ARTICLE 6.4 MECHANISM

**A6.4-SBM021-A05**

# Mechanism Methodology

# $N_2O$ abatement from nitric acid production

Version 01.0

Sectoral scope(s): 05

**United Nations**
Framework Convention on
Climate Change

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# 1. Introduction

## 1.1. Scope

1. This mechanism methodology applies to Article 6.4 activities that introduce, restart, or enhance nitrous oxide ($N_2O$) abatement measures in existing nitric acid production lines. [1]

2. Article 6.4 Emission Reductions (A6.4ERs) issued based on this mechanism methodology represent emission reductions that are not subject to reversal risks.

## 1.2. Entry into force

3. This mechanism methodology enters into force on 21 May 2026.

4. This mechanism methodology remains valid for five years, until 20 May 2031, unless an earlier date applies if the mechanism methodology is revised or withdrawn in accordance with the “Procedure: Development, revision and clarification of methodologies and methodological tools” (A6.4-PROC-METH-001).[2]

## 1.3. Applicability of sectoral scopes

5. Designated operational entities (DOEs) validating and verifying Article 6.4 activities that use this mechanism methodology shall apply sectoral scope 5.

# 2. Definitions

## 2.1. General terms

6. 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; and

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

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[1] The Methodological Expert Panel (MEP) notes that the mechanism methodology applies only to Article 6.4 projects and it 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] See https://unfccc.int/sites/default/files/resource/A6.4-PROC-METH-001.pdf.

## 2.2. Methodological terms and definitions

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

   (a) **Existing nitric acid production line:** a nitric acid production line that has started operation not later than 31 December 2025 and for which at least one nitric acid production campaign has been completed prior to the earlier of: (i) the start of operation of the Article 6.4 activity; and (ii) the submission of the project design document (PDD) for validation;

   (b) **Nitric acid production plant:** a plant for producing nitric acid, consisting of one or more nitric acid production lines;

   (c) **Nitric acid production line:** a set of components that can be operated independently to produce nitric acid;

   (d) **Non-selective catalytic reduction (NSCR):** an emission control system which reduces nitrous compounds ($NO_x$ and $N_2O$) to $N_2$ and $H_2O$ by passing the exhaust gas and a reducing agent (e.g., natural gas, propane, butane or hydrogen) over a catalyst.[3] It requires the oxygen concentration in tail gases to be very low (lower than one per cent);[4]

   (e) **Secondary $N_2O$ abatement:** the installation of a catalyst inside an ammonia reactor with the sole purpose of removing $N_2O$ from the gaseous stream;

   (f) **Selective catalytic reduction (SCR):** an emission control system which reduces a targeted nitrous compound (either $NO_x$ or $N_2O$) using a catalyst and a reducing agent (usually ammonia or urea); and

   (g) **Tertiary $N_2O$ abatement:** the installation of an abatement system in the tail gas downstream of the absorption column of a nitric acid production line to destroy the $N_2O$ generated in an ammonia reactor. This may include, inter alia, SCR of $N_2O$, NSCR, or thermal decomposition of $N_2O$.

8. Furthermore, the terms in the “Glossary: Article 6.4 mechanism terms” (A6.4-GLOS-GOV-001) and the definitions and terms in the methodological tools referred to in section 3 shall apply. [5]

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[3] This definition is based on the US Environmental Protection Agency (US EPA) definition as quoted by the International Sustainable Chemistry Collaborative Centre. See: https://www.isc3.org/page/best-practice-detail/nonselective-catalytic-reduction-nscr.

[4] This definition is based on the US EPA definition as provided in: U.S. Environmental Protection Agency. (2017). Selective catalytic reduction (SCR) (Chapter 2). EPA air pollution control cost manual (7th ed., 2016 revisions). https://www.epa.gov/sites/default/files/2017-12/documents/scrcostmanualchapter7thedition_2016revisions2017.pdf.

[5] See https://unfccc.int/sites/default/files/resource/A6.4-Glossary.pdf.

# 3. Normative references

9. This mechanism methodology is based on elements from version 4.0 of the Clean Development Mechanism (CDM) methodology “ACM0019: $N_2O$ abatement from nitric acid production”.[6]

10. The following documents are indispensable for the application of this mechanism methodology. When applying this mechanism methodology, a valid version of the documents listed below shall be used:

    (a) “Methodological tool: Common practice analysis” (A6.4-AMT-001);[7]

    (b) “Methodological tool: Mass flow of a greenhouse gas in a gaseous stream” (A6.4-AMT-005);[8] and

    (c) “Methodological tool: Emissions from electricity generation and consumption” (A6.4-AMT-007).[9]

11. The following documents provide supporting information that may assist in the application of this mechanism methodology:

    (a) Intergovernmental Panel on Climate Change (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 1: General Guidance and Reporting. IPCC, Geneva, Switzerland;[10]

    (b) Intergovernmental Panel on Climate Change (2019). 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 1: General Guidance and Reporting. IPCC, Geneva, Switzerland;[11]

    (c) Intergovernmental Panel on Climate Change (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 3: Industrial Processes and Product Use. IPCC, Geneva, Switzerland;[12] and

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[6] See https://cdm.unfccc.int/UserManagement/FileStorage/RDX2Q6IWUVC8Y3H4MFLT7OJ1G05PEA.

[7] See https://unfccc.int/process-and-meetings/the-paris-agreement/article-6/article-64-pacm/mechanism-process/methodologies/a64-amt-001.

[8] See https://unfccc.int/process-and-meetings/the-paris-agreement/article-6/article-64-pacm/mechanism-process/methodologies/a64-amt-005.

[9] See https://unfccc.int/process-and-meetings/the-paris-agreement/article-6/article-64-pacm/mechanism-process/methodologies/a64-amt-007-emissions-from-electricity-generation-and-consumption.

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

[11] See https://www.ipcc.ch/report/2019-refinement-to-the-2006-ipcc-guidelines-for-national-greenhouse-gas-inventories/.

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

(d) Intergovernmental Panel on Climate Change (2000). Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories. IPCC, Geneva, Switzerland.[13]

# 4. Applicability

12. This mechanism methodology is applicable to Article 6.4 activities that involve the introduction, restart, or enhancement of secondary and/or tertiary abatement of $N_2O$ at an existing nitric acid production line.

13. The mechanism methodology is only applicable where the conditions for the applicable type of activity are satisfied (see Table 1 for a summary):

    (a) **Type 1: introduction of $N_2O$ abatement.** For this type of Article 6.4 activity, the following two conditions shall be satisfied:

        (i) Prior to the implementation of the Article 6.4 activity, no secondary or tertiary $N_2O$ abatement has been installed at the nitric acid production line at any point since the start of operation of the nitric acid production line; and

        (ii) The Article 6.4 activity introduces secondary $N_2O$ abatement and/or any type of tertiary $N_2O$ abatement;

    (b) **Type 2: restart of $N_2O$ abatement.** For this type of Article 6.4 activity, the following two conditions shall be satisfied:

        (i) Prior to the implementation of the Article 6.4 activity, a secondary and/or tertiary $N_2O$ abatement system has been installed at the nitric acid production line, but it can be demonstrated that the operation of these abatement system(s) has been discontinued. The discontinuation of the abatement shall be demonstrated as follows:[14]

            a. In the case of a pre-existing secondary $N_2O$ abatement system: Documented evidence is available that the secondary catalyst has been removed prior to the start of the nitric acid production campaign that began on or after 1 January 2021 or and that no secondary or tertiary $N_2O$ abatement system has been installed since then;[15]

            b. In the case of a pre-existing tertiary $N_2O$ abatement system:

                i. Documented evidence is available that the tertiary catalyst has been removed prior to the start of the nitric acid production campaign that began on or after 1 January 2021 and that no

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[13] See https://www.ipcc.ch/publication/good-practice-guidance-and-uncertainty-management-in-national-greenhouse-gas-inventories/.

[14] For other types of verifiable evidence of discontinuation of abatement, activity participants may propose a revision to this mechanism methodology.

[15] The non-replacement of an existing secondary catalyst is not considered a discontinuation of abatement, since installed catalysts may still abate some $N_2O$ emissions.

secondary or tertiary $N_2O$ abatement system has been installed since then; or

ii. Automatically generated plant recordings are available that demonstrate that the tertiary $N_2O$ abatement system has been bypassed continuously since 1 January 2021;

c. Where the provisions in sub-paragraphs 13(b)(i)a. and 13(b)(i)b above. cannot be demonstrated, the Article 6.4 activity may be considered as a Type 3 activity, as long as the conditions for Type 3 activities are satisfied; and

(ii) The Article 6.4 activity involves the following:

a. In the case of a pre-existing secondary $N_2O$ abatement system: The Article 6.4 activity reinstalls a secondary $N_2O$ abatement system and/or installs a new tertiary $N_2O$ abatement system; or

b. In the case of a pre-existing tertiary $N_2O$ abatement system: The Article 6.4 activity restarts the operation of the pre-existing tertiary $N_2O$ abatement system or introduces a new secondary and/or tertiary $N_2O$ abatement system; or

(c) **Type 3: enhancement of $N_2O$ abatement.** For this type of Article 6.4 activity, the following two conditions shall be satisfied:

(i) Prior to the implementation of the Article 6.4 activity, one of the following two forms of $N_2O$ abatement (but not a combination thereof) has been in operation at any point since 1 January 2021 at the nitric acid production line:[16] [17]

a. Secondary $N_2O$ abatement; or

b. A NSCR abatement system.

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[16] Secondary and NSCR abatement systems commonly have a lower abatement efficiency compared to tertiary $N_2O$ abatement systems other than NSCR, such as thermal decomposition of $N_2O$. Therefore, for secondary and NSCR abatement systems a conservative best available technology (BAT) emission factor can be estimated (see Appendix), such that any further emission reductions achieved by complementing or replacing these systems can be conservatively estimated. This does not hold for any pre-existing tertiary $N_2O$ abatement systems other than NSCR for which high efficiencies may be achieved. For this reason, the enhancement of $N_2O$ abatement is limited to situations where either secondary or NSCR abatement systems are in place.

[17] For types of enhancement beyond those specified in paragraph 13(c)(i), and noting that these may require baseline measurement campaigns, stakeholders may submit a request for revision to this methodology or propose a new mechanism methodology.

(ii) The Article 6.4 activity involves the following:[18]

   a. In the case of a pre-existing secondary $N_2O$ abatement system:

      i. The pre-existing secondary $N_2O$ abatement system is complemented by a tertiary $N_2O$ abatement system; or

      ii. The pre-existing secondary $N_2O$ abatement system is replaced by a tertiary $N_2O$ abatement system;

   b. In the case of a pre-existing NSCR abatement system:

      i. The pre-existing NSCR abatement system is complemented by a secondary and/or tertiary $N_2O$ abatement system other than an NSCR system; or

      ii. The pre-existing NSCR abatement system is replaced by a secondary and/or tertiary $N_2O$ abatement system other than an NSCR system.

**Table 1. Summary of types of Article 6.4 activities that are eligible under this mechanism methodology**

| | **Historical situation** | **Activity scenario conditions** |
|---|---|---|
| **Type 1: introduction of $N_2O$ abatement** | No secondary or tertiary $N_2O$ abatement has been installed at any point since the start of operation of the nitric acid production line | Introduction of secondary and/or any type of tertiary $N_2O$ abatement |
| **Type 2: restart of $N_2O$ abatement** | Secondary and/or tertiary $N_2O$ abatement has been installed at the nitric acid production line but has been discontinued | Restart of secondary and/or any type of tertiary $N_2O$ abatement |
| **Type 3: enhancement of $N_2O$ abatement** | One of the following two forms of $N_2O$ abatement (but not a combination thereof) has been in operation at any point since 1 January 2021: secondary $N_2O$ abatement or an NSCR abatement system | Complementing or replacing the pre-existing $N_2O$ abatement system by a new form of $N_2O$ abatement system. |

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[18] The replacement of an existing $N_2O$ abatement system by a new $N_2O$ abatement system of the same form but with higher performance is not eligible under this mechanism methodology. For example, the replacement of an existing secondary $N_2O$ abatement with a new secondary $N_2O$ abatement with higher performance is not eligible. For such activities, activity participants may submit a proposed revision to this mechanism methodology or propose a new mechanism methodology.

14. Activity participants shall describe in the PDD the following elements and provide appropriate evidence:

    (a) The historical conditions at the nitric acid production line prior to the implementation of the Article 6.4 activity, including:

        (i) Whether any $N_2O$ abatement systems were installed;

        (ii) Where such systems were in place, what type of system(s) were installed;

        (iii) Where applicable, when the system(s) were installed, discontinued, or decommissioned; and

        (iv) Where available, what level of $N_2O$ emissions was achieved with the system(s).

    (b) The type of new $N_2O$ abatement system that is installed under the Article 6.4 activity and whether this complements or replaces any existing $N_2O$ abatement system; and

    (c) To which of the three types above (introduction, restart, or enhancement of $N_2O$ abatement) the Article 6.4 activity belongs, pursuant to paragraph 13.

15. Notwithstanding the provisions in paragraphs 13 and 14 above, clean development mechanism (CDM) projects that have transitioned to the Article 6.4 mechanism shall be considered as a type 1 activity (introduction of $N_2O$ abatement), irrespective of whether and when the $N_2O$ abatement system was operating under the CDM.

16. This version of the mechanism methodology is applicable to Article 6.4 activities implemented at the project level. The mechanism methodology may be amended in the future to also cover activities implemented at other scales (e.g., programmes of activities (PoAs), policies, sectoral approaches).

17. Under this mechanism methodology, a PDD and a registered Article 6.4 activity may only include several nitric acid production lines if these are located at the same plant[19].

18. This mechanism methodology is only applicable on a standalone basis and shall not be applied in combination with other methodologies, unless one or more of the other methodologies specify how the interaction with this mechanism methodology is taken into account.

19. Furthermore, this mechanism methodology is only applicable if the following conditions apply:

    (a) The $N_2O$ abatement equipment installed under the Article 6.4 activity has not previously been used in any other plant and is newly produced;[20]

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[19] Once this mechanism methodology becomes applicable to PoAs, a PoA may include nitric acid production lines located at different plants as separate component projects.

[20] This condition is introduced to avoid leakage from baseline equipment transfer, consistent with section 5.2 Avoidance or minimisation of leakage of the “Standard: Addressing leakage in mechanism methodologies” (version 01.0) (A6.4-STAN-METH-005).

(b) No policies that may affect $N_2O$ emissions from nitric acid production[21] (other than legal requirements as addressed in section 6.1) 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;[22]

(c) There are no specific national or sub-national targets for the sector or the type of activity or, if any such targets exist, they are not supported by policy frameworks for implementation;[23]

(d) Activity participants do not receive any subsidies or funding other than revenues from A6.4ERs for abating $N_2O$ emissions;[24] and

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[21] Such policies may, for example, include taxes or fees on $N_2O$ emissions, or the inclusion of $N_2O$ emissions in an emissions trading system.

[22] This condition is introduced for two reasons: First, the mechanism methodology demonstrates the investment analysis at the level of the mechanism methodology (see the Appendix). In this demonstration, it is assumed that Article 6.4 activities do not generate revenues or cost savings from the installation of secondary or tertiary $N_2O$ abatement. However, policies could potentially generate such revenues or cost savings (see footnote 21). Second, the mechanism methodology determines the business-as-usual (BAU) scenario and quantifies the BAU emission factor at the level of the mechanism methodology (see the Appendix). According to section 8 Determination of a conservative business-as-usual baseline of the "Standard: Setting the baseline in mechanism methodologies" (version 01.0) (A6.4-STAN-METH-004), policies shall be incorporated in the BAU scenario and in quantifying BAU emissions. In determining the BAU scenario and quantifying the BAU emission factor at the mechanism methodology level in the Appendix, this mechanism methodology does not incorporate any such policies. Note that the establishment of a baseline emission factor by the host Party in accordance with paragraph 38 below is not considered to be a policy that affects $N_2O$ emissions. To use the methodology in situations where policies may affect $N_2O$ emissions from nitric acid production, stakeholders may submit a request for revision to this methodology or propose a new mechanism methodology.

[23] This condition is introduced because the mechanism methodology determines the BAU scenario and quantifies the BAU emission factor at the level of the methodology (see the Appendix). According to section 8 Determination of a conservative business-as-usual baseline of the "Standard: Setting the baseline in mechanism methodologies" (version 01.0) (A6.4-STAN-METH-004), any specific national or sub-national targets for the sector or the type of activity, where these are supported by policy frameworks for implementation (but excluding general goals that are not specific to the sector or type of activity, such as national emission targets), shall be incorporated in the BAU scenario and in quantifying BAU emissions. In determining the BAU scenario and quantifying the BAU emission factor at the mechanism methodology level in the Appendix, this mechanism methodology does not consider specific national or sub-national targets. Note that specific national or sub-national targets are (i) only relevant if the policy frameworks in place are sufficient to enable the achievement of the targets; and (ii) not relevant if they refer to or formally integrate the mechanism as an instrument for implementation. Note that the establishment of a baseline emission factor by the host Party in accordance with paragraph 38 below is not considered to be a target in the context of this applicability condition.

[24] This condition is introduced because the mechanism methodology demonstrates the investment analysis at the level of methodology (see the appendix). In this demonstration, it is assumed that Article 6.4 activities do not generate revenues or cost savings from the installation of secondary or tertiary $N_2O$ abatement. However, subsidies or funding other than revenues from A6.4ERs for abating $N_2O$ emissions could make the installation of secondary or tertiary $N_2O$ abatement economically viable.

(e) To ensure that the $N_2O$ abatement system installed under the Article 6.4 activity is environmentally sound, the Article 6.4 activity shall have been designed in a manner that ensures that:

  (i) The implementation of the Article 6.4 activity does not lead to an increase in emissions of nitrogen oxides ($NO_x$); and

  (ii) Levels of emissions of $NO_x$, ammonia, carbon monoxide, and hydrocarbons comply with any legal requirements.

20. The above provisions shall be demonstrated as follows:

(a) The provisions in paragraphs 12, 13, 14, 15, 17, 18 and 19(e) shall be demonstrated in the PDD and be assessed at the initial validation, as well as in the case of a change in abatement design over the activity lifetime (e.g., addition of tertiary $N_2O$ abatement to a secondary $N_2O$ abatement); and

(b) The provisions in paragraphs 19(a) to 19(d) above shall be demonstrated in each monitoring report and be assessed at each verification.

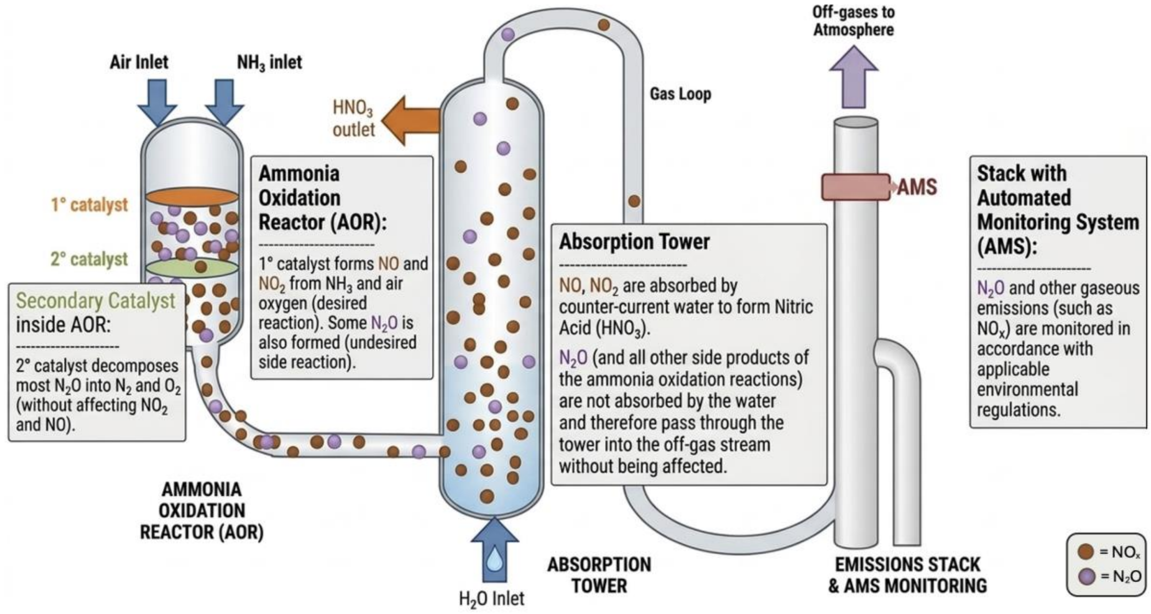
21. The applicability conditions included in the methodological tools referred to in paragraph 10 also apply.

# 5. Activity boundary

22. The spatial extent of the activity boundary shall encompass the facility and equipment for the nitric acid production process, from the inlet of the ammonia reactor to the outlet of the tail gas section.

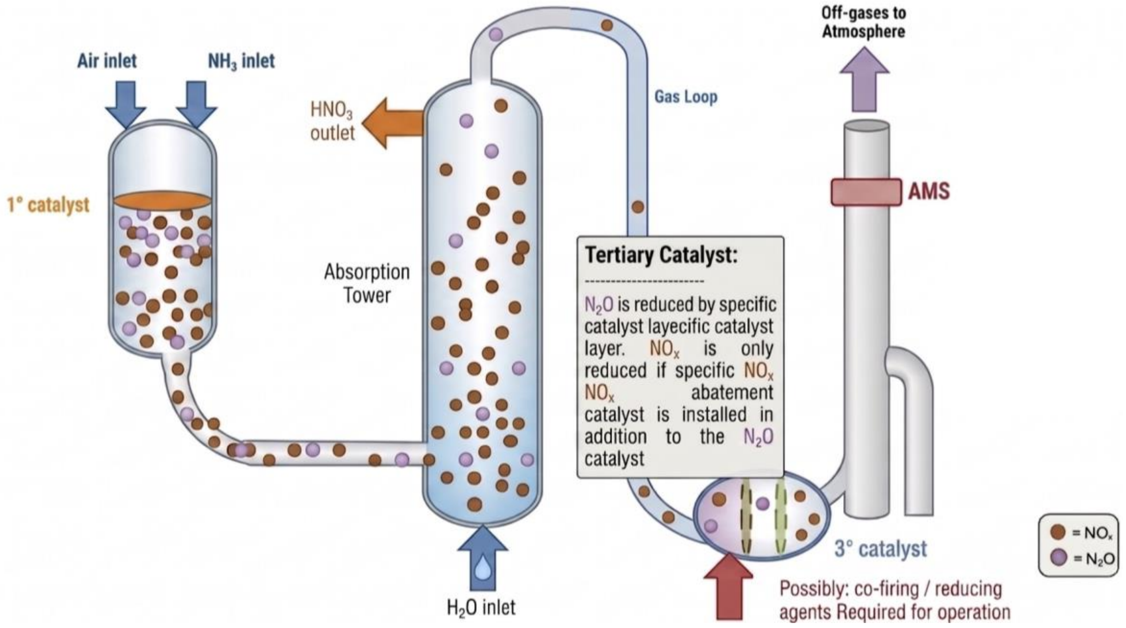
23. If the A6.4 activity operates only secondary and no tertiary $N_2O$ abatement, then the only gas that shall be included as activity emissions is the $N_2O$ that is not destroyed and is still present in the tail gas stream of the plant. The situation using a secondary $N_2O$ abatement system is illustrated in Figure 1 below.

Figure 1. Activity boundary for an Article 6.4 activity with secondary $N_2O$ abatement only



24. If the Article 6.4 activity operates only tertiary and no secondary $N_2O$ abatement, then any remaining $N_2O$ emissions from the plant and the greenhouse gas (GHG) emissions arising from the operation of the tertiary $N_2O$ abatement system shall be included as activity emissions in the activity boundary. The situation using a tertiary $N_2O$ abatement system is illustrated in Figure 2 below.

Figure 2. Activity boundary for an Article 6.4 activity with tertiary $N_2O$ abatement only



25. If the Article 6.4 activity operates a combination of secondary and tertiary $N_2O$ abatement, the gases to be included as activity emissions in the activity boundary shall be the $N_2O$ that is not destroyed and is still present in the tail gas stream of the plant and the GHG emissions arising from the operation of the tertiary $N_2O$ abatement system. The situation using a combined operation of secondary and tertiary $N_2O$ abatement systems is illustrated in Figure 3 below.

**Figure 3. Activity boundary for an Article 6.4 activity with a combination of secondary and tertiary $N_2O$ abatement**

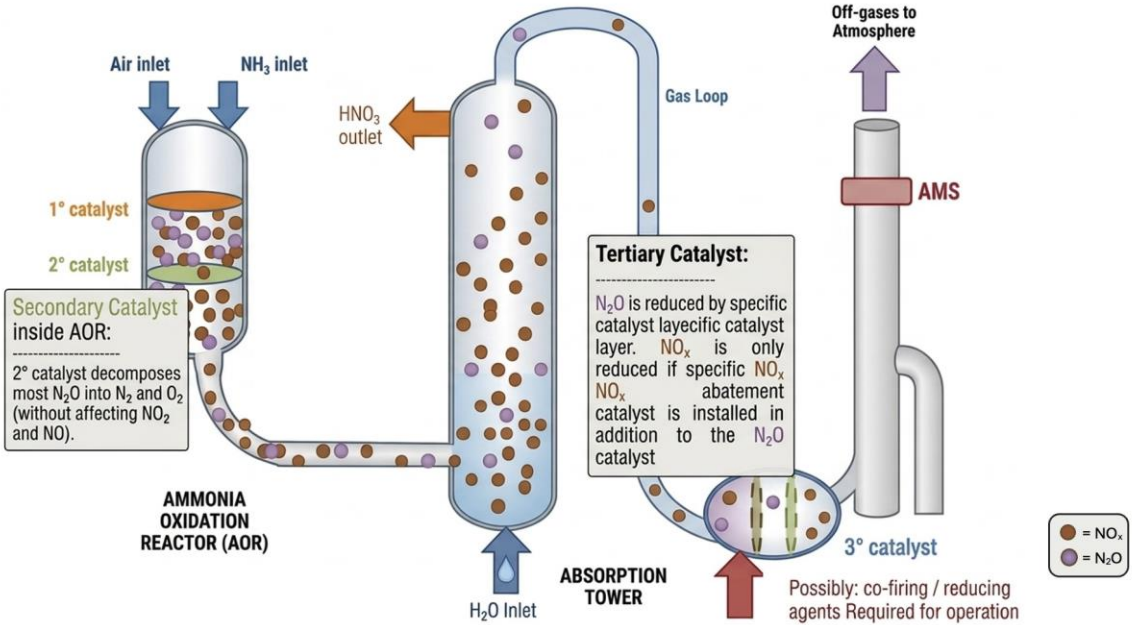


**Table 2. Emission sources and sinks included in or excluded from the activity boundary**

| | Source | Greenhouse gas | Included/ Excluded | Controlled / Related to / Affected by | Justification / Explanation |
|---|---|---|---|---|---|
| **BASELINE** | $NH_3$ oxidation at the primary catalyst gauze | $CO_2$ | Not occurring | | |
| | | $CH_4$ | | | |
| | | $N_2O$ | Included | Controlled | Included, main emission source |
| **ACTIVITY** | $NH_3$ oxidation at the primary catalyst gauze | $CO_2$ | Not occurring | | |
| | | $CH_4$ | | | |
| | | $N_2O$ | Included | Controlled | Included; main emission source. |
| | Operation of a tertiary $N_2O$ abatement system | $CO_2$ | Included | Controlled or related to | Included. the operation of a tertiary $N_2O$ abatement may entail emissions from consumption of electricity, fossil fuels, steam (e.g., for reheating the tail gas), and input materials (e.g., urea or ammonia as reducing agents). |
| | | $CH_4$ | | | |
| | | $N_2O$ | | | |
| **LEAKAGE** | Production and transport of equipment and catalysts | $CO_2$ | Included | Related to | Included; minor emission source. |
| | | $CH_4$ | | | |
| | | $N_2O$ | | | |

26. 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, represented 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

27. To demonstrate additionality, activity participants shall apply:

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

    (b) A common practice analysis (section 6.2).

28. The proposed Article 6.4 activity shall only be considered additional if the two analyses are concluded positively. The investment analysis and the analysis of lock-in risk are conducted at the level of the methodology and are concluded positively for all applicable Article 6.4 activities under this methodology (see Appendix).

## 6.1. Regulatory analysis

29. Activity participants shall review relevant legal requirements applicable to the host Party and to the nitric acid plant and demonstrate and justify, for each relevant legal requirement, that either:

    (a) The law or regulation refers to or formally integrates the mechanism as an instrument for implementation;[25] or

    (b) The emission reductions resulting from the Article 6.4 activity would not occur as a result of the legal requirement, by confirming that all of the following conditions are true:

        (i) The legal requirement does not explicitly require nitric acid production lines or plants to install a secondary and/or tertiary $N_2O$ abatement system;

        (ii) The legal requirement does not include direct or indirect requirements regarding any flue gases from nitric acid production lines or plants, which can only be achieved by installing secondary and/or tertiary $N_2O$ abatement systems, such as:

            a. Absolute or relative GHG or $N_2O$ emission performance standards for nitric acid plants;

            b. Legal requirements for the $N_2O$ concentration in the flue gases;

            c. Absolute or relative $N_2O$ or GHG performance standards to produce nitric acid or downstream products obtained from nitric acid (e.g., fertilizers); or

            d. Legal requirements concerning gases other than $N_2O$, such as requirements for NOx emissions, which would result in the installation of an NSCR) system; and

        (iii) The Article 6.4 activity neither participates in any support scheme, nor is subject to any penalty scheme, that:

            a. Is applicable to $N_2O$ emissions from nitric acid production and their abatement;

            b. Is designed to achieve a quantitative target or outcome; and

            c. Would likely result in the same amount of emission reductions if the activity were not implemented as an Article 6.4 activity.

30. If one or more of the legal requirements identified in paragraph 29 above do not meet the requirements of that paragraph, then A6.4ERs cannot be claimed, except for any emission reductions in excess of those that would be achieved to comply with relevant regulations (e.g., regarding the abatement of NOx emissions).

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[25] For example, where the regulations explicitly state that Article 6.4ERs and their generated revenues are to be used as incentives to achieve the emission reductions in a specific sector.

31. Activity participants shall assess the requirements of paragraphs 29 and 30 for each monitoring period. Crediting shall cease on the date on which a new relevant legal requirement becomes applicable.

## 6.2. Common practice analysis

32. Activity participants shall use a valid version of the “Methodological tool: Common practice analysis” (A6.4-AMT-001) to conduct the common practice analysis. The methodological tool shall be applied as follows:

    (a) **Approach for common practice analysis:** approach A (which is based on the identification of existing “comparable activities” and differentiation between “similar” and “different” activities) shall be applied;

    (b) **Indicator of common practice:** the nameplate capacity of nitric acid production lines, expressed in tonnes of nitric acid per hour, shall be used;

    (c) **Stock-based or time-bound approach:** a stock-based approach shall be used (i.e., considering all nitric acid production lines that are in operation at the earlier of: (i) the start of operation of the Article 6.4 activity; or (ii) the submission of the PDD for validation);

    (d) **Applicable geographical area:** the host Party shall be used.[26] Where the applicable geographical area must be widened in accordance with step 4 of the “Methodological tool: Common practice analysis” (A6.4-AMT-001), the widening shall be conducted as follows:

        (i) For Article 6.4 activities implemented in a least developed country (LDC) or small island developing state (SIDS), the applicable geographical area shall consist of all LDCs and SIDS;

        (ii) For Article 6.4 activities implemented in countries other than LDCs or SIDS, the applicable geographical area shall correspond to the relevant continent; and

        (iii) Where the widening based on sub-paragraphs 32(d)(i) and 32(d)(ii) above is not sufficient in accordance with step 4 of the methodological tool, the applicable geographical area shall be global (i.e., including all countries);

    (e) **Consideration of scale of output or capacity of the technology, measure, or practice:** all scales of nitric acid plants shall be considered;

    (f) **Common practice threshold:** the common practice factor thresholds to be applied under this mechanism methodology shall be:

        (i) 16 per cent of nitric acid production capacity for Article 6.4 activities located in countries other than LDCs or SIDS; and

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[26] While the baseline scenario, the BAU scenario, and the analysis of lock-in risk are conducted at the global level, the common practice analysis is conducted at the level of the host Party, as the actual deployment of secondary or tertiary $N_2O$ abatement could be influenced by country-specific factors.

(ii) 20 per cent of nitric acid production capacity for Article 6.4 activities located in LDCs or SIDS; and

(g) **Comparable, similar and different activities:** comparable, similar and different activities are defined as follows:

(i) Comparable activities shall be all nitric acid production lines;

(ii) Similar activities shall be nitric acid production lines where secondary and/or tertiary $N_2O$ abatement other than NSCR is in operation; and

(iii) Different activities shall be nitric acid production lines where neither secondary nor tertiary $N_2O$ abatement other than NSCR is in operation.

# 7. Baseline emissions

33. This mechanism methodology applies the following provisions in the “Standard: Setting the baseline in mechanism methodologies” (A6.4-STAN-METH-004) at the level of the mechanism methodology, as specified in the appendix: [27]

(a) The application of the BAT approach to derive a BAT emission factor;

(b) The determination of a conservative BAU baseline; and

(c) The comparison of the downward-adjusted baseline and the conservative BAU baseline.

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

34. The following approach from the Rules, Modalities and Procedures , as per decision 3/CMA.3, is used to determine the baseline in this mechanism methodology:[28]

☒ Best available technologies that represent an economically feasible and environmentally sound course of action, where appropriate.

☐ An ambitious benchmark approach where the baseline is set at least at the average emission level of the best performing comparable activities providing similar outputs and services in a defined scope in similar social, economic, environmental and technological circumstances.

☐ An approach based on existing actual or historical emissions, adjusted downwards to ensure alignment with paragraph 33 above of the Rules, Modalities and Procedures.

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

[28] The approach is selected on the basis that nitric acid production and alternative technologies for $N_2O$ abatement provide a homogeneous output.

## 7.2. Calculation of the downward-adjusted baseline emissions

35. The downward-adjusted baseline emissions shall be calculated as follows:

$$BE_{adj,y} = MIN\left[BE_{adj,BAT,y}; BE_{legal,y}\right] \qquad \text{Equation (1)}$$

and

$$BE_{adj,BAT,y} = MIN\left[P_{NA,y}; P_{NA,cap,y}\right] \times EF_{BL,y} \times GWP_{N2O} \times 10^{-3} \\ \times [1 - INDA \times (y - y1)] \qquad \text{Equation (2)}$$

Where:

$BE_{adj,y}$ = Downward-adjusted baseline emissions in year *y* (t $CO_2$eq)

$BE_{adj,BATy}$ = Downward-adjusted baseline emissions determined based on BAT in year *y* (t $CO_2$eq)

$BE_{legal,y}$ = Baseline emissions that occur due to any legal requirements in year *y* (t $CO_2$eq), where applicable

$P_{NA,y}$ = Amount of nitric acid produced in the Article 6.4 nitric acid production line in year *y* (t $HNO_3$)

$P_{NA,cap,y}$ = Cap on the nitric acid production level used for determining baseline emissions in year *y* (t $HNO_3$)

$EF_{BL,y}$ = BAT baseline $N_2O$ emission factor in year *y* (kg $N_2O$ / t $HNO_3$)

$GWP_{N2O}$ = Global warming potential of $N_2O$ (t $CO_2$eq / t $N_2O$)

$10^{-3}$ = A unit conversion factor ($10^{-3}$ t $CO_2$eq / kg $CO_2$eq)

$INDA$ = Annual increase in the downward adjustment for calendar years following the calendar year of the start date of the first crediting period (dimensionless)

$y$ = Calendar year of the crediting period

$y1$ = Calendar year of the start date of the first crediting period

36. The following sections describe how the relevant parameters shall be determined.

### 7.2.1. Determination of the cap on the nitric acid production level used for determining baseline emissions ($P_{NA,cap,y}$)

37. The cap on the nitric acid production level used for determining baseline emissions in year *y* ($P_{NA,cap,y}$) is introduced to avoid the possibility that A6.4ERs are claimed from any increases in nitric acid production levels as a result of incentives associated with A6.4ERs. $P_{NA,cap,y}$ shall be determined as follows:

$$P_{NA,cap,y} = P_{NA,NPC} \times H_y \qquad \text{Equation (3)}$$

Where:

$P_{NA,cap,y}$ = Cap on the nitric acid production level used for determining baseline emissions in year *y* (t $HNO_3$)

$P_{NA,NPC}$ = Nameplate capacity of the nitric acid production line at the time of the start date of the Article 6.4 activity (t $HNO_3$/hour)

$H_y$ = Number of hours in which the nitric acid production line is in operation in year *y* (hours)

$y$ = Calendar year of the crediting period

### 7.2.2. Determination of the best available technology baseline $N_2O$ emission factor ($EF_{BL,y}$)

38. To determine the baseline $N_2O$ emission factor ($EF_{BL,y}$), activity participants shall apply the lowest of the following values:

    (a) A value of **3.99 kg $N_2O$ / t $HNO_3$** for type 1 and type 2 activities (i.e., Article 6.4 activities that involve the introduction or restart of $N_2O$ abatement) and a value of **0.60 kg $N_2O$ / t $HNO_3$** for type 3 activities (i.e., Article 6.4 activities that involve the enhancement of $N_2O$ abatement);[29] and

    (b) Where applicable, any value for the baseline emission factor specified by the host Party.

### 7.2.3. Determination of the annual increase in the downward adjustment

39. An initial downward adjustment is not applicable under this mechanism methodology because it uses the BAT approach to determine baseline emissions.

40. The choice of the annual increase in downward adjustment (INDA) in subsequent years is informed by the principles and considerations referred to in section 7.2. Downward adjustment in subsequent years of the “Standard: Setting the baseline in mechanism methodologies” (version 01.0) (A6.4-STAN-METH-004). The chosen approach aims to set incentives for activity participants to adopt $N_2O$ abatement practices that lead to lower remaining emissions. Accordingly, a relatively higher downward adjustment is applied where the remaining $N_2O$ emissions are higher. It is also noted that achieving a high $N_2O$ abatement level is generally economically viable with the support of A6.4ERs. Based on these considerations, the parameter INDA shall be determined as follows:

    (a) Where the activity emissions of $N_2O$ in the period covered by a monitoring report, divided by the amount of nitric acid produced in that period, are lower than 0.20 kg $N_2O$ / t $HNO_3$, then INDA = 0.01 shall apply;[30]

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[29] The appendix describes how these values have been derived.

[30] The value of 0.2 kg $N_2O$ / t $HNO_3$ was derived based on the performance of best-performing plants that abate $N_2O$ emissions through secondary and/or tertiary $N_2O$ abatement. These data were derived from information on CDM and JI plants.

(b) Where the activity emissions of $N_2O$ in the period covered by a monitoring report, divided by the amount of nitric acid produced in that period, are higher than 1.00 kg $N_2O$ / t $HNO_3$, then INDA = 0.05 shall apply;[31] and

(c) Otherwise, INDA = 0.03 shall apply.

41. Notwithstanding the provisions in paragraph 40 above, where the designated national authority (DNA) of the host Party has specified a more ambitious value for INDA to be used under this mechanism methodology, this value shall be used.

42. The annual INDA 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 value to periods other than a full calendar year.[32] The value for INDA shall be determined for each monitoring period and may thus differ between monitoring periods.[33]

# 8. Activity emissions

43. Activity emissions include emissions of $N_2O$ in the tail gas of the nitric acid production line ($AE_{N2O,y}$) and, where applicable, emissions from the operation of a tertiary $N_2O$ abatement system. They shall be calculated as follows:

$$PE_y = PE_{N2O,y} + PE_{tertiary,y} \tag{4}$$

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[31] The value of 0.6 kg $N_2O$ / t $HNO_3$ was derived based on approximately the median performance of plants that abate $N_2O$ emissions through tertiary $N_2O$ abatement. The value of 1.0 kg $N_2O$ / t $HNO_3$ was derived based on approximately the median performance of plants that abate $N_2O$ emissions through secondary or tertiary $N_2O$ abatement. These data were derived from information on CDM and Joint Implementation (JI) plants.

[32] 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 unadjusted baseline emissions correspond to 500 t $CO_2$eq in all years of the crediting period. Consistent with this methodology, no initial downward adjustment is applied. The downward adjustment for subsequent calendar years is calculated based on an increase of 1 percent per year (i.e., the parameter INDA in equation 2 equals 0.01). In this example, no downward adjustment is applied for the period from 1 October 2025 to 31 December 2025 (i.e., in equation 2 the parameter $y$ is equal to $y_1$ and the term $[1 – \text{INDA} \times (y – y_1)]$ is equal to 1). For the calendar year 2026 (i.e., the period from 1 January 2026 to 31 December 2026), a downward adjustment of 1.26 t $CO_2$eq shall be applied, calculated as the sum of (i) 273 days divided by 365 days multiplied by 0 t $CO_2$eq and (ii) 92 days divided by 365 days multiplied by 5 t $CO_2$eq. Starting in 2027, the annual downward adjustment is increased by 5 t $CO_2$eq on 1 January of each year, resulting in a value of 6.26 t $CO_2$eq for 2027, 11.26 t $CO_2$eq for 2028, and so forth.

[33] This is illustrated through the following example. An Article 6.4 activity starts operation on 1 January 2027. In a monitoring report covering the period from 1 July 2030 to 31 December 2030 (i.e., in the fourth calendar year of the crediting period), the nitric acid plant has an average performance of 0.4 kg $N_2O$ / t $HNO_3$. Therefore, INDA corresponds to 0.03. The total downward adjustment (i.e., the term $INDA \times (y – y_1)$) corresponds to 0.12 for that monitoring period (0.03 × 4). In the subsequent monitoring period from 1 January 2031 to 30 June 2031, the nitric acid plant has an average performance of 0.1 kg $N_2O$ / t $HNO_3$. Therefore, INDA corresponds to 0.01. The total downward adjustment (i.e., the term $INDA \times (y – y_1)$ corresponds to 0.05 for that monitoring period (0.01 × 5).

Where:

$AE_y$ = Activity emissions in year *y* (t $CO_2$eq)

$AE_{N2O,y}$ = Activity emissions of $N_2O$ from the tail gas of the nitric acid production line in year *y* (t $CO_2$eq)

$AE_{tertiary,y}$ = Activity emissions from the operation of the tertiary $N_2O$ abatement system in year *y* (t $CO_2$eq)

*y* = Calendar year of the crediting period

## 8.1. Activity emissions of $N_2O$ from the tail gas of the nitric acid production line

44. The activity emissions of $N_2O$ from the tail gas of the nitric acid production line ($AE_{N2O,y}$) shall be calculated based on the mass flow of $N_2O$ in the gaseous stream of the tail gas in each hour *h* that the nitric acid production line was in operation ($F_{N2O,tailgas,h}$) and the global warming potential of $N_2O$ ($GWP_{N2O}$), as follows:

$$AE_{N2O,y} = \sum_{h} F_{N2O,tailgas,h} \times GWP_{N20} \times 10^{-3} \qquad \text{Equation (5)}$$

Where:

$AE_{N2O,y}$ = Activity emissions of $N_2O$ from the tail gas of the nitric acid production line in year *y* (t $CO_2$eq)

$F_{N2O,tailgas,h}$ = Mass flow of $N_2O$ in the gaseous stream of the tail gas in hour *h* (kg $N_2O$)

$GWP_{N20}$ = Global warming potential of $N_2O$ (t $CO_2$eq / t $N_2O$)

$10^{-3}$ = A unit conversion factor ($10^{-3}$ t $CO_2$eq / kg $CO_2$eq)

*h* = Hours in calendar year *y* during which the nitric acid production line was in operation

*y* = Calendar year of the crediting period

45. The mass flow of $N_2O$ in the gaseous stream of the tail gas for each hour *h* during which the nitric acid production line was in operation ($F_{N2O,tailgas,h}$) shall be determined using a valid version of the “Methodological tool: Mass flow of a greenhouse gas in a gaseous stream” (A6.4-AMT-005). In applying the tool, the following provisions apply:

    (a) Throughout the crediting periods of the Article 6.4 activity, the $N_2O$ concentration and volume or mass flow of the tail gas shall be monitored continuously. The monitoring system shall be installed and maintained throughout the crediting periods based on the European Norm 14181 “Stationary source emissions – Quality assurance of automated measuring systems” (2015) or any update of that standard, or any equivalent national or international standard;

    (b) An automatic monitoring system (AMS) shall be used for the measurements. The AMS shall provide hourly average values for the $N_2O$ concentration and the volume or mass flow of the tail gas, based on intervals readings that occur no less frequently than every two seconds and that are recorded and stored electronically. These measurement record sets shall be identified by means of a unique time/date key indicating when exactly the values were measured;

(c) The simplification offered for calculating the molecular mass of the gaseous stream in equations (3) or (17) in version 01.0 of the methodological tool (A6.4-AMT-005) may be applied;

(d) The correction factors derived from the calibration curve of the QAL2 audit for the monitoring components as determined during the QAL2 test in accordance with chapter 6 of European Norm 14181 shall be applied to both the $N_2O$ concentration and the volume or mass flow of the tail gas. This may be applied either automatically to the raw data recorded by the AMS at the plant or to the calculated hourly averages as part of the calculation of activity emissions;

(e) If data for the $N_2O$ concentration and/or the volume or mass flow of the tail gas are not available for more than one third of any hour while the nitric acid production line was in operation, the value for that hour shall be replaced with the maximum hourly value of the $N_2O$ concentration and/or volume or mass flow of the tail gas observed since the start of operation of the Article 6.4 activity. Values observed during the five operating hours following the start-up of the nitric acid production line and during the five operating hours before a shutdown of the nitric acid production line shall not be used for the determination of the maximum values;

(f) If data for the $N_2O$ concentration and/or the volume or mass flow of the tail gas is not available for more than 20 days, then no emission reductions shall be claimed for the period thereafter until the measurements have been resumed;

(g) In the case that the $N_2O$ concentration and the volume or mass flow of the tail gas and by-pass are automatically converted to normal conditions by the AMS during the monitoring process, the parameters $P_t$ and $T_t$ in the methodological tool do not need to be monitored, except if applicable, for the purpose of determining the moisture content in the gaseous stream; and

(h) In determining the mass flow of $N_2O$ in the gaseous stream of the tail gas in each hour $h$ that the nitric acid production line was in operation ($F_{N2O,tailgas,h}$), activity participants shall use the average value for each hour, adjusted upwards based on the upper bound of the uncertainty interval at a 95 per cent confidence. The uncertainty shall be determined using error propagation in accordance with the provisions in the methodological tool.

## 8.2. Activity emissions from the operation of the tertiary $N_2O$ abatement system

46. Activity emissions from the operation of the tertiary $N_2O$ abatement system ($AE_{tertiary,y}$) shall be estimated if:

(a) A tertiary $N_2O$ abatement system is installed or restarted under the Article 6.4 activity; and

(b) Fossil fuels, steam, electricity, or other inputs (e.g., ammonia or urea) are used to operate the tertiary $N_2O$ abatement system or reheat the tail gas.

47. Activity emissions from the operation of the tertiary $N_2O$ abatement system ($PE_{tertiary,y}$) shall include, where applicable:

   (a) Activity emissions from fossil fuel use for the operation of the tertiary $N_2O$ abatement system in year $y$ ($AE_{FF,y}$);

   (b) Activity emissions from electricity consumption for the operation of the tertiary $N_2O$ abatement system in year $y$ ($AE_{EC,y}$);

   (c) Activity emissions from steam consumption for the operation of the tertiary $N_2O$ abatement system in year $y$ ($AE_{steam,y}$); and

   (d) Activity emissions from the use of inputs $i$ for the for the operation of the tertiary $N_2O$ abatement system in year $y$ ($AE_{input,i,y}$).

48. Activity participants shall document and justify in the PDD which of the activity emission sources listed in paragraph 47 above are applicable to the tertiary $N_2O$ abatement system used under the Article 6.4 activity, including which inputs $i$ are used (e.g., ammonia, urea, etc.) and how the quantities of fossil fuels, electricity consumption, steam, and any other inputs is monitored and quantified in accordance with the monitoring tables in section 014.

49. Activity emissions from the operation of the tertiary $N_2O$ abatement system ($PE_{tertiary,y}$) shall be calculated as follows:

$$AE_{tertiary,y} = AE_{FF,y} + AE_{EC,y} + AE_{steam,y} + \sum_{i} AE_{input,i,y} \quad \text{Equation (6)}$$

Where:

$AE_{tertiary,y}$ = Activity emissions of $CO_2$ from the operation of the tertiary $N_2O$ abatement system in year $y$ (t $CO_2$eq)

$AE_{FF,y}$ = Activity emissions from fossil fuel use for the operation of the tertiary $N_2O$ abatement system in year $y$ (t $CO_2$), where applicable

$AE_{EC,y}$ = Activity emissions from electricity consumption for the operation of the tertiary $N_2O$ abatement system in year $y$ (t $CO_2$), where applicable

$AE_{steam,y}$ = Activity emissions from steam consumption for the operation of the tertiary $N_2O$ abatement system in year $y$ (t $CO_2$), where applicable

$AE_{input,\mathrm{i}\ y}$ = Activity emissions from the use of input $i$ for the operation of the tertiary $N_2O$ abatement system in year $y$ (t $CO_2$), where applicable

$i$ = Inputs used for the operation of the tertiary $N_2O$ abatement system in year $y$

50. Where steam is produced in a boiler and based on fossil fuels only, activity participants shall account for these emissions either as activity emissions from fossil fuel use ($AE_{FF,y}$) or as activity emissions from steam consumption ($AE_{steam,y}$), and not include them in both terms.

### 8.2.1. Activity emissions from fossil fuel use for the operation of the tertiary $N_2O$ abatement system ($PE_{FF,y}$)

51. This source of activity emissions shall be calculated as follows:

$$AE_{FF,y} = \sum_{i} \left( FC_{i,y} \times EF_{FC,CO2,i,y} \right) \times \left( 1 + F_{CH4/N2O,i} + F_{upstream,i,y} \right) \quad \text{Equation (7)}$$

Where:

$AE_{FF,y}$ = Activity emissions from fossil fuel use for the operation of the tertiary $N_2O$ abatement system in year $y$ (t $CO_2$eq)

$FC_{i,y}$ = Quantity of fuel type $i$ combusted during the year $y$ (mass or volume unit)

$EF_{FC,CO2,i,y}$ = $CO_2$ emission factor of fuel type $i$ in year $y$ (t $CO_2$ / mass or volume unit)

$F_{CH4/N2O,i}$ = Factor to account for $CH_4$ and $N_2O$ emissions in relation to $CO_2$ emissions for fuel type $i$ (dimensionless)

$F_{upstream,i,y}$ Factor to account for upstream emissions in relation to $CO_2$ emissions for fuel type $i$ (dimensionless)

$i$ = Fuel types combusted

52. The emission factor may be calculated using one of the following three options, depending on the availability of data on fossil fuel type $i$, as follows:

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

$$EF_{FC,CO2,i,y} = w_{c,i,y} \times 44/12 \quad \text{Equation (8)}$$

Where:

$EF_{FC,CO2,i,y}$ = $CO_2$ emission factor of fuel type $i$ in year $y$ (t $CO_2$ / mass or volume unit)

$w_{c,i,y}$ = Mass fraction of carbon in fuel type $i$ in year $y$ (t C / mass unit of the fuel)

(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:

$$EF_{FC,CO2,i,y} = w_{c,i,y} \times \rho_{,i,y} \times 44/12 \quad \text{Equation (9)}$$

Where:

$EF_{FC,CO2,i,y}$ = $CO_2$ emission factor of fuel type $i$ in year $y$ (t $CO_2$ / mass or volume unit)

$w_{c,i,y}$ = Mass fraction of carbon in fuel type $i$ in year $y$ (t C / mass unit of the fuel)

$\rho_{,i,y}$ = Density of fuel type *i* in year *y* (mass unit / volume unit of the fuel)

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

$$EF_{FC,CO2,i,y} = NCV_{i,y} \times EF_{CO2,i,y} \quad \text{Equation (10)}$$

Where:

$EF_{FC,CO2,i,y}$ = $CO_2$ emission factor of fuel type *i* in year *y* (t $CO_2$ / mass or volume unit)

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

$EF_{CO2,i,y}$ = $CO_2$ emission factor of fuel type *i* in year *y* (t $CO_2$ / GJ)

53. Activity participants shall use **options A.1 or A.2** unless they can demonstrate that the necessary data is unavailable. If the necessary data is unavailable, activity participants may use **option B**.

54. Given the small size of this emission source and that a conservative BAT baseline emission factor is used, activity participants do not need to quantify and account for the uncertainty from this emission source.

### 8.2.2. Activity emissions from electricity consumption for the operation of the tertiary $N_2O$ abatement system in year *y* ($AE_{EC,y}$)

55. Activity participants shall use a valid version of the “Methodological tool: Emissions from electricity generation and/or consumption” (A6.4-AMT-007) to calculate the activity emissions from electricity consumption for the operation of the tertiary $N_2O$ abatement system in year *y* ($PE_{EC,y}$). The methodological tool shall be applied as follows:

(a) **Electricity generation or consumption sources *s*:** the electricity consumption sources *s* shall include any electricity consumption from the operation of the $N_2O$ destruction system and from reheating the flue gas;

(b) **Determination of the amount of electricity generated or consumed:** the amount of electricity consumption for each consumption source *s* shall be directly metered, consistent with the provisions of the methodological tool;

(c) **Type of electricity generation or consumption source *s*:** the electricity consumption sources *s* shall be deemed to be non-intermittent;

(d) **Applicable scenarios:** where a captive power plant at the site of the industrial facility uses fossil fuels, scenario B shall apply. Otherwise, scenario A shall apply; and

(e) **Whether Case 1 or Case 2 applies:** case 1, as defined in step 4 of the methodological tool shall apply.

56. Given the small size of this emission source and a conservative baseline emission factor is used, activity participants do not need to quantify and account for the uncertainty of (i) the

emission factor, (ii) the transmission and distribution losses, and (iii) the electricity consumption.

### 8.2.3. Activity emissions from steam consumption for the operation of the tertiary $N_2O$ abatement system ($AE_{steam,y}$)

57. This source of activity emissions shall be calculated based on the monitored amount of steam consumption for the operation of the tertiary $N_2O$ abatement system and an emission factor for steam consumption, as follows:

$$AE_{steam,y} = ST_{PJ,y} \times EF_{steam} \qquad \text{Equation (11)}$$

Where:

$AE_{steam,y}$ = Activity emissions from steam consumption for the operation of the tertiary $N_2O$ abatement system in year *y* (t $CO_2$eq)

$ST_{PJ,y}$ = Amount of steam consumed for the operation of the tertiary $N_2O$ abatement system in year *y* (GJ)

$EF_{steam}$ = Emission factor for steam consumption (t $CO_2$eq / GJ)

### 8.2.4. Activity emissions from the use of inputs *i* for the operation of the tertiary $N_2O$ abatement system ($AE_{input,i,y}$)

58. This source of activity emissions shall be calculated based on the monitored amount of inputs *i* used for the operation of the tertiary $N_2O$ abatement system and a respective emission factor. For each input, it shall be calculated as follows:

$$AE_{input,i,y} = IN_{PJ,i,y} \times EF_{IN,i} \times 10^{-3} \qquad \text{Equation (12)}$$

Where:

$AE_{input,i,y}$ = Activity emissions from the use of input *i* for the operation of the tertiary $N_2O$ abatement system in year *y* (t $CO_2$eq)

$IN_{PJ,i,y}$ = Amount of input *i* consumed for the operation of the tertiary $N_2O$ abatement system in year *y* (kg input)

$EF_{IN.i}$ = Emission factor for input *i* (kg $CO_2$eq / kg input)

$10^{-3}$ = A unit conversion factor ($10^{-3}$ t $CO_2$eq / kg $CO_2$eq)

*i* = Inputs consumed for the operation of the tertiary $N_2O$ abatement (ammonia or urea)

# 9. Leakage

59. Leakage emissions include emissions arising from the manufacturing, transportation, and installation of secondary and/or tertiary $N_2O$ abatement systems under the Article 6.4 activity.[34] They shall be determined as follows:

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[34] Leakage emissions from the diversion of baseline equipment are addressed through an applicability condition.

$$LE_y = LF \times P_{NA,y}$$ Equation (13)

Where:

$LE_y$ = Leakage emissions in year *y* (t $CO_2$eq)

$LF$ = Factor to account for leakage emissions (t $CO_2$eq / t $HNO_3$)

$P_{NA,y}$ = Amount of nitric acid produced in the Article 6.4 nitric acid production line in year y (t $HNO_3$)

# 10. Emission reductions

60. Emission reductions shall be determined as follows:

$$ER_y = BE_{adj,y} - AE_y - LE_y$$ Equation (14)

Where:

$ER_y$ = Emission reductions in year *y* (t $CO_2$eq)

$BE_{adj,y}$ = Downward adjusted baseline emissions in year *y* (t $CO_2$eq)

$AE_y$ = Activity emissions in year *y* (t $CO_2$eq)

$LE_y$ = Leakage emissions in year *y* (t $CO_2$eq)

61. For informational purposes, the following equation reflects the number of A6.4ERs to be issued to the accounts of activity participants:[35]

$$A6.4ER_{activity,y} = ER_y - A6.4ER_{SOP,y} - A6.4ER_{OMGE,y}$$ Equation (15)

Where:

$A6.4ER_{activityy}$ = The number of Article 6.4ERs to be forwarded to the accounts of the activity participants for year y (t $CO_2$eq)

$A6.4ER_{SOP,y}$ = The number of A6.4ERs to be forwarded or first transferred to an account of the Adaptation Fund for year y (t $CO_2$eq) (where applicable)

$A6.4ER_{OMGE,y}$ = The number of A6.4ERs to be forwarded to the account for cancellation towards delivering overall mitigation in global emissions for year y (t $CO_2$eq)

62. This mechanism methodology addresses uncertainty in the determination of individual parameters and through conservative assumptions. It is therefore not necessary to determine the overall uncertainty of the aggregated emission reductions.

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[35] The forwarding or first-transfer of A6.4ERs is operationalized through the “Procedure: Article 6.4 mechanism registry” (A6.4-PROC-REGS-001).

# 11. Avoidance of double counting

63. 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 ($N_2O$ abatement in the production of nitric acid) for which they intend to request issuance of A6.4ERs are not also claimed in other environmental markets or accounting frameworks, except for outcomes not related to reducing GHG emissions (e.g., 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 (i.e., the $N_2O$ emission reductions achieved) 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, by:

        (i) Declaring and providing evidence in each monitoring report that the Article 6.4 activity does not fall within the scope of any mandatory domestic mitigation scheme; or

        (ii) Where the Article 6.4 activity falls within the scope of a mandatory domestic mitigation scheme, providing evidence in each monitoring report that the mitigation outcomes of the Article 6.4 activity are not counted in the scheme to reduce the obligations of entities covered by the scheme. For example, in the case of an emissions trading system covering $N_2O$ emissions from nitric acid production, a confirmation from the operator of the emissions trading system may be sought that a number of allowances equal to the difference between the downward adjusted baseline emissions ($BE_{adj,y}$) and the activity emissions of $N_2O$ from the tail gas of the nitric acid production line in year $y$ ($AE_{N2O,y}$) were cancelled before the issuance of the A6.4ERs.

64. Notwithstanding paragraph 63 above, where the policy establishing the framework or environmental market or 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.

## 12. Demonstration of alignment with the policies, options and implementation plans of the host Party with regard to its nationally determined contribution and long-term low greenhouse gas emission development strategies and the long-term temperature goal of the Paris Agreement and long-term goals of the Paris Agreement

65. The activity participants applying this methodology shall ensure that the activity complies with paragraph 10 in Appendix of the “Standard: Setting the baseline in mechanism methodologies” (A6.4-STAN-METH-004).

## 13. Data and parameters not monitored

**Data / Parameter table 1.**

| **Data/parameter** | ***Operating pressure and plant classification*** |
|---|---|
| Description | Operating pressure of nitric acid plant (ammonia oxidation reactor and absorber) and the classification of the plant based on this operating pressure |
| Data unit | Bar/plant types specified below |
| Equations referred | N/A |
| Purpose of data | ☒ Baseline emissions ☐ Activity emissions ☐ Leakage emissions |
| Value(s) applied | The following table provides the different ranges of nitric acid plant pressure (according to the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories): |
| Source of data | ☐ Measured ☒ Other sources |
| Choice of data or measurement methods and procedures | Manufacturer specifications |

| **Operating conditions** | **Applied pressure in Bar** | |
|---|---|---|
| | **Oxidation** | **Absorption** |
| Single low pressure | 0 – 1.7 | |
| Dual low/medium (L/M) pressure | <1.7 | 1.7 – 6.5 |
| Single medium pressure | 1.7 – 6.5 | |
| Dual medium/high (M/H) pressure | 1.7 – 6.5 | 6.5 – 13 |
| Single high pressure | 6.5 – 13 | |

| | |
|---|---|
| Treatment of uncertainty | Not applicable (the operating pressure of the nitric acid plant is used solely for classification of the plant´s pressure category in accordance with the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories) |
| Additional comments | The parameter is used to determine the nitric acid plant´s operating pressure classification |

### Data / Parameter table 2.

| **Data/parameter** | ***$EF_{BL,y}$*** |
|---|---|
| Description | BAT baseline $N_2O$ emission factor in year *y* (kg $N_2O$ / t $HNO_3$) |
| Data unit | kg $N_2O$/t $HNO_3$ |
| Equations referred | Equation (2) |
| Purpose of data | ☒ Baseline emissions ☐ Activity emissions ☐ Leakage emissions |
| Value(s) applied | The emission factor for all plant types is provided below:<br>- Type (1) and (2) activities: 3.99 kg $N_2O$ / t $HNO_3$<br>- Type (3) activities: 0.60 kg $N_2O$ / t $HNO_3$ |
| Source of data | ☐ Measured ☒ Other sources |
| Choice of data or measurement methods and procedures | As per Appendix |
| Treatment of uncertainty | Not applicable (no further adjustments for uncertainty are applied to BAT values) |
| Additional comments | - |

### Data / Parameter table 3.

| **Data/parameter** | ***$GWP_{N2O}$*** |
|---|---|
| Description | Global warming potential of $N_2O$ |
| Data unit | t $CO_2$eq / t $N_2O$ |
| Equations referred | Equation (2), Equation (5) |
| Purpose of data | ☒ Baseline emissions ☒ Activity emissions ☐ Leakage emissions |
| Value(s) applied | 265 |
| Source of data | ☐ Measured ☒ Other sources |

| | |
|---|---|
| Choice of data or measurement methods and procedures | Default value taken from the IPCC Fifth Assessment Report . The use of this value is subject to any further decisions by the CMA or the Supervisory Body of the Article 6.4 mechanism |
| Treatment of uncertainty | N/A |
| Additional comments | - |

### Data / Parameter table 4.

| **Data/parameter** | ***$P_{NA,NPC}$*** |
|---|---|
| Description | Nameplate capacity of the nitric acid production line at the time of the start date of the Article 6.4 activity |
| Data unit | t $HNO_3$ / hour |
| Equations referred | Equation (3), Equation (5) |
| Purpose of data | ☒ Baseline emissions ☐ Activity emissions ☐ Leakage emissions |
| Value(s) applied | Variable (depends on the production line) |
| Source of data | Project operator and/or technology provider |
| Choice of data or measurement methods and procedures | As per design specification and/or permitting documents |
| Treatment of uncertainty | Not applicable |
| Additional comments | Where the nameplate capacity is specified for a different time period (e.g. t $HNO_3$ / day) it shall be converted respectively (e.g. by dividing the value per day by 24). |

### Data / Parameter table 5.

| **Data/parameter** | ***$CF_{default}$*** |
|---|---|
| Description | Default value for the capacity utilization factor |
| Data unit | dimensionless |
| Equations referred | Equation (3) |
| Purpose of data | ☒ Baseline emissions ☐ Activity emissions ☐ Leakage emissions |
| Value(s) applied | 80% |
| Source of data | ☐ Measured ☒ Other sources |

| | |
|---|---|
| Choice of data or measurement methods and procedures | Intergovernmental Panel on Climate Change (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 1: General Guidance and Reporting (chapter 3: Chemical Industry Emissions, page 23). IPCC, Geneva, Switzerland |
| Treatment of uncertainty | Not applicable |
| Additional comments | - |

### Data / Parameter table 6.

| **Data/parameter** | $F_{CH4/N2O,i}$ |
|---|---|
| Description | Factor to account for $CH_4$ and $N_2O$ emissions in relation to $CO_2$ emissions for fuel type *i* |
| Data unit | dimensionless |
| Equations referred | Equation (7) |
| Purpose of data | ☐ Baseline emissions ☒ Activity emissions ☐ Leakage emissions |
| Value(s) applied | 1.002 |
| Source of data | ☐ Measured ☒ Other sources |
| Choice of data or measurement methods and procedures | This value was derived from table 2.2 of volume 2, chapter 1 of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories |
| Treatment of uncertainty | Not applicable (uncertainty is taken into account in determining a conservative default value) |
| Additional comments | - |

### Data / Parameter table 7.

| **Data/parameter** | $F_{upstream,i}$ |
|---|---|
| Description | Factor to account for upstream emissions in relation to $CO_2$ emissions for fuel type *i* |
| Data unit | dimensionless |
| Equations referred | Equation (7) |
| Purpose of data | ☐ Baseline emissions ☒ Activity emissions ☐ Leakage emissions |
| Value(s) applied | 0.2 |
| Source of data | ☐ Measured ☒ Other sources |

| | |
|---|---|
| Choice of data or measurement methods and procedures | A global value of 0.2 shall be used |
| Treatment of uncertainty | Not applicable (uncertainty has been taken into account in determining the conservative default value) |
| Additional comments | - |

### Data / Parameter table 8.

| **Data/parameter** | ***$EF_{steam}$*** |
|---|---|
| Description | Emission factor for steam consumption |
| Data unit | t $CO_2$eq / GJ |
| Equations referred | Equation (10) |
| Purpose of data | ☐ Baseline emissions ☒ Activity 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 | Use the applicable conservative default value specified in |
| Treatment of uncertainty | N/A (uncertainty has been taken into account in determining the conservative default values) |
| Additional comments | - |

### Data / Parameter table 9.

| **Data/parameter** | $EF_{steam}$ |
|---|---|
| Description | Emission factor for steam consumption |
| Data unit | t $CO_2$eq / GJ |
| Equations referred | Equation (11) |
| Purpose of data | ☐ Baseline emissions ☒ Activity emissions ☐ Leakage emissions |
| Value(s) applied | Steam produced from natural gas boilers: 0.0988<br>Steam produced from oil boilers: 0.1224<br>Steam produced from coal boilers: 0.1752 |
| Source of data | ☐ Measured ☒ Other sources |

| | |
|---|---|
| Choice of data or measurement methods and procedures | Activity participants shall select the value based on the most carbon-intensive fuel type used at the industrial facility where the nitric acid production line is located.<br>The figures provided in the table are derived based on the assumption that the steam would be generated in a boiler. The values include $CO_2$, $CH_4$ and $N_2O$ emissions from the combustion of the fuel and upstream emissions from associated with fuel production. The following data sources were used: (i) for the emission factors from combustion of the fuels, the upper bound of the uncertainty range provided in table 2.2 of volume 2, chapter 1 of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories has been used; (ii) for upstream emissions associated with the fossil fuel use, the values provided in table 3 of CDM TOOL15 have been used; and (iii) for the energy efficiency of the boiler, the lowest bound of boiler efficiencies for the applicable fuels provided by Barmaa et al. (2017) have been used (respectively 81% for coal, 78% for gas, and 76% for oil). See: Barmaa, M. C., Saidur, R., Rahman, S. M. A., Allouhi, A., Akash, B. A., & Sait, S. M. (2017). A review on boilers energy use, energy savings, and emissions reductions. Renewable and Sustainable Energy Reviews, 79, 970–983. https://doi.org/10.1016/j.rser.2017.05.186. The values provided in the table may be updated if new default values for upstream emissions become available once a corresponding tool covering upstream emissions from fossil fuels has been approved by the Supervisory Body of the Article 6.4 mechanism |
| Treatment of uncertainty | Value based on conservative assumptions |
| Additional comments | - |

### Data / Parameter table 10.

| **Data/parameter** | ***LF*** |
|---|---|
| Description | Factor to account for leakage emissions |
| Data unit | t $CO_2$eq / t $HNO_3$ |
| Equations referred | Equation (13) |
| Purpose of data | ☐ Baseline emissions ☐ Activity emissions ☒ Leakage emissions |
| Value(s) applied | 0.00015 |
| Source of data | ☐ Measured ☒ Other sources |
| Choice of data or measurement methods and procedures | This emission factor was calculated based on the following assumptions: A nitric acid plant operates with a capacity of 500 tonnes $HNO_3$ per year operating 330 days per year; For the operation of a secondary $N_2O$ abatement system the following assumptions are used: 1.5 t of catalyst is replaced every year with the following emissions: (i) 14 t $CO_2$eq per tonne of catalyst for the production of the catalyst; (ii) 0.3 t $CO_2$eq per tonne of catalyst for the transportation of the catalyst; and (iii) 0.5 t $CO_2$eq per tonne of catalyst for the disposal or recycling of the catalyst; This results in about 0.135 kg $CO_2$eq / t $HNO_3$ produced. |

| | |
|---|---|
| | For the operation of a tertiary $N_2O$ abatement system the following assumptions are used: (i) 15 years of operation of the Article 6.4 activity; (ii) 3 years of catalyst lifetime; (iii) a weight of 25 tonnes of the tertiary $N_2O$ abatement system consisting mostly of steel; (iv) 10 tonnes of catalyst; (v) a steel emission intensity of 2.1 $tCO_2eq$ / t steel; (vi) a catalyst emission intensity of 4 $tCO_2eq$ / t; and (vii) emissions of 10 $CO_2eq$ for all transportation over the span of 15 years. This results in about 0.106 kg $CO_2eq$ / t $HNO_3$ produced |
| Treatment of uncertainty | As a conservative approach, a value of 0.00015 t $CO_2eq$ / t $HNO_3$ is used |
| Additional comments | - |

### Data / Parameter table 11.

| **Data/parameter** | $EF_{IN,i}$ |
|---|---|
| Description | Emission factor for input *i* |
| Data unit | kg $CO_2eq$ / kg input |
| Equations referred | Equation (12) |
| Purpose of data | ☐ Baseline emissions ☒ Activity emissions ☐ Leakage emissions |
| Value(s) applied | Ammonia: 4.37<br>Urea: 3.41 |
| Source of data | ☐ Measured ☒ Other sources |
| Choice of data or measurement methods and procedures | For ammonia: This value was calculated based on an assumed share of 70 per cent of the global ammonia produced from steam methane reforming with an emission intensity of 2.9 t $CO_2eq$ / t $NH_3$ and 30 per cent of global ammonia produced using coal with an emission intensity of 7.8 t $CO_2eq$ / t $NH_3$. These numbers were sourced from: Stafford, W. H. L., Chaba, K. J., Russo, V., Goga, T., Roos, T. H., Sharp, M., & Nahman, A. (2025). *Life cycle assessment of green ammonia production at a coastal facility in South Africa*. *Frontiers in Energy, 19*(6), 1072–1092. https://doi.org/10.1007/s11708-025-1013-5.<br>For urea: This value was derived from the following data and assumptions: (i) the emission factor for urea was sourced from: Shi, L., Liu, L., Yang, B., Sheng, G., & Xu, T. (2020). *Evaluation of industrial urea energy consumption (EC) based on life cycle assessment (LCA)*. *Sustainability, 12*(9), 3793. https://doi.org/10.14288/1.0390686 and (ii) a value of 0.73 t $CO_2$ per t urea is added, based on molecular weight of urea and the $CO_2$ to which it decomposes |
| Treatment of uncertainty | Value based on conservative assumptions |
| Additional comments | - |

# 14. Data and parameters monitored

66. In the case of activities including several nitric acid production lines, all parameters shall be monitored separately for each production line.

67. Activity participants shall provide the information on data monitored hourly in a spreadsheet. For each hour, data shall at least be provided on;

(a) whether the nitric acid production was in operation during the hour; and

(b) for any hour in which the nitric acid production line was in operation:

  (i) The volume or mass flow of the tail gas;

  (ii) The $N_2O$ concentration in the volume or mass flow of the tail gas; and

  (iii) The resulting mass flow of $N_2O$ in the gaseous stream of the tail gas in hour *h* (kg $N_2O$), calculated based on the parameters in sub-paragraphs 67(b)(i)and 67(b)(ii) above.

**Data / Parameter table 12.**

| **Data/parameter** | $P_{NA,y}$ | |
|---|---|---|
| Description | Amount of nitric acid produced in the Article 6.4 nitric acid production line in year *y* | |
| Data unit | t $HNO_3$ | |
| Equations referred | Equation (2) | |
| Purpose of data | ☒ Baseline emissions ☐ Activity emissions ☐ Leakage emissions | |
| Measurement and updating frequency | Measurements by activity participants and production reports | |
| Measurement methods and procedures | N/A | |
| Entity/person responsible for the measurement | Activity participants | |
| Measuring instrument(s) | *Type of instrument* | - Instruments for determining the mass or volumetric flow of the nitric acid solution; and<br>- Instruments for determining the $HNO_3$ concentration of that solution |
| | *Accuracy class* | As per manufacturer specification |
| | *Calibration requirements* | As per manufacturer specification |
| | *Location* | N/A |

| | |
|---|---|
| Measurement intervals | Continuous |
| QA/QC procedures | For measurement devices (e.g. as weight scales), the QA/QC procedures specified by the supplier of the measurement devices shall be followed |
| Treatment of uncertainty | • For measurement devices, the uncertainty specified by the supplier of the measurement devices shall be used; and<br>• The higher bound of the uncertainty shall be applied to the measured value for the purpose of determining this parameter in equation (2) |
| Additional comment | - |

### Data / Parameter table 13.

| **Data/parameter** | $F_{N2O,tailgas,h}$ | |
|---|---|---|
| Description | Mass flow of $N_2O$ in the gaseous stream of the tail gas in hour *h* | |
| Data unit | kg $N_2O$ | |
| Equations referred | Equation (5) | |
| Purpose of data | ☐ Baseline emissions ☒ Activity emissions ☐ Leakage emissions | |
| Measurement and updating frequency | As per the provisions in section 8.1 above | |
| Measurement methods and procedures | As per the requirements of the “Methodological tool: Mass flow of a greenhouse gas in a gaseous stream” (A6.4-AMT-005) | |
| Entity/person responsible for the measurement | Activity participants | |
| Measuring instrument(s) | *Type of instrument* | As per the requirements of the “Methodological tool: Mass flow of a greenhouse gas in a gaseous stream” (A6.4-AMT-005) |
| | *Accuracy class* | As per the requirements of the “Methodological tool: Mass flow of a greenhouse gas in a gaseous stream” (A6.4-AMT-005) |
| | *Calibration requirements* | As per the requirements of the “Methodological tool: Mass flow of a greenhouse gas in a gaseous stream” (A6.4-AMT-005) |
| | *Location* | As per the requirements of the “Methodological tool: Mass flow of a greenhouse gas in a gaseous stream” (A6.4-AMT-005) |
| QA/QC procedures | As per the calibration requirements | |

| | |
|---|---|
| Treatment of uncertainty | Uncertainty shall be determined based on the measuring instruments |
| Additional comment | - |

### Data / Parameter table 14.

| **Data/parameter** | **$EF_{CO2,i,y}$** | |
|---|---|---|
| Description | $CO_2$ emission factor of fuel type *i* in year *y* | |
| Data unit | t $CO_2$ / GJ | |
| Equations referred | Equation (7) | |
| Purpose of data | ☐ Baseline emissions ☒ Activity emissions ☐ Leakage emissions | |
| Measurement and updating frequency | Option 1: At each fuel delivery;<br>Option 2: At each fuel delivery;<br>Option 3: Annually;<br>Option 4: Updated based on future revisions of the IPCC Guidelines | |
| Measurement methods and procedures | Option 1: Values provided by the fuel supplier (preferred source), in line with national or international fuel standards;<br>Option 2: Measurements by activity participants undertaken in line with national or international fuel standards (if supplier-provided values are not available);<br>Option 3: Regional or national default values (if supplier-provided values are not available and only for liquid fuels). Values shall be reviewed annually;<br>Option 4: Upper bound for case 1 and lower bound for case 2, at a 95 per cent confidence interval, from IPCC default values provided in the 2019 Refinement to the 2006 IPCC Guidelines on National Greenhouse Gas Inventories (if supplier-provided values are not available) | |
| Entity/person responsible for the measurement | Activity participants | |
| Measuring instrument(s) | *Type of instrument* | As per the national or international standard if the parameter is measured by activity participants |
| | *Accuracy class* | As per the national or international standard if the parameter is measured by activity participants |
| | *Calibration requirements* | As per the national or international standard if the parameter is measured by activity participants |
| | *Location* | N/A |
| QA/QC procedures | • The recorded data shall be stored monthly in a central database with backup; | |

| | |
|---|---|
| | • Laboratories in options 1 and 2 shall have ISO/IEC 17025 accreditation or justify compliance with equivalent quality standards |
| Treatment of uncertainty | Verify whether the values under options 1, 2, and 3 fall within the uncertainty range of the IPCC default values as provided in table 1.2, volume 2 of the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. If the values fall outside of this range, additional information shall be collected from the testing laboratory to justify the outcome, or additional measurements shall be conducted |
| Additional comment | For option 1, if the fuel supplier provides both the net calorific value (NCV) and $CO_2$ emission factor on the invoice and these values are based on measurements for the specific fuel delivered, the provided $CO_2$ emission factor shall be used. If another source is used for the $CO_2$ emission factor, or no $CO_2$ emission factor is provided, Options 2, 3, or 4 shall be used |

### Data / Parameter table 15.

| **Data/parameter** | **$FC_{i,y}$** | |
|---|---|---|
| Description | Quantity of fuel type i combusted in process *j* during year *y* | |
| Data unit | Mass or volume unit | |
| Equations referred | Equation (7) | |
| Purpose of data | ☐ Baseline emissions ☒ Activity emissions ☐ Leakage emissions | |
| Measurement and updating frequency | Continuously | |
| Measurement methods and procedures | • Use either mass or volume meters;<br>• In cases where fuel is supplied from small daily tanks, ruler gauges can be used to determine mass or volume of fuel consumed, subject to the following conditions: the ruler gauge shall be part of the daily tank, shall be calibrated at least once a year and, shall have a logbook for recording measurements (on a daily basis or per shift);<br>• Accessories such as transducers, sonar and piezoelectronic devices may be used if they are properly calibrated with the ruler gauge and maintained appropriately; and<br>• In the case of daily tanks with pre-heaters for heavy oil, calibration shall be conducted under typical operational conditions | |
| Entity/person responsible for the measurement | Activity participants | |
| Measuring instrument(s) | *Type of instrument* | Mass or volume meters, ruler gauges (installed in daily tanks), transducers, sonar and piezoelectronic devices |
| | *Accuracy class* | As per manufacturer specification |
| | *Calibration requirements* | Ruler gauges shall be calibrated at least once a year. |

| | | |
|---|---|---|
| | | Transducers, sonar and piezoelectronic devices shall be calibrated with the ruler gauge and maintained appropriately |
| | *Location* | N/A |
| QA/QC procedures | The recorded data shall be stored monthly in a central database with backup | |
| Treatment of uncertainty | Uncertainties are determined based on the measuring instruments | |
| Additional comment | • The consistency of metered fuel consumption quantities shall be cross-checked by an annual energy balance based on purchased quantities and stock changes;<br>• Where purchased fuel invoices can be attributed specifically to the Article 6.4 activity, the metered fuel consumption quantities shall also be cross-checked against available purchase invoices from financial records; and<br>• Where data gaps occur due to meter failure or other unforeseen reasons, activity participants may estimate the quantity of fuel using one of the following options, provided that the gap period does not exceed 30 consecutive days within six consecutive months:<br>o Purchased fuel or energy invoices/bills, where the purchased fuel can be attributed specifically to the Article 6.4 activity;<br>o Energy produced by the equipment, adjusted for efficiency. Conservative default values of 40 per cent for combustion engines and generators and 80 per cent for thermal heaters shall be used. Energy produced shall be measured directly or calculated based on operating hours; or<br>o The highest value of the parameter for the same calendar period in the previous years | |

### Data / Parameter table 16.

| **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 | Equation (8), Equation (9) |
| Purpose of data | ☐ Baseline emissions ☒ Activity emissions ☐ Leakage emissions |
| Measurement and updating frequency | Continuously or for each fuel batch |
| Measurement methods and procedures | • Values provided by the supplier of the fuel (preferred source);<br>• Measurements by activity participants undertaken in line with national or international fuel standards (if supplier-provided values are not available); and |

| | | |
|---|---|---|
| | - Regional or national default values (if supplier-provided values are not available and only for liquid fuels) | |
| Entity/person responsible for the measurement | Activity participants | |
| Measuring instrument(s) | *Type of instrument* | As per the national or international standard if the parameter is measured by activity participants |
| | *Accuracy class* | As per the national or international standard if the parameter is measured by activity participants |
| | *Calibration requirements* | As per the national or international standard if the parameter is measured by activity participants |
| | *Location* | N/A |
| QA/QC procedures | The recorded data must be stored monthly in a central database with backup | |
| Treatment of uncertainty | Apply uncertainties based on the IPCC (2019 Refinement) | |
| Additional comments | For values provided by the fuel supplier, the density of the fuel shall be obtained for each fuel delivery, from which weighted average annual values shall be calculated | |

### Data / Parameter table 17.

| **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 | Equation (8), Equation (9) | |
| Purpose of data | ☐ Baseline emissions ☒ Activity emissions ☐ Leakage emissions | |
| Measurement and updating frequency | Continuously or for each fuel batch | |
| Measurement methods and procedures | a) Values provided by the fuel supplier (preferred source);<br>b) Measurements by activity participants undertaken in line with national or international fuel standards (if supplier-provided values are not available); and<br>c) Regional or national default values (if supplier-provided values are not available and only for liquid fuels) | |
| Entity/person responsible for the measurement | Activity participants | |
| Measuring instrument(s) | *Type of instrument* | As per the national or international standard if the parameter is measured by activity participants |

| | | |
|---|---|---|
| | *Accuracy class* | As per the national or international standard if the parameter is measured by activity participants |
| | *Calibration requirements* | As per the national or international standard if the parameter is measured by activity participants |
| | *Location* | N/A |
| QA/QC procedures | The recorded data shall be stored monthly in a central database with backup | |
| Treatment of uncertainty | Uncertainties are determined based on the measuring instruments | |
| Additional comments | Verify whether the values measured or obtained from the fuel supplier fall within the uncertainty range derived from the product of the IPCC default values provided in table 1.2 and table 1.3, volume 2 of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. If the values fall below this range, additional information shall be obtained from the testing laboratory to justify the outcome, or additional measurements shall be conducted. Laboratories performing measurements in (b) should have ISO/IEC 17025 accreditation or demonstrate compliance with equivalent quality standards | |

### Data / Parameter table 18.

| **Data/parameter** | $NCV_{i,y}$ |
|---|---|
| Description | Net calorific value of fuel type *i* in year *y* |
| Data unit | GJ / mass or volume unit |
| Equations referred | Equation (10) |
| Purpose of data | ☐ Baseline emissions ☒ Activity emissions ☐ Leakage emissions |
| Measurement and updating frequency | Option 1: At each fuel delivery;<br>Option 2: At each fuel delivery;<br>Option 3: Annually;<br>Option 4: Updated based on future revisions of the IPCC Guidelines |
| Measurement methods and procedures | • Option 1: Values provided by the fuel supplier (preferred source). The NCV of the fuel shall be obtained for each fuel delivery, from which weighted average annual values shall be calculated;<br>• Option 2: Measurements by activity participants undertaken in line with national or international fuel standards (if supplier-provided values are not available). The NCV of the fuel shall be obtained for each fuel delivery, from which weighted average annual values shall be calculated;<br>• Option 3: Regional or national default values (if supplier-provided values are not available and only for liquid fuels). Values shall be reviewed annually;<br>• Option 4: Upper bound of the 95 per cent confidence interval from IPCC default values provided in table 1.2 of chapter 1, volume 2 (Energy), of |

| | | |
|---|---|---|
| | the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, if supplier-provided values are not available. Values shall be updated based on future revisions of the IPCC Guidelines | |
| Entity/person responsible for the measurement | Activity participants or fuel supplier | |
| Measuring instrument(s) | *Type of instrument* | As per the national or international standard if the parameter is measured by activity participants |
| | *Accuracy class* | As per the national or international standard if the parameter is measured by activity participants |
| | *Calibration requirements* | As per the national or international standard if the parameter is measured by activity participants |
| | *Location* | As per the national or international standard if the parameter is measured by activity participants |
| QA/QC procedures | The recorded data shall be stored monthly in a central database with backup | |
| Treatment of uncertainty | Verify whether the values under options 1, 2 and 3 fall within the uncertainty range of the IPCC default values as provided in table 1.2, volume 2 of the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. If the values fall below this range, additional information shall be obtained from the testing laboratory to justify the outcome, or additional measurements shall be conducted. Laboratories in options 1, 2 and 3 – shall have ISO/IEC 17025 accreditation or demonstrate compliance with similar quality standards | |
| Additional comments | - | |

### Data / Parameter table 19.

| **Data/parameter** | $ST_{PJ,y}$ |
|---|---|
| Description | Amount of steam consumed from the operation of the tertiary $N_2O$ abatement system in year *y* |
| Data unit | GJ |
| Equations referred | Equation (11) |
| Purpose of data | ☐ Baseline emissions ☒ Activity emissions ☐ Leakage emissions |
| Measurement and updating frequency | Continuous measurement and at least monthly recording |
| Measurement methods and procedures | Mass, volume or differential pressure meters |

| | | |
|---|---|---|
| Entity/person responsible for the measurement | Activity participants | |
| Measuring instrument(s) | *Type of instrument* | Steam meter |
| | *Accuracy class* | In accordance with national, international, or meter supplier instructions |
| | *Calibration requirements* | Calibration shall be conducted in accordance with national, international, or manufacturer's instructions |
| | *Location* | At the outlet of the equipment providing/generating the steam to be used for reheating the tail gas for the tertiary $N_2O$ abatement system |
| QA/QC procedures | The recorded data shall be stored daily in a central database with backup | |
| Treatment of uncertainty | Uncertainty shall be determined based on the specifications of the measuring instruments | |
| Additional comment | Where applicable, the values shall be cross-checked against fuel use records for steam production or calculated amounts of steam diverted from other processes | |

### Data / Parameter table 20.

| **Data/parameter** | $IN_{PJ,I,y}$ |
|---|---|
| Description | Amount of input *i* consumed for the operation of the tertiary $N_2O$ abatement system in year *y* |
| Data unit | kg input |
| Equations referred | Equation (12) |
| Purpose of data | ☐ Baseline emissions ☒ Activity emissions ☐ Leakage emissions |
| Measurement methods and procedures | • Use either mass or volume meters;<br>• In cases where the input is supplied from small daily tanks, ruler gauges may be used to determine the mass or volume of fuel consumed, subject to the following conditions: the ruler gauge shall be part of the daily tank, shall be calibrated at least once a year, and shall have a logbook for recording measurements (on a daily basis or per shift);<br>• Accessories such as transducers, sonar and piezoelectronic devices may be used if they are properly calibrated with the ruler gauge and maintained appropriately; and<br>• In case of daily tanks with pre-heaters for heavy oil, the calibration shall be conducted under typical operating conditions |

| | | |
|---|---|---|
| Entity/person responsible for the measurement | Activity participants | |
| Measuring instrument(s) | *Type of instrument* | Mass or volume meters, ruler gauges (installed in daily tanks), transducers, sonar and piezoelectronic devices |
| | *Accuracy Class* | N/A |
| | *Calibration requirements* | • Ruler gauges shall be calibrated at least once a year;<br>• Transducers, sonar and piezoelectronic: devices shall be calibrated with the ruler gauge and maintained appropriately |
| | *Location* | N/A |
| QA/QC procedures | The recorded data shall be stored daily in a central database with backup | |
| Treatment of uncertainty | Uncertainty shall be determined based on the measuring instruments | |
| Additional comment | • The consistency of metered input consumption quantities shall be cross-checked by an annual mass/flow balance based on purchased quantities and stock changes;<br>• Where purchased input invoices can be attributed specifically to the Article 6.4 activity, metered input consumption quantities should also be cross-checked against available purchase invoices from financial records;<br>• Where data gaps occur due to meter failure or other unforeseen reasons, activity participants may estimate the quantity of inputs using one of the following options, provided that the gap period does not exceed 30 consecutive days within six consecutive months:<br>o Purchased input invoices or bills, where the purchased inputs can be attributed specifically to the Article 6.4 activity; or<br>o The highest value of the parameter for the same calendar period in previous years | |

# Appendix. Demonstration of requirements at the level of the mechanism methodology

1. This section describes how specific requirements in the provisions of the “Standard: Demonstration of additionality in mechanism methodologies” (A6.4-STAN-METH-003)[1] and the “Standard: Setting the baseline in mechanism methodologies” (A6.4-STAN-METH-004) are demonstrated at the level of the mechanism methodology.

## 1. Analysis of lock-in risk

2. Article 6.4 activities using this mechanism methodology are not deemed to cause lock-in risk for the following reasons:

    (a) The installation of secondary or tertiary nitrous oxide ($N_2O$) abatement is very unlikely to prolong the technical lifetime of existing nitric acid plants. Therefore, Article 6.4 activities do not prolong $N_2O$ emissions;

    (b) Secondary $N_2O$ abatement systems have a technical lifetime of less than 10 years. Therefore, these abatement systems are not considered to cause any lock-in risk with regard to greenhouse gas (GHG) emissions intensity;

    (c) Tertiary $N_2O$ abatement systems can have a technical lifetime of more than 10 years. However, these systems can achieve high abatement levels and often exceed the performance of secondary $N_2O$ abatement. Tertiary $N_2O$ abatement at existing plants is therefore the technology with the lowest GHG emissions intensity and is not considered to cause lock-in risk with regard to GHG emissions intensity; and

    (d) Article 6.4 activities using this mechanism methodology are not expected to result in an inefficient use of resources for mitigating climate change or achieving other policy objectives.

## 2. Investment analysis

3. In accordance with the applicability conditions in paragraph 19 of the mechanism methodology, Article 6.4 activities eligible to apply this mechanism methodology do not have any incentive, in the form of either a financial incentive or a penalty, for reducing their $N_2O$ emissions from nitric acid production. At the same time, the installation of secondary or tertiary $N_2O$ abatement systems involves costs and does not generate cost savings or revenues other than from Article 6.4 emission reductions (A6.4ERs).

4. For this project type, a simple cost analysis is applied. It is found that:

    (a) The implementation of the Article 6.4 activity does not generate any cost savings or revenues other than from A6.4ERs (as ensured through the applicability conditions); and

    (b) Alternative scenarios to the Article 6.4 activity also do not generate cost savings or revenues, since the installation of secondary or tertiary $N_2O$ abatement systems involves capital and/or operational expenditures and does not generate cost savings or revenues other than from A6.4ERs.

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

5. The simple cost analysis is therefore concluded positively at the methodology level.

## 3. Determination of the best available technology (BAT)

6. This mechanism methodology determines baseline emissions using a baseline emission factor based on best available technology (BAT). This section explains how this emission factor has been derived.

### 3.1. Level of aggregation at which the BAT is determined

7. In this mechanism methodology, the BAT emission factor is determined at the global level, as the technologies used to produce nitric acid and abate $N_2O$ emissions do not differ between countries.

8. The values determined here are applicable throughout the entire validity of this mechanism methodology. As the technologies used to abate $N_2O$ emissions have not changed significantly over the past 20 years, it is expected that similar technologies will be applied over the next five years. This applies to existing nitric acid production lines, noting that new technologies may be employed in new nitric acid facilities that could result in significantly lower $N_2O$ formation.

### 3.2. Determination of the BAT baseline scenario

9. The available technologies for reducing $N_2O$ emissions from nitric acid production include primary, secondary and tertiary $N_2O$ abatement.

10. All these technologies can be considered environmentally sound under the applicability conditions of this mechanism methodology, in particular with regard to emissions other than $N_2O$.

11. Among the three technologies, only primary abatement is considered economically viable under the applicability conditions of this mechanism methodology, for the following reasons:

    (a) Operators of nitric acid production plants have incentives to use advanced primary catalytic gauzes that reduce the formation of $N_2O$, as this can enhance yield and may also reduce $NO_x$ emissions. Although advanced primary catalytic gauzes are not installed throughout the industry, advanced primary catalytic gauzes are being installed in some plants and can be considered to be an economically viable course of action; and

    (b) Under the applicability conditions of this mechanism methodology, secondary and tertiary $N_2O$ abatement are not economically viable because these technologies involve capital and/or operating expenditures but do not generate cost savings or revenues other than from A6.4ERs, in the absence of relevant legal requirements, policies or targets.

### 3.3. Determination of the BAT emission factor

12. The emission performance of nitric acid plants depends on plant design, such as the type of primary catalyst and the plant pressure, and, for activities enhancing $N_2O$ abatement, on any pre-existing $N_2O$ abatement. The 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories differentiates between the following types of plants:

    (a) Single low pressure (0–1.7 bar);

(b) Single medium pressure (1.7–6.5 bar);

(c) Single high pressure (6.5–13 bar);

(d) Dual low/medium pressure, with low pressure in the ammonia reactor and medium pressure in the absorption column; and

(e) Dual medium/high pressure, with medium pressure in the ammonia reactor and high pressure in the absorption column.

13. Plant pressure has two effects on the $N_2O$ emission factor. A high plant pressure in the ammonia burner generally leads to higher $N_2O$ formation, whereas lower pressures lead to lower $N_2O$ formation. By contrast, a higher pressure in the absorption column leads to a higher nitric acid yield and thus a relatively lower $N_2O$ emission factor per tonne of nitric acid production. For this reason, dual pressure plants with low pressure in the ammonia reactor and medium pressure in the absorption column can be expected to have the lowest $N_2O$ emissions per tonne of nitric acid produced.

14. IPCC default values are not considered for determining the BAT emission factor, as they typically reflect average plant performance and may therefore represent business-as-usual (BAU) emission factors rather than BAT emission factors.

15. Data on best-performing primary abatement technologies are scarce. One reason is that many plants only perform $N_2O$ measurements when secondary or tertiary abatement is applied, typically in response to legal requirements or incentives There is also limited data available in the literature.

16. One available data source consists of baseline measurement campaigns conducted by clean development mechanism (CDM) projects prior to installing the secondary $N_2O$ abatement systems using the CDM methodology “AM0034: Catalytic reduction of $N_2O$ inside the ammonia burner of nitric acid plants,” and measurements conducted by CDM projects in the gaseous stream prior to the tertiary $N_2O$ abatement system using the CDM methodology “AM0028: $N_2O$ destruction in the tail gas of Nitric Acid or Caprolactam production plants” up to version 4.0.[2,3]. Similar data is also available from some JI projects. Data from other carbon crediting programmes were not publicly available or not sufficiently complete to derive baseline emission factors. Table below shows the lowest baseline emission factor reported among CDM and JI plants for each plant pressure category.

**Table 1. Lowest baseline emission factor reported among CDM and JI nitric acid production plants (kg $N_2O$ / t $HNO_3$)[4]**

| Plant pressure | Lowest observed baseline emission factor | Number of plants for which data is available |
|---|---|---|
| Single low pressure | 4.84 | 8 |
| Single medium pressure | 3.99 | 43 |
| Single high pressure | 4.27 | 27 |

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[2] See https://cdm.unfccc.int/UserManagement/FileStorage/XY91IV0P6MU5L782WQ4C3AOZHGJDBE.

[3] See https://cdm.unfccc.int/UserManagement/FileStorage/IV326LBA5XCTF04RUQ7MWDKG8SPNZ1.

[4] The data is based on information provided in validated project design documents and verified first monitoring reports. Data from one project (CDM reference number 2995) with a lower performance (3.57 kg $N_2O$ / t $HNO_3$) was excluded because the project campaign was shorter than the normal campaign length of that plant. Therefore, the baseline emission factor may not be representative for the full normal length of a nitric acid production campaign.

| Plant pressure | Lowest observed baseline emission factor | Number of plants for which data is available |
|---|---|---|
| Dual low/medium pressure | 7.19 | 5 |
| Dual medium/high pressure | 4.65 | 12 |

17. The data shows that a performance in the range of 3.99 to 4.84 kg $N_2O$ / t $HNO_3$ has been achieved for all pressure levels in the ammonia burner. The Methodological Expert Panel considers that the higher value of 7.19 kg $N_2O$ / t $HNO_3$ for dual low/medium pressure plants is owed to the limited number of plants for which data is available, noting that generally dual low/medium pressure plants can be expected to have a lower emission factor than single - low-pressure plants. Overall, based on this data there is not sufficient basis to assign different BAT values for different pressure levels in the ammonia burner. For this reason, a single BAT value is used for all pressure levels in this mechanism methodology.

18. The data on CDM and JI plants dates back to the time when these projects were registered, mostly during the first commitment period of the Kyoto Protocol. However, according to industry experts, no major technological changes have occurred since that time but some improvements in primary catalytic gauzes may have reduced $N_2O$ emissions to some degree.

19. A review of information from manufacturers of primary catalysts and from the literature also provides the following limited data:

    (a) An article by Jantsch and Hesse (2024) of Heraeus Precious Metals reports process performance results for $N_2O$ reduction using FTC gauze systems.[5] Figure 3 in this article shows a low-pressure plant, running with a Heraeus FTC-Flex gauze, yielding tail-gas concentrations of around 200 ppm without secondary or tertiary abatement. The gas flow is not specified. Assuming a gas flow of 10.000 $Nm^3/h$, this corresponds to approximately 3.9 kg $N_2O$ / t $HNO_3$ (200 x 1.96 x 10.000 x $10^{-6}$). For a dual pressure plant, assuming a 2 per cent higher yield, this would correspond to approximately 3.8 kg $N_2O$ / t $HNO_3$.

    (b) A vendor brochure by Heraeus Precious Metals indicates that the FTC-Flex gauze can reduce $N_2O$ formation by up to 70 per cent and indicates (in a figure on page 8) a 30 per cent reduction compared to a "standard gauze" system. Although absolute values are not provided (assuming a "standard gauze" performance of 5 kg $N_2O$ / t $HNO_3$ for low pressure, this broadly confirms the estimate in the literature source cited in sub-paragraph 19(a) above).[6]

20. Based on these considerations, a value of 3.99 kg $N_2O$ / t $HNO_3$ is used as the BAT emission factor for type 1 and type 2 activities, i.e. the introduction or restart of $N_2O$ abatement. This value is derived from the best performance observed from CDM and JI plants. It also broadly aligns with information from the literature and manufacturers.

21. The BAT emission factors for type 3 activities, i.e. activities that enhance $N_2O$ abatement, are based on the BAT emission factor for type 1 and type 2 activities and the abatement

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[5] Jantsch, U. & Hesse, J (2024): Catalyst systems for $N_2O$ abatement. In: Nitrogen+Syngas Issue 391. Pages 22-23. September-October 2024. https://www.bcinsight.crugroup.com/wp-content/uploads/sites/7/2024/11/NS_391.pdf.

[6] Heraeus Precious Metals. Ammonia oxidation — Solutions to avoid and reduce $N_2O$ emissions — vendor brochure. https://www.heraeus-precious-metals.com/dam/jcr%3Ae7d35b52-568c-40ed-b97c-41aa20ed0483/avoid-n2o-emissions.pdf.

level expected to be achieved through secondary $N_2O$ abatement and tertiary $N_2O$ abatement using non-selective catalytic reduction (NSCR).

22. To determine this abatement level, IPCC default emission values are not suitable for this purpose, as they reflect average rather than best available performance and do not differentiate by type of $N_2O$ abatement system. In addition, the default values provided by the IPCC are significantly higher than the values reported by countries with policies for $N_2O$ abatement in their national GHG inventories.[7]

23. The following information was identified with respect to the abatement level achieved with secondary $N_2O$ abatement systems:

    (a) Performance data from CDM and JI plants: An average abatement performance was calculated based on CDM and JI data. In total, 147 production lines registered as CDM or JI projects abated $N_2O$ emissions using a secondary abatement system. The abatement performance, expressed in per cent reduction from measured baseline emissions achieved during the first monitoring period, was retrieved from these projects. Abatement performance data was available for 70 of these nitric acid production lines. Abatement performance values lower than 70 per cent were excluded in the analysis, as these do not represent well operated secondary abatement systems. This leads to a narrowed down set of 50 nitric acid production lines considered. The average abatement performance of these nitric acid production lines was calculated to be 84.1 per cent abatement compared to the baseline emissions;

    (b) A report commissioned by the International Climate Initiative indicates that secondary abatement systems abate around 80 to 90 per cent of baseline emissions from nitric acid plants; [8] and

    (c) A report from the Federal Ministry of Environment of Austria provided an abatement performance between 70 per cent and 90 per cent for secondary abatement systems;[9]

24. The following information was identified with respect to the abatement level achieved with NSCR abatement systems:

    (a) A report from the Federal Ministry of Environment of Austria provided an abatement performance of 85 per cent for NSCR abatement systems; [10] and

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[7] For example, the European Union has included $N_2O$ emissions from nitric acid production in its emissions trading system. For this reason, nitric acid production plants generally have secondary and/or tertiary $N_2O$ abatement installed. In its GHG inventory submitted to the UNFCCC, the European Union reports $N_2O$ emissions of 7.036 kt $N_2O$ and nitric acid production of 11,599.617 kt HNO3. This corresponds to an emission factor of 0.61 kg $N_2O$ / t $HNO_3$. This is significantly lower than the IPCC default values of 1.5 and 2.5 kg $N_2O$ / t $HNO_3$ indicated in the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories for plants with abatement.

[8] Scholz, D., & Nickel, F. (2022). Handbook on $N_2O$ mitigation experience in Germany/Europe. FutureCamp Climate GmbH (commissioned by GIZ, International Climate Initiative).

[9] Umweltbundesamt. (2001). State-of-the-art for the production of nitric acid (M-150). Umweltbundesamt (Federal Environment Agency Austria). https://www.umweltbundesamt.at/fileadmin/site/publikationen/M150z.pdf.

[10] Umweltbundesamt. (2001). State-of-the-art for the production of nitric acid (M-150). Umweltbundesamt (Federal Environment Agency Austria). https://www.umweltbundesamt.at/fileadmin/site/publikationen/M150z.pdf.

(b) The IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (2000) indicates a range of 80 per cent to 90 per cent abatement of $N_2O$ achieved with NSCR systems.[11]

25. Based on these considerations, an abatement level of 85 per cent is assumed for both secondary and NSCR abatement systems. This value is expected to represent the performance of well-managed systems. A value at the higher end of the possible range is not used because this abatement level is applied to an already conservative BAT value for type 1 and type 2 activities.

26. The above approach results in a BAT emission factor for type 3 activities of 0.60 kg $N_2O$ / t $HNO_3$ for type 3 activities (calculated as 3.99 kg $N_2O$ / t $HNO_3$ multiplied with (1 – 0.85)).

## 4. Determination of a conservative "business as usual" scenario and "business as usual" emissions

27. The conservative BAU scenario is assumed to be the absence of secondary or tertiary $N_2O$ abatement. This is a reasonable assumption in light of the applicability conditions of the methodology.

28. The conservative BAU emission factor is derived from two different data sources: the IPCC default values and data from CDM and JI plants. Consistent with the "Standard: Setting the baseline in mechanism methodologies" (A6.4-STAN-METH-004), the lower bound of the uncertainty interval relative to the central estimate is used to derive the conservative BAU emission factor, and the lower BAU emission factor between the two approaches is used. Table  summarizes this information for type 1 and type 2 activities.

29. IPCC values are provided for different plant pressure levels. The conservative BAU values derived based on data from CDM and JI plants are indicated for all pressure levels. However, given that a single BAT emission factor is used for all pressure levels, a single BAU value is selected. The selected value of 4.16 kg $N_2O$ / t $HNO_3$ is based on all CDM and JI plants, including all pressure levels. The value is lower than all IPCC values and thus conservative.

**Table 2. Conservative BAU emission factors derived from CDM and JI nitric acid production plants for type 1 and 2 activities (kg $N_2O$ / t $HNO_3$)[12]**

| Plant pressure | IPCC default values for plants without $N_2O$ abatement adjusted for uncertainty | Calculated values from CDM and JI plants adjusted for uncertainty at a 95 % confidence interval[13] | Selected BAU value |
|---|---|---|---|
| Single low pressure | 4.50 | 4.84 | 4.16 |
| Single medium pressure | 6.40 | 3.99 | |
| Single high pressure | 5.40 | 4.27 | |

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[11] Intergovernmental Panel on Climate Change (2000). Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories. IPCC, Geneva, Switzerland.

[12] As data does not have a normal distribution, a bootstrap analysis was conducted to determine the uncertainty at a 95 per cent confidence level.

[13] The data is sourced from the first monitoring report of 97 CDM and JI projects for which measured baseline emission factors are provided. In the case of JI projects, only baseline emission factors not influenced by regulatory requirements were used.

| | | | |
|---|---|---|---|
| Dual low/medium pressure | 5.60 | 7.19 | |
| Dual medium/high pressure | 6.30 | 4.65 | |
| All pressure levels | Not applicable | **4.16** | |

30. For type 3 activities, the conservative BAU emission factor is derived in the same way, based on IPCC default values with $N_2O$ abatement and data from CDM and JI plants. For the latter, the values for type 1 and type 2 activities are used, adjusted for an abatement level of 85 per cent. Table  summarizes this information for type 3 activities.

31. The selected value of 0.62 kg $N_2O$ / t $HNO_3$ is based on all CDM and JI plants, including all pressure levels. The value is lower than all IPCC values and thus conservative.

**Table 3. Conservative BAU emission factors derived from CDM and JI nitric acid production plants for type 3 activities (kg $N_2O$ / t $HNO_3$)**

| Plant pressure | IPCC default values for plants with $N_2O$ abatement adjusted for uncertainty | Calculated values from CDM and JI plants adjusted for uncertainty at a 95 % confidence interval | Selected BAU value |
|---|---|---|---|
| Single low pressure | 2.25 | 0.73 | 0.62 |
| Single medium pressure | 2.25 | 0.60 | |
| Single high pressure | 2.25 | 0.64 | |
| Dual low/medium pressure | 1.35 | 1.08 | |
| Dual medium/high pressure | 2.00 | 0.70 | |
| All pressure levels | Not applicable | **0.62** | |

## 5. Comparison of the downward adjusted emissions baseline with the "business as usual" emissions

32. The BAT value for type 1 and type 2 activities is lower than the selected BAU value provided in Table  and the BAT value for type 3 activities is lower than the selected BAU value in Table . Therefore, the downward adjusted baseline emissions are also consistently lower than the conservative BAU emissions.

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### Document information

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