determined through existing actual or historical emissions (paragraph 36(iii) of the RMPs) because emissions per ton of heat generated are highly activity- or site-specific and because the type and characteristics of the heat produced depends on its usage (e.g., hot air, high-pressure steam, low-pressure steam, hot water, etc.) and the fuel type used (e.g., coal, diesel, natural gas, etc.). The approach shall apply until the end of the remaining lifetime[11] of the baseline equipment;

(ii) After the end of the remaining lifetime of the baseline equipment, or if the heat generated from the LFG or the biomethane is replacing heat produced in a new piece of equipment, the baseline is determined based on the best available technology that represents an economically feasible and environmentally sound course of action (paragraph 36(i) of the RMPs) because the emissions per unit of output (i.e., tCO_2e/unit of output such as tonnes of steam, tonnes of hot water, tonnes of brick, tonnes of melted glass, etc.) are determined primarily by the technology(ies) and/or practice(s) used in the Article 6.4 activity (e.g., boiler, glass melting furnace, water heater, air heater, brick kiln, etc.). In addition, the same output is provided for the same pool of users by the activity and by other technologies and/or practices (i.e., a boiler is used to produce steam or hot water; a brick kiln is used to produce bricks; a glass melting furnace is used to produce melted glass; etc.).

(d) For the supply of LFG or biomethane to consumers component, the baseline is determined through existing actual or historical emissions (paragraph 36(iii) of the RMPs).

[11] The remaining lifetime is determined as a difference between the technical lifetime provided by the manufacturer and the operational time since the commissioning of the equipment.

7.3. Application of the selected approach, prior to implementation of a downward adjustment

7.3.1. Procedure for the identification of the baseline scenario

40. The baseline scenario for the different components of Article 6.4 activities eligible under the mechanism methodology are described in the table below:

Table 2. Baseline scenario for different components of Article 6.4 activities eligible under the mechanism methodology

Component	Baseline approach	Baseline scenario
LFG – Article 6.4 activities implemented in an existing SWDS	Existing actual or historical emissions	The continuation of the pre-activity scenario, i.e., the methane generated is emitted to the atmosphere or is partially captured and/or partially destroyed
LFG – Article 6.4 activities implemented in new SWDS	Best available technologies that represent an economically feasible and environmentally sound course of action	Determined based on section 7.3.1.1 below
Electricity generation and supply to the electric grid	Existing actual or historical emissions (grid emission factor)	The continuation of the pre-activity scenario, i.e. the electricity would have been generated by existing power plants connected to the same electricity grid
Electricity generation replacing electricity generated in an existing captive fossil fuel fired power plant	Existing actual or historical emissions	The continuation of the pre-activity scenario, i.e. the electricity would have been generated in the existing captive fossil fuel power plant using the same fossil fuel up to the end of the remaining lifetime of the captive fossil fuel fired power plant. After the end of the lifetime of the captive fossil fuel fired power plant, the baseline shall be determined based on BAT
Electricity generation replacing electricity generated in new captive fossil fuel fired power plant	Best available technologies that represent an economically feasible and environmentally sound course of action	Determined based on section 7.3.1.3 below

Component	Baseline approach	Baseline scenario
Heat generation replacing heat generated in an existing equipment	Existing actual or historical emissions	The continuation of the pre-activity scenario, i.e. the heat would be generated in the same heat generation equipment using the same fuels up to the end of the remaining lifetime of the heat generation equipment. After the end of the lifetime of the heat generation equipment, the baseline shall be determined based on BAT
Heat generation replacing heat generated in new equipment	Best available technologies that represent an economically feasible and environmentally sound course of action	Determined based on section 7.3.1.4 below
Supply of LFG or biomethane to consumers	Existing actual or historical emissions	The continuation of the pre-activity scenario, i.e., consumers would be supplied with natural gas from the network

7.3.1.1. Identification of the baseline scenario for Article 6.4 activities implemented in a new SWDS

41. Activity participants shall determine the best available technology and economically feasible and environmentally sound course of action for Article 6.4 activities implemented in a new SWDS based on the stepwise process described below.

7.3.1.2. Step 1: Identification of the baseline geographical reference area

42. The baseline geographical reference area is the host country by default.

43. Activity participants may choose to limit the baseline geographical reference area to a narrower specific geographical area (such as municipality, province, states, etc.) within the host country if they can demonstrate and justify that there are essential distinctions between the identified specific geographical area and rest of the host country. For example, such distinctions may include certain benefits that make the Article 6.4 activity financially/economically more attractive (e.g., subsidies or other financial flows), different climatic conditions, or unfeasible distances to transport the solid waste.

7.3.1.2.1. Step 2. Identification of technologies and/or practices available in the baseline geographical reference area

44. Activity participants shall identify the technologies and/or practices, including combinations of technologies and/or practices, that are available for solid waste treatment in the baseline geographical reference area, and which can deliver the same solid waste treatment capacity.

45. Available technologies and/or practices are those that are accessible off the shelf, via a tendering or direct contracting process, or by direct implementation by an end user within the boundary of potential Article 6.4 activities.

46. Technologies and/or practices that may be available for solid waste treatment include, but are not limited to:

(a) Disposal in a managed SWDS, with and without LFG collection and destruction;

(b) Incineration of solid waste, with and without energy recovery;

(c) Composting of solid waste;

(d) Production of residue derived fuel (RDF);

(e) Treatment of solid waste in anaerobic reactors, with and without recovery of the biogas for energy generation;

(f) Gasification of solid waste, with and without energy recovery;

(g) Pyrolysis of solid waste, with and without energy recovery; and

(h) Treatment of the solid waste using plasma.

7.3.1.2.2. Step 3. Identification of the environmentally sound technologies

47. Out of the technologies and/or practices identified as available in Step 2 above, activity participants shall exclude from the analysis those that are not in line with legal requirements in the applicable baseline geographical reference area. For example, this may apply to waste treatment facilities that are not in compliance with limits or thresholds for atmospheric emissions (e.g., NOx, VOCs, particulates and black carbon, etc.), the proper management of leachate and wastewater, the proper management of odour, and the proper management of noise.

7.3.1.2.3. Step 4. Identification of the economically viable technologies

48. Out of the technologies and/or practices that are identified as environmentally sound in Step 3 above, activity participants shall further identify those that are deemed economically viable (i.e., those that provide sufficient returns to cover investment, operations, and maintenance costs).

49. Technologies and/or practices are deemed economically viable if they:

(a) Have been implemented under prevailing market conditions without significant subsidies by at least one facility within the applicable baseline geographical reference area without the revenues from carbon credits or other incentives; or

(b) Are accessible off the shelf or via tendering within the applicable baseline geographical reference area, on terms that are economically viable when compared against a benchmark.

50. To identify the economic viability of a technology or practice under paragraph 49(b), activity participants shall conduct an investment analysis (using benchmark analysis approach) following the same requirements used for the additionality demonstration as per section 6.3.1 above and shall:

(a) Collect relevant information directly from technology or practice suppliers; or

(b) Demonstrate that it is not possible to collect relevant information directly from technology or practice suppliers. In this case, activity participants:

(i) May determine costs from similar facilities located outside of the baseline geographical reference area, or from peer reviewed studies and papers; and

(ii) Shall provide proper justification that any such information can reasonably be applied in the baseline geographical reference area.

7.3.1.2.4. Step 5. Define the emissions intensity of each of the remaining technologies

51. Out of the economically viable technologies and/or practices identified in Step 4, activity participants shall determine the emissions intensity per tonne of waste treated and shall:

(a) Collect relevant information directly from technology or practice suppliers; or

(b) Demonstrate that it is not possible to collect relevant information directly from technology or practice suppliers. In this case, activity participants:

(i) May determine the emissions intensity from similar facilities located outside of the baseline geographical reference area, or from peer reviewed studies and papers; and

(ii) Shall provide proper justification that any such information can reasonably be applied in the baseline geographical reference area.

52. In case managed SWDSs are identified by the analysis required under Steps 3 and 4 above, then the emission intensity of any managed SWDSs shall be determined as follows:

(a) Identify the following:

(i) (A): The estimated methane generated using the solid waste tool throughout the total duration of the crediting period (i.e., 10 or 15 years, as applicable);

(ii) (B): The GWP of methane;

(iii) (C): The average collection efficiency of an LFG destruction system; and

(iv) (D): Either a parameter describing the methane destruction efficiency of a flare or 100 per cent for energy utilization, as applicable;

(v) (E): The amount of waste that would be delivered to the SWDS through the total duration of the crediting period (i.e., 10 or 15 years, as applicable).

(b) Calculate the emissions intensity as [A x B x C x (1 – D) + A x B x (1 – C)] / E.

7.3.1.2.5. Step 6. Selection of the Best Available Technology

53. The technology that constitutes the BAT is the one with the lowest emission intensity among those that are economically feasible and environmentally sound.

7.3.1.3. Identification of the baseline scenario for electricity generation replacing electricity generated in new captive fossil fuel fired power plants

54. Activity participants shall determine the best available technology and economically feasible and environmentally sound course of action for Article 6.4 activities that involve

the electricity generation replacing the electricity generated in new captive fossil fuel fired power plants based on the stepwise process described below:

7.3.1.3.1. Step 1: Identification of the geographical area

55. The geographical area by default is the host country by default.

56. Activity participants may choose to limit the baseline geographical reference area to a narrower specific geographical area (e.g., a municipality, province, or state) within the host country if they can demonstrate and justify that there are essential distinctions between the identified specific geographical area and rest of the host country. For example, such distinctions may include certain benefits that make the Article 6.4 activity financially/economically more attractive (e.g., subsidies or other financial flows).

7.3.1.3.2. Step 2. Identification of technologies and/or practices available in the geographical area

57. Activity participants shall identify the technologies and/or practices, including combinations of technologies and/or practices, that:

(a) Are available in the baseline geographical reference area for electricity generation;

(b) Generate electricity in the same electrical grid and/or to serve the same users from the Article 6.4 activity; and

(c) Have the similar generation capacity with up to +/- 15 per cent difference; and

(d) Activity participants shall indicate the type of fuel used.

58. Available technologies and/or practices are those that are accessible off the shelf, via a tendering or direct contracting process, or by direct implementation by an end user within the boundary of potential Article 6.4 activities.

7.3.1.3.3. Step 3. Identification of the environmentally sound technologies available in the geographical area

59. Out of the technologies and/or practices identified in Step 2 above, activity participants shall exclude from the analysis those that are not in line with legal requirements in the applicable geographical reference area. For example, this may apply to power plants that are not in compliance with limits or thresholds for atmospheric emissions (NOx, VOCs, particulates and black carbon, etc).

7.3.1.3.4. Step 4. Identification of economically viable technologies in the geographical area

60. Out of the technologies and/or practices that identified as environmentally sound in Step 3 above, activity participants shall further identify those that are deemed economically viable (i.e., those that provide sufficient returns to cover investment, operations, and maintenance costs).

61. Out of the technologies and/or practices that are identified as environmentally sound in Step 3 above, activity participants shall further identify those that are deemed economically viable (i.e., those that provide sufficient returns to cover investment, operations, and maintenance costs).

62. Technologies and/or practices are deemed economically viable if they:

(a) Have been implemented by at least one facility within the applicable baseline geographical reference area without the revenues from carbon credits or other incentives; or

(b) Are accessible off the shelf or via tendering within the applicable baseline geographical reference area, on terms that are economically viable when compared against a benchmark.

63. To identify the economic viability of a technology or practice under paragraph 62(b), activity participants shall conduct an investment analysis following the same requirements used for the additionality demonstration as per section 6.3.1 above and shall:

(a) Collect relevant information directly from technology or practice suppliers; or

(b) Demonstrate that it is not possible to collect relevant information directly from technology or practice suppliers. In this case, activity participants:

(i) May determine costs from similar facilities located outside of the baseline geographical reference area, or from peer reviewed studies and papers; and

(ii) Shall provide proper justification that any such information can reasonably be applied in the baseline geographical reference area.

7.3.1.3.5. Step 5. Define the emissions intensity of each of the remaining technologies

64. Out of the technologies and/or practices identified as economically viable in Step 4, activity participants shall determine the emissions intensity per unit of electricity generated (i.e., tCO_2e/MWh), taking into account the different types of fuels used to generate electricity.

65. Activity participants shall:

(a) Collect relevant information directly from technology or practice suppliers; or

(b) Demonstrate that it is not possible to collect relevant information directly from technology or practice suppliers. In this case, activity participants:

(i) May determine the emissions intensity from similar facilities located outside of the baseline geographical reference area, or from peer reviewed studies and papers; and

(ii) Shall provide proper justification that any such information can reasonably be applied in the baseline geographical reference area.

7.3.1.3.6. Step 6. Selection of the BAT

66. The technology that constitutes the BAT is the one with the lowest emission intensity among those that are economically feasible and environmentally sound.

7.3.1.4. Identification of the baseline scenario for heat generation replacing heat generated in new equipment

67. Activity participants shall determine the best available technology and economically feasible and environmentally sound course of action for Article 6.4 activities that involve

the heat generation replacing heat generated in new equipment based on the stepwise process described below.

7.3.1.4.1. Step 1: Identification of the geographical area

68. The geographical area by default is the host country.

69. Activity participants may choose to limit the baseline geographical reference area to a narrower specific geographical area (such as municipality, province, states, etc.) within the host country if they can demonstrate and justify that there are essential distinctions between the identified specific geographical area and rest of the host country. For example, such distinctions may include certain benefits that make the Article 6.4 activity financially/economically more attractive (e.g., subsidies or other financial flows).

7.3.1.4.2. Step 2. Identification of technologies and/or practices available in the geographical area

70. Activity participants shall identify the technologies and/or practices, including combinations of technologies and/or practices, that:

    (a) Are available for heat generation in the baseline geographical reference area;

    (b) Generate the same type of output produced by the Article 6.4 activity (e.g., hot water, hot air, saturated steam, overheated steam, brick, melted glass);

    (c) Deliver heat to the same pool or users from the Article 6.4 activity (e.g., a specific industrial process, or customer class);

    (d) Have similar capacity with up to +/- 15 per cent difference; and

    (e) Indicate the type of fuel used.

71. Available technologies and/or practices are those that are accessible off the shelf, via a tendering or direct contracting process, or by direct implementation by an end user within the boundary of potential Article 6.4 activities.

7.3.1.4.3. Step 3. Identification of the environmentally sound technologies available in the geographical area

72. Out of the technologies and/or practices identified as available in Step 2 above, activity participants shall exclude from the analysis those that are not in line with legal requirements in the applicable baseline geographical reference area. For example, this may apply to heat generation facilities that are not in compliance with limits or thresholds for atmospheric emissions (NOx, VOCs, particulates and black carbon, etc).

7.3.1.4.4. Step 4. Identification of economically viable technologies in the geographical area

73. Out of the technologies and/or practices that are identified as environmentally sound in Step 3 above, activity participants shall further identify those that are deemed economically viable (i.e., those that provide sufficient returns to cover investment, operations, and maintenance costs).

74. Technologies and/or practices are deemed economically viable if they:

(a) Have been implemented by at least one facility within the applicable baseline geographical reference area without the revenues from carbon credits or other incentives; or

(b) Are accessible off the shelf or via tendering within the applicable baseline geographical reference area, on terms that are economically viable when compared against a benchmark.

75. To identify the economic viability of a technology or practice under paragraph 74(b) above, activity participants shall conduct an investment analysis (using benchmark analysis approach) following the same requirements used for the additionality demonstration as per section 6.3.1 above and shall:

(a) Collect relevant information directly from technology or practice suppliers; or

(b) Demonstrate that it is not possible to collect relevant information directly from technology or practice suppliers. In this case, activity participants:

(i) May determine costs from similar facilities located outside of the baseline geographical reference area, or from peer reviewed studies and papers; and

(ii) Shall provide proper justification that any such information can reasonably be applied in the baseline geographical reference area.

7.3.1.4.5. Step 5. Define the emissions intensity of each of the remaining technologies

76. Out of the technologies and/or practices identified as economically viable in Step 4, activity participants shall determine the emissions intensity per unit of the output produced identified in Step 2 above (e.g., tonnes of CO_2 per tonnes of hot water, steam, brick glass, etc.), taking into account the different types of fuels used to generate the heat, and shall:

(a) Collect relevant information directly from technology or practice suppliers; or

(b) Demonstrate that it is not possible to collect relevant information directly from technology or practice suppliers. In this case, activity participants:

(i) May determine the emissions intensity from similar facilities located outside of the baseline geographical reference area, or from peer reviewed studies and papers; and

(ii) Shall provide proper justification that any such information can reasonably be applied in the baseline geographical reference area.

7.3.1.4.6. Step 6. Selection of the BAT

77. The technology that constitutes the BAT is the one with the lowest emission intensity among those that are economically feasible and environmentally sound.

7.3.2. Calculation of baseline emissions prior to downward adjustment

78. Baseline emissions prior to the downward adjustment are determined separately for of each of the following sources, as applicable:

(a) Emissions of methane from the SWDS ($BE_{CH4,y}$);

(b) Electricity generation ($BE_{EG,y}$);

(c) Heat generation ($BE_{HG,y}$); and

(d) LFG or biomethane supplied to consumers replacing natural use from a natural gas network ($BE_{NG,y}$).

7.3.2.1. Baseline emissions of methane from the SWDS (*$BE_{CH4,y}$*)

79. Baseline emissions of methane from Article 6.4 activities developed in an existing or new SWDS are determined based on the amount of actual methane that is captured under the activity, discounted by the amount that would have been captured and destroyed in the baseline (such as due to legal requirements). In addition, the effect of methane oxidation due to the cover material in the baseline shall be taken into account:

$$BE_{CH4,y} = \left[F_{CH4,PJ,capt,y} \times \left(1 - OX_y\right) - F_{CH4,BL,y}\right] \times GWP_{CH4} \quad \text{Equation (1)}$$

Where:

$BE_{CH4,y}$	=	Baseline emissions of methane from the SWDS in year *y* (t CO_2e/year)
OX_y	=	Fraction of methane in the LFG that would be oxidized in the top layer of the SWDS in the baseline scenario in year *y* (dimensionless)
$F_{CH4,PJ,capt,y}$	=	Amount of methane in the LFG which is collected and sent to flares and/or use under the project scenario in year *y* (t CH_4/year)
$F_{CH4,BL,y}$	=	Amount of methane in the LFG that would be destroyed in the baseline in year *y* (t CH_4/year)
GWP_{CH4}	=	Global warming potential of CH_4 (t CO_2e/t CH_4)

7.3.2.1.1. Ex post determination of *$F_{CH4,PJ,capt,y}$*

80. During the crediting period, $F_{CH4,PJ,capt,y}$ is determined as the sum of the quantities of methane flared, used for electricity or heat generation, and/or supplied to consumers via a natural gas distribution network and/or dedicated pipeline and/or to the trucks, as follows:

$$F_{CH4,PJ,capt,y} = F_{CH4,flared,y} + F_{CH4,EL,y} + \left(F_{CH4,HG,y} \times fd_{CH4,HG,j,default}\right) + F_{CH4,NG,y} \quad \text{Equation (2)}$$

Where:

$F_{CH4,PJ,capt,y}$	=	Amount of methane in the LFG which is collected and sent to flares and/or use under the project scenario in year *y* (tCH_4/year)
$F_{CH4,flared,y}$	=	Amount of methane in the LFG which is flared in year *y* (tCH_4/year)
$F_{CH4,EL,y}$	=	Amount of methane in the LFG or in the biomethane which is used for electricity generation in year *y* (tCH_4/year)

$F_{CH4,HG,y}$	=	Amount of methane in the LFG or in the biomethane which is used for heat generation in year *y* (tCH_4/year)
$fd_{CH4,HG,j,default}$	=	Default value for the fraction of methane destroyed when used for heat generation equipment type *j*
$F_{CH4,NG,y}$	=	Amount of methane in the LFG or in the biomethane which is supplied to consumers via a natural gas distribution network and/or dedicated pipeline and/or trucks in year *y* (tCH_4/year)

81. The parameters $F_{CH4,flared,y}$ is determined as the sum of methane destroyed in the backup flare ($F_{CH4,Backup\text{-}Flare,y}$) and in the Primary flare ($F_{CH4,Primary\text{-}Flare,y}$), as follows:

$$F_{CH4,flared,y} = F_{CH4,Backup-Flare,y} + F_{CH4,Primary-Flare,y} \quad \text{Equation (3)}$$

Where:

$F_{CH4,flared,y}$	=	Amount of methane in the LFG that is flared in year *y* (tCH_4/year)
$F_{CH4,Primary-Flare,y}$	=	Amount of methane in the LFG which is flared in the primary flare in year *y* (tCH_4/year)
$F_{CH4,Backup-Flare,y}$	=	Amount of methane in the LFG which is flared in the backup flare in year *y* (tCH_4/year)

82. The parameters $F_{CH4,BackupFlare,y}$ and $F_{CH4,PrimaryFlare,y}$ are determined as the difference between the amount of methane supplied to the types of flare(s) and any methane emissions from the types of flare(s), as follows:

$$F_{CH4,Primary-Flare,y} = F_{CH4,sent-PrimaryFlare,y} - \frac{PE_{PrimaryFlare,y}}{GWP_{CH4}} \quad \text{Equation (4)}$$

$$F_{CH4,Backup-Flare,y} = F_{CH4,sent-BackupFlare,y} - \frac{PE_{BackupFlare,y}}{GWP_{CH4}} \quad \text{Equation (5)}$$

Where:

$F_{CH4,sent-PrimaryFlare,y}$	=	Amount of methane in the LFG which is sent to the primary flares in year y (tCH_4e /year)
$PE_{Primary-Flare,y}$	=	Project emissions from flaring of the residual gas in the primary flare year *y* (tCO_2e/year), determined as per the flaring tool
$F_{CH4,sent-BackupFlare,y}$	=	Amount of methane in the LFG which is sent to the backup flares in year *y* (tCH_4e /year)
$PE_{Backup-Flare,y}$	=	Project emissions from flaring of the residual gas in the backup flare year *y* (tCO_2e/year), determined as per the flaring tool

83. The parameters $F_{CH4,sent\text{-}PrimaryFlare,y}$, $F_{CH4,sent\text{-}BackupFlare,y}$, $F_{CH4,EL,y}$, $F_{CH4,HG,y}$ and $F_{CH4,NG,y}$ are determined using the mass flow tool and monitoring the working hours, such that no emission reductions are claimed for methane destruction during non-working hours. This is taken into account by monitoring the hours that the equipment utilizing the LFG is operating in year *y* ($Op_{j,h,y}$).

84. The following requirements apply:

(a) As per the mass flow tool, if the LFG is used for multiple purposes (e.g., flaring or energy generation), and all methane destruction devices are verified to be operational (e.g., by means of flame detectors records, energy generated), a single flow meter may be used to record the flow into multiple destruction devices. The destruction efficiency of the least efficient among the destruction devices shall be used as the destruction efficiency for all destruction devices monitored by this flow meter. If there are any periods for which one or more destruction devices are not operational, paragraph 5(a) and (b) of the Appendix of the mass flow tool shall be followed;

(b) CH_4 is the greenhouse gas for which the mass flow should be determined;

(c) The simplification offered for calculating the molecular mass of the gaseous stream is valid (Equations (3) or (17) in the tool);

(d) The mass flow should be calculated on an hourly basis for each hour *h* in year *y*; and

(e) The mass flow calculated for hour *h* is 0 if the equipment is not working in hour *h* ($Op_{j,h}$ = not working), with hourly values summed to a yearly unit basis.

7.3.2.1.2. Determination of OX_y

85. For Article 6.4 activities developed in existing SWDSs, activity participants shall select one of the three options from section 5.3.2 of the solid waste tool to determine this parameter and document the choice in the PDD. If activity participants chose Option 1 or Option 2, the parameter J_{out} (flux of methane leaving the surface, in g_{CH4}/m^2d) shall be included in the monitoring plan, following the monitoring provisions contained in the solid waste tool.

86. For Article 6.4 activities developed in new SWDSs, OX_y shall be based on the default values (Option 3) provided in the solid waste tool.

7.3.2.1.3. Determination of $F_{CH4,BL,y}$

87. This section provides a procedure to determine the amount of LFG that would have been captured and destroyed (by flaring) in the baseline due to legal or contractual requirements, to address safety and odour concerns, or for other reasons (collectively referred to as “requirements” in this section). The four cases in the table below are distinguished. Activity participants shall identify the appropriate case and follow the corresponding instructions. Where the Article 6.4 mechanism is used in the host country as an instrument for implementation of legal or contractual requirements and no other legal or contractual requirements that regulate the flaring of LFG or methane exist, activity participants may apply a value of 0 for $F_{CH4,BL,y}$.

88. For Article 6.4 activities developed in new SWDSs, $F_{CH4,BL,y}$ shall be determined using Case 1 if there are no requirements to capture and destroy LFG or using Case 2 if there are requirements to capture and destroy LFG. If the requirement does not specify a date of entry into force, it would be conservatively assumed that the regulation is enforced; if the date of entry into force is in the future, the requirement must be considered only from the date of entry into force onwards.

Table 3. Cases for determining LFG captured and destroyed in the baseline

Situation at the start of the Article 6.4 activity	Requirements to capture and destroy LFG	Existing LFG capture system
Case 1	No	No
Case 2	Yes	No
Case 3	No	Yes
Case 4	Yes	Yes

7.3.2.1.4. Determining $F_{CH4,BL,y}$ for Case 1

89. In the absence of a requirement to capture and destroy LFG and in the absence of an existing LFG capture and destruction system, $F_{CH4,BL,y} = 0$.

7.3.2.1.5. Determining $F_{CH4,BL,y}$ for Case 2

90. In this situation, $F_{CH4,BL,y} = F_{CH4,BL-case\ 2,y}$, and $F_{CH4,BL-case\ 2,y}$ is determined based on the different scenarios below:

(a) **Scenario A:** If the requirement specifies the absolute amount of LFG ($F_{LFG,BL,R,y}$) that must be flared, then:

$$F_{CH4,BL-case\ 2,y} = F_{LFG,BL,R,y} \quad \text{Equation (6)}$$

(b) **Scenario B:** If the requirement specifies a fraction ($\rho_{reg,y}$) of the captured LFG ($F_{LFG,PJ,capt,y}$) that must be flared, the amount shall be calculated as follows:

$$F_{CH4,BL-case\ 2,y} = \rho_{reg,y} \times F_{LFG,PJ,capt,y} \quad \text{Equation (7)}$$

(c) **Scenario C:** If the requirement does not specify the amount or the fraction of the captured LFG that must be flared but requires the installation of an LFG capture system (which is not yet installed), without requiring the LFG to be flared, then:

$$F_{CH4,BL-case\ 2,y} = 0 \quad \text{Equation (8)}$$

(d) **Scenario D:** if the requirement does not specify the amount or the percentage of the captured LFG that must be flared, but mandates the installation of a passive LFG capture system for safety reasons and flaring the captured LFG, the following options may be applied:

(i) A destruction rate of 40 per cent is assumed:[12]

[12] This default value of 40 per cent is based on assuming a situation in which: the efficiency of the LFG capture system in the activity scenario is 50 per cent; the efficiency of the LFG capture system in the baseline is 20 per cent; and the amount captured in the baseline is flared using an open flare with a destruction efficiency of 100 per cent, as a conservative approach. Activity participants may propose and justify an alternative default value as a request for revision to this methodology.

$$F_{CH4,BL-case\ 2,y} = 0.4 \times F_{LFG,PJ,capt,y}$$ Equation (9)

(ii) Destruction rate is calculated as per the equation below:

$$F_{CH4,BL-case\ 2,y} = \eta_{passive,BL} \times \eta_{flare,BL} \times BE_{CH4,SWDS,y}/GWP_{CH4}$$ Equation (10)

(e) **Scenario E:** If the requirement enforces the captured LFG to be flared without specifying the amount or fraction, no A6.4 ERs can be claimed for any of the components (it is conservatively assumed that an active system with 100 per cent collection efficiency and with a 100 per cent destruction efficiency is implemented).

Where:

$F_{CH4,BL-case\ 2,y}$	=	Amount of methane that would be destroyed in the baseline scenario in year *y* as per Case 2 (tCH_4/year)
$F_{LFG,BL,R,y}$	=	Amount of LFG which is flared in the baseline due to a requirement in year *y* (m^3/year), which is converted to the amount of methane (tCH_4/year) as per paragraph 91 below
$\rho_{reg,y}$	=	Fraction of LFG that is required to be destroyed due to a requirement in year *y*
$F_{LFG,PJ,capt,y}$	=	Amount of LFG which is captured in the project scenario in year *y* (m^3/year), which is converted to the amount of methane (tCH_4/year) as per paragraph 91 below
$\eta_{passive,BL}$	=	Conservative default efficiency for passive LFG capture systems (%). Apply a value of 20 per cent
$\eta_{flare,BL}$	=	Conservative default efficiency for baseline flaring (%). Apply a value of 100 per cent
$BE_{CH4,SWDS,y}$	=	Estimated amount of methane generated by the SWDS in year y (tCH4/year), determined as per paragraph 96 below

91. The following options apply to the approaches from paragraphs 90(a), 90(b) and 90(d) above to determine $F_{LFG,BL,R,y}$ and $F_{LFG,PJ,capt,y}$:

(a) **Option 1:** Calculate the parameter using the mass flow tool, applying the following requirements:

(i) The mass flow tool shall be applied to the LFG pipeline immediately downstream of the LFG capture system and before any split in the gaseous flow to different uses or flares;

(ii) CH_4 is the greenhouse gases for which the mass flow should be determined;

(iii) The simplification offered for calculating the molecular mass of the gaseous stream is valid (Equations (3) or (17) in the tool); and

(iv) The mass flow should be calculated on an hourly basis for each hour *h* in year *y*.

(b) **Option 2:** Calculate the parameter as the sum of the amount of methane that is sent to the flare; used for electricity or heat generation; or provided to consumers through dedicated pipeline, natural gas distribution network, or trucks in year *y*, as determined in section 7.3.2.1.1 above.

7.3.2.1.6. Determining $F_{CH4,BL,y}$ for Case 3

92. In this situation, $F_{CH4,BL,y} = F_{CH4,BL-case\ 3,y}$, and $F_{CH4,BL-case\ 3,y}$ is determined based on the different scenarios below:

(a) Scenario A: If the amount of methane captured with the existing system can be monitored separately from the amount captured under the project, and the efficiency of the existing system is not impacted by the project system during the crediting period(s), then $F_{CH4,BL\text{-}case\ 3,y}$ is determined as follows:

$$F_{CH4,BL-case\ 3,y} = F_{CH4,BL-flare,y}$$ Equation (11)

(b) Scenario B: If the amount of methane captured with the existing system cannot be monitored separately from the amount captured under the project, but there is historic data on the amount of methane that was captured during the three years prior to the implementation of the Article 6.4 activity, then $F_{CH4,BL\text{-}case\ 3,y}$ is determined as the average fraction of LFG that was recovered in the three years prior to the implementation of the Article 6.4 activity will be the same fraction recovered under the Article 6.4 activity. In case data for less than 3 years, but at least for one year, is available, use the average fraction in the available years:

$$F_{CH4,BL-case\ 3,y} = \frac{\sum_i \frac{F_{CH4,BL,i}}{F_{CH4,i}}}{i} \times F_{CH4,PJ,capt,y}$$ Equation (12)

Where:

$F_{CH4,BL-case\ 3,y}$	=	Amount of methane in the LFG that would be destroyed in the baseline scenario in year y as per Case 3 (tCH_4/year)
$F_{CH4,BL-flare,y}$	=	Amount of methane in the LFG which is sent to flare(s) under the baseline year *y* and which can be monitored separately (tCH_4/year)
$F_{CH4,BL,i}$	=	Amount of methane in the LFG which is captured and destroyed in the year *i* prior to the implementation of the Article 6.4 activity (tCH_4/year), calculated as per paragraph 93(b) below
$F_{CH4,i}$	=	Amount of methane in the LFG generated in the SWDS in the year *i* prior to the implementation of the Article 6.4 activity (tCH_4/year), calculated as per paragraph 93(b) below
$F_{CH4,PJ,capty}$	=	Amount of methane in the LFG which is collected and sent to flares and/or use under the project scenario in year *y* (tCH_4/year)
i	=	Year prior to the implementation of the Article 6.4 activity (i = 1, 2, 3, as applicable)

93. The following applies to the scenarios from paragraph 92 above:

(a) $F_{CH4,BL\text{-}flare,y}$ shall be determined using the mass flow tool and applying the requirements described in paragraphs 83 and 84 above, where the gaseous stream the tool shall be applied to is the pipeline collecting LFG from the existing LFG capture system;

(b) $F_{CH4,i}$ shall be estimated using the solid waste tool. The guidance and requirements described in section 7.3.2.1.8 below shall be followed. The year *y* in the tool is equivalent to the year prior to the implementation of the project.

7.3.2.1.7. Determining $F_{CH4,BL,y}$ for Case 4

94. In this situation, $F_{CH4,BL,y}$ shall be determined as the higher value for $F_{CH4,BL,y}$ that is determined for Case 2 and Case 3 above:

$$F_{CH4,BL-case\ 4,y} = max\{F_{CH4,BL-case\ 2,y}; F_{CH4,BL-case\ 3,y}\} \quad \text{Equation (13)}$$

Where:

$F_{CH4,BL-case\ 4,y}$	=	Amount of methane in the LFG that would be destroyed in the baseline scenario in year y as per Case 4 (tCH_4/year)
$F_{CH4,BL-case\ 2,y}$	=	Amount of methane in the LFG that would be destroyed in the baseline scenario in year y as per Case 2 (tCH_4/year), as per paragraphs 90–91 above
$F_{CH4,BL-case\ 3,y}$	=	Amount of methane in the LFG that would be destroyed in the baseline scenario in year y as per Case 3 (tCH_4/year), as per paragraphs 92–93 above

7.3.2.1.8. Ex ante estimation of $F_{CH4,PJ,capt,y}$

95. An ex-ante estimate of $F_{CH4,PJ,capt,y}$ is used to estimate baseline methane emissions from the SWDS (according to Equation (2)) and calculate the emission reductions of the proposed Article 6.4 activity in the PDD. It is determined as follows:

$$F_{CH4,PJ,capt,y} = \eta_{PJ} \times BE_{CH4,SWDS,y} / GWP_{CH4} \quad \text{Equation (14)}$$

Where:

$F_{CH4,PJ,capt,y}$	=	Ex-ante estimation of the amount of methane in the LFG which collected and sent to flares and/or use under the project scenario in year *y* (t CH_4/year)
$BE_{CH4,SWDS,y}$	=	Amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year *y* (t CO_2e/year)
η_{PJ}	=	Efficiency of the Article 6.4 activity’s LFG capture system
GWP_{CH4}	=	Global warming potential of CH_4 (t CO_2e/t CH_4)

96. $BE_{CH4,SWDS,y}$ is determined using the solid waste tool. The following guidance applies to the use of the tool:

(a) f_y in the tool shall be assigned a value of 0 because the amount of LFG that would have been captured and destroyed is already accounted for in Equation (2) of this mechanism methodology;

(b) In the tool, *x* begins with the year that the SWDS started receiving waste (e.g. the first year of SWDS operation);

(c) Use the default values from the table “Data / Parameter table 2” of the solid waste too for OX_y; and

(d) Sampling to determine the fractions of different waste types is not necessary because the waste composition can be obtained from previous studies.

7.3.2.2. Baseline emissions associated with electricity generation (***$BE_{EG,y}$***)

7.3.2.2.1. Electricity generated and supplied to the electric grid

97. Baseline emissions from electricity generated and supplied to the electric grid are calculated as follows:

$$BE_{EG,y} = BE_{EG,grid,y} = EG_y \times EF_{grid,y} \quad \text{Equation (15)}$$

Where:

$BE_{EG,y}$	=	Baseline emissions from electricity generation in year *y* (t CO_2/year)
$BE_{EG,grid,y}$	=	Baseline emissions from electricity generated and supplied to the electric grid in year *y* (tCO_2/year)
EG_y	=	Quantity of electricity generated by the power plant in the activity scenario in year *y* (MWh/year)
$EF_{grid,y}$	=	Emission factor of the electric grid in year *y* (tCO_2/MWh)

98. Apply one of the following default values for $EF_{grid,y}$: [13]

(a) 0.2 tCO_2/MWh for electricity supplied to the electric grid where the proportion of renewable energy (including solar and wind) and nuclear energy in the annual electricity generation in the electric grid is 33 per cent or less for the latest year which data is available;

(b) 0.1 tCO_2/MWh for electricity supplied to the electric grid where the proportion of renewable energy (including solar and wind) and nuclear energy in the annual electricity generation in the electric grid exceeds 33 per cent but is less than 67 per cent for the latest year which data is available;

(c) 0.03 CO_2/MWh for electricity supplied to the electric grid where the proportion of renewable energy (including solar and wind) and nuclear energy in the annual electricity generation in the electric grid exceeds 67 per cent for the latest year which data is available, or where its proportion is uncertain.

[13] The conservative default emission factors proposed under this sub-section is an interim solution, since the revision of the CDM methodologies "ACM0002: Grid-connected electricity generation from renewable sources," "AMS-I.D.: Grid-connected renewable electricity generation," and "Methodological Tool: Emission factor for an electricity system," are yet to be finalized. This mechanism methodology will be revised accordingly to include the calculation of baseline emissions and project emissions from electricity generated and consumed once the revision of ACM0002, AMS-I.D. and the "Methodological Tool: Emission factor for an electricity system" is concluded and the respective standard(s) are adopted by the Supervisory Body.

7.3.2.2.2. Electricity generation replacing electricity generated in an existing captive fossil fuel fired power plant

99. Baseline emissions from electricity generation replacing electricity generated in an existing captive fossil fuel fired power plant are calculated as follows:

$$BE_{EG,y} = BE_{EG,captive-existing,y} = EG_y \times EF_{captive,y}$$ Equation (16)

Where:

$BE_{EG,y}$	=	Baseline emissions from electricity generation in year *y* (t CO_2/year)
$BE_{EG,captive-existing,y}$	=	Baseline emissions from electricity generated replacing electricity generated in an existing captive fossil fuel fired power plant in year *y* (t CO_2/year)
EG_y	=	Electricity generated by the power plant in the activity scenario in year *y* (MWh/year)
$EF_{captive,y}$	=	Emission factor of the replaced captive fossil fuel fired power plant in year y (MWh/year)

100. Apply a default value equal to 0.3 tCO_2/MWh for $EF_{captive,y}$.

7.3.2.2.3. Electricity generation replacing electricity generated in a new captive fossil fuel fired power plant

101. Baseline emissions from electricity generation replacing electricity generated in a new captive fossil fuel fired power plant are calculated as follows:

$$BE_{EG,y} = BE_{EG,captive-new,y} = EG_y \times EF_{CO2,EG,BAT}$$ Equation (17)

Where:

$BE_{EG,y}$	=	Baseline emissions from electricity generation in year *y* (t CO_2/year)
$BE_{EG,captive-new,y}$	=	Baseline emissions from electricity generated replacing electricity generated in a new captive fossil fuel fired power plant in year *y* (tCO_2/year)
EG_y	=	Electricity generated by the power plant in the activity scenario in year *y* (MWh/year)
$EF_{CO2,EG,BAT}$	=	CO_2 emissions intensity of the best-available technology (tCO_2e/MWh) identified in section 7.3.1.3 above

7.3.2.3. Baseline emissions associated with heat generation ($BE_{HG,y}$)

7.3.2.3.1. Heat generation replacing heat generated in an existing equipment

102. The baseline emissions associated with replacing heat generated in an equipment in year *y* ($BE_{HG,y}$) are determined based on the amount of methane in the LFG or the

biomethane which is sent to the heat generation equipment in the Article 6.4 activity (boiler, air heater, glass melting furnace(s) and/or kiln), as follows:

$$BE_{HG,y} = NCV_{CH4} \times \sum_{j} \sum_{n} \left(R_{efficiency,n,j,y} \times F_{CH4,HG,dest,n,j,y} \times EF_{CO2,BL,HG,n,j} \right) \quad \text{Equation (18)}$$

Where:

$BE_{HG,y}$	=	Baseline emissions associated with heat generation in year *y* (tCO_2/year)
NCV_{CH4}	=	Net calorific value of methane at reference conditions (TJ/tCH_4)
$R_{efficiency,n,j,y}$	=	Ratio of the project and baseline efficiency of heat equipment unit *n* of type *j* in year *y* (unitless parameter)
$F_{CH4,HG,dest,n,j,y}$	=	Amount of methane in the LFG or the biomethane which is destroyed for heat generation by equipment unit *n* of type *j* in year *y* (tCH_4/year)
$EF_{CO2,BL,HG,n,j}$	=	CO_2 emission factor of the fossil fuel type used for heat generation by equipment unit *n* of type *j* in the baseline (tCO_2/TJ)
j	=	Type of heat generation equipment (e.g., an individual boiler, air heater, glass melting furnace(s) or kiln)
n	=	Number of different pieces of equipment per type used for heat generation in the Article 6.4 activity

103. The ratio of the project and baseline efficiency of an air heater, boiler, glass melting furnace or kiln ($R_{efficiency,j,n,y}$) is determined as follows:

$$R_{efficiency,j,n,y} = min\left\{1; \frac{\eta_{HG,PJ,n,j,y}}{\eta_{HG,BL,n,j}}\right\} \quad \text{Equation (19)}$$

Where:

$R_{efficiency,n,j,y}$	=	Ratio of the project and baseline efficiency of equipment unit *n* of type *j* in year *y*
$\eta_{HG,BL,n,j}$	=	Efficiency of the heat generation equipment unit *n* of type *j* used in the baseline
$\eta_{HG,PJ,n,j,y}$	=	Efficiency of the heat generation equipment unit *n* of type *j* used in the Article 6.4 activity in year *y*
j	=	Heat generation equipment type (boiler, air heater, glass melting furnace(s) or kiln)
n	=	Heat generation equipment unit *n* of type *j*

104. Activity participants shall apply a baseline energy efficiency ($\eta_{HG,BL,n,j}$) that is the higher of 90 per cent and the manufacturer's efficiency energy rating for each piece of equipment (Vatopoulos et al, 2012).

105. The amount of methane that is destroyed in the LFG that is sent to heat generation equipment *j* ($F_{CH4,HG,dest,n,j,y}$) is determined with Equation (20) if *j* is a boiler or air heater, or

glass melting furnace, or with Equation (21) if *j* is a brick kiln. For the particular case of intermittent brick kilns, project participants may choose to apply either Equation (20) or (21).

$$F_{CH4,HG,dest,n,j,y} = fd_{CH4,HG,j,default} \times F_{CH4,HG,n,j,y} \quad \text{Equation (20)}$$

Where:

$F_{CH4,HG,dest,j,y}$	=	Amount of methane in the LFG or the biomethane which is destroyed for heat generation by equipment unit *n* of type *j* in year *y* (tCH_4/year)
$fd_{CH4,HG,j,default}$	=	Default value for the fraction of methane destroyed when used for heat generation equipment type *j* (dimensionless)
$F_{CH4,HG,n,j,y}$	=	Amount of methane in the LFG which is used for heat generation in unit *n* of equipment type *j* in year *y* (tCH_4/year)

106. $F_{CH4,HG,n,j,y}$ is determined according to paragraphs 83 and 84 above, where *j* is each item of heat generation equipment, and *n* is the unit of equipment type *j*.

$$F_{CH4,HG,dest,n,j,y} = \sum_{n} \sum_{h=1}^{8,760} \left(fd_{CH4,kiln,h} \times F_{CH4,HG,kiln,n,h}\right) \quad \text{Equation (21)}$$

107. With: $fd_{CH4,kiln,h}$ = 0.9 as per the table from default values if $Q_{O2,kiln,h} > 0$, and otherwise $fd_{CH4,kiln,h} = 0$.

Where:

$F_{CH4,HG,dest,n,j,y}$	=	Amount of methane in the LFG which is destroyed for heat generation by brick kiln unit *n* in year *y* (tCH_4/year)
$fd_{CH4,kiln,h}$	=	Fraction of methane destroyed when used for heat generation in a brick kiln in hour *h*
$F_{CH4,HG,kiln,n,h}$	=	Amount of methane in the LFG which is used for heat generation by brick kiln unit *n* in hour *h* (tCH_4/hour)
$Q_{O2,kiln,n,h}$	=	Average volumetric fraction of oxygen in the exhaust gas flow of the kiln unit *n* in hour *h* (volume of O_2/volume of the gas stream)
h	=	Hours in year *y*

108. $F_{CH4,HG,kiln,n,h}$ is determined using the mass flow tool, following the requirements given in paragraphs 83 and 84 above for *j* = kiln, except that the mass flow should be summed to an hourly (not yearly) unit basis (tCH_4/hour).

7.3.2.3.2. Heat generation replacing heat generated in new equipment

109. The baseline emissions associated with heat generation replacing heat generated in new equipment in year *y* ($BE_{HG,y}$) are determined by multiplying the output of the heat generation equipment by the emissions intensity of the technology identified at the best available technology, as follows:

$$BE_{HG,y} = Q_{output,y} \times EF_{CO2,HG,BAT} \quad \text{Equation (22)}$$

Where:

$BE_{HG,y}$	=	Baseline emissions associated with heat generation in year *y* (tCO_2/year)
$Q_{output,y}$	=	Quantity of the output produced by the heat generation equipment in year *y* (units of output/year)
$EF_{CO2,HG,BAT}$	=	CO_2 emissions intensity of the best-available technology (tCO2e/unit of output) identified in section 7.3.1.4 above

7.3.2.4. Baseline emissions associated with LFG or biomethane supplied to consumers replacing natural use from a natural gas network (*$BE_{NG,y}$*)

110. $BE_{NG,y}$ is estimated as follows:

$$BE_{NG,y} = 0.0504 \times F_{CH4,NG,y} \times EF_{CO2,NG,y}$$ Equation (23)

Where:

$BE_{NG,y}$	=	Baseline emissions associated with LFG or biomethane supplied to consumers replacing natural use from a natural gas network component in year *y* (t CO_2e/year)
0.0504	=	Conversion factor (TJ/t CH4)
$EF_{CO2,NG,y}$	=	Average CO_2 emission factor for the source of baseline natural gas consumption in year *y* (t CO_2e/TJ)
$F_{CH4,NG,y}$	=	Amount of methane in the LFG which is sent to the natural gas distribution network or dedicated pipeline or to the trucks in year *y* (t CH_4/year)

7.4. Application of the downward adjustment

111. The downward adjusted baseline emissions are separately determined for the calendar year of the start date of the first crediting period (section 7.4.1) and subsequent calendar years (section 7.4.2).

7.4.1. Downward adjusted baseline emissions in the calendar year of the start date of the first crediting period

7.4.1.1. Step 1. Determine whether and to which components of the Article 6.4 activity an initial downward adjustment applies

112. An initial downward adjustment does not apply ($DA_{i,y1}$ = 0 in Equation (27) below) to the following components and sub-components of an Article 6.4 activity:

(a) The methane component for Article 6.4 activities developed in new SWDSs;

(b) The electricity generation sub-component in which the electricity generated by the Article 6.4 activity replaces new captive fossil fuel fired power plants; and

(c) The heat generation sub-component in which the heat generated by the Article 6.4 activity replaces new equipment.

113. For the component and sub-components referred to in paragraph 112 above, the unadjusted baseline emissions, as determined in section 7.3.2 through Equations (1), (15),

(16), (17), (18), (22) and (23) respectively, shall be used as the downward adjusted baseline emissions in the calendar year of the start date of the crediting period.

114. In all other instances, Steps 2 to 5 below shall be applied to determine the downward adjusted baseline emissions for each applicable component or sub-component.

7.4.1.2. Step 2. Determine the uncertainty at the lower bound of the uncertainty interval for each baseline emission component or sub-component *i* ($UNC_{BE\ act/hist,i,y1}$)

115. Activity participants shall determine the overall uncertainty of baseline emissions for each baseline emission component or sub-component *i* at the lower bound of the 95 per cent confidence interval relative to the central estimate of estimated baseline emissions in the first year of the crediting period ($UNC_{BE\ act/hist,i,y1}$).

116. Activity participants shall consider uncertainty in all parameters used to calculate baseline emissions, following the guidance from Volume 1, Chapter 3 of the IPCC (2019 Refinement) through the error propagation method or Monte Carlo simulation.

117. Activity participants shall document the uncertainties assigned to each parameter, specify assumptions made, and include any associated references for estimating the uncertainties of parameters in the PDD. This documentation and the derivation of the overall uncertainty through the error propagation or Monte Carlo simulation methods shall be provided together with the PDD (e.g., in a spreadsheet).

7.4.1.3. Step 3. Determine the downward adjusted baseline emissions based on uncertainty for each baseline emission component or sub-component *i* ($BE_{adj,UNC,i,y1}$)

118. For the calendar year of the start date of the first crediting period, determine the downward adjusted baseline emissions for each baseline emission component or sub-component *i* based on uncertainty ($BE_{adj,UNC,i,y1}$) as follows:

$$BE_{adj,UNC,i,y1} = BE_{act/hist,i,y1} \times \left(1 - UNC_{BE\ act/hist,i,y1}\right) \quad \text{Equation (24)}$$

Where:

$BE_{adj,UNC,i,y1}$	=	Downward adjusted baseline emissions based on uncertainty for each baseline emission component or sub-component *i* in year *1* of the crediting period (tCO_2e/year)
$BE_{act/hist,i,y1}$	=	Unadjusted existing actual or historical net baseline emissions and/or removals for each baseline emission component or sub-component *i* in year *1* of the crediting period (tCO_2e/year)

$UNC_{BE_{act/hist,i,y1}}$	=	Uncertainty of baseline emissions at the lower bound of the 95 per cent confidence interval relative to the central estimate of quantified unadjusted net baseline emissions[14] for each baseline emission component or sub-component *i* in year 1 of the crediting period (fraction)
$y1$	=	Calendar year of the start date of the crediting period
i	=	Baseline emissions component or sub-component

7.4.1.4. Step 4. Determine the minimum downward adjusted baseline emissions ($BE_{adj,min,i,y1}$)

119. The minimum downward adjusted baseline shall be determined during the first year of the crediting period for each baseline emission component or sub-component *i* as follows:

$$BE_{adj,min,i,y1} = BE_{act/hist,i,y1} - \left(BE_{act/hist,i,y1} - PE_{i,y1}\right) \times 0.1 \quad \text{Equation (25)}$$

Where:

$BE_{adj,min,i,y1}$	=	Minimum downward adjusted baseline emissions for each baseline emission component or sub-component *i* in year *y* (tCO_2e/year)
$BE_{act/hist,i,y1}$	=	Unadjusted existing actual or historical net baseline emissions for each baseline emission component or sub-component *i* in year *1* of the crediting period (tCO_2e/year)
$PE_{i,y1}$	=	Project emissions for each baseline emission component or sub-component *i* in year *1* of the crediting period (tCO_2e/year)
$y1$	=	Calendar year of the start date of the first crediting period
i	=	Baseline emissions component or sub-component i

120. The project emissions in referred in Equation (25) and calculated as per section 8.1 below must be determined separately for each baseline component or sub-component implemented under the Article 6.4 activity. As these emissions are not necessarily quantified separately for each component, the project emissions shall be attributed to the components as follows:

(a) Project emissions from the distribution of LFG or biomethane to consumers using trucks ($PE_{DT,y}$) and project emissions from physical leakage due to the supply of LFG or biomethane to consumers through a dedicated pipeline ($PE_{SP,y}$) shall be attributed to the supply of LFG or biomethane to consumers component/sub-component;

(b) Project emissions from electricity consumption ($PE_{EC,y}$) and project emissions from fossil fuel consumption ($PE_{FC,y}$) shall be attributed to all components or sub-components through one of the following options:

(i) <u>Option 1:</u> Allocation based on the following considerations

[14] This proposal draws on paragraph 64(b) of the baseline standard that allows for other approaches different from the approach in paragraph 64(a) which determines the uncertainty of baseline emissions at the lower bound of the 95 per cent confidence interval relative to the central estimate of the ex ante quantified unadjusted net baseline emissions.

a. Allocated the electricity and fossil fuel consumed to the component or sub-component that causes the electricity or fuel consumption, e.g. by:

i. Monitoring the electricity and fossil fuel consumed by each component or sub-component *i* individually ($PE_{EC,i,y}$ and $PE_{FC,i,y}$);

ii. Attributing the total electricity and fossil fuel consumed ($PE_{EC,y}$ and $PE_{FC,y}$) based on the design capacity of each component or sub-component *i*;

b. Allocate the electricity and fossil fuel consumed for the capture of LFG to the methane component;

(ii) Option 2: Conservatively assume a value of zero for project emissions from electricity generation and fossil fuel combustion ($PE_{EC,y}$ and $PE_{FC,y}$) in Equation (25) above.

7.4.1.5. Step 5. Compare $BE_{adj,UNC,i,y1}$ and $BE_{adj,min,i,y1}$

121. For each baseline emission component or sub-component *i,* the downward adjusted baseline emissions shall be determined as follows:

$$BE_{adj,i,y1} = min\left(BE_{adj,min,i,y1}\ ;\ BE_{adj,UNC,i,y1}\right) \quad \text{Equation (26)}$$

Where:

$BE_{adj,y1}$	=	Downward adjusted baseline emissions for each baseline emission component or sub-component *i* in year *1* of the crediting period (tCO_2e/year)
$BE_{adj,min,i,y1}$	=	Minimum downward adjusted baseline emissions for each baseline emission component or sub-component *i* in year *1* of the crediting period (tCO_2e/year)
$BE_{adj,UNC,i,y1}$	=	Downward adjusted baseline emissions based on uncertainty for each baseline emission component or sub-component *i* in year *1* of the crediting period (tCO_2e/year)
$y1$	=	Calendar year of the start date of the crediting period
i	=	Baseline emissions component or sub-component i

7.4.1.6. Step 6. Determine the initial downward adjustment DA_{iy1}

122. The minimum downward adjustment and the downward adjustment based on the uncertainty for each component *i* are implicitly included in Equations (25) and (26) above. The minimum downward adjustment is represented by the term ($BE_{act/hist,i,y1} - PE_{y1}$) x 0.1. The downward adjustment based on the uncertainty is represented by the term ($BE_{act/hist,i,y1}$ x $UNC_{BE\ act/hist,i,y1}$). In the following section on downward adjusted baselines in subsequent years, the initial downward adjustment is required as a term. It shall be determined for

each component or sub-component *i* as the highest value between the minimum downward adjustment and the downward adjustment based on the uncertainty, as follows:

$$DA_{i,y1} = max\begin{pmatrix} \left(BE_{act/hist,i,y1} - PE_{y_1}\right) \times 0.1 \\ or \\ BE_{act/hist,i,y1} \times UNC_{BE_{act/hist,i,y1}} \end{pmatrix}$$ Equation (27)

Where:

$DA_{i,y1}$	=	Initial downward adjustment for each component or sub-component *i* (t CO_2e/year)
$BE_{act/hist,i,y1}$	=	Unadjusted existing actual or historical net baseline emissions for each baseline emission component or sub-component *i* in year *1* of the crediting period (tCO_2e/year)
PE_{y_1}	=	Project emissions for each baseline emission component or sub-component *i* in year *1* of the crediting period (tCO_2e/year)
$UNC_{BE_{act/hist,i,y1}}$	=	Uncertainty of baseline emissions at the lower bound of the 95 per cent confidence interval relative to the central estimate of quantified unadjusted net baseline emissions for each baseline emission component or sub-component *i* in year 1 of the crediting period (fraction)
y_1	=	Calendar year of the start date of the first crediting period

7.4.2. Downward adjusted baseline emissions in subsequent years

123. The downward adjusted baseline emissions in subsequent years are separately determined for the different components of the Article 6.4 activity, as applicable:

(a) Methane component (section 7.4.2.1);

(b) Electricity generation component (section 7.4.2.2);

(c) Heat generation component (section 7.4.2.3);

(d) Supply of LFG or biomethane to consumers component (section 7.4.2.4).

124. Subsequently, the downward adjusted baseline emissions for each component are aggregated to determine the overall downward adjusted baseline emissions (section 7.4.2.5).

125. For all components, the following applies:

(a) Where the baseline has been determined based on existing or actual/historical emissions adjusted downwards, the starting point for increasing the downward adjustment over time shall be the downward adjusted baseline values in the calendar year of the start date of the first crediting period, as determined in section 7.4.1;

(b) Where the baseline has been determined based on the best available technology, the starting point for increasing the downward adjustment over time shall be the emissions corresponding to the best available technology in the calendar year of the start date of the first crediting period, as determined in section 7.4.1;

(c) The annual increase in the downward adjustment shall be applied starting on

1 January of a calendar year. The first increase shall be applied in the calendar year following the calendar year of the start date of the first crediting period. A pro-rata approach may be used to apply this minimum value to periods other than a full calendar year.[15]

7.4.2.1. Methane component

126. The downward adjustment in subsequent years for the methane component depends on whether the methane is flared or utilized.

127. For the purpose of determining the downward adjusted baseline emissions, in a first step a downward adjusted amount of methane destruction is determined. That amount is determined separately for different sub-amounts of methane, depending on how the methane is destroyed, as follows:

(a) For the amount of methane in the LFG that is destroyed in flares, the downward adjusted amount of methane is determined as follows:

$$F_{CH4,Primary-Flare,adj,y} = MAX\left\{F_{CH4,Primary-Flare,y} - \left(DA_{CH4,Primary-Flare,y1} + F_{CH4,Primary-Flare,y} \times INDA_{flare} \times (y - y_1)\right); 0\right\}$$ Equation (28)

$$F_{CH4,Backup-Flare,adj,y} = MAX\left\{F_{CH4,Backup-Flare,y} - \left(DA_{CH4,Backup-Flare,y1} + F_{CH4,Backup-Flare,y} \times INDA_{flare} \times (y - y_1)\right); 0\right\}$$ Equation (29)

Where:

$F_{CH4,Primary-Flare,adj,y}$	=	Downward adjusted amount of methane in the LFG which is flared in the primary flare in year *y* (t CH_4/year)

[15] The pro-rata approach is illustrated through the following numerical example. The first crediting period of an Article 6.4 activity starts on 1 October 2025. The initial downward adjustment is determined to be 50 tCO_2 per year and the annual increase in the downward adjustment is determined to be 5 tCO_2 per year, resulting in a total downward adjustment is 55 tCO_2 per year in the second year and 60 tCO_2 per year in the third year. In this example, following a pro-rata approach means that a downward adjustment of 50 tCO_2 per year shall be pro-rated before being applied in the calendar year of the start date of the first crediting period, i.e., for the period from 1 October 2025 to 31 December 2025. This corresponds to an absolute value of 12.60 tCO_2 for that period, calculated as 92 days divided by 365 days multiplied by 50 tCO_2. For the calendar year 2026 (i.e., the period from 1 January 2026 to 31 December 2026), a downward adjustment of 51.26 tCO_2 shall be applied, calculated as the sum of (i) 273 days divided by 365 days multiplied by 50 tCO_2 50 and (i) 92 days divided by 365 days multiplied by 55 tCO_2. Starting from 2027, the annual downward adjustment is increased by 5 tCO_2 on 1 January of each year, resulting in a value of 56.26 tCO_2 for 2027, 61.26 tCO_2 for 2028, and so forth).

$F_{CH4,Primary-Flare,y}$	=	Amount of methane in the LFG which is flared in the primary flare in year *y* (tCH_4/year), determined based on Equation (4)
$DA_{CH4,Primary-Flare}$	=	Initial downward adjustment to the amount of methane in the LFG which is flared in the primary flare in year (t CH_4/year), determined by replacing $BE_{act/hist,i,y1}$ by $F_{CH4,Primary-flare,y1}$ and $UNC_{BE_{act/hist,i,CP1}}$ by $UNC_{F_{CH4,primary-flare,CP1}}$ in Equation (27)
$INDA_{flare}$	=	Increase in the downward adjustment in subsequent years for the amount of methane in the LFG which is flared (unitless)
$F_{CH4,Primary-Flare,y_1}$	=	Amount of methane in the LFG which is flared in the primary flare in the calendar year of the start date of the crediting period (t CH_4/year)
$F_{CH4,Backup-Flare,adj,y}$	=	Downward adjusted amount of methane in the LFG which is flared in the backup flare in year *y* (t CH_4/year)
$F_{CH4,Backup-Flare,y}$	=	Amount of methane in the LFG which is flared in the backup flare in year *y* (t CH_4/year)
$DA_{CH4,Backup-Flare}$	=	Initial downward adjustment to the amount of methane in the LFG which is flared in the backup flare in year *y* (t CH_4/year) determined by replacing $BE_{act/hist,i,y1}$ by $F_{CH4,Backup-flare,y1}$ and $UNC_{BE_{act/hist,i,CP1}}$ by $UNC_{F_{CH4,Backup-flare,CP1}}$ in Equation (27)
$F_{CH4,Backup-Flare,y_1}$	=	Amount of methane in the LFG which is flared in the backup flare in the calendar year of the start date of the crediting period (t CH_4/year)
y	=	Calendar years of the crediting period after the calendar year of the start date of the crediting period
y_1	=	Calendar year of the start date of the crediting period

(b) For the amount of methane in the LFG that is utilized for electricity or heat generation or that is supplied to consumers, the downward adjusted amount of methane is determined as follows:

$$F_{CH4,EL,adj,y} = F_{CH4,EL,y} - \left[DA_{CH4,EL,y1} + F_{CH4,EL,y_1} \times 0.01 \times (y - y_1)\right] \quad \text{Equation (30)}$$

$$F_{CH4,HG,adj,y} = F_{CH4,HG,y} - \left[DA_{CH4,HG,y1} + F_{CH4,HG,y_1} \times 0.01 \times (y - y_1)\right] \quad \text{Equation (31)}$$

$$F_{CH4,NG,adj,y} = F_{CH4,NG,y} - \left[DA_{CH4,NG,y1} + F_{CH4,NG,y_1} \times 0.01 \times (y - y_1)\right] \quad \text{Equation (32)}$$

Where:

$F_{CH4,EL,adj,y}$	=	Downward adjusted amount of the methane in the LFG or in the biomethane which is used for electricity generation in year *y* (t CH_4/year)
$F_{CH4,HG,adj,y}$	=	Downward adjusted amount of methane in the LFG or in the biomethane which is used for heat generation in year *y* (t CH_4/year)
$F_{CH4,NG,adj,y}$	=	Downward adjusted amount of the methane in the LFG or in the biomethane which is supplied to consumers in year *y* (t CH_4/year)
$F_{CH4,EL,y}$	=	Amount of methane in the LFG or in the biomethane which is used for electricity generation in year *y* (t CH_4/year), determined based on paragraphs 83 and 84 above

$F_{CH4,HG,y}$	=	Amount of methane in the LFG or in the biomethane which is used for heat generation in year *y* (t CH_4/year), determined based on paragraphs 83 and 84 above
$F_{CH4,NG,y}$	=	Amount of methane in the LFG or in the biomethane which is supplied to consumers in year *y* (t CH_4/year), determined based on paragraphs 83 and 84 above
$DA_{CH4,EL,y1}$	=	Initial downward adjustment to the amount of methane in the LFG or in the biomethane which is used for electricity generation (t CH_4/year), determined by replacing $BE_{act/hist,i,y1}$ by $F_{CH4,EL,y1}$ and $UNC_{BE_{act/hist,i,y1}}$ by $UNC_{F_{CH4,EL,y1}}$ in Equation (27)
$DA_{CH4,HG,y1}$	=	Initial downward adjustment to the amount of methane in the LFG or in the biomethane which is used for heat generation in year *y* (t CH_4/year), determined by replacing $BE_{act/hist,i,y1}$ by $F_{CH4,HG,y1}$ and $UNC_{BE_{act/hist,i,y1}}$ by $UNC_{F_{CH4,HG,y1}}$ in Equation (27)
$DA_{CH4,NG,y1}$	=	Initial downward adjustment to the amount of methane in the LFG or in the biomethane which is supplied to consumers in year *y* (t CH_4/year), determined by replacing $BE_{act/hist,i,y1}$ by $F_{CH4,NG,y1}$ and $UNC_{BE_{act/hist,i,y1}}$ by $UNC_{F_{CH4,NG,y1}}$ in Equation (27)
F_{CH4,EL,y_1}	=	Amount of methane in the LFG or in the biomethane which is used for electricity generation in the calendar year of the start date of the crediting period (t CH_4/year), determined based on paragraphs 8383 and 84 above
F_{CH4,HG,y_1}	=	Amount of methane in the LFG or in the biomethane which is used for heat generation in the calendar year of the start date of the crediting period (t CH_4/year), determined based on paragraphs 8383 and 84 above
F_{CH4,NG,y_1}	=	Amount of methane in the LFG or in the biomethane which is supplied to consumers in the calendar year of the start date of the crediting period (t CH_4/year), determined based on paragraphs 8383 and 84 above
y	=	Calendar years of the crediting period after the calendar year of the start date of the first crediting period
y_1	=	Calendar year of the start date of the first crediting period

128. For Article 6.4 activities implemented in new SWDSs, the parameters $DA_{CH4,flared,y1}$, $DA_{CH4,EL,y1}$, $DA_{CH4,HG,y1}$ and $DA_{CH4,NG,y1}$ are equal to 0.

129. The degree of downward adjustment in subsequent years in Equations (28) to (32) is informed by the principles and considerations referred to in paragraph 70 of the baseline standard. In the case of utilization of the landfill gas, the minimum downward adjustment of 1 per cent per calendar is applied. This also applies to any back-up flaring that does not exceed 10 per cent of the amount methane utilised. In the case of flaring landfill gas, a higher downward adjustment is applied as an approach to providing incentives for adopting landfill gas utilization which is a less GHG intensive technology and to reducing the risk of locking-in the levels of emissions and carbon-intensive technologies associated with landfill gas flaring. In this case, the degree of downward adjustment also depends on the size of the plant and the financial viability of utilizing the LFG.

130. Based on these considerations, the increase in the downward adjustment factor in subsequent years for the amount of methane in the LFG which is flared ($INDA_{flare}$) shall be determined as follows:

(a) **Flaring only:** For Article 6.4 activities that involve flaring only (i.e. no utilization of methane for electricity generation, heat generation and/or supplying consumers):

(i) Use a value of 0.05 if the following conditions apply:

a. The amount of LFG captured from the SWDS would not be sufficient to continuously operate an electricity generation plant with an electric capacity equal to or larger than 5 MW; and

b. The activity participants are able to prove that, for the specific circumstances of the SWDS, electricity or heat generation or supply of LFG or biomethane to consumers is not financially attractive, even when including the revenues from A6.4ERs;

(ii) Use a value of 0.1 where the conditions in (i) above are not met.

(b) **Utilization with a back-up flare:** For Article 6.4 activities that involve the utilization of methane for electricity generation, heat generation and/or supplying consumers and operates a back-up flare:

(i) Use a value of 0.01 for up the amount of methane in the LFG that is supplied to the back flare and that does not exceed 10 per cent of the amount of methane in the LFG or biomethane that is utilized;

(ii) Use a value of 0.1 for any amount of methane in the LFG that is supplied to the back flare and that exceeds the amount referred to in sub-paragraph (i) above.

(c) **Flaring and utilization with a back-up flare:** For Article 6.4 activities that involve both utilization of methane for electricity generation, heat generation and/or supplying consumers with a back-up flare and the operation of a primary flare:

(i) Use a value of 0.01 for up the amount of methane in the LFG that is supplied to the back flare and that does not exceed 10 per cent of the amount of methane in the LFG or biomethane that is utilized;

(ii) Use a value of 0.1 for any amount of methane in the LFG that is:

a. supplied to the back flare and that exceeds the amount referred to in sub-paragraph (i) above;

b. supplied to the primary flare.

131. The downward adjusted baseline emissions from the methane component in the SWDS ($BE_{CH4,adj,y}$) are determined by applying the following equation below based on (i) the downward adjusted baseline emissions from methane listed in the equations above, (ii) the oxidation factor (OX_y) determined based on section 7.3.2.1.2 above and (iii) the $F_{CH4,BL,y}$ determined based on section 7.3.2.1.3 above.

$$BE_{CH4,adj,y} = \{[F_{CH4,Primary-Flare,adj,y} + F_{CH4,Backup-Flare,adj,y} + F_{CH4,EL,adj,y} + (F_{CH4,HG,adj,y} \times fd_{CH4,HG,j,default}) + F_{CH4,NG,adj,y}] \times (1 - OX_y) - F_{CH4,BL,y}\} \times GWP_{CH4}$$ Equation (33)

Where:

$BE_{adj,CH4,y}$	=	Downward adjusted baseline emissions of methane from the SWDS in year *y* (t CO_2e/year)
$F_{CH4,Primary-Flare,adj,y}$	=	Downward adjusted amount of methane in the LFG which is flared in the primary flare in year *y* (tCH_4/year), determined based on Equation (28)
$F_{CH4,Backup-Flare,adj,y}$	=	Downward adjusted amount of methane in the LFG which is flared in the backup flare in year *y* (t CH_4/year), determined based on Equation (29)
$F_{CH4,EL,adj,y}$	=	Downward adjusted amount of methane in the LFG or biomethane which is used for electricity generation in year y (t CH4/year), determined based on Equation (30)
$F_{CH4,HG,adj,y}$	=	Downward adjusted amount of methane in the LFG or biomethane which is used for heat generation in year *y* (tCH_4/year), determined based on Equation (31)
$fd_{CH4,HG,j,default}$	=	Default value for the fraction of methane destroyed when used for heat generation equipment type *j* (dimensionless)
$F_{CH4,NG,adj,y}$	=	Downward adjusted amount of the methane in the LFG or in the biomethane which is supplied to consumers in year *y* (t CH_4/year), determined based on Equation (32)
OX_y	=	Fraction of methane in the LFG that would be oxidized in the top layer of the SWDS in the baseline scenario in year *y* (dimensionless), determined based on section 7.3.2.1.2
$F_{CH4,BL,y}$	=	The amount of LFG that would have been captured and destroyed (by flaring) in the baseline due to legal or contractual requirements, to address safety and odour concerns, or for other reasons, determined based on section 7.3.2.1.3
GWP_{CH4}	=	Global warming potential for methane (tCO_2e/tCH_4)

7.4.2.2. Electricity generation component

132. This section applies to Article 6.4 activities that involve electricity generation.

133. The downward adjusted baseline emissions from electricity generation shall be determined based on an increase in the downward adjustment by 1 per cent per calendar year, as follows:

$$BE_{EG,adj,y} = BE_{EG,y} - \left[DA_{BE_{EG},y1} + \left(BE_{EG,y_1} \times 0.01 \times (y - y_1)\right)\right]$$ Equation (34)

Where:

$BE_{EG,adj,y}$	=	Downward adjusted baseline emissions from the electricity generation component in year *y* (t CO_2e/year)
$BE_{EG,y}$	=	Baseline emissions from the electricity generation component in year *y* (t CO_2e/year), determined based on section 7.3.2.2 above
$DA_{BE_{EG},y1}$	=	Initial downward adjustment to electricity generation component (t CO_2/year), determined by replacing $BE_{act/hist,i,y1}$ by $BE_{EG,y1}$ and $UNC_{BE_{act/hist,i,y1}}$ by $UNC_{BE_{EG,y1}}$ in the Equation (27)
BE_{EG,y_1}	=	Baseline emissions from the electricity generation component in the calendar year of the start date of the crediting period (tCO_2/year)
y	=	Calendar years of the crediting period after the calendar year of the start date of the crediting period
y_1	=	Calendar year of the start date of the crediting period

134. For Article 6.4 activities that only involve the generation of electricity replacing electricity from new captive fossil fuel fired power plant, $DA_{BE_{EG},y1}$ is equal to 0 as per paragraph 112 above.

7.4.2.3. Heat generation component

135. This section applies to Article 6.4 activities that involve heat generation.

136. The downward adjusted baseline emissions from heat generation shall be determined based on an increase in the downward adjustment by 1 per cent per calendar year, as follows:

$$BE_{HG,adj,y} = BE_{HG,y} - \left[DA_{BE_{HG},y1} + BE_{HG,y_1} \times 0.01 \times (y - y_1)\right] \quad \text{Equation (35)}$$

Where:

$BE_{HG,adj,y}$	=	Downward adjusted baseline emissions from the heat generation component in year *y* (t CO_2e/year)
$BE_{HG,y}$	=	Baseline emissions from the heat generation component in year *y* (t CO_2e/year), determined based on section 7.3.2.3 above
$DA_{BE_{HG},y1}$	=	Initial downward adjustment to heat generation component (t CO_2/year), determined by replacing $BE_{act/hist,i,y1}$ by BE_{HG,y_1} and $UNC_{BE_{act/hist,i,y1}}$ by $UNC_{BE_{HG,y1}}$ in Equation (27)
BE_{HG,y_1}	=	Baseline emissions from the heat generation component in the calendar year of the start date of the crediting period (t CO_2/year)
y	=	Calendar years of the crediting period after the calendar year of the start date of the crediting period
y_1	=	Calendar year of the start date of the crediting period

137. For Article 6.4 activities that only involve the heat generation replacing heat generated in a new equipment, $DA_{BE_{HG},y1}$ is equal to 0 as per paragraph 112 above.

7.4.2.4. LFG or biomethane supplied to consumers replacing natural use from a natural gas network

138. This section applies to Article 6.4 activities that involve the supply of LFG or biomethane to consumers.

139. The downward adjusted baseline emissions from the supply of LFG or biomethane to consumers shall be determined based on an increase in the downward adjustment by 1 per cent per calendar year, as follows:

$$BE_{NG,adj,y} = BE_{NG,y} - \left[DA_{BE_{NG},y1} + BE_{NG,y_1} \times 0.01 \times (y - y_1)\right] \quad \text{Equation (36)}$$

Where:

$BE_{NG,adj,y}$	=	Downward adjusted baseline emissions associated with LFG or biomethane supplied to consumers replacing natural use from a natural gas network component in year *y* (t CO_2e/year)
$BE_{NG,y}$	=	Baseline emissions associated with LFG or biomethane supplied to consumers replacing natural use from a natural gas network component in year *y* (t CO_2e/year), determined based on section 7.3.2.4 above
$DA_{BE_{NG},y1}$	=	Initial downward adjustment associated with LFG or biomethane supplied to consumers replacing natural use from a natural gas network component in year *y* (t CO_2/year), determined by replacing $BE_{act/hist,i,y1}$ by BE_{NG,y_1} and $UNC_{BE_{act/hist,i,y1}}$ by $UNC_{BE_{NG,y1}}$ in the Equation (27)
BE_{NG,y_1}	=	Baseline emissions from the supply of LFG or biomethane to consumers in the calendar year of the start date of the first crediting period (t CO_2/year)
y	=	Calendar years of the crediting period after the calendar year of the start date of the first crediting period
y_1	=	Calendar year of the start date of the first crediting period

7.4.2.5. Aggregation of downward adjusted baseline emissions from different components

140. The downward adjusted baseline emissions from the Article 6.4 activity is determined based on the equation below:

$$BE_{adj,y} = BE_{CH4,adj,y} + BE_{EG,adj,y} + BE_{HG,adj,y} + BE_{NG,adj,y} \quad \text{Equation (37)}$$

Where:

$BE_{adj,y}$	=	Downward adjusted baseline emissions in year *y* (t CO_2e/year)
$BE_{CH4,adj,y}$	=	Downward adjusted baseline emissions of methane from the SWDS in year *y* (t CO_2e/year), determined based on section 7.4.2.1 above
$BE_{EG,adj,y}$	=	Downward adjusted baseline emissions from the electricity generation component in year *y* (t CO_2e/year), determined based on section 7.4.2.2 above

$BE_{HG,adj,y}$	=	Downward adjusted baseline emissions from the heat generation component in year *y* (t CO_2e/year), determined based on section 7.4.2.3 above
$BE_{NG,adj,y}$	=	Downward adjusted baseline emissions associated with LFG or biomethane supplied to consumers replacing natural use from a natural gas network component in year *y* (t CO_2e/year), determined based on section 7.4.2.4 above

7.5. Identification of the conservative Business-as-usual scenario

141. The conservative business-as-usual (BAU) scenario for each component of Article 6.4 activities eligible under this mechanism methodology are:

Table 4. BAU for the different components of Article 6.4 activities eligible under the mechanism methodology under the different baseline approaches

Component	Baseline approach (see Table 2 above)	BAU
LFG – Article 6.4 activities implemented in an existing SWDS	Existing actual or historical emissions	Continuation of the historical situation, i.e. the collection and destruction of the LFG in the existing SWDS to address legal requirements, contractual requirements or safety and odour concerns
LFG – Article 6.4 activities implemented in new SWDS	Best available technologies that represent an economically feasible and environmentally sound course of action	SWDS using the similar design and management practices in the geographical area, i.e. the collection and destruction of the LFG to address legal requirements, contractual requirements or safety and odour concerns, with the same cover type identified under the BAT
Electricity generation and supply to the grid	Existing actual or historical emissions (grid emission factor)	Continuation of the historical situation, i.e. the generation of electricity from power plants connected to the grid;
Electricity generation replacing existing captive fossil fuel power plants	Existing actual or historical emissions	Continuation of the historical situation, i.e. the generation of electricity in the captive fossil fuel power plant using the baseline fuel
Electricity generation replacing new captive fossil fuel power plants	Best available technologies that represent an economically feasible and environmentally sound course of action	The average emissions intensity of any new capacity from other new power plants in similar projects that started operations in the past three years, provided that: a) The new captive fossil fuel power plants operate within the geographical reference area; b) The users of the electricity generated from the new captive fossil fuel power plants are the same; c) The new captive power plant has equivalent capacity of the new captive fossil fuel fired power plant installed as part of the project.
Heat generation replacing existing heat generation equipment	Existing actual or historical emissions	Continuation of the historical situation, i.e. the generation of heat using the baseline equipment and fuel

Component	Baseline approach (see Table 2 above)	BAU
Heat generation replacing new heat generation equipment	Best available technologies that represent an economically feasible and environmentally sound course of action	The average emissions intensity of any new capacity from other new heat generation equipment in similar projects that started operations in the past three years, provided that: a) The other new heat generation equipment operates within the geographical reference area; b) The type of output (e.g. hot water, hot air, saturated steam, overheated steam, brick, melted glass, etc) and the users (e.g. residential, commercial and institutional consumers, industrial processes, etc) of the other new heat generation equipment are the same; c) The other new heat generation equipment has equivalent capacity of the new heat generation equipment installed as part of the project.
Supply of LFG or biomethane to consumers	Existing actual or historical emissions	Continuation of the historical situation, i.e. consumers supplied by natural gas

142. In determining the BAU scenario and quantifying the BAU emissions, activity participants shall identify and incorporate in the BAU:

(a) Any policies[16] that are active or scheduled to take effect within the crediting period, unless they refer to or formally integrate the mechanism as an instrument for implementation. All legal requirements shall be deemed to be enforced while recognizing that regulatory environments vary; and

(b) Any specific national or sub-national targets[16] for the sector or the type of activity, as long as these are supported by policy frameworks for implementation, but not general goals that are not specific to the sector or type of activity (e.g. national emissions target).

7.5.1. Calculation of the conservative Business-as-usual emissions

143. BAU emissions for each component *i* (methane, electricity, heat and supply of LFG or biomethane) are determined as follows:

(a) For Article 6.4 activities where the BAU for the component *i* is the continuation of the historical situation, apply the equation below:

$$BAU_y = BE_{CH4,y} + BE_{EG,y} + BE_{HG,y} + BE_{NG,y}$$ Equation (38)

Where:

BAU_y	=	Business-as-usual emissions in year *y* (tCO_2e/year)

[16] The extent to which the policy frameworks in place are sufficient to enable the achievement of the policies/targets may be considered in determining their relevance for the BAU scenario.

$BE_{CH4,y}$	=	Baseline emissions of methane from the SWDS component in year *y* (tCO_2e/year), determined based on section 7.3.2.1 above
$BE_{EG,y}$	=	Baseline emissions associated with electricity generation component in year *y* (tCO_2e/year), determined based on section 7.3.2.2 above
$BE_{HG,y}$	=	Baseline emissions associated with heat generation component in year *y* (tCO_2e/year), determined based on section 7.3.2.3 above
$BE_{NG,y}$	=	Baseline emissions associated with LFG or biomethane supplied to consumers replacing natural use from a natural gas network component in year *y* (tCO_2e/year), determined based on section 7.3.2.4 above

(b) For Article 6.4 activities where the BAU for the component *i* is SWDS using the similar design and management practices in the geographical area: through the same equations applied to determine baseline emissions under section 7.3.2.1 above but applying the oxidation factor corresponding to the cover type identified under the BAT analysis in section 7.3.1.1 above. The oxidation factor shall be determined based on the default values provided in the “Data / Parameter table 1” in section 13 below;

(c) For Article 6.4 activities where the BAU for the component *i* is determined based on the average emissions intensity of any new capacity in the past 3 years, use the equations below:

$$BAU_{HG,y} = Q_{output,y} \times EF_{CO2,HG,BAU}$$ Equation (39)

$$BAU_{EG,y} = EG_y \times EF_{CO2,EG,BAU}$$ Equation (40)

Where:

$BAU_{HG,y}$	=	BAU emissions associated with heat generation in year *y* (tCO_2/year)
$Q_{output,y}$	=	Quantity of the output produced by the heat generation equipment in year *y* (units of output/year)
$EF_{CO2,HG,BAU}$	=	Average CO_2 emissions intensity of any new capacity from other new heat generation plants in similar projects that started operations in the past three years (tCO_2e/unit of output)
$BAU_{EG,y}$	=	BAU emissions associated with heat generation in year *y* (tCO_2/year)
EG_y	=	Electricity generated by the power plant in the activity scenario in year *y* (MWh/year)
$EF_{CO2,EG,BAU}$	=	Average CO_2 emissions intensity of any new capacity from other new power plants in similar projects that started operations in the past three years (tCO_2e/MWh)

144. The conservative BAU emissions shall be determined based on the stepwise process below:

7.5.1.1. Step 1. Determine the uncertainty at the lower bound of the uncertainty interval ($UCN_{BAU,CP1,i,y}$)

145. The 95 per cent confidence interval for uncertainty shall be determined considering uncertainty in all parameters used to calculate BAU emissions during the first crediting

period following the guidance from Volume 1, Chapter 3 of the IPCC (2019 Refinement) through the error propagation method or through the Monte Carlo simulation.

146. Uncertainties should be traceable for each and every parameter, with clear values and assumptions for uncertainty and any associated references for estimating uncertainties of parameters.

7.5.1.2. Step 2. Determine the conservative business-as-usual baseline emissions and/or removals based on uncertainty ($BE_{cons,UNC,i,y}$)

147. Determine the conservative BAU emissions based on the uncertainty ($BAU_{cons,UNC,i,y}$) as follows:

$$BAU_{cons,UNC,i,y} = BAU_{i,y} \times \left(1 - UNC_{BAU,CP1,i,y}\right) \quad \text{Equation (41)}$$

Where:

$BAU_{cons,UNC,i,y}$	=	Conservative BAU baseline emissions based on the uncertainty for the component *i* in year *y* (tCO_2e/year)
$BAU_{i,y}$	=	Most likely net BAU baseline emissions for the component *i* in year *y* (tCO_2e/year), determined based on guidance from paragraph 143 above
$UNC_{BAU,CP1,i,y}$	=	Uncertainty at the lower bound of the uncertainty interval relative to the central estimate of the ex-ante quantified most likely net BAU baseline emissions for the component *i* during the first crediting period year *y* (fraction)
y	=	Relevant year or period
i	=	BAU component (i = methane, electricity, heat and supply of LFG/biomethane)

7.5.1.3. Step 3. Determine the minimum conservative value of the business-as-usual baseline ($BAU_{cons,min,i,y}$)

$$BAU_{cons,min,i,y} = BAU_{i,y} - \left(BAU_{i,y} - PE_y\right) \times 0.1 \quad \text{Equation (42)}$$

Where:

$BAU_{cons,min,i,y}$	=	Minimum conservative BAU baseline emissions for the component *i* in year *y* (tCO_2e/year)
PE_y	=	Project emissions in year *y* (tCO_2e/year). The same approach from paragraph 120 above shall be applied to determined PE_y separately for each BAU component or sub-component
y	=	Relevant year or period
i	=	BAU component (*i* = methane, electricity, heat and supply of LFG/biomethane)

7.5.1.4. Step 4. Compare $BAU_{cons,UNC,i,y}$ and $BAU_{cons,min,i,y}$

148. The conservative BAU baseline emissions shall be the lowest between $BAU_{cons,UNC,i,y}$ and $BAU_{cons,min,i,y}$, as follows:

$$BAU_{cons,i,y} = min(BAU_{cons,min,i,y}\ ;\ BAU_{cons,UNC,i,y}) \quad \text{Equation (43)}$$

Where:

$BAU_{cons,i,y}$	=	Conservative BAU baseline emissions for the component *i* in year *y* (tCO_2e/year)
y	=	Relevant year or period
i	=	BAU component (i = methane, electricity, heat and supply of LFG/biomethane)

149. The BAU scenario shall be determined ex ante and described in the PDD at the start of the first crediting period for the same duration as the crediting period of the proposed Article 6.4 activity, and shall be redetermined at each crediting period renewal.

150. The quantification of the BAU emissions shall be determined:

(a) Ex ante and in the PDD at the start of the first crediting period for the same duration as the crediting period of the proposed Article 6.4 activity and specified for each calendar year within the crediting period; and

(b) Ex post for each calendar year within the crediting period.

7.6. Comparison of crediting baselines

151. Activity participants shall compare, in the PDD, the downward adjusted baseline ($BE_{adj,y}$) determined in section 7.4.2.5 with the conservative BAU baseline ($BAU_{cons,y}$) determined in section 7.5.1 above.

152. If, as a result of the comparison, the ex-ante $BAU_{cons,y}$ is lower than the ex-ante $BE_{adj,y}$ for any calendar year or cumulatively over the crediting period, activity participants shall revise the quantitative methods and factors to determine the downward adjustment in section 7.4 above to ensure that the downward adjusted baseline is lower than the conservative BAU baseline for each calendar year and cumulatively for the crediting period or use a discounted value of conservative BAU ($BAU_{cons,y}$).

153. Activity participants shall also compare in monitoring reports, for each individual calendar year during the crediting period, the ex-post calculated downward adjusted baseline for the year and the ex-post calculated conservative BAU baseline for the same year to confirm that the downward adjusted baseline is lower than the conservative BAU baseline. If it is not, then the conservative BAU baseline shall be used for that specific calendar year.

8. Project scenario

8.1. Calculation of project emissions

154. Project emissions are calculated as follows:

$$PE_y = PE_{EC,y} + PE_{FC,y} + PE_{DT,y} + PE_{SP,y}$$ Equation (44)

Where:

PE_y	=	Project emissions in year *y* (t CO_2/year)
$PE_{EC,y}$	=	Project emissions from electricity consumption due to the Article 6.4 activity in year *y* (tCO_2/year)
$PE_{FC,y}$	=	Project emissions from fossil fuel consumption due to the Article 6.4 activity for purposes other than electricity generation in year *y* (tCO_2/year)
$PE_{DT,y}$	=	Project emissions from the distribution of LFG or biomethane using trucks, in year *y* (tCO_2/year)
$PE_{SP,y}$	=	Project emissions from the supply of biomethane or LFG to consumers through a dedicated pipeline, in year *y* (tCO_2/year)

8.1.1. Project emissions from electricity consumption

155. Project emissions from electricity consumption are calculated as follows:

$$PE_{EC,y} = \left(EC_{grid,y} \times EF_{EC,grid,y} \times F_{TDL,grid}\right) + \left(EC_{captive,y} \times EF_{EC,captive,y}\right)$$ Equation (45)

Where:

$PE_{EC,y}$	=	Project emissions from electricity consumption due to the Article 6.4 activity in year *y* (t CO_2/yr)
$EC_{grid,y}$	=	Quantity of electricity consumed from the electric grid in year *y* (MWh/yr)
$EF_{EC,grid,y}$	=	Emission factor from the electric grid in year *y* (t CO_2/MWh)
$F_{TDL,grid}$	=	Factor to account for transmission and distribution losses from the electric grid (unitless)
$EC_{captive,y}$	=	Quantity of electricity consumed from the captive fossil fuel fired power plant in year *y* (MWh/yr)
$EF_{EC,captive,y}$	=	Emission factor from the fossil fuel fired captive power plant in year *y* (t CO_2/MWh)

156. Apply one of the following default values for $EF_{EC,grid,y}$: [17]

(a) A default emission factor of 1.3 tCO_2/MWh where the proportion of renewable and nuclear energy (excluding solar and wind) in the annual electricity generation is 33 per cent or less for the latest year which data is available, or where its proportion is uncertain;

(b) A default emission factor of 0.87 tCO_2/MWh where the proportion of renewable and nuclear energy (excluding solar and wind) in the annual electricity generation exceeds 33 per cent but is less than 67 per cent for the latest year which data is available;

(c) A default emission factor of 0.44 tCO_2/MWh for electricity sourced from the grid where the proportion of renewable and nuclear energy (excluding solar and wind) in the annual electricity generation exceeds 67 per cent for the latest year which data is available.

157. Apply a value of 1.3 tCO_2/MWh for $EF_{EC,captive,y}$.

158. For the parameter $F_{TDL,grid}$, apply a value of 1.25. [18]

8.1.2. Project emissions from fossil fuel consumption

159. This source of project emissions is calculated as follows:

$$PE_{FC,y} = \sum_{i}\left(FC_{i,y} \times COEF_{i,y}\right) \quad \text{Equation (46)}$$

Where:

$PE_{FC,y}$	=	Project emissions from fossil fuel consumption due to the Article 6.4 activity for purposes other than electricity generation in year *y* (tCO_2/year)
$FC_{i,y}$	=	Quantity of fuel type *i* combusted in process *j* during the year *y* (mass or volume unit/year)

[17] The conservative default emission factors proposed under this sub-section is an interim solution, since the revision of the CDM methodologies “ACM0002: Grid-connected electricity generation from renewable sources”, “AMS-I.D.: Grid-connected renewable electricity generation”, and “Methodological Tool: Emission factor for an electricity system” are yet to be finalized. This mechanism methodology will be revised accordingly to include the calculation of baseline emissions and project emissions from electricity generated and consumed once the revision of ACM0002, AMS-I.D. and the “Methodological Tool: Emission factor for an electricity system” is concluded and the respective standard(s) are adopted by the Supervisory Body.

[18] The conservative default factor to account for transmission and distribution losses from the electric grid proposed under this sub-section is an interim solution, since the revision of the CDM methodologies “ACM0002: Grid-connected electricity generation from renewable sources,” “AMS-I.D.: Grid-connected renewable electricity generation,” and “Methodological Tool: Emission factor for an electricity system,” are yet to be finalized. This mechanism methodology will be revised accordingly to include the calculation of baseline emissions and project emissions from electricity generated and consumed (including how to determine the factor to account for transmission and distribution losses from the electric grid) once the revision of ACM0002, AMS-I.D. and the “Methodological Tool: Emission factor for an electricity system” is concluded and the respective standard(s) are adopted by the Supervisory Body.

$COEF_{i,y}$	=	Is the CO_2 emission coefficient of fuel type *i* in year *y* (tCO_2/mass or volume unit)
i	=	Fuel types combusted

160. The CO_2 emission coefficient ($COEF_{i,y}$) can be calculated using one of the following three options, depending on the availability of data on the fossil fuel type *i*, as follows:

(a) Option A.1: Calculated based on the chemical composition of the fossil fuel type *i*, if $FC_{i,y}$is measured in a mass unit:

$$COEF_{i,y} = w_{c,i,y} \times 44/12 \times 1.002 \quad \text{Equation (47)}$$

(b) Option A.2: Calculated based on the chemical composition of the fossil fuel type *i*, if $FC_{i,y}$is measured in a volume unit:

$$COEF_{i,y} = w_{c,i,y} \times \rho_{,i,y} \times 44/12 \times 1.002 \quad \text{Equation (48)}$$

Where:

$w_{c,i,y}$	=	Mass fraction of carbon in fuel type *i* in year *y* (tC/mass unit of the fuel)
$\rho_{,i,y}$	=	Density of fuel type *i* in year *y* (mass unit/volume unit of the fuel)
1.002	=	Factor to account for emissions of N_2O and CH_4 from the combustion of the fossil fuel

(c) Option B: Calculated based on net calorific value and CO_2 emission factor of the fuel type *i*, as follows:

$$COEF_{i,y} = NCV_{i,y} \times EF_{CO2e,i,y} \quad \text{Equation (49)}$$

Where:

$NCV_{i,y}$	=	Net calorific value of the fuel type *i* in year *y* (GJ/mass or volume unit)
$EF_{CO2e,i,y}$	=	CO_2 emission factor of fuel type *i* in year *y* (tCO_2e/GJ)

161. Activity participants shall use Options A.1 or A.2, unless they can demonstrate that the necessary data are unavailable. If the necessary data are unavailable, activity participants may use Option B.

8.1.3. Project emissions from the distribution of LFG or biomethane to consumers using trucks

162. This source of project emissions is calculated as follows:

$$PE_{DT,y} = PE_{TR,y} + PE_{leaks,y} \quad \text{Equation (50)}$$

Where:

$PE_{DT,y}$	=	Project emissions from the distribution of LFG or biomethane using trucks (tCO_2e/year)

$PE_{TR,y}$	=	Project emissions from the transportation of LFG or biomethane using trucks in year *y* (tCO_2/year)
$PE_{leaks,y}$	=	Emissions from CH_4 leaks during the transportation of LFG or biomethane using trucks in year *y* (tCO_2e/year)

8.1.3.1. Emissions from the transportation of LFG biomethane using trucks

163. Project emissions from the transportation of LFG or biomethane may be monitored using either of Option A or Option B:

(a) Option A: Monitoring fuel consumption. Activity participants shall apply the equations and requirements provided in section 8.1.2 above to determine $PE_{TR,y}$. None of the other provisions of this section 8.1.3.1 shall apply;

(b) Option B: Using conservative default values. Activity participants shall apply the rest of the provisions of this section 8.1.3.1.

164. For Option B, activity participants shall use conservative default emission factors to estimate project or leakage emissions from road transportation of freight. These default values shall be established for two vehicle classes: light vehicles and heavy vehicles. The following data shall be monitored separately for each freight transportation activity *f* to estimate the emissions:

(a) The quantity of freight transported in year *y* ($FR_{f,y}$);

(b) The origin and destination of the freight transported and the road (or rail line) distance between the origin and the destination (D_f); and

(c) The vehicle class used, if the freight is transported by road.

165. The equation to calculate $PE_{TR,y}$shall be calculated as follows:

$$PE_{TR,y} = \sum_{f}\sum_{i} D_{f,i} \times FR_{f,i,y} \times EF_{CO2,f} \times 10^{-6}$$ Equation (51)

Where:

$PE_{TR,y}$	=	Project emissions from the transportation of LFG or biomethane using trucks in year *y* (tCO_2/year)
$D_{f,i}$	=	Return trip distance between the origin and destination of freight transportation activity *f* (km)
$FR_{f,i,y}$	=	Total mass of freight transported in vehicle class *i* and freight transportation activity *f* in year *y* (t/year)
$EF_{i,f}$	=	Default CO_2 emission factor for vehicle class *i* and freight transportation activity f (gCO_2e/t-km)
i	=	Vehicle class (heavy or light duty, if transported by road)
f	=	Freight transportation activity
y	=	Year

166. Activity participants shall document in the PDD which freight transportation activities *f* will occur under the activity scenario, including for each transportation activity information on:

(a) The origin and destination of the freight (to the extent that this is known at validation);

(b) The type(s) of freight that are planned to be transported;

(c) The planned number of trips made and/or the planned quantity of freight that should be transported; and

(d) The option selected (A or B) to determine emissions.

167. For a particular freight transportation activity *f*, the option selected for determining emissions from freight transportation shall not be changed during the crediting period.

8.1.3.2. Emissions from leaks of LFG or biomethane using trucks

168. This source of project emissions is determined as follows:

$$PE_{leaks,y} = GWP_{CH4} \times \left(F_{CH4,NG-TR,y} - F_{CH4,NG-cons,y}\right) \quad \text{Equation (52)}$$

Where:

$PE_{leaks,y}$	=	Emissions from CH_4 leaks during the transportation of LFG or biomethane using trucks in year *y* (tCO_2e/year)
GWP_{CH4}	=	Global Warming Potential of CH4
$F_{CH4,NG-TR,y}$	=	Amount of methane in the LFG or biomethane which is sent to trucks in year *y* (tCH_4/year)
$F_{CH4,NG-cons,y}$	=	Amount of methane in LFG or biomethane which is delivered to consumers using trucks in year *y* (tCH_4/year)

169. The parameters $F_{CH4,NG-TR,y}$ and $F_{CH4,NG-TR,y}$ are determined based on the mass flow tool.

8.1.4. Project emissions from physical leakage due to the supply of LFG or biomethane to consumers through a dedicated pipeline

170. This activity emission source is determined as follows:

$$PE_{SP,y} = 0.0504 \times DEFT_{SP,y} \times F_{CH4,NG,y} \quad \text{Equation (53)}$$

Where:

$PE_{SP,y}$	=	Project emissions from the supply of LFG or biomethane through a dedicated pipeline to consumers due to physical leakage from the dedicated pipeline, in year *y* (tCO_2)
0.0504	=	Conversion factor (TJ/tCH_4)
$DEFT_{SP}$	=	Default emission factor for the supply of LFG or biomethane to consumers through a dedicated pipeline due to physical leakage (tCO_2e/TJ)

$F_{CH4,NG,y}$	=	Amount of methane in the LFG or biomethane which is sent to the consumer through a dedicated pipeline in year *y* (tCH_4/year), determined based on paragraphs 8383 and 84 above

8.2. Project emissions uncertainties

171. Activity participants shall determine the mean project emissions and the 95 per cent confidence interval for uncertainty following the guidance from Volume 1, Chapter 3 of the IPCC (2019 Refinement) through the error propagation method or through the Monte Carlo simulation.

172. Given that project emissions are typically much smaller than baseline emissions for this type of mitigation activity, uncertainty in project emissions shall be addressed as follows:

(a) If the uncertainty range is above +/- 10 per cent, project emissions shall be calculated based on mean plus the upper bound of the 95 per cent confidence interval;

(b) If the uncertainty range is equal to or below +/- 10 per cent, the mean value for project emissions shall be used.

9. Leakage

173. Adjusted yearly baseline emissions shall be discounted by 0.5 per cent to account for leakage emissions[19], as follows:

$$LE_y = 0.005 \times BE_{adj,y} \quad \text{Equation (54)}$$

Where:

LE_y	=	Leakage emissions in year *y* (tCO_2e/year)
0.005	=	Leakage discount factor (%)
$BE_{adj,y}$	=	Downward adjusted baseline emissions in year *y* (tCO_2e/year)]

10. Emission reductions

174. Emission reductions are determined ex-ante as follows:

$$ER_y = BE_{adj,y} - PE_y - LE_y \quad \text{Equation (55)}$$

Where:

ER_y	=	Emission reductions in year *y* (tCO_2e/year)
$BE_{adj,y}$	=	Downward adjusted baseline emissions in year *y* (tCO_2e/year)
PE_y	=	Conservative project emissions in year *y* (tCO_2e/year), determined by applying the uncertainties required in section 8.2 above to the parameters from Equation (45) above

[19] The rationale for the proposed default factor, including the detailed calculation, is provided in Appendix 1.

LE_y = Leakage emissions in year y (tCO_2e/year)

11. Avoidance of double counting

175. All activity participants shall demonstrate that the Article 6.4 activity will not result in double counting by:

(a) Providing evidence, in each monitoring report, that the outcomes from the Article 6.4 activity (e.g. flaring, electricity generation) for which they intend to request issuance of A6.4ERs are not also claimed in other environmental markets or accounting framework (e.g. guarantees of origin for renewable energy generation, green hydrogen schemes, low-carbon fuel standards), except for outcomes not related to reducing greenhouse gases emissions (e.g., air contaminant reductions or social impacts); and

(b) Demonstrating that the reported GHG emission reductions for which they intend to request issuance of A6.4ERs do not overlap with mandatory domestic mitigation schemes (e.g., emissions trading systems), or that measures are in place to ensure that any relevant impacts of the activity (e.g. the GHG emission reductions achieved or the kilowatt-hours of renewable electricity produced) are not counted towards the achievement of targets or obligations under the mandatory domestic mitigation scheme (e.g. by cancelling allowances from the emissions trading system before issuing carbon credits) if the overlap exists,[20] by:

(i) Declaring and providing evidence in each monitoring report that the Article 6.4 activity and the activities displaced in the baseline scenario (e.g. heat generation using fossil fuels) do not fall within the scope of any mandatory domestic mitigation scheme; or

(ii) Where the Article 6.4 activity or the activities displaced in the baseline scenario fall within the scope of a mandatory domestic mitigation scheme, activity participants may:

a. Provide evidence in each monitoring report that the mitigation outcomes of the Article 6.4 activity are not counted in the mandatory mitigation scheme to reduce the obligations by the entities covered by the scheme. For example, in the case of an emissions trading system covering electricity generation, a confirmation from the operator of the emissions trading system may be sought that a number of allowances equal to the A6.4 ERs being requested for issuance for the electricity generation component were cancelled before the issuance of the A6.4 ERs; or

b. Demonstrate that project participants are not requesting the issuance of A6.4ERs for any emission reductions resulting from a component of the Article 6.4 activity that falls within the scope of the mandatory domestic scheme. For example, in the case of an emissions trading

[20] When full or partial impact of the activity is covered under mandatory domestic mitigation scheme and counted towards the achievement of targets and obligations under mandatory domestic mitigation scheme, the relevant share of the impact shall be deducted by the activity participants from the amount requested for issuance.

system covering electricity generation, the activity participant could elect to not include baseline emissions from electricity generation in the calculation of the total emission reductions and thereby demonstrate that no double-counting has occurred.

176. Notwithstanding paragraph 175 above, where the policy for establishing the framework or environmental market or for establishing the mandatory domestic mitigation scheme refers to or formally integrates the mechanism as an instrument for implementation, participation in such a framework or environmental market or domestic mitigation scheme does not result in double counting.

177. All Article 6.4 activities that involve the use of LFG by consumers other than the activity participants shall also employ signed contracts with all consumers of the heat, electricity, LFG or biomethane generated under the Article 6.4 activity. These contracts must explicitly indicate that A6.4ERs can only be claimed by the activity participants and that the users of the heat, electricity, LFG or biomethane shall not claim A6.4ERs or carbon credits from any other carbon crediting programme.

12. Demonstration of alignment with the policies, options and implementation plans with regard to the NDC and LT-LEDS of the host Party and the long-term temperature goal of the Paris Agreement and long-term goals of the Paris Agreement

178. Activity participants shall attach to the PDD presented to the DOE performing the validation a confirmation from the DNA of the host Party that the DNA has undertaken an assessment of the activity's consistency with Decision 3/CMA.3 paragraph 40 (c) and paragraph 27 (a), as part of the host Party's approval, to demonstrate that the activity does not constrain, but aligns with the policies, options and implementation plans of the host Party with regard to the nationally determined contribution (NDC) of the host Party, its long-term low greenhouse gas emission development strategies (LT-LEDS) if it has submitted one, and the long-term temperature goal of the Paris Agreement and long-term goals of the Paris Agreement.

13. Data and parameters not monitored

179. For parameters where the uncertainty was not provided, activity participants shall assume uncertainty based on expert judgement and justify the estimates.

Data / Parameter table 1.

Data/parameter	OX_y
Description	Fraction of methane in the LFG that would be oxidized in the top layer of the SWDS in the baseline scenario in year *y*
Data unit	-
Equations referred	(1), (33)

<table>
<tr><td>Purpose of data</td><td colspan="5">☒ Baseline emissions   ☐ Project emissions   ☐ Leakage emissions</td></tr>
<tr><td rowspan="11">Value(s) applied</td><td>Type of SWDS</td><td>Age of the SWDS cell</td><td>Type of cover material</td><td>OX_y (mean)</td><td>Uncertainty</td></tr>
<tr><td rowspan="5">Existing SWDS</td><td rowspan="4">Immature and mature</td><td>No cover (LDCs/SIDS)</td><td>0</td><td>N/A</td></tr>
<tr><td>No cover (non-LDCs/SIDS)</td><td>0.1</td><td></td></tr>
<tr><td>Synthetic</td><td>0.1</td><td></td></tr>
<tr><td>Soil</td><td>0.383</td><td>± 8%</td></tr>
<tr><td>Aged</td><td>Soil</td><td>0.383</td><td>± 8%</td></tr>
<tr><td rowspan="2">Hypothetical SWDS</td><td rowspan="2">N/A</td><td>Synthetic</td><td>0.1</td><td></td></tr>
<tr><td>Soil</td><td>0.383</td><td>± 8%</td></tr>
<tr><td>Source of data</td><td colspan="5">☐ Measured   ☒ Other sources</td></tr>
<tr><td>Choice of data or measurement methods and procedures</td><td colspan="5">The rationale for each default factor is provided in the “Data / Parameters table” of the respective parameter in section 5.5 of the solid waste tool</td></tr>
<tr><td>Treatment of uncertainties</td><td colspan="5">See table under “Value(s) applied”</td></tr>
<tr><td>Additional comments</td><td colspan="5">Apply the default values only of the parameter is determined through Option 3 of the solid waste tool</td></tr>
</table>

Data / Parameter table 2.

Data/parameter	GWP_{CH4}
Description	Global warming potential of CH_4
Data unit	tCO_2e/tCH_4
Equations referred	(1), (4), (5), (10), (14), (33), (53)
Purpose of data	☒ Baseline emissions ☐ Project emissions ☐ Leakage emissions
Value(s) applied	28
Source of data	☐ Measured ☒ Other sources
Choice of data or measurement methods and procedures	Default value and uncertainty from IPCC Fifth Assessment Report (AR5). Shall be updated according to any future CMA decisions
Treatment of uncertainties	N/A
Additional comments	-

Data / Parameter table 3.

Data/parameter	$F_{CH4,x-i}$		
Description	Amount of methane in the LFG which is captured and destroyed in the year *i* prior to the implementation of the Article 6.4 activity		
Data unit	tCH_4/year		
Equations referred	(12)		
Purpose of data	☒ Baseline emissions	☐ Project emissions	☐ Leakage emissions
Value(s) applied	N/A (not a fixed value)		
Source of data	☐ Measured	☒ Other sources	
Choice of data or measurement methods and procedures	Determined by applying the solid waste tool based on guidance provided for Application A		
Treatment of uncertainties	Uncertainties calculated based on the solid waste tool		
Additional comments	Uncertainty already considered when applying the solid waste tool		

Data / Parameter table 4.

Data/parameter	$\boldsymbol{\eta_{PJ}}$		
Description	Efficiency of the Article 6.4 activity's LFG capture system		
Data unit	%		
Equations referred	(14)		
Purpose of data	☒ Baseline emissions	☐ Project emissions	☐ Leakage emissions
Value(s) applied	Technical specifications of the LFG capture system to be installed (if available) or a default value of 50 per cent (+/- 50 per cent uncertainty)		
Source of data	☒ Measured	☒ Other sources	
Choice of data or measurement methods and procedures	If "measured", demonstrate how the value was determined		
Treatment of uncertainties	N/A		
Additional comments	-		

Data / Parameter table 5.

Data/parameter	$\boldsymbol{BE_{CH4,SWDS,y}}$
Description	Ex-ante estimated amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year *y*
Data unit	tCO_2e/year
Equations referred	(10), (14),

Purpose of data	☒ Baseline emissions	☐ Project emissions	☐ Leakage emissions
Value(s) applied	N/A (not a fixed value)		
Source of data	☐ Measured	☒ Other sources	
Choice of data or measurement methods and procedures	Determined by applying the solid waste tool		
Treatment of uncertainties	Uncertainty already considered when applying the solid waste tool		
Additional comments	-		

Data / Parameter table 6.

Data/parameter	$\boldsymbol{EF_{CO2,BL,HG,n,j}}$; $\boldsymbol{EF_{CO2,NG,y}}$		
Description	$\boldsymbol{EF_{CO2,BL,HG,j}}$: CO_2 emission factor of the fossil fuel type used for heat generation by equipment unit *n* of type *j* in the baseline $\boldsymbol{EF_{CO2,NG,y}}$: Average CO_2 emission factor of natural gas in the natural gas network or dedicated pipeline or in the trucks in year *y*		
Data unit	tCO_2/TJ		
Equations referred	$\boldsymbol{EF_{CO2,BL,HG,n,j}}$: (18) $\boldsymbol{EF_{CO2,NG,y}}$: (23)		
Purpose of data	☒ Baseline emissions	☐ Project emissions	☐ Leakage emissions
Value(s) applied	Variable (depends on the type of fuel)		
Source of data	☐ Measured	☒ Other sources	
Choice of data or measurement methods and procedures	Sourced from Table 1.4 of Volume 2, Chapter 1 of the IPCC (2006)		
Treatment of uncertainties	Apply uncertainties based on the IPCC (2019 Refinement)		
Additional comments	-		

Data / Parameter table 7.

Data/parameter	$\boldsymbol{EF_{CO2,EG,BAT}}$		
Description	CO_2 emissions intensity of the best-available technology		
Data unit	tCO_2e/MWh		
Equations referred	(17)		
Purpose of data	☒ Baseline emissions	☐ Project emissions	☐ Leakage emissions
Value(s) applied	Determined based on procedure to identify the baseline scenario for electricity generation replacing electricity generated in new captive fossil fuel fired power plants contained in section 7.3.1.3 above		

Source of data	☐ Measured	☒ Other sources
Choice of data or measurement methods and procedures	As per the procedure contained in section 7.3.1.3 above	
Treatment of uncertainties	Apply uncertainties based on the IPCC (2019 Refinement)	
Additional comments	-	

Data / Parameter table 8.

Data/parameter	$\eta_{HG,BL,n,j}$		
Description	Efficiency of the heat generation equipment unit *n* of type *j* used in the baseline		
Data unit	%		
Equations referred	(18)		
Purpose of data	☒ Baseline emissions	☐ Project emissions	☐ Leakage emissions
Value(s) applied	90%		
Source of data	☐ Measured	☒ Other sources	
Choice of data or measurement methods and procedures	Value from new boilers running on natural gas, sourced from Vatopoulos et al (2012)		
Treatment of uncertainties	N/A		
Additional comments	-		

Data / Parameter table 9.

Data/parameter	$fd_{CH4,HG,j,default}$		
Description	Default value for the fraction of methane destroyed when used for heat generation equipment type *j*		
Data unit	%		
Equations referred	(2), (20)		
Purpose of data	☒ Baseline emissions	☐ Project emissions	☐ Leakage emissions
Value(s) applied	Use the values below for the different types of heat generation equipment:		

Fraction of CH_4 destroyed	**Equipment type *j***
1	Boilers
1	Air heaters
1	Glass melting furnaces
0.9	Intermittent brick kiln

Source of data	☐ Measured	☒ Other sources
Choice of data or measurement methods and procedures	The values for boilers and air heaters are based on default values provided in Tier 3 approach from Volume 2, Chapter 2 of the IPCC (2006). The value for intermittent brick kilns is based on the assumption that combustion temperatures in the kiln will exceed 600ºC and that the time of exposure is sufficiently long to support 90 per cent combustion	
Treatment of uncertainties	N/A	
Additional comments	-	

Data / Parameter table 10.

Data/parameter	$EF_{CO2,HG,BAT}$		
Description	CO_2 emissions intensity of the best-available technology (tCO_2e/unit of output) identified in section 7.3.1.4 above		
Data unit	tCO_2e/unit of output		
Equations referred	(22)		
Purpose of data	☒ Baseline emissions	☐ Project emissions	☐ Leakage emissions
Value(s) applied	Determined based on procedure to identify the baseline scenario for heat generation replacing heat generated by existing equipment contained in section 7.3.1.3 above		
Source of data	☐ Measured	☒ Other sources	
Choice of data or measurement methods and procedures	As per the procedure contained in section 7.3.1.3 above		
Treatment of uncertainties	Apply uncertainties based on the UPCC (2019 Refinement)		
Additional comments	-		

Data / Parameter table 11.

Data/parameter	$EF_{CO2,f}$		
Description	Default CO_2 emission factor for freight transportation activity *f*		
Data unit	gCO_2/tkm		
Equations referred	(52)		
Purpose of data	☐ Baseline emissions	☒ Project emissions	☐ Leakage emissions
Value(s) applied	- <u>Light vehicles:</u> 245 gCO_2/tkm; - <u>Heavy vehicles:</u> 129 gCO_2/tkm;		
Source of data	☐ Measured	☒ Other sources	

Choice of data or measurement methods and procedures	The default CO_2 emission factors take into account emissions generated by loaded outbound trips and empty return trips and were from two sources: • For light vehicles: empirical data from European vehicles; • For heavy vehicles: derived based on custom design transient speed-time-gradient drive cycle (adapted from the international FIGE cycle), vehicle dimensional data, mathematical analysis of loading scenarios, and dynamic modelling based on engine power profiles, which, in turn, are a function of gross vehicle mass (GVM), load factor, speed/acceleration profiles and road gradient. The following assumptions on key parameters have been made: an average driving speed of 30 km/h, an average gradient of 1 per cent, and a load factor attained when biomass5 is transported were assumed
Additional comments	-

Data / Parameter table 12.

Data/parameter	$DEFT_{SP}$		
Description	Default emission factor for the supply of LFG to consumers due to physical leakage through the dedicated pipeline		
Data unit	tCO_2e/TJ		
Equations referred	(54)		
Purpose of data	☐ Baseline emissions	☒ Project emissions	☐ Leakage emissions
Value(s) applied	2.2		
Source of data	☐ Measured	☒ Other sources	
Choice of data or measurement methods and procedures	Value determined based on Natural gas distribution, sourced from the the report “Detailed California-Modified GREET Pathway for Liquefied Natural Gas (LNG) from North American and Remote Natural Gas Sources”		
Additional comments	Value sourced from the GREET Model for NG distribution, Pressure let down from the transmission system and transport in medium and low-pressure pipelines to the end users		

14. Data and parameters monitored

Data / Parameter table 13.

Data/parameter	***Management of the SWDS***		
Description	Management of the SWDS		
Data unit	-		
Equations referred	N/A. This parameter is monitored to ensure compliance with the applicability condition that the management of the SWDS in the Article 6.4 activity is not deliberately changed during the crediting in order to increase methane generation (for example by recirculating the leachate) compared to the situation prior to the implementation of the Article 6.4 activity		
Purpose of data	☒ Baseline emissions	☐ Project emissions	☐ Leakage emissions

Measurement methods and procedures	Use different sources of data: (a) Original design of the SWDS; (b) Technical specifications for the management of the SWDS; (c) Local or national regulations	
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
Measurement intervals	Annually	
QA/QC procedures	-	
Treatment of uncertainties	N/A	
Additional comment	For Article 6.4 activities that determine the OX_y based on Option 1, the type of cover used under the activity scenario must be the same as the one used historically. Evidence that the type of cover before and after the implementation of the Article 6.4 activity is the same must be provided to the DOE undertaking the verification	

Data / Parameter table 14.

Data/parameter	***Amount of organic fraction***		
Description	Amount of organic fraction recycled impacted by the Article 6.4 activity		
Data unit	tonnes or %		
Equations referred	N/A. This parameter is monitored to ensure compliance with the applicability condition that the project does not reduce the amount of organic waste that would be recycled in the absence of the Article 6.4 activity		
Purpose of data	☒ Baseline emissions	☐ Project emissions	☐ Leakage emissions
Measurement methods and procedures	a) Determine the yearly amount of organic waste disposed in the SWDS by multiplying the amount of waste disposed in the SWDS (W_x or W_i) by the organic fraction of the waste ($p_{n,j,x}$ or $p_{n,j,i}$), following the monitoring requirements of these parameters from solid waste tool, with samples of waste collected at least every year; b) Describe the prevailing waste management practices pertinent to organic waste recycling in the area that is served by the SWDS identified during the validation of the PDD to comply with the requirements of paragraph 13 above; c) Identify the facility(ies) that recycle organic waste in the area identified in (a) above; d) Activity participant may conduct interviews with authorities, refer to national/local statistics or studies related to solid waste management in		

	the area, and obtain opinion from relevant local experts. If data is available for the historical amount of organic waste recycled and the annual amount of organic waste for the recycling facility during the implementation of the Article 6.4 activity, a comparison can be done to conclude that there is no change in the amount of recycled organic fraction of the waste by existing facilities; e) In case there is extra capacity in the identified recycling facilities, activity participants may provide evidence that there is surplus organic waste available in the area. Activity participants may use other evidence to conclude that there is no diversion of the organic fraction of the solid waste that would have been processed by the recycling facility	
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
Measurement intervals	At least annually	
QA/QC procedures	-	
Treatment of uncertainties	N/A	
Additional comment	-	

Data / Parameter table 15.

Data/parameter	$F_{CH4,sent\text{-}PrimaryFlare,y}$; $F_{CH4,sent\text{-}BackupFlare,y}$; $F_{CH4,EL,y}$; $F_{CH4,HG,y}$; $F_{CH4,HG,kiln,h}$; $F_{CH4,NG,y}$; $F_{CH4,NG\text{-}cons,y}$; $F_{CH4,NG\text{-}TR,y}$
Description	$F_{CH4,sent\text{-}PrimaryFlare,y}$: Amount of methane in the LFG which is sent to the primary flares year y $F_{CH4,sent\text{-}BackupFlare,y}$: Amount of methane in the LFG which is sent to the backup flares year y $F_{CH4,EL,y}$: Amount of methane in the LFG which is used for electricity generation in year y; $F_{CH4,HG,y}$: Amount of methane in the LFG which is used for heat generation in year *y* $F_{CH4,HG,kiln,n,h}$: Amount of methane in the LFG which is used for heat generation by brick kiln unit *n* in hour *h* $F_{CH4,NG,y}$: Amount of methane in the LFG or in the biomethane which is supplied to consumers via a natural gas distribution network and/or dedicated pipeline and/or trucks in year *y* $F_{CH4,NG\text{-}TR,y}$: Amount of methane in the LFG or biomethane which is sent to trucks in year *y* $F_{CH4,NG\text{-}cons,y}$: Amount of methane in LFG or biomethane which is delivered to consumers using trucks in year *y*

Data unit	tCH_4/year		
Equations referred	$F_{CH4,sent-PrimaryFlare,y}$: (4) $F_{CH4,sent-BackupFlare,y}$: (5) $F_{CH4,EL,y}$: (2), (30) $F_{CH4,HG,y}$: (2), (20), (31) $F_{CH4,HG,kiln,n,h}$: (21) $F_{CH4,NG,y}$: (2), (23), (32), (54) $F_{CH4,NG-TR,y}$: (53) $F_{CH4,NG-cons,y}$: (53)		
Purpose of data	☒ Baseline emissions	☐ Project emissions	☐ Leakage emissions
Measurement methods and procedures	As per the requirements of the mass flow tool		
Entity/person responsible for the measurement	Activity participants		
Measuring instrument(s)	*Type of instrument*	As per the requirements of the mass flow tool	
	Accuracy class	As per the requirements of the mass flow tool	
	Calibration requirements	As per the requirements of the mass flow tool	
	Location	As per the requirements of the mass flow tool	
Measurement intervals	As per the requirements of the mass flow tool		
QA/QC procedures	As per the requirements of the mass flow tool		
Treatment of uncertainty	Uncertainties are determined based on the measuring instruments and propagated through error propagation method or Monte Carlo Simulation as per the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gases Inventories		
Additional comment	-		

Data / Parameter table 16.

Data/parameter	$F_{LFG,BL,R,y}$		
Description	Amount of LFG which is flared in the baseline due to a requirement in year y		
Data unit	m^3/year		
Equations referred	(6)		
Purpose of data	☒ Baseline emissions	☐ Project emissions	☐ Leakage emissions
Measurement methods and procedures	N/A. Information is sourced directly from the law, regulation or contractual requirement		

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
Measurement intervals	Annual check of the law, regulation or contractual requirements	
QA/QC procedures	-	
Treatment of uncertainty	N/A	
Additional comment	The parameter is converted to the amount of methane (tCH_4/year) as per paragraph 91 above	

Data / Parameter table 17.

Data/parameter	$\boldsymbol{\rho_{reg,y}}$		
Description	Fraction of LFG that is required to be destroyed due to a requirement in year *y*		
Data unit	%		
Equations referred	(7)		
Purpose of data	☒ Baseline emissions	☐ Project emissions	☐ Leakage emissions
Measurement methods and procedures	N/A. Information is sourced directly from the law, regulation or contractual requirement		
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	
Measurement intervals	Annual check of the law, regulation or contractual requirements		
QA/QC procedures	-		
Treatment of uncertainties	N/A		
Additional comment	-		

Data / Parameter table 18.

Data/parameter	$\eta_{HG,PJ,n,j,y}$		
Description	Efficiency of the heat generation equipment unit *n* of type *j* used in the Article 6.4 activity in year *y*		
Data unit	%		
Equations referred	(19)		
Purpose of data	☒ Baseline emissions	☐ Project emissions	☐ Leakage emissions
Measurement methods and procedures	Use one of the following options to determine the efficiency: • Option 1: Measured efficiency during monitoring; • Option 2: Manufacturer's information on the efficiency; or • Option 3: Use a default value of 60 per cent		
Entity/person responsible for the measurement	• Option 1: Activity participants; • Option 2: Manufacturer of the heat generation equipment		
Measuring instrument(s)	*Type of instrument*	N/A	
	Accuracy class	N/A	
	Calibration requirements	N/A	
	Location	N/A	
Measurement intervals	Annual if measurements are conducted as per Option 1		
QA/QC procedures	If measurements are conducted as per Option 1, use recognized standards for the measurement of the heat generator efficiency, such as the "British Standard Methods for Assessing the thermal performance of boilers for steam, hot water and high temperature heat transfer fluids" (BS845). Where possible, use preferably the direct method (dividing the net heat generation by the energy content of the fuels fired during a representative time period), as it is better able to reflect average efficiencies during a representative time period compared to the indirect method (determination of fuel supply or heat generation and estimation of the losses). Document measurement procedures and results and manufacturer's information transparently in the PDD		
Treatment of uncertainties	For Option 1, the uncertainty is to be determined based on the guidance from the standard BS845. For Option 2, the uncertainty is to be provided by the manufacturer		
Additional comment	-		

Data / Parameter table 19.

Data/parameter	$Op_{j,h}$
Description	Operation of the equipment *j* that consumes the LFG in hour *h*
Data unit	Hours

Equations referred	N/A. This parameter is measured to determine whether the equipment type *j* is in operation during the hour *h*.		
Purpose of data	☒ Baseline emissions	☐ Project emissions	☐ Leakage emissions
Measurement methods and procedures	For each equipment unit j using the LFG monitor that the plant is operating in hour h by the monitoring any one or more of the following three parameters: • Temperature: Determine the location for temperature measurements and minimum operational temperature based on manufacturer's specifications of the burning equipment. Document and justify the location and minimum threshold in the PDD; • Flame: Flame detection system is used to ensure that the equipment is in operation. This option is applicable only for flares; • Products generated: Monitor the generation of steam for the case of boilers and air-heaters and glass for the case of glass melting furnaces. This option is not applicable to brick kilns		
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	
Measurement intervals	Every minute (temperature and flame detector), or every hour (products)		
QA/QC procedures	-		
Treatment of uncertainties	N/A		
Additional comment	A value of 0 shall be assigned for the specific hour *h* when: a) One of more temperature measurements are missing or below the minimum threshold in hour h (instantaneous measurements are made at least every minute); b) Flame is not detected continuously in hour h (instantaneous measurements are made at least every minute); c) No products are generated in the hour h		

Data / Parameter table 20.

Data/parameter	EG_y
Description	Quantity of electricity generated by the power plant in the activity scenario in year *y*
Data unit	MWh/year
Equations referred	(15), (16), (17), (40)

<table>
<tr><td>Purpose of data</td><td>☒ Baseline emissions</td><td>☐ Project emissions</td><td>☐ Leakage emissions</td></tr>
<tr><td>Measurement methods and procedures</td><td colspan="3">Directly measured using electricity meters</td></tr>
<tr><td>Entity/person responsible for the measurement</td><td colspan="3">Activity participants</td></tr>
<tr><td rowspan="4">Measuring instrument(s)</td><td>Type of instrument</td><td colspan="2">Bi-directional energy meter</td></tr>
<tr><td>Accuracy class</td><td colspan="2">Regulated electricity-meters: in accordance with the stipulation of the meter supplier and/or as per the requirements set by the grid operators or national requirements
Non-regulated electricity-meters: in accordance with the stipulation of the meter supplier or national requirements (if the standards are not available and meter supplier does not specify, calibrate the meters every 3 years and use the meters with at least 0.5 accuracy class)</td></tr>
<tr><td>Calibration requirements</td><td colspan="2">Regulated electricity-meters: in accordance with national standards or requirements set by the meter supplier or requirements set by the grid operators
Non-regulated electricity-meters: in accordance with national standards or requirements set by the meter supplier</td></tr>
<tr><td>Location</td><td colspan="2">For electricity supplied to the electric grid: installed at the grid interface.
For electricity supplied to captive consumers: installed at the entrance of the electricity consuming facility</td></tr>
<tr><td>Measurement intervals</td><td colspan="3">Continuous measurement and at least monthly recording</td></tr>
<tr><td>QA/QC procedures</td><td colspan="3">Electricity meters will be subject to regular maintenance and testing in accordance with the stipulation of the meter supplier and/or as per the requirements set by the grid operators or national requirements.
The electricity generation (gross or net) shall be cross-checked with records of electricity sale (e.g. sales receipt)</td></tr>
<tr><td>Treatment of uncertainties</td><td colspan="3">Uncertainties are determined based on the measuring instruments</td></tr>
<tr><td>Additional comment</td><td colspan="3">-</td></tr>
</table>

Data / Parameter table 21.

Data/parameter	$EC_{grid,y}$; $EC_{captive,y}$
Description	$EC_{grid,y}$: Quantity of electricity consumed from the electric grid in year y $EC_{captive,y}$: Quantity of electricity consumed from the captive fossil fuel fired power plant in year y
Data unit	MWh/year

Equations referred	(46)		
Purpose of data	☐ Baseline emissions	☒ Project emissions	☐ Leakage emissions
Measurement methods and procedures	Directly measured using electricity meters		
Entity/person responsible for the measurement	Activity participants		
Measuring instrument(s)	*Type of instrument*	Electricity-meters	
	Accuracy class	Regulated electricity-meters: in accordance with the stipulation of the meter supplier and/or as per the requirements set by the grid operators or national requirements Non-regulated electricity-meters: in accordance with the stipulation of the meter supplier or national requirements (if the standards are not available and meter supplier does not specify, calibrate the meters every 3 years and use the meters with at least 0.5 accuracy class)	
	Calibration requirements	Regulated electricity-meters: in accordance with national standards or requirements set by the meter supplier or requirements set by the grid operators Non-regulated electricity-meters: in accordance with national standards or requirements set by the meter supplier	
	Location	Installed at the electricity consumption sources	
Measurement intervals	Continuous measurement and at least monthly recording		
QA/QC procedures	Electricity meters will be subject to regular maintenance and testing in accordance with the stipulation of the meter supplier and/or as per the requirements set by the grid operators or national requirements		
Treatment of uncertainties	Uncertainties are determined based on the measuring instruments		
Additional comment	-		

Data / Parameter table 22.

Data/parameter	$FC_{i,y}$		
Description	Is the quantity of fuel type *i* combusted in process *j* during the year *y*		
Data unit	Mass or volume unit/year		
Equations referred	(47)		
Purpose of data	☐ Baseline emissions	☒ Project emissions	☐ Leakage emissions
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 case of 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 must be calibrated at least once a year. Transducers, sonar and piezoelectronic devices must be calibrated with the ruler gauge and receiving a reasonable maintenance
	Location	N/A
Measurement intervals	Continuously	
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: • The purchased fuel/energy invoices/bills, where the purchased fuel can be identified specifically for the Article 6.4 activity; • The energy produced by the equipment, adjusted by efficiency. A conservative value for efficiency of the equipment is of 40 per cent for combustion engines and generator and 80 per cent for thermal heaters shall be used, while energy produced is measured directly or calculated based on operation hours; • The highest value of the parameter for the same calendar period of the previous years; • The fuel consumption of a representative sample of the first batch1 of project devices. It may be assumed that the fuel consumption measured in a representative sample of the first batch of project devices apply to all subsequent batches	

Data / Parameter table 23.

Data/parameter	D_f

Description	Return trip distance between the origin and destination of freight transportation activity *f*		
Data unit	km		
Equations referred	(52)		
Purpose of data	☐ Baseline emissions	☒ Project emissions	☐ Leakage emissions
Measurement methods and procedures	Determined for each freight transportation activity *f* for a reference trip		
Entity/person responsible for the measurement	Activity participants or vehicle operator (if the trucks are not owned by the activity participants)		
Measuring instrument(s)	*Type of instrument*	Vehicle odometer, other appropriate sources (e.g. on-line sources)	
	Accuracy class	N/A	
	Calibration requirements	N/A	
	Location	N/A	
Measurement intervals	Determined once for each freight transportation activity f. To be updated whenever the distance changes		
QA/QC procedures			
Treatment of uncertainties	Uncertainties are determined based on the measuring instruments		
Additional comment			

Data / Parameter table 24.

Data/parameter	$FR_{f,i,y}$		
Description	Total mass of freight transported in vehicle class *i* and freight transportation activity *f* in year *y*		
Data unit	Tonnes		
Equations referred	(52)		
Purpose of data	☐ Baseline emissions	☒ Project emissions	☐ Leakage emissions
Measurement methods and procedures	Determined for each freight transported f		
Entity/person responsible for the measurement	Activity participants or vehicle operator (if the trucks are not owned by the activity participants)		
Measuring instrument(s)	*Type of instrument*	N/A	
	Accuracy class	N/A	
	Calibration requirements	N/A	

	Location	N/A
Measurement intervals	Continuously	
QA/QC procedures		
Treatment of uncertainties	Uncertainties are determined based on the measuring instruments	
Additional comment		

Data / Parameter table 25.

Data/parameter	$w_{c,i,y}$		
Description	Mass fraction of carbon in fuel type *i* in year *y*		
Data unit	t_C /mass unit of the fuel		
Equations referred	(48), (49)		
Purpose of data	☐ Baseline emissions	☒ Project emissions	☐ Leakage emissions
Value(s) applied	Variable (depends on the type of fuel)		
Source of data	☒ Measured	☒ Other sources	
Choice of data or measurement methods and procedures	- Values provided by the supplier of the fuel (preferred source); - Measurements by activity participants undertaken in line with national or international fuel standards		
Treatment of uncertainties	Uncertainties are determined based on the measuring instruments		
Additional comments	Verify if the values measured or sourced from the fuel supplier or from measurements are within the uncertainty range of the product of the IPCC default values as provided in Table 1.2 and Table 1.3, Vol. 2 of 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 (b) should have ISO17025 accreditation or justify that they can comply with similar quality standards		

Data / Parameter table 26.

Data/parameter	$\rho_{,i,y}$		
Description	Density of fuel type *i* in year *y*		
Data unit	Mass unit/volume unit of the fuel		
Equations referred	(49)		
Purpose of data	☐ Baseline emissions	☒ Project emissions	☐ Leakage emissions
Value(s) applied	Variable (depends on the type of fuel)		
Source of data	☒ Measured	☒ Other sources	

Choice of data or measurement methods and procedures	- Values provided by the supplier of the fuel (preferred source); - 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); - Regional or national default values (if the values provided by the supplier of the fuel are not available and only for liquid fuels)
Additional comments	For option 1: The density of the fuel should be obtained for each fuel delivery, from which weighted average annual values should be calculated

Data / Parameter table 27.

Data/parameter	$NCV_{i,y}$		
Description	Weighted average net calorific value of the fuel type *i* in year *y*		
Data unit	TJ per Mass unit or volume unit of the fuel		
Equations referred	(50)		
Purpose of data	☐ Baseline emissions	☒ Project emissions	☐ Leakage emissions
Value(s) applied	Variable (depends on the type of fuel)		
Source of data	☒ Measured	☒ Other sources	
Choice of data or 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 of the 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		
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 comments			

Data / Parameter table 28.

Data/parameter	$EF_{CO2e,i,y}$

Description	Weighted average CO_2e emission factor of fuel type *i* in year *y*		
Data unit	tCO_2e/GJ		
Equations referred	(50)		
Purpose of data	☐ Baseline emissions	☒ Project emissions	☐ Leakage emissions
Value(s) applied	Variable (depends on the type of fuel)		
Source of data	☒ Measured	☒ Other sources	
Choice of data or 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 of the 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		
Additional comments	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 tCO_2e/GJ and added to the emission factor of CO_2 to estimate a total equivalent emission factor in tCO_2e/GJ for the three greenhouse gases		

14.1. Frequency of submission of monitoring reports

180. N/A, since this requirement is only applicable for activities involving removals and for emission reduction activities with risks of reversals.

Appendix. Identification and avoidance or minimization of leakage

1. Identification of leakage emission sources

1. As required by the leakage standard, the following potential sources of leakage are considered:

   (a) Baseline equipment transfer;

   (b) Competition for resource use;

   (c) Diversion of existing production processes or outputs;

   (d) Increases in release of GHGs from the environment as a result of Article 6.4 activity;

   (e) Additional leakage sources not covered by the leakage standard:

      (i) Upstream emissions from the manufacturing of flares used by the Article 6.4 activity;

      (ii) Upstream emissions from the manufacturing of HDPE pipeline used for LFG collection and supply of LFG or biomethane to consumers;

      (iii) Upstream emissions from the manufacturing of the containers used for the transportation of the LFG or the biomethane, manufacturing of trucks, and manufacturing of equipment used for LFG compression or upgrade to biomethane;

      (iv) Upstream emissions from the generation of energy using fossil fuels, including emissions from the production, processing and transportation of fossil fuels to the energy plant, manufacturing of the energy generation equipment and construction of the energy generation plant.

2. Avoidance or minimization of leakage

2. Out of the potential sources identified above, the following are not impacted by typical Article 6.4 activities eligible under this mechanism methodology and, therefore, do not need to be further considered:

   (a) Diversion of existing production processes or outputs: the types output provided by typical Article 6.4 activities eligible under this mechanism methodology are the same as in the baseline, (i.e. treated waste, biomethane/LFG to replace natural gas, heat or electricity);

   (b) Increases in release of GHGs from the environment as a result of the project: the project will be implemented in SWDS, therefore there will be no release of GHG from the environment.

3. Leakage from the transfer of baseline equipment may happen if the heat generation equipment used in the baseline replaces a new heat generation equipment that is used

outside of the project boundary. In order to avoid this leakage, an applicability condition was added requiring activity participants to either demonstrate that the heat generation equipment used in the baseline scenario are scrapped or that the existing heat generation equipment used outside of the project boundary has a lower efficiency than the heat generation equipment used in the baseline scenario.

4. Leakage from the competitive use of the solid waste may happen if solid waste used for other activities, e.g. recycling, is diverted to the SWDS. To avoid this leakage, an applicability condition was introduced in this mechanism methodology that requires activity participants to demonstrate that the Article 6.4 activity does not reduce the amount of organic waste that would be recycled in the absence of the Article 6.4 activity.

3. Discount of leakage

5. As justified above, the leakage emissions sources that need to be accounted are those associated with the:

   (a) Upstream emissions from the manufacturing of flares used by the project;

   (b) Upstream emissions from the manufacturing of HDPE pipeline used for LFG collection and supply of LFG or biomethane to consumers via dedicated pipeline;

   (c) Upstream emissions from the manufacturing of the containers used for the transportation of the LFG or the biomethane, of manufacturing of trucks, and manufacturing of equipment used for LFG compression and biomethane upgrade and compression;

   (d) Upstream emissions from the generation of energy using fossil fuels, including emissions from the production, processing and transportation of fossil fuel to the energy plant, manufacturing of the energy generation equipment and construction of the energy plant.

6. The table below illustrates the upstream emission sources identified for the baseline and for the activity scenarios associated with the type of Article 6.4 activity being implemented based on the different components:

Table 1. Upstream baseline and activity emission sources identified for each component of Article 6.4 activities eligible under this mechanism methodology

Type of project	Baseline situation	Source of upstream baseline emissions	Activity situation	Source of upstream project emissions
Flaring only	• Operation of the landfill without implementing the LFG collection and destruction systems that are part of the project;	• N/A	• Installation of an efficient LFG collection system; • Installation of one or more flares to destroy the methane	• Manufacturing of HDPE pipeline to collect the LFG • Manufacturing of flares

Type of project	**Baseline situation**	**Source of upstream baseline emissions**	**Activity situation**	**Source of upstream project emissions**
Supply of biomethane or LFG to consumers	• Operation of the landfill without implementing the LFG collection system that is part of the project; • Consumers would have been supplied with natural gas from the distribution network	• N/A • Production, processing and transportation of the natural gas to the consumers	• Installation of an efficient LFG collection system; • Installation of biomethane production plant; • Transportation of the biomethane to consumers via pipeline, natural gas grid or trucks	• Manufacturing of HDPE pipeline to collect the LFG; • Construction of the biomethane production plant; • Manufacturing of biomethane transportation pipelines, trucks and vessels
Electricity generation	• Operation of the landfill without implementing the LFG collection system that is part of the project; • For simplification: electricity would have been generated by a natural gas power plant	• N/A • Production, processing and transportation of the natural gas to the power plant	• Installation of an efficient LFG collection system; • Construction of a LFG power plant	• Manufacturing of HDPE pipeline to collect the LFG; • Manufacturing of LFG engines and construction of the power plant
Heat generation and replacement of existing equipment	• Operation of the landfill without implementing the LFG collection system that is part of the project; • For simplification: heat would have been generated in the same natural gas boiler	• N/A • Production, processing and transportation of the natural gas to the boiler	• Installation of an efficient LFG collection systems	• Manufacturing of HDPE pipeline to collect the LFG
Heat generation and replacement of new equipment	• Operation of the landfill without implementing the LFG collection system that is part of the project; • For simplification: heat would have been generated in a natural gas boiler	• N/A • Production, processing and transportation of the natural gas to the boiler	• Installation of an efficient LFG collection system; • Installation of a new boiler	• Manufacturing of HDPE pipeline to collect the LFG; • Manufacturing of the boiler

7. The upstream the leakage emissions shall be determined as the difference between the upstream project emissions and the upstream baseline emissions.

8. The sections below elaborate on how each of the upstream sources were determined.

4. Upstream project emissions from the manufacturing or flares

9. In the absence of a published life-cycle analysis for the production of flares, the upstream emissions from the manufacturing of the flares were estimated as the product between the weight of a flare (assuming that flares are 100 per cent composed of steel) by the CO_2 emission factor for the production of steel (1.27 tCO_2e/t_{steel}, as per Appendix 3 of the approved CDM methodology AMS-III.BA.[1]), and the result is multiplied by 1.3 to account for 30 per cent more emissions due to the transportation and assembly of the flare in the activity site. Therefore, upstream emissions to produce a 5,000 $m^3{}_{LFG}$/h flare that weighs 9.6 tons (information provided by a manufacturer) is equal to 15.8 tCO_2e.

10. A SWDS with a capacity to collect 5,000 m3/h of LFG can generate around 360,000 tCO_2e/year (determine by applying the mass flow tool, assuming the gas has a methane concentration equals to 50 per cent, an operational temperature of 323 K and a manometric pressure of 50 Pa). Applying the discount factors for downward adjustment as per the adjustment factor, it results in or 1,000,000 tCO_2e over a 5-years crediting period. Therefore, the upstream emissions from the production of the flare can be neglected since it represents 0.001 per cent of the baseline emissions achieved during a 5-years crediting period.

5. Upstream project emissions from the manufacturing or HDPE pipeline for the collection of LFG and for the distribution of biomethane or LFG to consumers via dedicated pipeline

11. Upstream emissions from the manufacturing of HDPE pipeline were estimated based on public available information on the specific weight of a SDR11 HDPE pipeline per meter (equals to 25.6 kg/m^2), and the emission factor of HDPE (equals to 2.6 $kgCO_2e/kg_{HDPE}$ [3]), assuming that the pipe is 100 per cent composed by HDPE, and adding 30 per cent to account for emissions associated with the transportation and installation of the pipes in the site. The result is equal to 0.087 tCO_2e/m_{HDPE}.

12. The assumption that this is the type of HDPE pipes (SDR11) employed by SWDSs for wells, headers, gas lines and distribution lines to consumers is conservative since it is used for fluids with an internal pressure up to 10 bar and gas flow above 15,000 m^3/h, whereas the typical operating pressure of LFG collection system is 6-8 bar and the estimated waste disposed to achieve such flow of gas should be around 8,000 tonnes/day – or a SWDS that receives the waste from around 8,000,000 inhabitants.

---

[1] Approved small-scale CDM methodology 'AMS-III.BA: Recovery and recycling of materials from E-waste', available at: https://cdm.unfccc.int/UserManagement/FileStorage/30BQNA7GEM4ZCPWI895FHDXRLJTSK6.

[2] See https://www.youmats.com/en/plumbing/pipe-and-fittings/hdpe-pipes-and-fittings/hdpe-pipes/hdpe-pipe-pn-10-bar-pe-80-od-315-mm-black-color-alwasail-194/.

[3] See Life cycle greenhouse gas emissions and energy use of polylactic acid, bio-derived polyethylene, and fossil-derived polyethylene (page 14).

13. Large-scale LFG-to-energy activities (LFG generation rate above 10,000 m3/h that can be used to generate electricity in a power plant with more than 10 MW installed capacity) tend to install the longest pipeline network possible in the SWDSs in order to maximize the amount of LFG collected, however the total pipeline length installed (gas wells, headers, and gas lines) does not usually reach 50 km. Therefore, the upstream emissions from the manufacturing of 50 km of HDPE results in 4,350 tCO_2e. If another 20 km are added to connect the SWDS with the natural gas distribution network or with the dedicated consumer, upstream emissions would be rounded up to 6,100 tCO_2e.

14. For sake of comparison, this leakage would represent 0.3 per cent of the baseline emissions over a 5-years crediting period for Article 6.4 activities with a collection design of 5,000 m^3/h (360,000 tCO_2e/year, or 1,850,000 over a 5-years period for a project that involves 100 per cent of the FLG being supplied to consumers via dedicated pipeline without destruction in flares, see rationale in paragraph 10 above).

6. Upstream project emissions from the manufacturing of the containers used for the transportation of the LFG or the biomethane, of trucks, and equipment used for LFG compression/liquefaction or upgrade to biomethane

15. This upstream emission source will be assessed separately for the manufacturing of the containers, for the manufacturing of trucks and for the manufacturing and construction of the biomethane production plant.

6.1. Upstream project emissions from the manufacturing of the containers used for the transportation of the LFG or biomethane

16. In the absence of a published life-cycle analysis for the production of containers used for the transportation of the LFG or biomethane, the CO_2 emissions were estimated assuming that:

(a) The cylinder used for the storage of the LFG or biomethane is a Type 3 vessel, with maximum operating pressure of 250 bar and hydraulic volume of 120 L. The vessel is manufactured using a mix of carbon fibre and epoxy composite for the structural shell and glass fibre and epoxy composite as protective barrier and has a mass equal to 57 kg.[4] For conservative reasons, the calculation will assume that the cylinder is 100 per cent composed by carbon fibre due to its higher LCA emissions compared to glass fibre (53.4 $kgCO_2e/kg_{carbon\ fibre}$[5] and 2.02 $kgCO_2e/kg_{glass\ fibre}$[6]);

(b) The mass of biomethane that can be stored at 250 bar and 15ºC in a 120 L vessel is around 20 kg. Transportation trucks can be designed with different storage capacities, ranging from 1,000 to 2,500 hydraulic L – or with a storage capacity from 170 to 420 kg of biomethane at 250 bar. For simplification, trucks with 2,500 hydraulic L capacity (or 420 kg of biomethane) vessels will be considered in the calculations;

[4] See https://steelheadcomposites.com/sites/default/files/2024-01/CNG-Brochure.pdf.

[5] See https://www.sciencedirect.com/science/article/pii/S1526612523000944?ref=pdf_download&fr=RR-7&rr=976f1ff31c261db8, accessed on 11 August 2025.

[6] See https://glassfibreeurope.eu/life-cycle-assessment-of-continuous-filament-glass-fibre-products-2/, accessed on 11 August 2025.

(c) The LFG collected from a SWDS with a collection capacity of 5,000 m3/h at standard conditions can produce 1.6 tons/hour of biomethane, meaning that for every hour a total of 4 trucks can be filled with biomethane at the same time.

17. The estimation of upstream leakage will depend on the number of trucks available to make the transportation, which depends on the duration of a round-trip to transport the biomethane to consumers: if the round-trip is 1 hour, the project must operate with 8 trucks (4 to transport the biomethane whereas the other 4 are being filled with biomethane); if the round-trip is 2 hours, the project must operate with 16 trucks – and so on and so forth.

18. The upstream emissions to manufacture the 2,500 hydraulic L vessel used in this example is equal to 64 tons of CO_2 (21 vessels x 57 kg/vessel x 53.4 $kgCO_2e/kg_{vessel}$, assuming the vessels are 100 per cent made of carbon fibre). Therefore, for a round-trip of 1 hour, upstream emissions will be equal to 8 trucks x 64 tCO_2e/truck, which is equal to 512 tCO_2e.

19. Converting the upstream emissions to tCO2e per MJ to transport 14,000 tons of biomethane (616 TJ) in one year, the result is 512 tCO_2e / 616 TJ = 0.83 tCO_2e/TJ (or 0.83 gCO_2e/MJ).

6.2. Upstream project emissions from the manufacturing of the trucks used for the transportation of the LFG or the biomethane

20. Data is available to determine the cradle-to-gate emissions from the manufacturing and use of heavy-duty trucks, in gCO_2e/km. According to the white paper published by the ICCT[7], the LCA emissions from a 40-tonnes articulated truck (tractor trailer) driving 1,300,000 km over a 20 years lifetime and consuming a mix of diesel and biofuel. The upstream emissions from the manufacturing of the truck can be conservatively assumed from Figure 4 of this white paper as 100 gCO_2e/km, which results in emissions equals to 100 gCO_2e/km x 1,300,000 km = 130 tCO_2e to manufacture one 40-tonnes truck. The upstream emissions for manufacturing the 8 trucks used for the transportation of the biomethane above will be equal to 1,040 tCO_2e.

21. Therefore, the upstream emissions for the supply of biomethane from the collection of 5,000 m3/h of LFG, assuming that the round-trip between the SWDS and the consumer is 1 hour, is equal to 1,500 tCO_2e.

22. Over a year, the SWDS with a capacity to collect 5,000 m3/h of biogas can produce 70,200 MJ/h, assuming the biomethane has the same composition as the natural gas and the NCV of the natural gas is equal to 48 TJ/GJ (as per Table 1.2 from Volume 2, Chapter 1 of the IPCC (2006). On an yearly basis, the SWDS would produce around 14,000 tonnes of biomethane – or 673 TJ. Therefore, the upstream emissions for the manufacturing of the vessels to store the biomethane and the trucks to transport the biomethane to the consumers is equal to 1,500 tCO_2e / 673,000,000 = 2.2 tCO_2e/TJ, or 2.2 gCO_2e/MJ.

[7] International Council on Clean Transportation (ICCT). The life-cycle greenhouse gas emissions of European heavy-duty vehicles and fuels. 2023. White paper. Available at <https://theicct.org/wp-content/uploads/2023/02/Lifecycle-assessment-trucks-and-buses-emissions-Europe.pdf>, accessed on 10 August 2025.

6.3. Upstream project emissions from the manufacturing of the equipment used for LFG compression/liquefaction or upgrade to biomethane

23. In the absence of a published life-cycle analysis for the manufacturing of a biomethane production plant from LFG, a proxy was considered based on upstream emissions to process natural gas. The National Energy Technology Laboratory, published, in 2024, the report “Life cycle analysis of natural gas extraction and power generation: U.S. 2020 emissions profile”[8] containing an analysis of the U.S. natural gas (NG) supply chain and a study on the impact associated with an average unit of NG traversing from the upstream production basins to the downstream delivery regions. According to analysis, the upstream emissions of a processing natural gas plant is equal to 2.08 gCO_2/MJ. Adding this value to the 2.2 gCO_2e/MJ determined in section 3.2 above gives a total of 4.28 gCO_2/MJ.

7. Upstream project emissions from the generation of electricity

24. In the absence of LCAs that provide the emissions from the construction of an LFG power plant and from the manufacturing of engines, an approximate emission factor per kWh was estimated by:

(a) Calculating the electricity generation by a 4 MW gas engine as the product between 8,760 hours/year x 4 MW x 85 per cent capacity factor (same basis as the NGCC power plant from item 5 above) x 30 years (same basis as the NGCC power plant from item 5 above), which is equal to 893,520 MWh;

(b) Determining the emissions to produce a 4 MW LFG engine by multiplying the weight of a typical 4 MW LFG engine (54 tonnes[9]) by the specific CO_2 emission factor for the production of steel 1.27 tCO_2e/t_{steel} (assuming that the engine is 100 per cent steel), and further multiplying the result by 1.3 to account for emissions from the construction of the power plant, which results in 89 tCO_2 per 4 MW engine;

(c) The upstream project emissions is the ratio between the electricity CO_2 emissions and the electricity generated, which is equal to 89 tCO_2/893,520 MWh = 0.1 gCO_2/kWh.

8. Upstream project emissions form the manufacturing of a boiler

25. Upstream emissions for the manufacturing of a boiler for the construction of the energy plant were sourced from available literature of LAC for the natural gas supply chain and for a 25 $MW_{thermal}$ boiler.

26. In the absence of open LCA for the production of boilers, the upstream emissions to manufacture one boiler were estimated by multiplying the weight of the boiler by 1.27 tCO_2e/t_{steel} (assuming the boiler is 100 per cent made of steel), plus 30 per cent added to account for assembly and transportation emissions. To narrow down the search, a boiler with a capacity of 31.5 tonnes/h of steam at 11 bar and efficiency of 90 per cent was considered based on the thermal energy that 5,000 m3/h of LFG can generate

---

[8] See https://www.netl.doe.gov/projects/files/LifeCycleAnalysisofNaturalGasExtractionandPowerGenerationUS2020EmissionsProfile_121724.pdf, accessed on 20 August 2025.

[9] See https://www.cat.com/en_US/products/new/power-systems/electric-power/gas-generator-sets/15969826.html.

(approximately 25 $MW_{thermal}$) – the weight of such type of boiler is equal to 52.7 tons,[10] and its upstream emissions are equal to 52.7 tons x 1.27 tCO_2e/t_{steel} x 130 per cent = 87 tCO_2e. If the boiler operates throughout a whole year (8,760 hours, to align with the basis of the natural gas upstream emissions determined in item 4), the total MJ produce will be equal to $6.75x10^8$ MJ, which results in 0.12 gCO_2/MJ.

9. Upstream baseline emissions from the production, processing and transportation of the natural gas to consumers

27. The National Energy Technology Laboratory, published, in 2024, the report "Life cycle analysis of natural gas extraction and power generation: U.S. 2020 emissions profile"[11] containing an analysis of the U.S. natural gas (NG) supply chain and a study on the impact associated with an average unit of NG traversing from the upstream production basins to the downstream delivery regions, including the calculation of two U.S. average emissions from NG produced and delivered in the year 2020: 8.8 gCO_2e/MJ for the emissions associated from the production of the NG to the distribution to final consumers via natural gas grid (the "production through distribution" life-cycle analysis, including the production, gathering and boosting, processing, transmission and distribution of natural gas to end users), and 7.8 gCO_2e/MJ for the emissions associated from the production of the NG to the transmission gas pipeline (the "production through transmission network" life-cycle analysis, including the production, gathering and boosting, processing and transmission of natural gas to the natural gas network).

10. Upstream baseline emissions form the generation of electricity using fossil fuels

28. Upstream baseline emissions from the generation of electricity using fossil fuels, including emissions from the production, processing and transportation of fossil fuel to the energy plant, manufacturing of the energy generation equipment and construction of the energy plant were sourced from available literature of lifecycle analysis (LAC)[12], based on a natural gas combined cycle (NGCC) power plant located in Europe, with an installed capacity of 497 MW with an operational lifetime of 30 years.

29. The LCA provides emissions equal to 434 gCO_2e/kWh for the full life-cycle of the power plant, from the natural gas production to the decommissioning of the power plant. According to Figure 9 of the report, emissions from the production and transportation of natural gas and for the construction of the power plant is between 15 per cent and 20 per cent of the life-cycle emissions. To be conservative, the analysis assume that the

[10] See https://cdn0.scrvt.com/2828ebc457efab95be01dd36047e3b52/8fde0b1cea96b7c1/22e104ceb3e7/Vitomax-HS-Technical-Data.PDF?utm_source=chatgpt.com, accessed on 20 August 2025. Refer to the dry weight of boiler size G for 10 bar (page 9 of the catalogue).

[11] See https://www.netl.doe.gov/projects/files/LifeCycleAnalysisofNaturalGasExtractionandPowerGenerationUS2020EmissionsProfile_121724.pdf, accessed on 20 August 2025.

[12] United Nations Economic Commission for Europe; Life Cycle Assessment of Electricity Generation Options; Geneva, 2021; Available at https://unece.org/sed/documents/2021/10/reports/life-cycle-assessment-electricity-generation-options.

upstream baseline emissions are equal to 20 per cent of the life-cycle analysis, or 87 gCO_2e/kWh.

11. Addressing upstream leakage under the mechanism methodology

30. As explained in sections 1 above, the upstream project emissions from the production of flares can be neglected since it represents 0.002 per cent of the baseline emissions for an Article 6.4 activity with a capacity to collect 5,000 m^3/h of LFG.

31. As explained in section 2 above, the upstream project emissions from the manufacturing of a long and conservative length of HDPE pipeline represent less than 0.5 per cent of total baseline reductions achieved during the first crediting period for an Article 6.4 activity with a capacity to collect 5,000 m^3/h of LFG.

32. For activities that involve the supply of biomethane or LFG via trucks, dedicated pipelines or via natural gas distribution grid, the activity upstream emissions for the production and transportation of the biomethane or LFG to consumers can be neglected since the baseline upstream emissions to produce the same amount of natural gas (in an energy basis) is 4 times higher.

33. For activities that involve the generation of electricity, the activity upstream emissions for the production of 1 kWh (including the manufacturing of the LFG engines and the construction of the power plant) represents 0.11 per cent of the baseline upstream emissions for the production, processing and transportation of natural gas and construction of the power plant. However, this comparison is not realistic since the upstream baseline emissions were determined for a power plant with a capacity more than 100 times higher than the activity plant, therefore it's necessary to allocate the emissions proportionally to the same power plant capacity. By multiplying the CO_2 emissions of the NGCC power plant by 4 MW / 497 MW, the result is 0.8 per cent; multiplying this value by 87 gCO_2/kWh results in 0.696 gCO_2/kWh – which is still higher than the emissions to manufacture a 4MW engine, therefore this upstream source can be neglected.

34. For activities that involve the generation of heat in the baseline heat generation equipment, the upstream baseline emissions are determined for the production, processing and transportation of natural gas, whereas no upstream project emissions take place in the activity scenario, therefore it is conservative to neglect this upstream source.

35. For activities that involve the generation of heat in a new baseline heat generation, the upstream baseline emissions are determined for the production, processing and transportation of natural gas (7.912 gCO_2e/MJ), whereas the upstream project emissions are associated with the manufacturing of the new heat generation equipment (0.12 gCO_2/MJ) and represent 1.5 per cent of the upstream baseline emissions, therefore they can be neglected.

36. The table below summarizes the upstream baseline and project emissions.

Table 2. Upstream baseline and project emissions for each component of Article 6.4 activities eligible under this mechanism methodology

Type of project	Baseline situation	Source of upstream baseline emissions	Upstream baseline emissions	Activity situation	Source of upstream project emissions	Upstream project emissions	Proposal to address leakage
Flaring only	• Operation of the landfill without implementing the LFG collection and destruction systems that are part of the project	• N/A	• N/A	• Installation of an efficient LFG collection system; • Installation of one or more flares to destroy the methane	• Manufacturing of HDPE pipeline to collect the LFG • Manufacturing of flares	• 0.5 per cent of baseline emissions • Neglected (0.002 per cent of baseline emissions)	• Discount 0.5 per cent from the baseline emissions
Supply of biomethane or LFG to consumers	• Operation of the landfill without implementing the LFG collection system that is part of the project; • Consumers would have been supplied with natural gas from the distribution network	• N/A • Production, processing and transportation of the natural gas to the consumers	• N/A • 8.8 gCO_2/TJ	• Installation of an efficient LFG collection system; • Installation of biomethane production plant; • Transportation of the biomethane to consumers via pipeline, natural gas grid or trucks	• Manufacturing of HDPE pipeline to collect the LFG; • Construction of the biomethane production plant; • Manufacturing of biomethane transportation pipelines, trucks and vessels	• 0.5 per cent of baseline emissions • 2.08 gCO_2e /MJ • 2.2 gCO_2e/MJ (the sum can be neglected since it’s 2 times lower than baseline upstream emissions)	• Discount 0.5 per cent from the baseline emissions

Type of project	Baseline situation	Source of upstream baseline emissions	Upstream baseline emissions	Activity situation	Source of upstream project emissions	Upstream project emissions	Proposal to address leakage
Electricity generation	• Operation of the landfill without implementing the LFG collection system that is part of the project; • For simplification: electricity would have been generated by a natural gas power plant	• N/A • Production, processing and transportation of the natural gas to the power plant and generation of electricity	• N/A • 87 gCO_2e /kWh	• Installation of an efficient LFG collection system; • Construction of a LFG power plant	• Manufacturing of HDPE pipeline to collect the LFG; • Manufacturing of LFG engines and construction of the power plant	• 0.5 per cent of baseline emissions • 0.1 gCO_2e /kWh (can be neglected since it represents 0.11 per cent of baseline upstream emissions)	• Discount 0.5 per cent from the baseline emissions
Heat generation in an existing equipment	• Operation of the landfill without implementing the LFG collection system that is part of the project; • For simplification: heat would have been generated in the same natural gas boiler	• N/A • Production, processing and transportation of the natural gas to the boiler	• N/A • 87 gCO_2e /kWh	• Installation of an efficient LFG collection system	• Manufacturing of HDPE pipeline to collect the LFG	• 0.5 per cent of baseline emissions	• Discount 0.5 per cent from the baseline emissions

Type of project	Baseline situation	Source of upstream baseline emissions	Upstream baseline emissions	Activity situation	Source of upstream project emissions	Upstream project emissions	Proposal to address leakage
Heat generation in a new equipment	• Operation of the landfill without implementing the LFG collection system that is part of the project; • For simplification: heat would have been generated in a natural gas boiler	• N/A • Production, processing and transportation of the natural gas to the boiler	• N/A • 7.912 gCO_2e /MJ	• Installation of an efficient LFG collection system; • Installation of a new boiler	• Manufacturing of HDPE pipeline to collect the LFG; • Manufacturing of the boiler	• 0.5 per cent of baseline emissions • 0.12 gCO_2e /MJ (can be neglected since it is lower than the baseline upstream emissions)	• Discount 0.5 per cent from the baseline emissions

37. In summary, the common upstream leakage source among the different types of Article 6.4 activities is the manufacturing of the HDPE pipeline, therefore it is proposed to discount 0.5 per cent of the baseline emissions to address any potential leakage.

- - - - -

Document information

Version	*Date*	*Description*
01.0	30 October 2025	SBM 019, Annex 2. Initial adoption.

Decision Class: Regulatory
Document Type: Standard
Business Function: Methodology
Keywords: A6.4 mechanism, landfill gas, methane, methodologies, pipeline