

**Revision of the ‘Guidance document on preventing and abating ammonia emissions from agricultural sources’ (ECE/EB.AIR/120)
(Ammonia Guidance Document).**

Summary of the revision process

Note submitted by the Co-chairs of the Task Force on Reactive Nitrogen (TFRN).

The present note has been prepared by members of the
TFRN Expert Panel on Mitigation of Agricultural Nitrogen (EPMAN).

Summary: The ‘Guidance document on preventing and abating ammonia emissions from agricultural sources’ (ECE/EB.AIR/120), hereafter the ‘Ammonia Guidance Document’ was adopted in 2012 and has now been in use for 12 years. The Task Force on Reactive Nitrogen (TFRN) has revision of the guidance document as a priority task for the 2024-2026 Workplan of the Convention. This note updates on the current state of progress.

Revision process: Work started 1.5 years ago with creation of the core group of researchers and other actors potentially interested and finally involved in the revision process. Several on-line meetings have taken taking place with a hybrid one in November 2023 at Aarhus University (AU) supported by AU and the Land-CRAFT research centre. There is a group of c. 30 people from more than 12 countries coordinating the revision of the chapters. The revision process is coordinated by Alberto Sanz-Cobena (UPM, Spain), Rasmus Einarsson (SLU, Sweden) and being done through the TFRN Expert Panel on Mitigation of Agricultural Nitrogen (EPMAN), as chaired by Shabtai Bittman (Canada) and Barbara Amon (Germany).

Expected timeline: Following the latest on-line meeting on 21 May 2024, progress will be discussed in Aarhus at the 18th TFRN meeting (June 2024). It is anticipated that the main revisions are completed by the end of 2024. Discussions are taking place with a party about a possible workshop with stakeholders to finalize the guidance document early in 2025 (to be confirmed). It is anticipated to provide an informal draft to WGSR in Spring 2025 to allow reaction to the main element, as a basis for subsequent finalization. The Task Force anticipates that it would be most likely to expect adoption by the Executive Body in December 2026, unless there is a unless there is a second session of WGSR during autumn 2025.

The Task Force notes that it will be important to ensure harmony between a revised Guidance Document (GD) and possible future revision of Annex IX. For this reason, it may be advisable to see both revisions finalized at the same time.

Aspects highlighted in the revision (by chapter)

Chapter 1. Ammonia abatement through a systems approach

1. Existing info/aspects intended to be left mostly unchanged

Key sections to be revised include:

paragraphs 36 (introduction), 38 (considerations in relation to Category 1 strategies) and 39-40 (on N input output balances).

2. Existing info/aspects intended to be kept, but substantially revised

Key sections to be revised include:

Paragraph 35 (overview N management): further emphasize and elaborate on pollution swapping. Reference situation for farm types needs further revision: Keep the point about intrinsic differences between production systems but likely remove detailed list. Add discussion and references on differences in NUE/surplus etc depending on whether farm exports/imports manure, etc. e.g., Godinot et al 2014, Quemada et al. 2020, Zhang et al. 2020.

Paragraph 42 (measuring progress in N management): Point of discussion: How do we update the "best management practice" or benchmarking to be maximally relevant considering current and future policy in UNECE countries? Also elaborate on question of system boundaries/farm types (c.f. para 37).

Paragraph 43 and Table 2 (quantitative target ranges for NUE and N surplus): Replace by typical NUE and N surplus in crops and livestock separately, referring to new agri-food system overview figure. Stating general surplus or NUE for a whole farm is very difficult because of different system boundaries/scope of activities (c.f. Paragraph 37).

Paragraph 44 (indicative costs): Make new cost estimate.

Paragraph 45 (net costs incl. N savings): Add references to support quantification or remove.

Paragraph 46 (National N budgets): Update with updated info on National N budgets or remove.

3. Existing info/aspects intended to be removed

Possibly Paragraphs 41 (need to adapt NUE and N surplus to agronomic and environmental objectives), 45 (net cost of improved N management), 46 (national N budgets). Detailed list of farm types in Paragraph 37.

4. New info/aspects intended to be added

It is intended to include one or two overview diagrams that bring together all the main issues from other chapters of the GD. Explanation that reducing losses in one part of the system is an opportunity to decrease system inputs and/or increase system outputs; and otherwise, the reduced losses will, as a matter of mass balance, lead to increased losses at some other time

or place. Reference to the UNECE GD on Integrated Sustainable Nitrogen Management (ISNM). It is considered to include an example to clearly communicate this point.

It is proposed to mention to trade-offs between NH₃ mitigation and other emissions (other N forms and greenhouse gases), with ref to NH₃ GD Annex on GHGs and to UNECE GD on ISNM.

It is expected to highlight that crops have decreasing marginal efficiency of N inputs, which means that extensification of a farming system, all other things equal, leads to higher relative decrease in N surplus than product N output. This would be added with caveats related to market effects and total land use, moderate extensification of farming systems can lead to considerable decreases in N emissions.

It is expected to add an overview of main issues related to the use of N surplus and NUE as indicators, considering system boundary issues (e.g., related to import and export of feed, manure, etc.). Some changes on farm level do not fundamentally eliminate N losses, but merely move them outside the (farm) system boundary.

It is expected to include a section on perspectives on livestock density and technologies to recover N from manure in a more concentrated and transportable form. These can help mitigate NH₃ emissions, but also may contribute to maintaining suboptimal spatial structure of agriculture.

It is expected to include references to key resources in quantitative modelling of N flows in different perspectives/system boundaries (farm, agricultural production system, food system). E.g. EMEP/EEA Guidebook Manure management tool <https://www.eea.europa.eu/publications/emep-eea-guidebook-2023> and key academic references e.g., Zhang et al. 2020.

It is proposed to include a new section on pros and cons of biological N fixation as a source of new N in a farming system.

It is proposed briefly to highlight that N emissions in agri-food systems are ultimately driven by demand (mainly food products). The section would include references to research showing how major mitigation of N pollution depends on changing dietary habits, especially in high-income countries.

5. Possible changes, if any, concerning the for the categorization of measures (UNECE Categories 1, 2, 3)

The GD includes a categorization of each measure according to UNECE Category 1, 2 or 3 (where 1 is most robust/established, and 3 is least robust/established).

No category changes are proposed at present for Chapter 1.

Chapter 2: Livestock feeding strategies

1. Existing info/aspects intended to be left mostly unchanged

All general info on N losses origin. Insert information from chapter on "livestock production and developments" (initially chapter 2, not considered in this revised version)

2. Existing info/aspects intended to be kept, but substantially revised

Low protein diets (ruminants and monogastric), grazing (ruminants), phase feeding (monogastric) => look at recent literature to update figures (abatment and economic cost).

Clarifications on the way to express ammonia reduction always in the same unit (NH₃ or N-NH₃)? both are mixed in this chapter.

3. Existing info/aspects intended to be removed

Earlier chapters (2, 4 and ANNEX II) to be compiled in this new version of the earlier chapter 4, substantial text to be removed.

4. New info/aspects intended to be added

Aminoacids in the case of ruminants if substantial published information available. Forage diversification to reduce concentrate feeding, algae?

For monogastric, explore to include grazing

Feed choices, what possibilities and restrictions are there in the feedstuffs (amounts, quality, price) available.

Focus point on multiphase strategy for fattening pig (not really developed in the last version, a special paragraph - between paragraphs 56 and 57- could be added) + new paragraph on precision feeding strategies.

5. Possible changes, if any, concerning the for the categorization of measures (UNECE Categories 1, 2, 3)

to be further discussed

Chapter 3. Livestock housing

No info available yet.

Chapter 4. Manure treatment (inc. acidification, additives, separation, AD, composting, ...)

1. Existing info/aspects intended to be left mostly unchanged

This is a new chapter since "Manure treatment" is only one of some aspects briefly mentioned in chapter 9 ("other measures related to agricultural nitrogen") in the current guidebook.

Single aspects are covered in other chapters of current guidebook such as acidification (housing and application), Liquid/solid separation (application) and some additives (housing and application).

2. Existing info/aspects intended to be kept, but substantially revised

Paragraph 198: Other measures related to agricultural nitrogen only very short and briefly mentioned (Composting, Controlled denitrification, Manure separation) and generally classified in cat 2/3. Substantially more information needs to be given and categorization needs to be revised.

Paragraphs 91-174: Acidification mentioned in housing (pigs) and application chapters so far. Needs to be revised and aspects be added for housing, storage and application. Coordination with these chapters is necessary (as for almost all techniques).

3. Existing info/aspects intended to be removed

Some of the additives mentioned in the housing and application chapter so far.

4. New info/aspects intended to be added

Processing technologies like biogas-production. Means of reducing emissions from the process and from digestate use.

Treatment technologies including membrane filtration, stripping and precipitation with the production of high added value products.

Plasma technology to increase N content of slurry and decrease slurry pH.

5. Possible changes, if any, concerning the for the categorization of measures (UNECE Categories 1, 2, 3)

Discussion needed in what the categorization of the different processes focusses on. On its effect to reduce NH₃ (or even increasing it) individually or its effect in an overall manure management strategy (i.e. storage and spreading of the by-products (digestate, liquid, compost...)).

Chapter 5. Manure storage

1. Existing info/aspects intended to be left mostly unchanged

Key sections to be revised include the following paragraphs:

Paragraph 119 (general info about storage), 121 (application of stored manure; extra focus points will be added with refer to trade-off with e.g. CH₄), 122 (tight covers, to be expanded if needed), 123 (floating cover only for small earth-banked techniques), 125 (new research about natural crusts, definition of the crust, e.g. which crust height? how manure types and pumping affect crust formation and emissions), 126 (LECA, covering with clay; to be checked for updates, e.g. climatical condition affects), 127 (replacement of lagoons by tanks), 128 (floating covers other than tech. 123, to be checked for updates).

2. Existing info/aspects intended to be kept, but substantially revised

Paragraph 118 (updated the baseline NH₃ emission; if possible, baseline emission for storage types (slurry or liquid and solid manure), Definition of solid and liquid manure based on Dry Matter (DM) content for example in Kupper et al. (2020) or van der Zaag et al. (2015), most studies not conducted on concrete floor).

Paragraph 120 should be revised to include all solid manure types and information about poultry manure will be drafted in the section about categories of measures.

Paragraph 124 needs revision as storage bag is not a single measure for NH₃ reduction, NH₃ is a side-effect, therefore will be categorized under tight covers category with the same reduction potential (80%).

Paragraph 129 needs revision as covering of solid manure with plastic sheeting, by finding enough facts and explaining the conditions such as fast coverage, precisely covered, etc. this measure can be classified as Category 1, loose covers may be considered as Category 2. Therefore, definition and specifications of the covers are crucial factors to be considered.

Question about poultry manure in cages needs to be addressed as it could not be always in solid form in some countries.

3. Existing info/aspects intended to be removed

Costs (qualitative information about costs can be provided, e.g. high, medium, low,... costs)--> unified was as in another chapters is preferred.

4. New info/aspects intended to be added

A short introduction explaining the system boundary of this chapter. Including all the measures in a one-to-one way in the table of measures as in the text with numbering of measures as provided in the text. If needed and possible, photos can be added. Advancements in the use of semipermeable membranes for ammonia capture in storage.

5. Possible changes, if any, concerning the for the categorization of measures (UNECE Categories 1, 2, 3)

Category 2 technique: 129 (covering of solid manure) should be Category 1.

For Category 1 techs: 123, 124, 126 need to confirm that there is enough research to support.

Categories for additives to storage might differ by type of additive and doses, e.g. acidification with H₂S and certain doses as Category 1 and others as Category 2 or 3.

It is expected to take a comprehensive look at the literature on additives, to be discussed with chapter members and GD update members.

Chapter 6. Manure application

1. Existing info/aspects intended to be left mostly unchanged

The existing Category 1 information will probably be reduced in length/simplified. Existing information on solid manure application, will probably be reduced in length/simplified.

2. Existing info/aspects intended to be kept, but substantially revised

None

3. Existing info/aspects intended to be removed

Addition of superphosphate and phosphogypsum (currently Category 2). Addition of other additives (Currently Category 3). Cost information. Information about anaerobic digestion.

4. New info/aspects intended to be added

References will be added throughout the chapter. Better definition of 'low emission application technique'. Triple spray in combination with chalk suspension (as Category 3).

5. Possible changes, if any, concerning the for the categorization of measures (UNECE Categories 1, 2, 3)

Separation from Category 2 to Category 1 for high-DM slurry with note on how solid manure should be handled. Possible move of Atmospheric Timing Management System (ATMS) from Category 2 to Category 1, and Acidification from Category 2 to Category 1.

Chapter 7. Synthetic fertilizer application

1. Existing info/aspects intended to be left mostly unchanged

Substitution of urea and anhydrous NH₃ with Ammonium Nitrate (AN), injection of Urea Ammonium Nitrate (UAN) or anhydrous NH₃: New Emission Factors (EFs) for new fertilizer class from factors of new EMEP guidebook (inc. Calcium Ammonium Nitrate, CAN+AN), not only replacement by AN, also CAN as AN fertilization not allowed in many countries.

Exploration of new EFs for closed slot injection.

2. Existing info/aspects intended to be kept, but substantially revised

Effects of urease inhibitors in urea and UAN: New EFs for different Urease Inhibitors (UIs) (particularly for NBPT), in both urea and UAN and assess uncertainties. Interaction with nitrification inhibitors (double inhibitor), single effect of Nitrification Inhibitors (NI), technical feasibility (spreading behaviour, varying quality of sources).

Fertilizer incorporation. Differentiation between incorporation techniques, efficacies with respect to soil texture and conditions.

Impact of irrigation (inc. fertigation) and rain (new): New EFs, more differentiated.

3. Existing info/aspects intended to be removed

Slow release/polymer-coated fertilizer: Old values based on synthetic polymer (plastic) coating not further applicable (micro plastic ban) in EU 2026 onwards, much higher uncertainties for biodegradable coatings, remove measure from Category 1.

4. New info/aspects intended to be added

1. New fertilizer products: organo-mineral fertilizers, as a new form to deliver larger fractions of nutrients in mineral form.
2. Some exchange needed with Chapters 7 and 5, topic has already been addressed.
3. Aspects of environmental side effects or pollution swapping (N₂O).
4. Interesting to discuss weather/soil adapted application of fertilizers.

5. Possible changes, if any, concerning the for the categorization of measures (UNECE Categories 1, 2, 3)

We consider down rating polymer coating to a lower UNECE Category measure.

Chapter 8. Non-agricultural ammonia emissions

No information available yet.

Annex A. Methods for measurements & Quality criteria of publications

Fully new in this revision.

Annex B. Ammonia and interactions with (all) GHG (focusing on methane)

Possibly linked and included in Chapter 1. Or referred by each chapter. Strongly related with existing reports.