Informal document n° 3

Task Force on Reactive Nitrogen – Informal Document for 33rd Session of the Executive Body

Version 2-12-14

"Draft Revision of the UNECE Framework Code for Good Agricultural Practice for Reducing Ammonia Emissions".

Background, Stakeholder Comments and Replies from the Task Force

Submitted by the Co-chairs of the Task Force on Reactive Nitrogen

Submitted to the 33rd meeting of the Executive Body of the Convention on Long-range Transboundary Air Pollution.

Summary

In June 2014, the Task Force on Reactive Nitrogen submitted the "Draft Revision of the UNECE Framework Code for Good Agricultural Practice for Reducing Ammonia Emissions", (hereafter referred to as the Ammonia Framework Code) to the Working Group on Strategies and Review. The Task Force invited all comments on the FC of a technical nature to be submitted to the Task Force by 31 August 2014, and these have been incorporated into ECE /EB.AIR/2014/8.

This document provides a) background to the Ammonia Framework Code revision, and status of Complance (Section 1), b) comments from stakeholder to the draft, which are here numbered for easy reference, together with replies prepared with the support of the co-chairs of the Task Force's Expert Panel on Mitigation of Agricultural Nitrogen (EPMAN), (Sections 2-6) c) additional comments and replies provided as part of an Expert Workshop on the Ammonia Framework Code, held in Edinburgh 12-13 November 2014 (Section 7).

Contents

1. Introduction

Purpose and Nature

1. The purpose of the "Draft Revision of the UNECE Framework Code for Good Agricultural Practice for Reducing Ammonia Emissions" (ECE /EB.AIR/2014/8) (hereafter « the Ammonia Framework Code ») is to provide the Parties to the Convention on Long-range Transboundary Air Pollution with easily understandable information on the good practices that are necessary to reduce ammonia (NH_3) emissions from agricultural sources.

2. The Ammonia Framework Code is not a prescriptive set of measures that must be adopted, but rather options that represent good agricultural practice for consideration by the Parties; alternative and novel measures and technologies can be considered by countries if evidence can be provided. The document has been prepared by the Task Force on Reactive Nitrogen (TFRN) through its Expert Panel on Mitigation of Agricultural Nitrogen (EPMAN).

3. The Ammonia Framework Code provides a foundation to support Parties to establish, publish and disseminate their own advisory code of good agricultural practice to control ammonia emissions (hereafter, National Ammonia Code), which is a requirement under paragraph 3 of Annex IX to the 1999 Gothenburg Protocol on Long-range Transboundary Air Pollution to Abate Acidification, Eutrophication and Ground-level Ozone.

4. The Ammonia Framework Code was first established in 2001 (EB.AIR/WG.5/2001), two years after signature of the Gothenburg Protocol. Since that time substantial progress has been made in further developing ammonia abatement techniques and in reducing their costs. A review of ammonia mitigation costs in 2010 indicated that many options now show a net financial benefit to farmers if they are conducted effectively, where the economic value of nitrogen saved can exceed the cost of implementing the measure, as illustrated in the Ammonia Guidance Document (ECE/EB.AIR/2012/L.9). [1]

5. With these developments, the overall cost of ammonia mitigation across the UNECE according to the GAINS model is now estimated to be much less than previously estimated.[2] Ammonia mitigation options are also now increasingly seen as part of strategies to improve overall nitrogen use efficiency of the food system, thereby providing wider benefits to the Green Economy.[3]

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[1] Now published as: Bittman, S., Dedina, M., Howard C.M., Oenema, O. and Sutton, M.A. (2014) (eds.) *Options for ammonia mitigation: Guidance from the UNECE Task Force on Reactive Nitrogen.* TFRN-CLRTAP, Centre for Ecology and Hydrology, UK. [ISBN: 978-1-906698-46-1]

[2] Winiwarter W. and Klimont Z. in: Reis S., Sutton M.A., Howard C.M. (eds) (2014) *Costs of ammonia abatement and the climate co-benefits*. Springer Publishers (in preparation).

[3] See: Sutton M.A., Bleeker A., Howard C.M., Bekunda M., Grizzetti B., de Vries W., van Grinsven H.J.M., Abrol Y.P., Adhya T.K., Billen G.,. Davidson E.A, Datta A., Diaz R., Erisman J.W., Liu X.J., Oenema O., Palm C., Raghuram N., Reis S., Scholz R.W., Sims T., Westhoek H. & Zhang F.S., with contributions from 25 others (2013) *Our Nutrient World: The challenge to produce more food and energy with less pollution.* Global Overview of Nutrient Management. Centre for Ecology and Hydrology, Edinburgh on behalf of the Global Partnership on Nutrient Management and the International Nitrogen Initiative. 114 pp.

Experience and Compliance

6. Since the Gothenburg Protocol entered into force on 17 May 2005, some Parties have established their own National Ammonia Codes. However, by 2010, the experience of the TFRN "highlighted that many Parties to the Gothenburg Protocol had not produced an unambiguously named code of practice, as required under annex IX. By contrast, several Parties had elements of ammonia codes embedded within several other codes of practice" (ECE/EB.AIR/WG.5/2010/13, paragraph 33).

7. This message has been reinforced as part of an Expert Workshop held in Edinburgh in November 2014 by the TFRN with the support of the European Commission. The purpose of the workshop was to take on board stakeholder comments and on the draft revised Ammonia Framework Code and to promote wider dissemination on the need to establish Nation Ammonia Codes. Review at the workshop highlighted that out of 26 ratified parties to the Gothenburg Protocol, less than 10 have so far established their own National Ammonia Code as required by the Protocol.

8. This finding highlights the opportunity for the present revision of the Ammonia Framework Code to stimulate Parties to establish, revise and more widely disseminate their own National Ammonia Codes.

The present revision

9. The present document provides supporting information on the revision of the Ammonia Framework Code. The draft revision was opened for consultation with Parties and other stakeholders in summer 2014. Feed back has been recieved and the draft code amended. This document includes the stakeholder comments and replies from the Task Force experts. The revisions from this process are incorporated into ECE /EB.AIR/2014/8.

10. In a following stage, the document was presented and discussed at the Edinburgh workshop in November 2014. Comments received during this process have been addressed at the end of this document, together with the expert replies. Amendments to the draft Ammonia Framework Code from this stage have been incorporated into an additional Informal Document to this meeting of the Executive Body.

Structure and Revision Process

11. For convenience, the revision of the Ammonia Framework Code follows the same headings of Annex IX, paragraph 3, of the Gothenburg Protocol, which specifies that the Ammonia Code of each Party "shall take into account the specific conditions within the territory of the Party and shall include provisions on":

    A. Nitrogen management, taking account of the whole nitrogen cycle;

    B. Livestock feeding strategies;

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http://initrogen.org/index.php/publications/our-nutrient-world/

C. Low-emission manure spreading techniques;

D. Low-emission manure storage systems;

E. Low-emission animal housing systems; and

F. Possibilities for limiting ammonia emissions from the use of mineral fertilizers.

12. The present revision of the Ammonia Framework Code has been led by Mr Shabtai Bittman (Canada), Mr Martin Dedina (Czech Republic) and Ms Barbara Amon (Germany) as co-chairs of the TFRN Expert Panel on Mitigation of Agricultural Nitrogen. The section Lead Authors are Mr Harald Menzi (Switzerland) (Sections A and B), Mr J. Webb (Section C), Ms Barbara Amon (Section D), Ms Karin Groenestein (Netherlands) (Section E) and Mr Tom Misselbrook (UK) (Section F). The TFRN co-chairs thank each of the lead authors and the other contributing authors for their work. As with the Ammonia Guidance Document (ECE/EB.AIR/120 see note 1), it is planned that the finalized Ammonia Framework Code will be published in a form that recognizes the wide contribution of experts and stakeholders to the preparation of this document.

13. This document is based on the original Ammonia Framework Code (EB.AIR/WG.5/2001) updated mainly using information described in the revised Ammonia Guidance Document (see note 1), where further details and references to the primary literature can be found.

2. Copa-Cogeca comments on the draft revision of the UNECE Framework Code for Good Agricultural Practice for reducing ammonia emissions (Draft 12-06-14)

Overview

COPA-COGECA submitted a list of general comments (COPA-COGECA-2, to COPA-COGECA –15) and more detailed comments (COPA-COGECA-16, to COPA-COGECA –30). The response by the TFRN to each comment is provided in italics and an overview response to the submission from COPA-COGECA by TFRN is provided below with reference COPA-COGECA-1.

COPA-COGECA-1 : An overview response from TFRN to the COPA-COGECA submission:

- *We (TFRN) found that the comments here are very thoughtful, reasonable and appropriate and we appreciate the effort and consideration. There are specific responses below point-by-point.*

  In general, with respect to the Framework Code (FC), it should be remembered that this is a general default document. It is there for parties to make good use of, but it is not intended to replace more detailed and robust national Codes where they exist. This is in accordance with the Gothenburg Protocol (Annex IX) requirement for Parties to establish national codes. There is no question that the Code for agricultural practices is more general and varied than a code for factory practices. Still, a great deal of research has been (and is being) conducted and the results of research have converged on the statements and technologies in the FC.

- *Also, it should be remembered that the FC is a sister document to the Guidance Document (GD) on preventing and abating ammonia emissions from agricultural sourcesECE/EB.AIR/120 . The GD is exactly that, a document to show how certain abatement levels might be attained in terms of implementing practices, and is intended more for policy makers, to help in their decision making. It does not say which practices must be applied, but suggests what improvements can be expected in general from these scientifically examined methods. In some cases such as the ATMS (Application Timing Management System), it is understood that evidence would be expected to show the benefits in a particular country. It is up to the parties to determine how their goals might be attained; noting that Category 1 techniques are more well-established that Category 2, and 2 more than 3. It is for Annex IX not the FC or GD to consider mandatory actions, which aim to achieve specified ammonia reduction levels, but not specify techniques. The FC in contrast is intended primarily as a tool to support Parties' engagement with the industry, and which is meant to be shorter and less imposing than the GD. Although intended to be brief, amendments can certainly be added as noted below.*

- *The advantage of this approach to the FC is that it offers, in detail, some technical or technological solutions for fulfillment of requirements of the Gothenburg Protocol, as well as other national and international legislation, such as the National Emissions Ceilings Directive of the European Union.*

- *It should also be noted that parts of the GD are supported by other documents developed as part of the GD development process and some of these all can be found on the TFRN website.*

- *The following important sources have been referred to in this document:*

  - *Book: **Costs of ammonia abatement and the climate co-benefits** by S. Reis et al (about to be published with Springer)*

  - *Review article on abatement form land applied manure by Webb et al. (TFRN): Webb J, Pain B, Bittman S, Morgan J. (2010). The impacts of manure application methods on*

emissions of ammonia, nitrous oxide and on crop response - A review. Agriculture Ecosystems and Environment 137, 39-46.

- *Article on critical farm sizes: Annex I of: UNECE (2010) Options for revising the Gothenburg Protocol. Reactive Nitrogen. Report by the co-chairs of the Task Force on Reactive Nitrogen. Presented to the 46th session of the Working Group on Strategies and Review. (Including a description of options for Annex IX of the Protocol and two annexes on farm size thresholds) ECE/EB.AIR/WG.5/2010/4 (in English, French and Russian) 27 pp*

General Comments

COPA-COGECA-2: *Growth in the industry:* *All mitigation me*asures need to take account of potential growth in the industry. There is a difference between emission intensity, and absolute emissions. We believe that emissi^{on} intensity may be a better and fairer measure of industry performance. This will also help reflect advancements made in system efficiency through improved management and genetics which may be key drivers in reducing emissions at individual farm level.

- *We think these are excellent points. Although the COPA-COGECA comment does not define "emission intensity", it is important to clarify that such intensity can refer to different metrics, such as emission rate per unit of land or emission rate per unit of agricultural produce. Here we understand emission intensity to refer primarily to the latter of these. There have been recent manuscripts presenting data on emission intensity From an environmental perspective, it is necessary to reduce the amount of emission regardless of level of production (i.e independent of emission intensity) but from an economic standpoint the farmer must produce the most product at a given level of emission, hence decreasing emission intensity. So we consider that there is no disagreement provided that emission reduction doesn not cause yield reduction and the FC and GD are very cognizant of this. Also, it is well known that this metric strongly favours some agricultural sectors over others and we think that this type of discussion is not the purpose of the FC.*

- *However, in order to meet internationally-agreed emission reduction targets, absolute emissions need to be reduced. Reducing emission intensity can certainly contribute to reducing total emissions but such reductions are usually relatively small and are unlikely to be sufficiently effective to obviate the need for specific abatement measures. We therefore consider that emission intensity is outside the scope of this document although very much part of the activity of TFRN. We also recognize that as there are differences in productivity among farms which suggest that there should be scope in general improving efficiency (ammonia related and otherwise), but this potential, like management skills in applying a technology, cannot be directly captured with emission factors. It is certainly up to farmers, advisors etc. to ensure that for a given amount of pollution there is the greatest amount of production possible. Although outside the scope of this document, we would be happy to add comments as suggested to consider emissions relative to amount of farm product, and that good overall farm management (including ammonia abatement) will help maximize production per ammonia loss (or minimize ammonia per production).*

COPA COGECA-3: Applicability / suitability of measures: Some measures outlined in the Code would not be suitable in all situations / farms / locations. For example, using injectors for slurry spreading

doesn't work well in stony soils. So it would be helpful to clarify that the document is for guidance only, and it is not a prescriptive set of measures for full adoption.

- *We have addressed the question of constraints in many places- as many as we could document and to the extent that is known, and there are more details in the GD. For example the GD makes it clear slurry injection is not appropriate for stony soils. The GD and FC are for guidance and are not meant to be prescriptive; this is certainly the underlying thread throughout. Here we present the tools and the emission values as we can best generalize them This information should be used according to specific circumstances and where there are more particular national or regional data, provided they can be documented.*

COPA COGECA-4: New technologies or alternative measures: Presumably alternative measures / technologies can be considered by countries if emissions reduction are proven and evidence can be provided? We would not like to rule out any new techniques or advances in technologies just because they do not appear in the guidance. Similarly, we would not like to rule out alternative measures such as incorporation of more dilute slurries / dirty water within longer timescales (as the ammonia emission potential will be lower). Can some words be added to clarify that alternative measures and technologies can be considered by countries if evidence can be provided?

- *Yes, new technologies are always in development and this Code is not intended to freeze progress. In fact, during the development of this work a number of new ideas were implemented. All parties are encouraged to pursue developments and share them as much as possible. For example the recent advances in manure acidification have been accepted in both the GD and the FC , and other countries are encouraged to assess and implement.*

- *We would be happy to add text stating that* ***'alternative and novel measures and technologies can be considered by countries if evidence can be provided.'***

- *Note that it is our plan to have an online version of the Code that will be both illustrated and a living document to allow adding well documented new technologies. Future meetings of the expert panel (EPMAN) as a part of the Task Force on Reactive Nitrogen will review current and new technologies so the document remains relevant.*

- *Note that, while the fraction of ammoniacal nitrogen emitted as ammonia following land application of dilute slurries and dirty water will be less than from thicker slurries (because of better infiltration rate), this does not necessarily mean that it is justifiable to allow longer timescales between application and incorporation. This is because the temporal profile of emissions remains rather rapid, with the highest emissions occurring in the first minutes and hours after application to land. Also, rate of infiltration which may be impeded by surface crusts on soils or high water content must be considered because in these cases higher manure volumes may increase emissions.*

COPA COGECA-5: Animal welfare: Animal welfare should also be considered at various stages of the recommendations relative to the proposed measures. For example particular aspects of building design can impact on animal health and welfare and this should be considered. Within the document 'Welfare' is raised in the context of access to grazing, while the reality is that good welfare is achievable across a whole range of systems, provided they are well designed and well managed.

- *We have no argument with this statement. In the GD, welfare is mentioned 23 times for a wide range of subjects including bird cages and free stall dairy barns. Other subjects include air quality and moderation of protein in feed.*

- *We note the relationship between ammonia emissions and animal welfare applies in both directions. The implementation of farm management and building changes to meet animal welfare objectives can lead to significant increases in ammonia emissions. Establishing ammonia emission abatement practices at the same time as implementing animal welfare changes can therefore provide a cost effective opportunity to reduce emissions, while ensuring that overall emissions do not increase as a result of animal welfare requirements.*

COPA_COGECA-6: Financial benefit of measuresParagraph 3 of original introduction, which is now in the attached annex to this document, that adopting many options will show 'net financial benefit'. It would be helpful to outline the time period over which it is expected that options will show 'net financial benefit'.

- *The costs here are reflective of the work in the FC. In general the costs are over the lifetime of the investment, taking interest and depreciation into account. A more complete summary of costs is in the GD, and a detailed analysis of costs associated with the documents is about to be published as a book (Reis et al., Springer).*

COPA_COGECA-7: Overall management: General day-to-day management is also key to reducing emissions – and will have a contribution - but is not mentioned. For example, keeping litter dry and keeping pigs clean are key elements of management that should make a contribution to ammonia emission reductions.

- *We agree. Keeping litter dry is in fact mentioned; likewise reducing soiled areas such as holding pads for cattle is encouraged (39a). You will find that the guidance document refers to management in several places- the ATMS or Application Timing Management system is perhaps an example of trying to put a value on good management. There was even a full section on management which was deleted for brevity.*

COPA_COGECA-8: All suggested emissions reductions: Better information is needed to inform decision making. So, under what circumstances are the reductions stated achieved and how does this vary dependent upon circumstanced. For example emissions from lagoons will depend on dry matter and total ammonia content, exposure, etc. Similarly, in terms of emissions reductions for low emissions spreading techniques, we need to clearly understand the variances resulting from differences in dry matter, separated and whole slurry, crop canopy, soil moisture and infiltration capacity.

- *Yes, there is quite a lot of information on some of these points, less on others. We did not specifically report on effect of dry matter on emission from lagoon but the effect on crusting is mentioned. There is much more information on all technologies in the GD and the supporting literature such as the Costs book as mentioned above. We wanted to keep this document quite brief for farmers.*

COPA_COGECA-9: Scrubbers: It is not always clear whether scrubbers or biological scrubbers or bio filters are suggested. Biological and bio filters are different and have different capital and running costs.

- *The FC mentions acid scrubbers, biotrickling filters and multistage scrubbers. The intention of the FC is to list air scrubbing as an effective mitigation measure. The FC does not want to prescribe a specific procedure of air treatment. Costs differ across Europe and between technologies and should be assessed at a national level.*

COPA_COGECA-10: Slurry separation: We need to know more about the effect of separation on storage and spreading, but also the degree of separation i.e. run down screen – belt press – screen press – decanting centrifuge.

- *The following quote is one of several references to separation in the GD. It refers to mesh size. The assumption is that tools like decanting centrifuges that are more efficient in removing solids will also improve ammonia conservation. Parties are invited to provide data to support their technologies. Obviously, we are recommending caution.*

"159. Another means of decreasing slurry DM content, and hence increasing the rate of infiltration into the soil, is to remove a proportion of the solids by mechanical separation or anaerobic digestion. Using a mechanical separator with a mesh size of 1–3 mm reduces NH_3 loss from the separated liquid by a maximum of 50 per cent. Another advantage lies in reduced soiling of grass swards. Disadvantages of the technique include the capital and operating costs of the separator and ancillary equipment, the need to handle both a liquid and a solid fraction and emissions from the solids. Information to verify such systems should include demonstration of the overall NH_3 emission reduction, taking account of the emissions from both the low-DM and high-DM fractions"

COPA_COGECA-11: Check for affordability: As an overall comment, we believe that the document needs a sense check to make sure that the measures are realistic, can be implemented and are affordable.

- *We agree fully with the need for sense checking. Indeed, we feel that over the 5 years or so that we took to develop the GD on which this Code is based, the multiple experts, many with extensive practical experience, from numerous countries were constantly 'sense checking' the technologies including costs. The more detailed information on costs can be found in the GD and more detail than that in the new book. We took into consideration farm size limits, manure tank size limits, the trend to contractor manure applicators, the likelihood of lower costs, the practicality of retrofitting barns and cleaning scrubbers, etc., etc.*

COPA_COGECA-12: Effect of specific system and level of production on capacity to adopt various mitigation measures: We need to recognise the diversity of systems across the EU due to specific local conditions (e.g. weather related, geographical, even land availability), and this will affect the capacity of areas to adopt various mitigation strategies. For example, grazing more mature grass with lower protein content conflicts with improving farm efficiency, being this (improving efficiency) an overarching EU goal and intrinsically linked to productivity and viability of EU farms. Similarly you may argue that in the majority of EU systems, grazing by itself cannot respond to the nutritional needs of very high yielding herd and therefore grazing is not a viable mitigation measure.

- *The authors of the Framework Code and GD fully appreciate regional diversity and the EPMAN (expert panel) group had a wide representation that included northern, western, eastern central and southern Europe (and Canada). The example of grazing is appropriate since it is recognized that dairy operations tend to be moving away from grazing, though we are not convinced that reasonably high level of nutrition and production at low cost cannot be achieved if grazing and feed supplementation is well managed. Even if grazing would not meet the need of high producing animals (and there may be not enough land for it), grazing might be used for the replacement animals, dry cows, and perhaps low producing lactating cows. In western Canada there is grazing in winter of pregnant beef cows, even at very low temperatures (with limited supplements) saving farmers a lot of money. This is rarely done for finishing cattle. We acknowledge that grazing is not a required mitigation (or welfare) practice for every farm. The FC is intended to give guidance on potential mitigation measures, but it does not state that the*

proposed mitigation measures are suitable for all farms. We agree that it will be required to compare local conditions with the suggested mitigation measures.

COPA_COGECA-13: Measurement of emissions and the effectiveness of mitigation measures: There are still clear gaps in our knowledge on the effectiveness of some mitigation measures, and their cost-effectiveness. More work is required to accurately reflect farm practices in the models and also to construct MACC curves of the proposed measures.

- *We certainly agree about gaps in knowledge and this is one of the reasons for listing the Category 2 and 3 technologies, including those which remain unproven, impractical or require further validation. By contrast, Category 1 refers to methods that are now well established, as are their costs although there are ample ranges in costs. Costs will vary with labour, local know how accumulated experience etc. An example is that for slurry spreading the measures apply to tanks above a minimum size. There is also the recognition that cost can be reduced by farmers pooling resources and by engaging specialized contractors. This can work even for smaller operations. Overall, we are pleased with the quality of the data but do not presume it applies in every case.*

- *Our identification of priorities for abatement were to a large extent based on expert interaction with estimated Marginal Abatement Cost Curves (MACC), including two-way interaction with the GAINS model, which have been used to guide these discussions for many years. We consider that there is an equal probability that cost will be lower or higher compared with data given. For more information on MACC please consult the costs book (Reis et al.) and the GD.*

COPA_COGECA-14: Practicality of mitigation measures: Of the measures suggested, retro-fitting many of these measures will be extremely difficult in existing buildings.

- *We totally agree and we always distinguish between 'new or largely renovated' buildings vs. retrofitting existing buildings or structures*.

COPA_COGECA-15: Decision support : We also suggest that a hierarchy or some form of decision tree serving to identify the scale of improvement or investment needed (investment: either capital or skill) is developed, so that users can focus first on the key measures.

- *We agree that further work to provide such a decision tree (or other approach to prioritize decision making) would be useful for the UNECE in future subject to resources being available. For example, a list of 5 priority actions to reduce ammonia emission was previously reported by the Task Force to support discussions by the WGSR on the revision of Annex IX to the Gothenburg Protocol (ECE/EB.AIR/WG.5/2011/16).*

More detailed comments

COPA_COGECA-16: Paragraph 4 from the intorudctory text which is now in the attached annex to this document, last two sentences: It is not clear whether this is questioning countries decision to embed ammonia guidance in other Codes or whether it is suggesting that a separate, standalone ammonia code is more appropriate.

- *We would suggest that both producing a stand alone document and embedding with other codes, as appropriate, might be done for greatest ease for the industry users. Obviously this is for each Party to decide.*

COPA_COGECA-17: Page 9, paragraph 18 b) (ii): Many EU countries have a competitive advantage to produce high quality forages (particularly grass). Moving to more mature grass based systems may

reduce on-farm efficiency (going against the EU overarching goal of improving efficiency), increase even more reliance on bought-in feedstuffs and reduce farm competitiveness.

- *Again, this is not prescriptive. The objective here is to stress the need for matching farm crop production to animal needs- in terms of quality and quantity. In cases where a variety of crops may be grown a strategy may be adopted whereby forages are used relatively more for roughage and other crops are grown to provide energy, protein types etc., or there maybe the possibility of using processing of by-products (like meals) or farm roasted soybeans. This would not apply of course to fully forage based farms, especially dairy farms with high producing cows, but in many cases these employ a lot of grazing hence less risk of ammonia emissions.*

COPA_COGECA-18: Page 8, paragraph 18: Ammonia emissions from legume and alternative protein sources must also be considered.

- *Agreed, feeding must take into account legumes and alternative sources such as by-products as they would also contribute to excess excretion. In Canada cheap distillers grains used by the cattle industry sometimes contribute to excess protein intake. Legumes and alternative feeds can be added to list in first sentence.*

COPA_COGECA-19: Page 9, paragraph 19 – "A minimum period of grazing per year may be required for animal welfare reasons": Currently there is a lack of robust evidence on the welfare trade-offs involved, which will be influenced by the type of production system, design of facilities and pre-conditioning/rearing experiences of the cattle.

- *This is intended only to recognize the rules in some countries which would be in support of ammonia reduction. The comment does seek to influence management on welfare considerations, which would be beyond the remit of the group. We can add wording "A minimum period of grazing per year may be required* ***in some countries*** *for animal welfare reasons"*

COPA_COGECA-20: Page 9, Table 1, Indicative target protein levels : Firstly, we note that these are indicative and are not set.

- *Thank you - this is a key point.*

However, it seems to us that the intention is to use these levels as benchmark, which would lead to less flexibility for farmers.

- *The intention of the FC is to allow flexibility to farmers and policy makers by providing a suite of tools that can be used best under local and individual circumstance, and we feel that for some farms protein reduction may be the cheapest and most practical way to reduce emissions. However, there also needs to be a discipline in terms of the use of tools so that emissions rates and abatement levels can be correctly attributed.*

Secondly, it is not just the reduction of protein per unit of feed that is important, but the total fed which links to feed conversion ratio and growth rate. So if you reduce the feed protein per unit but you need to feed more, and perhaps take longer to complete the process, overall final emissions may not show a decrease.

- *You will find a much more detailed discussion of feeding strategies in the GD: Ch 4 and Appendix 2. The intention of the FC is to present a very distilled and uncomplicated text which is supported by the GD and by associated documents and publications.*

The key to reducing emissions from feed inputs is to have an optimised overall process:

- Correctly balanced diet for the particular application – splitting this into the appropriate number of phases and to include all components including grazed.
- Good animal health and welfare
- Good management of the animals environment
- Good stockmanship skills
- Appropriate genetics
- Etc.

- *We fully agree with these comments. We consider that this is implied in paragraphs 4 and 5 (and elsewhere in FC), and paragraph 20 in appendix 2 of the GD. We agree that adding these comments to the FC to highlight their importance may be helpful (especially that most points apply also to crops).*

In addition, the crude protein targets for lactating cows are low. Yield depressions of between 10 - 30% have been evident on cows fed low protein diets (11.5 – 14.5%) and further work needs to be undertake in this area. Although the effects of reducing the crude protein content significantly may be buffered through changes in dietary composition which allow for microbial production of potentially limiting amino acids (e.g. methionine and lysine). This area needs further clarification and the risks to production, health and welfare need to be mitigated via optimal ration formulation. (For example, in the UK a paper reference is available from: Sinclair, K.D., Garnsworthy, P.C., Mann, G.E., Sinclair, L.A. 2013. Reducing dietary protein in dairy cow diets: implications for nitrogen utilization, milk production, welfare and fertility. Animal p1-13 DOI: http://dx.doi.org/10.1017/S1751731113002139)

- *We agree with these comments and we believe the Sinclair paper provides evidence that low Protein levels are possible and that even with some loss in milk there might be some improvements in conception rates and other health indicators. Note that the FC refers to late lactation with reference to the lowest protein. But more importantly, as recognized in the comment above the table values are Indicative Targets and are not proscriptive. Again, please note that there is a much more detailed discussion of feeding in the GD main text and Appendix 2.*

COPA_COGECA-21: Page 16, Table 2, last row, column 4: Is there a mistake? Should "incorporation within 4 h" actually be "incorporation within 24 h"?

- *We apologize, the table was truncated when converted to pdf format. Thank you for pointing this out. This was in the original:*

Incorporation into soil	Slurry	Arable land including new grass leys, seedings. Only effective, if incorporation occurs right after application.	Immediate ploughing 90%; Immediate non-inversion cultivation 70%; incorporation within 4 h =45-65%; incorporation within 24 h =30%	Land that is cultivated.

Incorporation into soil	Solid manure	Arable land including grass leys. Only effective, if incorporation occurs right after application	Immediate ploughing 90% Immediate non-inversion cultivation 60%; incorporation within 4 h =45-65%; incorporation within 12 h =50%; incorporation within 24 h =30%	Land that is cultivated.

COPA_COGECA-22: Page 18, paragraph 33: In some areas of the EU slurry lagoons are significantly lower cost compared to other types of storage for farmers and at present provide a key slurry storage solution for sand-based bedding systems. Hence novel techniques to reduce emissions from lagoons should be explored and not discouraged in those areas.

- *We would support the search for novel techniques to curtail emission from slurry lagoons. But for now these appear to be challenging- so there is no escaping the higher emissions except where crusts form. Note that slurry lagoons may lead to an increase in methane emissions due to higher slurry temperatures.*
- *As for sand bedding, we are aware of several operations using this approach Based on experience in Canada, this seems to work fine with new low-cost sand recovery technologies which are commercially available.*
- *It proposed to amend the FC text with the following: 'The construction of new lagoons should be discouraged in favour of tanks or other low-emission solutions (see below), unless effective mitigation methods for reducing emissions can be implemented and validated.'.*

COPA_COGECA-23: Page 21, paragraph 39 e): Clarification is required on the effect of 39 e) on reducing ammonia emissions.

- *The text states 'Offer the animals functional areas (for lying/sitting, feeding, defecating, exercising)': this mitigation measure is only applicable for pig housing and therefore we have amended the text to reflect this.*

COPA_COGECA-24: Page 21, paragraph 46: Unclear here as to which system (tie stall or cubicle) is being viewed as the reference conditions for the emission factors.

- *Thank you for the note. The sentence 'Because of maintaining continuity in emissions inventories, tied stalls are considered the traditional reference systems' will be removed from the FC. Note that the GD gives two separate reference emission factors: one for the loose housing system and one for the tied stall.*

COPA_COGECA-25: Page 22, paragraph 48 ter b) : Grooved flooring and automatic scraper systems also need to be considered in relation to hoof health and lameness.

- *We agree that this is an interesting point for further discussion in the future.*

COPA_COGECA-26: Page 22, paragraph 48 ter c) : Water flush systems can have negative effects on udder health if incorrectly managed. This system is unlikely to be suitable for retrofitting. Acid may have a corrosive effect on floor quality and consequently impact on hoof health and infrastructure.

- *Thank you for this comment. The FC options always imply proper management. A Management of acids without corrosive effects on floors is now possible due to technical improvements. The paragraph ends with "Further assessment is necessary". This means that acidified flushing water is an upcoming technology which we did not want to exclude from the FC.*

COPA_COGECA-27: Page 22, paragraph 40c: It seems that cooling of slurry using fins doesn't seem a very popular technique. In some countries, such as Denmark, embedding the heat pump coils in the slurry pit floor is the favored option.

- *Country specific cooling options are welcome. The paragraph is intended to alert the possibility of cooling in general and leaves open several possibilities for cooling slurry.*

COPA_COGECA-28: Page 26, paragraph 56 - Ammonium sulphate and ammonium phosphate: The potential for ammonia losses from ammonium sulphate and ammonium phosphate does not only largely depend upon soil pH, but also on soil water content, temperature affecting microorganisms activity, as well on how much and when these fertilisers are applied with various product formulations. These formulations do not only provide N to the crops, but also P and S, two essential nutrients. Looking for alternatives to them has technical and economic limitations.

- *We think it is OK to add that emissions may be affected by " soil water content, temperature affecting microorganism activity as well on how much and when these fertilisers are applied with various product formulations"*
- *With respect to the other nutrients, note that sulfur can be supplied cheaply in other forms such as elemental (although the availability may be initially somewhat delayed) as well gypsum and SulPoMag. In practice, we are less concerned about ammonium phosphate than for ammonium sulphate for these reasons: unlike ammonium sulphate, ammonium phosphate formulations are primarily P sources so rate of N applications are typically low (as also mentioned in the comments of the National Farmers Union of England and Wales). Also, for annual crops it is usually best to apply below the soil surface to improve P availability, and this of course will reduce ammonia loss. Also, non-ammonium P sources are often available where surface application is needed. For surface application consider ATMS Category 2 method as in the GD.*

COPA_COGECA-29: Page 26, paragraph 56bis: Rapid incorporation of fertilisers is positive regardless the soil conditions.

- *Agreed, but especially under certain conditions.*

COPA_COGECA-30: What would be suitable alternatives to Ammonium sulphate and ammonium phosphate in soils with high pH. The lower the pH is, the lesser P is accessible to crops, thus farmers take into account the pH lowering effect of ammonium sulphate and ammonium phosphate (e.g. by liming).

- *Alternative options to ammonium sulphate and ammonium phosphate and other aspects are discussed above.*

3. Comments from the National Farmers Union (NFU) of England and Wales

General comments

NFU-1 : Growth in the industry. All mitigation measures need to take account of potential growth within in the industry. There is a difference between emission intensity, and absolute emissions, and we believe that emission intensity may be a better measure and more fair of industry performance.This will also help reflect advancements made in system efficiency through improved management and genetics which may be key drivers in reducing emissions at individual farm level.

- *Please see response to 'COPA_COGECA-2'.*

NFU-2 : Applicability / suitability of measures. Some measures outlined in the Code would not be suitable in all situations / farms / locations. For example, using injectors for slurry spreading doesn't work well in stony soils. So it would be helpful to clarify that the document is for guidance only, and it is not a prescriptive set of measures for full adoption.

- *Please see response to 'COPA_COGECA-3'*

NFU-3 : New technologies or alternative measures. Presumably alternative measures / technologies can be considered by countries if the emission reduction are proven and evidence can be provided? We would not like to rule out any new techniques or advances in technologies just because they do not appear in the guidance. Similarly, we would not like to rule out alternative measures such as incorporation of more dilute slurries / dirty water within longer timescales (as the ammonia emission potential will be lower). Can some words be added to clarify that alternative measures and technologies can be considered by countries if evidence can be provided?

- *Please see response to 'COPA_COGECA-4'.*

NFU-4 : Animal welfare. Animal welfare should also be considered at various stages of the recommendations relative to the proposed measures. For example particular aspects of building design – floor surface, ventilation, washing procedure, cow flow etc. can all impact on animal health and welfare and this should be considered. Within the document 'Welfare' is raised in the context of access to grazing, while the reality is that good welfare is achievable across a whole range of systems, provided they are well designed and well managed.

- *Please see response to 'COPA_COGECA-5'.*

NFU-5 : Financial benefit of measures. Paragraph 3 of original introduction, which is now in the attached annex to this document, that adopting many options will show 'net financial benefit'. It would be helpful to outline the time period over which it is expected that options will show 'net

financial benefit'.

- *Please see response to 'COPA_COGECA-6'*

NFU-6: Overall management. General day-to-day management is also key to reducing emissions – and will have a contribution - but is not mentioned. For example, keeping litter dry and keeping pigs clean are key elements of management that should make a contribution to ammonia emission reductions.

- *Please see response to 'COPA_COGECA-7*

NFU-7: All suggested emissions reductions. Better information is needed to inform decision making. So, under what circumstances are the reductions stated achieved and how does this vary dependent upon circumstanced. E.g. emissions from lagoons will depend on dry matter and total ammonia content, exposure, etc. Similarly, in terms of emissions reductions for low emissions spreading techniques, we need to be clear of differences resulting from differences in dry matter, separated and whole slurry, crop canopy, soil moisture and infiltration capacity.

- *Please see response to 'COPA_COGECA-8'.*

NFU-8: Scrubbers. It is not always clear whether scrubbers or biological scrubbers or bio filters are suggested. Biological and bio filters are different and have different capital and running costs.

- *Please see response to 'COPA_COGECA-9'*

NFU-9: Slurry separation. We need to know more about the effect of separation on storage and spreading, but also the degree of separation i.e. run down screen – belt press – screen press – decanting centrifuge.

- *Please see response to 'COPA_COGECA-10'*

NFU-10: Missing techniques. Sequential batch aeration is not mentioned – it is a technique used in some countries but it should be clearly stated that it is not considered to be a solution unless no other better environmental solution can be found.

- *Wording can be added that sequential batch aeration (I assume this is nitrification /denitrification) as a last resort can be added*

NFU-11: Check on affordability: As an overall comment, we believe that the document needs a sense check to make sure that the measures can be implemented and are affordable.

- *Please see response to 'COPA_COGECA-11'.*

NFU-12: Effect of specific system and level of production on capacity to adopt various mitigation measures: We need to recognise the diversity of systems across Britain (and the EU) and this will affect the capacity of areas to adopt various mitigation strategies. For example, grazing more mature grass with lower protein content conflicts with improving farm efficiency and is not a viable measure on most farms in Great Britain. Similarly you may argue that grazing will not address the nutritional requirements of very high yielding herd and therefore grazing is not a viable mitigation measure.

- *Please see response to 'COPA_COGECA-12', and in addition, the idea of using grass of lower quality is only suggested where the quality, especially protein, is in excess of need, but the entire quality profile of the feed relative to requirements needs to be considered and this is discussed in detail in the GD, including Annex 2.*

NFU-13: Measurement of emissions and the effectiveness of mitigation measures: There are still clear gaps in our knowledge on the effectiveness of some mitigation measures, and their cost-effectiveness. More work is required to accurately reflect farm practices in the models and also toconstruct MACC curves of the proposed measures.

- *Please see response to 'COPA_COGECA-13'*

NFU-14: Practicality of mitigation measures. Of the measures suggested, retro- fitting many of these measures will be extremely difficult in existing buildings.

- *Please see response to 'COPA_COGECA-14'.*

NFU-15: Decision support: We also suggest that a hierarchy is needed or some form of decision tree to identify the scale of improvement or investment (either capital or skill) needed, so that users can focus on the key measures first. We also believe that it will be important to communicate how a benefit can follow on down the chain e.g. investing in measures to address feeds and spreading will be a better investment than just spreading.

- *Please see response to 'COPA_COGECA-14'.*

More detailed comments

NFU-16 : Paragraph 4 from the intorudctory text which is now in the attached annex to this document,last two sentences: It is not clear whether this is questioning countries decision to incorporate embed ammonia guidance in other Codes or whether it is suggesting that a separate, standalone ammonia code is more appropriate. Embedding ammonia guidance in other Codes, such as Code of Good Agricultural Practice in England, is helpful from our perspective because farmers do not have to read several different and separate texts but also because many of the management activities to solve similar issues (nitrates, nitrous oxide) are the same.

- *The Gothenburg Protocol clearly indicates that a specific ammonia code is necessary. According to Annex IX, para 3: "Parties should give a title to the code with a view to avoiding confusion with other codes of guidance". Recognizing the point made by the NFU, one option would be for Parties to establish both overview codes where the linkages can be made between topics, and*

specific codes (such as the National Ammonia Code), where further details can be found, while being aware of the linkages with other topics. However, it must be stressed that the detailed way to organize the National Ammonia Code in relation to other codes is a national decision.

NFU-17 : Page 9, paragraph 18 b) (ii) : Great Britain has a competitive advantage to produce high quality forages (particularly grass). Moving to more mature grass based systems may reduce on-farm efficiency, increase reliance on bought-in feedstuffs and reduce farm competitiveness.

- *As mentioned, the concept is to balance nutrient supply to requirement, and this goal applies to all farming systems. It is recognized that for grass only systems, for example on hillsides there may be no other solution but to have forage with high protein to achieve the other nutritional targets, especially with consideration of methane emission. But where supplementation is possible, such as access to low cost high protein by-products, this may be an option.*

NFU-18 : Page 8, paragraph 18: Ammonia emissions from legume and alternative protein sources must also be considered.

- *Please see response to 'COPA_COGECA-18'*

NFU-19 : Page 9, paragraph 19 : 'A minimum period of grazing per year may be required for animal welfare reasons'. Currently there is a lack of robust evidence on the welfare trade-offs involved, which will be influenced by the type of production system, design of facilities and pre-conditioning/rearing experiences of the cattle. Harper Adams University is currently undertaking some work in this area.

- *This is not intended as a recommendation, simply a recognition that there is intersecton between policies in some countries.*

NFU-20 : Page 9, Table 1, Indicative target protein levels :
Firstly, we note that these are indicative and are not set. Secondly, it is not just the reduction of protein per unit of feed that is important, but the total fed which links to feed conversion ratio and growth rate. So if you reduce the feed protein per unit but you need to feed more, and perhaps take longer to complete the process overall final emissions may not be decreased.

They key to reducing emissions form feed inputs is to have an optimised process;

- Correctly balanced diet for the particular application –splitting this into the appropriate number of phases and to include all components including grazed.
- Good animal health and welfare
- Good management of the animals environment
- Good stockmanship skills
- Appropriate genetics
- Etc.

In addition, the crude protein targets for lactating cows are low. Yield depressions of between 10 - 30% have been evident on cows fed low protein diets (11.5 – 14.5%) and further work needs to be undertake in this area. Although the effects of reducing the crude protein content significantly may be buffered through changes in dietary composition which allow for microbial production of potentially limiting amino acids (e.g. methionine and lysine). This area needs further clarification and the risks to production, health and welfare need to be mitigated via optimal ration formulation. A

recently completed literature review entitled 'The effect of reducing dietary crude protein on nitrogen utilisation, milk production, health and fertility in dairy cows' is available on the DairyCo website. http://www.dairyco.org.uk/media/864752/411098_fs2_protein_review_branded.pdf <http://www.dairyco.org.uk/media/864752/411098_fs2_protein_review_branded.pdf>

Paper reference is also available from: Sinclair, K.D., Garnsworthy, P.C., Mann, G.E., Sinclair, L.A. 2013. Reducing dietary protein in dairy cow diets: implications for nitrogen utilization, milk production, welfare and fertility. Animal p1-13 DOI: http://dx.doi.org/10.1017/S1751731113002139

- *Please see response to 'COPA_COGECA-20'.*

NFU-21 : Page 16, Table 2, last row, column 4: Is there a mistake? Should 'incorporation within 4 h' actually be 'incorporation within 24 h'?

- *Please see response to 'COPA_COGECA-21'.*

NFU-22: Page 181, paragraph 33:

Slurry lagoons are significantly lower cost compared to other types of storage and at present provide a key slurry storage solution for sand-based bedding systems. Hence novel techniques to reduce emissions from lagoons should be explored and not discouraged.

- *Please see response to 'COPA_COGECA-22'.*

NFU-23: Page 20, paragraph 39 bis a) : It is impractical to keep all areas of animal housing dry and clean at all times

- *We agree, of course. This is a general principle and relates to good managment. Some farmers are certianly more attentive than others.*

NFU-24: Page 21, paragraph 39 bis d) and Page 21, paragraph 47*:*

- *Changes to air velocity and temperature to reduce ammonia emissions need to come into agreement with animal welfare requirements related to appropriate ventilation and temperature regulation*

- *The text reads as follows:*

"Keep air velocity and temperature of air ***over surfaces that are fouled with excreta*** *as low as possible,"*
"There is some ongoing research in the possibilities to reduce emissions from NVBs by reducing the air ***velocity over emitting surfaces****"*
This means that the barn and slurry pit shall be designed in such a way that air velocity above the emitting surfaces is as low as possible. This is not necessarily connected with lowed total ventilation rate. Currently, some research is ongoing on the design of openings, wind shield nets, etc. of NVB to improve indoor climate and at the same time reduce emissions. The research has a special focus on avoiding heat stress during hot summer periods.

NFU-24: Page 21, paragraph 39 bis e): Clarification is required on the effect of 39e) on reducing ammonia emissions

- Please see *response to 'COPA_COGECA-23'.*

NFU-25: Page 21, paragraph 46 : Unclear here as to which system (tie stall or cubicle) is being viewed as the reference conditions for the emission factors. As cubicles is the predominant system in GB, would suggest that this is used here.

- *Please see response to 'COPA_COGECA-24'.*

NFU-26: Page 22, paragraph 48 bis b): Grooved flooring and automatic scraper systems also need to be considered in relation to hoof health and lameness

- *Please see response to 'COPA_COGECA-25'.*

NFU-27: Page 22, paragraph 48 bis c): Water flush systems can have negative effects on udder health if incorrectly managed. This system is unlikely to be suitable for retrofitting. Acid may have a corrosive effect on floor quality and consequently impact on hoof health and infrastructure.

- *Please see response to 'COPA_COGECA-26'.*

NFU-28 : Page 22, paragraph 40c: Cooling of slurry using fins – this does not seem to have taken off as we understand it was problematic. The current favoured option in Denmark is embedding the heat pump coils in the slurry pit floor.

- *Please see response to 'COPA_COGECA-27'.*

NFU-29 : Page 26, paragraph 56, Ammonium sulphate and ammonium phosphate:
This currently states '56. The potential for ammonia losses from ammonium sulphate and ammonium phosphate largely depend upon soil pH.'

Suggested change:

56. The potential for ammonia losses from ammonium sulphate and ammonium phosphate largely depend upon soil pH but also on rate of use and fertiliser product formulation.

- *We agree that rate of use is an important factor affecting total ammonia emissions. We are less convinced of the importance of product formulation on ammonia emissions these specific fertilizers. This could be a topic for future discussion.*

In the UK, these chemical salts are not primarily used to provide fertiliser Nitrogen but as sources of fertiliser Phosphate and Sulphur. At average application rates, (ref BSFP) the proportion of actual N applied is typically small at 10% and only a small percentage of that (1-2%) will be lost as ammonia. Appropriate use of these products should not be discouraged as phosphate and sulphur are key to increasing overall Nitrogen use efficiencies. Technically, and economically this measure would be problematic to apply.

- *Please see response to 'COPA_COGECA-28'. Additionally, we agree that ammonium phosphate is used mainly for P and that the amount of N is low, but the same is not always true for ammonium sulphate. In many cases subsurface application may be beneficial for P availability since it can be placed close to roots in concentrated bands with less soil binding of P and more moisture for uptake. So while the rates of N may be low, cumulatively for the country this might not be a trivial source. Overall, this is a national decision. In some countries ammonium sulphate is a very important N source and this source should not be ignored.*

An estimated 75% of Nitrogen containing blended (compound) fertilisers rely on ammonium phosphate and to a lesser extent, in terms of volume, approximately 30% are formulated with ammonium sulphate. Chemically produced compound fertilisers containing Phosphate, Potassium and Sulphur will be affected depending upon their formulation. Therefore the measure would be virtually impossible to implement practically and would not be economically proportionate to the ammonia saving. Global supply P and K is already inadequate for demand.

- *The use of blended fertilizers is a specific case which was not considered a priority for detailed discussion in the FC. This then is a national decision where to place the priorities in each Party's National Ammonia Code.*

NFU-30: It would be helpful for us to receive feedback on how you will address each of the points that we have raised.

- *This document provides that feedback, on a point by point basis.*

4. Comments from Switzerland on the draft revision of the UNECE Framework Code for Good Agricultural Practice for reducing ammonia emissions (Draft 12-06-14)

CH-1: Page 1, Summary: The Framework code is supposed to be coherent with BAT according to cat. 1 & 2 of the guidance document. Thus a discussion of the level of ambition is obsolete here. Levels of ambition have been discussed during the negotiations for the revision of the gothenburg protocol. They are not a topic of the framework

- *While it is intended that the contents of the Framework Code are broadly consistent with BAT, it must be recognized that the Category Definition of the Ammonia Guidance Document (i.e. Categories 1 and 2) is not the same as BAT. In the Ammonia Guidance Document, the categories consider robustness and suitability, but explicitly do not consider cost (rather explicit cost details are given for as far as possible for each method). This avoids the need for the Guidance Document to make a prior decision of what amounts the practical limitations associated with defining "not exceeding excessive cost". Definition of what constitutes BAT therefore necessarily incorporates a policy setting of ambition level, which is not the purpose of the UNECE Ammonia Guidance Document. By contrast, in the Ammonia Framework Code, there is necessarily an element of being clear about what constitutes "good agricultural practice". As with BAT (and the associated terms, BAT+, BAT++), good agricultural practice represents a certain degree of ambition. For example, what might be considered good practice in one country (e.g. use of trailing hose for slurry spreading) might not be considered as sufficiently good practice in another country (e.g. where there are requirements for more ambitious methods).*

- *It must therefore be recognized that the question of ambition level has to be considered within the Ammonia Framework Code. This may be expressed under the question "what is good?" In the proposed revisions prepared by the Task Force, the experts have described practical measures that achieve a measurable reduction in ammonia emissions. Conversely, practices that have sometimes been said to be 'good', but do not achieve a measureable reduction in ammonia emissions are not included. In order to provide some clarification on this point, a general statement has also been included at para 10 bis. It is a matter for the Executive Body to confirm whether the proposed revisions of the Framework Code, as prepared by the Task Force, represent a suitable level of ambition towards meeting the objectives of the Gothenburg Protocol.*

CH-2: Para. 1 of the introduction, now moved to the annex to this document: This text is very similar to the the text in the Guidance Document. We suggest that the differences between the framework code and the guidance Document be made more explicit here. The purpose of the framwork code is to present BAT in an easily understandable language.

1. *We agree that a better clarification is needed and have amended the text accordingly. The first paragraph has been modified to: "The purpose of this document is to provide the Parties to the Convention on Long-range Transboundary Air Pollution with easily understandable information on the good practices that are necessary to reduce ammonia (NH_3) emissions from agricultural sources. "*

CH-3: Para.3 of introduction, now moved to the annex to this document. Edit of text: We suggest the following edit (added text is in bold). 'The Ammonia Framework Code was first established in 2001 (EB.AIR/WG.5/2001), two years after signature of the Gothenburg Protocol. Since that time substantial progress has been made in further developing ~~and reducing the costs of~~ ammonia abatement techniques **and in reducing their costs**.'

- *We agree to this change.*

CH-4: Paras 6 & 7 from the introduction, now moved to the annex to this document, typos and edits: 'Menzi' is mis-spelt and please add the official UNECE document number for the Guidance Document.

- *We will make these changes.*

CH-5: Page 6, Para. 5: The following text is somewhat cryptic and might be replaced by language from §36 of the guidance document which is easier to understand. 'Ammonia from applied manure and fertilizer is mainly emitted from the soil Surface before it enters the pool of mineral (plant-available) nitrogen in the soil. Matching N applications to crop uptake therefore has less direct impact on ammonia emissions than on nitrate leaching and denitrification losses. However, reducing the overall amount of ammonia applied will reduce losses;'

- *Suggest (adapted from GD);*

'All N sources used on the farm must be carefully planned, and the amount of N used must not exceed crop or livestock requirement. All N loss pathways must be taken into account, for example, conserving ammonia from land applied manure may increase leaching if the optimum rate of N for the crop has been exceeded.'

CH-6: Page 6, Para. 9, Nitrogen Use Efficiency: With respect to text 'Note that crop or animal yield per nitrogen input provides another important measure of nitrogen use efficiency.' This criterion is not suitable to assess total losses; besides it is not mentioned in the guidance document.

- *This was added at the request of the industry, and while not specifically in the guidance document makes good sense, as well as reflecting the developing dialogue that has emerged over the last two years. The point is that emission control measures that reduce yield will not be helpful, or conversely that achieving high production without increasing N inputs will lead to lower losses (although not necessarily ammonia). For these reasons, we consider it is appropriate to retain mention of this point.*

CH-7: Page 7, Para. 12, protein surplus: With respect to text 'Reducing N excretion by reducing the protein content of the ration, therefore, results in a disproportional decrease in ammonia losses.' This text is not very clear (incl. its link to the first two sentences of this §) and cannot to be found as such in the Guidance Document.

- *We suggest the following amendment: 'Reducing protein in feed will reduce the amount of N in the excreta and will reduce the proportion of inorganic N, and as this is the main source of ammonia, there are disproportionate savings in ammonia.' While not explicitly stated in the GD, it is implied by paragraph 49.*

CH-8: Page 8, Para. 15 & 16: This language has been taken from the old framework code and has not been revised according to the new guidance document.

- *The text from the GD is appended below. There is only one sentence (15d) that is not in the GD but seems to be an advancement and does not contradict the GD so it would seem reasonable to include it.*

Quoting from the Guidance Document:'Feeding measures in pig production include phase feeding, formulating diets based on digestible/available nutrients, using low-protein amino acid-supplemented diets, and feed additives/supplements. These are all considered category 1 techniques. Further techniques are currently being investigated (e.g., different feeds for males (boars and castrated males) and females) and might be additionally available in the future.'

CH-9: Page 8, Para. 17, N excretion in poultry: According to the guidance document the strategies for poultry are more limited than for pigs.

- *The Guidance Document does not state that the strategies are more limited, but that the gains are more limited, therefore we suggest that Para. 17 is not changed, (see par 59 in Guidance Document). It does not*

seem necessary to add here that potential improvements are less for poultry than pigs because the current poultry efficiencies are greater.

CH-10: Page 16, Table 2:
Incoroporation into soil, slurry row:

Some '=' missing.
- *These will be added (before '90%' and '70%')*

Missing value
- *We will insert '=30%' after 'within 24hr'.*

Incoroporation into soil, manure, row :
Some '=' missing.
- *These will be added (before '90%' and '60%')*

Missing text and value
- *We will insert 'within 24h = 30%' after 'incorporation'.*

CH-8: Page 17, Para. 31 (a bis.): Techniques mentioned in §31a bis are not part of the Guid. Doc. and certainly are not cat. 1 or 2 techniques -> they should be deleted.

- *We are grateful for this comment and we agree that there are problems with frequent aeration. Our intention was to flag that this should not be considered as a good management practice because of other concerns and we have clarified this by adding supporting comments.*

CH-9: Page 17, Para. 31 b iii Natural Crusts: Important addition: according to Guidance Document efficiency depends on time to form the crust, on thickness and on duration.

- *We agree that we should add this wording. "Efficiency of crusts depends on their duration and thickness."*

CH-10: Page 18, Para. 31 b iv Floating Crusts, straw (now Floating Crusts 31 b iv b): This is a category 2 technique and should mentioned after Leca balls which are a category 1 technique.

- *We agree to changing the order of the techniques as suggested.*

CH-11: Page 18, Para. 33, Covers for lagoons: Covers for lagoons are no longer recommended in the Guidance Document and therefore should be deleted.

- *We understand that there is a new technology in the UK based on using floating booms to partition the lagoon, thereby allowing the use of some covers. Therefore we consider that this text should be retained.*

CH-12: Page 18, Para. 33 bis, Storage bags: According to the Guidance Document, this is only suitable for small farms.

- *It is correct that the text at para 33 bis in the draft Framework Code no longer restricts the use of slurry storage bags to small farms. This is because this is a rapidly developing area, where slurry storage bags are indeed beginning to be used on large farms. The attractiveness reflects a system that offers significant agronomic benefits (avoiding lost N fertilizer value of slurry) without the larger costs of building solid storage structures.*

CH-13: Page 21, Para. 39 bis c, removal of excreta: The important point to be added here is the rapid separation of faeces and urine (cf. Guidance Document).

- *We agree that this can be added although there are not many barns with this capability.*

Suggest: 'Rapid separation of manure and urine in the barn and storing them separately will reduce the conversion of urea to ammonium thereby limiting emissions.'

CH-14: Page 22, Para. 48 ter, Low emission systems for cattle buildings:

'b)' 'toothed scrapers' An indication has to be added on the running frequency of the scraper since this very important for its efficiency.

- *We are grateful for this comment, and have added clarification on the need for regular scraping. We are currently awiaitng feedback from Task Force experts on the operational range for frequency of scraping.*

'c) Adding acid to the flushing water can significantly reduce ammonia emissions from buildings. Further assessment is necessary' This approach should not be mentioned here, since further assessment is necessary and thus is in contradiction with the first sentence of this § which presents approaches that can be used.

- *We agree this is somewhat contradictory, and therefore suggest to reword the lead sentence (additions in bold) '48 ter. The following approaches can be used to reduce ammonia emissions from dairy and beef cattle housing***, but may need further assessments as indicated below***:'*

'd) Although adding formalin to slurry improves the effectiveness of ammonia emission abatement, it is hazardous and therefore not recommended.' This approach is not mentioned in the Guidance Document and should not be part of §48ter.

- *We agree, this seems to be left from previous version. Suggest it is deleted.*

CH-15: Page 22, Para. 40 a: 'Partly slatted floors covering 50% of floor area generally emit **20-50%** less ammonia than fully slatted floors, particularly if the slats are less sticky for manure than concrete (e.g., metal or plastic-coated slats).' According to §86 Guidance Document, the figures in bold are 15-20%.

- *We are grateful for this comment and have amended the text to be consistent with the Guidance Document. The Task Force has received recent comments on this estimate from experts but we retain the numbers from the Guidance Document, subject to further evidence on these estimates.*

CH-16: Page 23, Para. 40 e: Avoid ventilation directly above the surface of the slurry in the channels: In 'e bis' it states 'highest potential for mitigation' – however, according to the guidance document: 'reduction efficiency 70-90%'; should be mentioned here.

- *We agree to add this information.*

CH-17: Page 24, Para. 44 bis: 'acid scrubbers or biotrickling filters.' At this point in the text, according to guidance document: 'reduction efficiency 70-90%'; should be mentioned here.

- *Agree: add the words 70-90%*

CH-18: Page 26, Para. 55 f: 'Switching from urea to ammonium nitrate fertilizer can reduce ammonia emissions.' However, according to the guidance document: 'reduction up to 90%'; should be mentioned here.

- *We suggest that for simplicity to leave out the range here. The range is too large to be practically useful. (I disagree here as it is good to be quantitative and the difference is indeed very large. I would be find with sticking with the wording from the GD as suggested) We have added the text from the Guidance Document as requested.*

CH-19: Page 26, Para. 57: Ammonium bicarbonate: The text states 'ammonium bicarbonate should therefore not be used as N fertilizer.'However according to §5 annex IX to the Gothenburg Protocol the use of ammonium carbonate shall be prohibited.

- *There is not much difference- the tone of the document is meant to be advisory rather than regulatory.*

5. Comments from Italy on the draft revision of the UNECE Framework Code for Good Agricultural Practice for reducing ammonia emissions (Draft 12-06-14)

Italy-1: Page 8, lowering of protein in pig diets: In order to avoid possible negative effects on the quality of the meat, the bring down of the CP below 10-15% is not suggested.

- *We suggest amending text (inerted text shown in bold) as follows '16. In addition to the above options, the protein level of pig diets can be lowered* ***without impacting production*** *by optimizing the the essential amino acid content rather than the crude protein content.'*

Italy-2: Page 9, Table 1:

Measurement units in the table are g/kg **OR %**?

- *Reviewer is correct, both units are used. We suggest to convert units for cattle to % as for the other animal categories (see new version of Table 1 below).*

We suggest to introduce a third Production phase "110-170 Kg". This is important to include the pig supply chains associated with the products "Made in Italy".

- *This has been added as requested (see new verison of Table 1 below).*

Species	Category	Production phase	CP content (% of DM)
Cattle	Dairy cows	early lactation	15-16
	Dairy cows	late lactation	12-14
	Replacement (heifers)		12-13
	Fattening	Calf (veal production)	17-19
		Beef <3 months	15-16
		Beef >6 months	12
Pigs	Piglets	< 10 kg	19–21
		< 25 kg	17–19
	Fattening pigs	25–50 kg	15–17
		50–110 kg	14–15
		110-170kg	11-12 (with specific amino acids such as lysine and tryptophan) 13-14 (without specific amino acids)
	Sows	Gestation	13–15
		Lactation	15–17
Poultry	Broilers	Starter	20–22
		Grower	19–21
		Finisher	18–20

Layers	18–40 weeks	15.5– 16.5
	40+ weeks	14.5– 15.5
Turkeys	< 4 weeks	24–27
	5–8 weeks	22–24
	9–12 weeks	19 –21
	13+ weeks	16-19
	16+ weeks	14 –17

Italy-3: Page 12 Rapid incorporation: This time range is considered to be difficult to apply and control. For this reason we suggest that incorporation should be completed within 24 hours of spreading.

- *Although more difficult, rapid incorporation is needed to significantly abate emissions* ***and delays reduce the value of the measure.*** *`` systems such as disking may be used instead of delayed ploughing. Contractors or shared equipment may also be used. We have addressed this point by being quantitative about the benefits according to the time delay, consistent with the Guidance Document.*

Italy-4: Page 12 Acidification of slurry: The use of sulphuric acid requires many precautions. Furthermore, there isn't a sufficient bibliography on its use in the countries of Southern Europe. We believe there are other methods with minor problems.

- *There are now sufficient data to support the safe use of this technology in northern Europe. We suggest to amend the text as follows (inserted text in bold). 'A technique which automatically doses sulphuric acid during the application of slurry is now on the market and practiced on farms in Denmark with considerable success.* ***Adding sulphuric acid to manure at any stage of the farm operation must be done safely.'***

Italy-5: Page 13, Ploughing in, timing: We suggest that incorporation should be completed within 24 hours of spreading.

- *Please see response to* ***Italy-3,*** *there are options for rapid incorporation and they are more effective than delayed incorporation. To make this explicit, we have compared the effectiveness of 4 hour and 24 hour delay before incorporation, consistent with the Guidance Document.*

Italy-6 : Page 14, Manure spreading and acifidification of slurry : Same comment as above: sulphuric acid is not a preferable technique.

- *It is not suggested that this method is necessarily preferable to other methods, but rather an option where it has been well researched and where the infrastructure exists.*

Italy-7 : Page 18, Storage bags : Unsuitable for slurry with high DM content. The use of agitators and small openings are essential. Not appropriate for big manure volumes.

- *As noted above, slurry bags are increasingly being used for larger slurry volumes. We suggest the following amendments to the text (additions in bold). '33 bis. Storage bags are suitable for reducing emissions from slurry. Interest in this approach is growing because such systems can be implemented at significantly lower cost than building an elevated slurry store with*

solid roof. There may be a risk of water pollution if not correctly maintained ***and it may not be suitable for slurry with a high dry matter concentration.'***

Italy-8 : Page 21, Livestock housing (39Bis.)
'd) Keep air velocity and temperature of air over surfaces that are fouled with excreta as low as possible, except where manure is being dried, e.g. by cooling incoming air or, in the case of natural ventilation, considering prevailing wind direction;' This can influence the air quality in the housing systems.

- *The point being made here is that the air flow over the manure is kept low while maintaining general air circulation.*

'f) Clean the exhaust air in the case of artificially ventilated buildings.' The efficiency is very high but the applicability is difficult, the costs are high and the production of residues (ammonium salt) is difficult to manage.

- *This technology is now used in pig buildings. See par. 40e.*

Italy-9 : Page 22, 48 ter. C), Addition of acid **: '**Adding acid to the flushing water can significantly reduce ammonia emissions from buildings. Further assessment is necessary.' Problems with the disposal of the washing water!

- *We consider that this can be returned to storage and applied to the field.*

Italy-10 : Page 25, Reducing ammonia emissions from urea
The correct use of urease inhibitors is difficult. This practice needs an advisory system and training courses to avoid environmental damages.

- *We agree that urease inhibitors (UI) must be used wisely and local experience is important or the UI will not be effective in reducing N loss. We also agree that urea may be leached under high rainfall, so again local knowledge is important.*

Regarding the use of 'Polymer coated urea granules', see comment above.

- *Polymer coated urea is less likely to leach as it is contained in the polymer coat, but we agree that local knowledge is needed.*

6. Comments from Poland on the draft revision of the UNECE Framework Code for Good Agricultural Practice for reducing ammonia emissions (Draft 12-06-14)

Poland-1 : Paragraph 4 from the intorudctory text which is now in the attached annex to this document,, Guidance on ammonia embedded within other national codes : If several Parties have already ammonia codes within their codes of practices why not to supplement the latter ones instead of creating brand new ones. Cost-efficiency aspect.

- *We believe that this is up to the Parties to decide, in any case the stand alone code is available should it be needed.*

Poland-2: Page 5, Para. 2 : With respect to the following phrase (in particular the words in bold) : 'In agriculture, this applies especially in livestock, **crop and mixed farming systems**.' Why this structuring only? It is worth underlining that it depends on production intensity and scale/range (area) of agricultural holding as well.

- *The purpose of this phrasing was to reflect briefly that these represent the main ammonia sources across the UNECE region, as for example contrasted with horticulture and forestry activities. It would be a rather longer discussion to make clear the many dependencies and non-linearities associated with production intensity and scale/range of agricultural holdings. For this reason, we consider that in the present position it is better to keep the text short.*

Poland-3: Page 6, Para. 4 e : Regarding the phrase 'All important nitrogen loss pathways are considered in a coherent manner.', please clarify.

- *To clarify this point we have added, "to ensure that measures do not have unintended side effects."*

Poland-4: Page 6, Para. 6, Needs for good N management: Advanced technology and tools not possible on smaller farms in PL (10 ha).

- *We have added the following sentence to clarify: 'While the detailed approaches adopted should be consistent with the size of the farm business concerned, there suitable actions available for all farm types.'*
- *It should be noted that this paragraph is meant only to be a short statement rather than a detailed analysis. As has been pointed out in a previous report of the Task Force (ECE/EB.AIR/WG.5/2010/4, Annex 1, cited in reply to COPA-COGEGA-1), most ammonia emissions across the European Union are associated with medium and large farms (e.g. 70% of cattle are on farm holdings with more than 50 livestock units, while this represents only 12% of the farm holdings with cattle. This means that at a regional scale most emissions are associated with medium and large farms where a wide set of management options are well suited. However, many of the approaches mentioned inthe Framework Code can also be adopted on the large number smaller farms that contribute a smaller fraction of regional ammonia emissions.*

Poland-5: Page 6, Para. 8, : With respect to the following text 'An N surplus is an indicator for pressure on the environment while a deficit indicates nutrient depletion; both are expressed in terms of kg of nitrogen per ha per year.'. Completion: Nitrogen balance cannot be fully sustainable, as to be expected with some inevitable losses through volatilization of this component of its gaseous compounds to atmosphere or nitrate leaching. In simple

terms it can be assumed that safe for the environment is a positive balance of not exceeding 30 kg of nitrogen per 1 ha of agricultural land.

- *We agree that N losses are inevitable and the original wording does not imply othewise. The 30kg value is outside the scope of this document since it would relate more to nitrate leaching than ammonia emissions and this is not in the GD***.**

Poland-6: Page 7, Para. 10 bis: With respect to text, 'achievement of a 30% reduction in emissions from a component source can be considered as a suitable performance benchmark for good practice.', it might be understood as a suitable performance benchmark for good practice indeed. As the same time, it should be noted that in the case of acceptance of such ammonia ceiling for the year 2030, Poland will have to modify the National Air Pollution Control Program, providing it with additional measures beyond those currently specified in the project. As is clear from the reports produced under the NEC Directive, Poland had no problems so far in meeting the reduction ceiling of ammonia emissions. In addition, it should be emphasized that without a detailed knowledge of the expected reduction targets consequences for the agricultural sector in Poland there is a very high risk that liabilities will require immediate and very expensive measures.

- *This is intended to be an overall performance benchmark so that Parties can put into perspective a value that is reflective of 'good practice' for different components related to ammonia emissions across the UNECE region. For comparison, it would be hard to justify a method as "good practice" which offered little abatement for a component source, while cost-effective methods are available that deliver substantially greater reduction that should. Farmers may also choose to put more effort in one part of the manure chain than another. The important point to remember is that all stages should be considered since a neglected leak at one stage of the chain will reduce the overall benefits of measures at other stages.*

- *It should be added that there is no direct link between the FC and the NEC directive. While the Gothenburg Protocol Annex IX requires that "a Party shall establish, publish and disseminate an advisory code of good agricultural practice to control ammonia", this code is clearly stated as being "advisory" in nature. It is therefore for each Party to establish the content and degree of ambition of its own national code, so that it is consistent with the extent of its commitments to the Gothenburg Protocol and other national and international agreements.*

Poland-7: Page 8, Para. 16, Feed additives: Actions to reduce emissions from ammonia through the use of low-protein feeding strategies will incur too much investment effort for farmers. In consequence that may impair their competitiveness in the UE single market. Poland sees the difficulty in verifying the effects of such strategies and conducting their control.

- *This measure or any measure will not suit every country. We do find that phase feeding has been voluntarily adopted by farmers in many coutries to reduce costs. The same is true in some sectors for amino acid supplementation.*

Poland-8: Page 12, Para. 23, Rapid incorporation: This is however, not possible organizationally and not practical. What is the scientific evidence for 6 hours mentioned. As far as PL is concerned, often 1 hour after spreading is too late already while speaking abut volatilization. What might be control measures of such rapid incorporation?

- *Also in response to comments from Italy, the text has been changed to be more reflective of the Guidance Document (mentioning effectiveness at both 4 hour and 24 hour delay): the point is that immediate incorporation offers the best gains, but entails more coordination or equipment sharing to achieve it. Further details are given in the Guidance Document.*

Poland-10: Page 14, Para. 28 f, Manure spreading considerations : With respect to text ,'low-emission equipment should be chosen that is most suitable to local terrain;', any examples for small, irregularly shaped fields apart from dilution/mobile spreading systems?

- *Broadcasting followed by immediate incorporation and small surface banders, (especially trailing hoses), would be suitable.*

Poland-11: Page 22, Table 3, row, 'floating foil' : Is this perhaps a typo – should it read 'Floating oil' instead ?

- *Yes, we will change foil to oil. !!NB (5-11-14) This appears not to have changed in the formatted Framework Code which is now a Formal document for the 33rd Session of the Executive Body, the Task Force will pass this information back to the secretariat.*

Poland-12: Page 23, Para. 34 : With respect to text, 'However this can lead to significant losses through NH_3 emissions, denitrification and leaching.', it could eventually lead to small hot spots creation but cannot be treated as significant losses on a country level where average farm size is ca. 10 ha.

- *The farm size is important for costs and cost effectivelness but not for impact, if indeed there are many small high density farms. Effects of nitrate leaching on local aquifers are important in many regions even if the national totals might be moderate.*

Poland-13: Page 28, Para. 40 e bis.: Cost-efficiency analysis vs. potential for mitigation should be further explored in this case.

- *We agree but this does not need to be stated in the interest of brevity- as this statement can be added almost everywhere.*

7. Comments from Germany on the draft revision of the UNECE Framework Code for Good Agricultural Practice for reducing ammonia emissions (Draft September 2014 – Formally submitted document ECE EB AIR 8).

Received November 2014

Germany-1: If really the air purification should be kept in the FC, we should have an extra chapter/section for it. This would be more consistent and would avoid replications

- *TFRN prefer that we stay with the current version. We state air cleaning as a general measure in the introductiuon to the animal housing chapter (V-A-(f)). The sections on pig an poultry give more details on the scrubbers tailored to the respective requirements. We do not see too much repetition there. A farmer / advisor will very likely read only those passages that cover the animals that they keep. So they may not come across requirements that are written elsewhere in the Code.*

Germany-2: Covering of lagoons is well or even best known for 10 years and a can hardly accept to neglect this or even announce it as an emerging technique. It is state of the art!

- *A change has been made in Par. 33.*

Germany-3: Emissions after application of digestates are higher compared to raw manure. Therefore the requirements on manure and digestate application are the same (!) and of course they should be ambitious

- *A change has been made in Para. 28m.*

Germany-4: References: In order to be consistent we shold mention in all chapters the reference. Just to mention it for cattle cubicles is not really making me happy.

- *The reason for including the reference for cattle cubicles is that the original reference has changed and this can affect inventories, so it is flagged here. No change made*

Germany-5: Umbilical systems are not emission abatement techniques! skip it or add other transport and logistic systems

- *Changes made in Para. 28h*

Germany-6: The figures on emission abatement (after one-two ....hours) are misleading , since the range for various conditions and various manures is from 5 up to 50 % of NH_3 loss within one hour ! I prefer to skip this

- *We agree that there is a range due to conditions, but without this guideline I am not sure how we can encourage faster incorpraton without insisting that it be immediate. No change made*

Germany-6: Rapid urine -feaces separation does not prevent urease activity!

- *Change made in 39 bis c.*

Germany-7: We do have now many replications in the paper, which should be deleted

- *We do not think that there are any unhelpful/un-necessary ducplications - no change made*

Germany-7: Paragraph 44 is not consistent (also aviray systems have belt systems).

- *We are not sure we understand the comment. The Framework Code discusses aviary systems with manure belts underneath them in Para. 44 (b).*