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PREPARATORY WORK FOR THE NEGOTIATION OF
A REVISED GOTHENBURG PROTOCOL

REACTIVE NITROGEN

Report by the Co-Chairs of the Task Force on Reactive Nitrogen

I. INTRODUCTION

1. This report, prepared in cooperation with the secretariat, describes the results of the third meeting of the Task Force on Reactive Nitrogen, held on 24–25 November 2009 in Amsterdam, the Netherlands, in accordance with item 1.9 of the 2009 workplan for the implementation of the Convention (ECE/EB.AIR/96/Add.2) adopted by the Executive Body at its twenty-sixth session in December 2008. It also includes detailed description of the rationale to amend annex IX of the 1999 Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone. The presentations made during the meeting and the reports presented can be accessed at: www.clrtap-tfrn.org.

A. Attendance

2. Thirty-nine experts from the following Parties to the Convention attended the meeting of the Task Force: Austria, Belgium, Canada, Denmark, France, Germany, Ireland, Italy, the Netherlands, Norway, Portugal, the Russian Federation, Spain, Sweden, Switzerland, and the United Kingdom of Great Britain and Northern Ireland.

3. Also present were representatives from the Task Force on Emission Inventories and Projections, Centre for Integrated Assessment Modelling (CIAM) at the International Institute for Applied Systems Analysis (IIASA) of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP), the European Commission's Directorate-General Environment, and the European Fertilizers Manufacturers Association (EFMA). A member of the UNECE secretariat also attended.

B. Organizational matters

4. Mr. O. Oenema (Netherlands) and Mr. M. Sutton (United Kingdom), the Co-Chairs of the Task Force on Reactive Nitrogen, chaired the meeting. It was hosted by the Netherlands' Ministry of Agriculture, Nature and Food Quality.

II. REVISION OF ANNEX IX

5. The Task Force agreed to prepare the draft revised technical annex IX as a separate document (ECE/EB.AIR/WG.5/2010/xx) and to explain the rationale underlying the different proposed abatement options in this report. The following definitions for three ambition levels were used:

(a) High ambition (A): Technically feasible options that reflect a high level of ambition in reducing ammonia (NH_3) emissions, while remaining cost effective. These options are reflective of the urgent need for action to reduce ammonia emissions, in the light of widespread effects on the environment and human health;

(b) Medium ambition (B): Technically feasible options that reflect a moderate level of ambition, as well as being cost effective. These options include decisive action with unambiguous mandatory action to ensure that significant progress is made in reducing ammonia emissions, given its effects on the environment and human health;

(c) Low ambition (C): Technically feasible options that reflect a modest level of ambition. These options emphasize 'discretionary mandatory' requirements, recognizing that socio-political constraints may limit the possibility for the Parties to agree more ambitious commitments.

6. The Task Force agreed that the high ambition options described are in several cases less than the maximum feasible reductions, either because of cost considerations or because of current limited applicability of the measures across the whole UNECE region. The Task Force noted that it is a matter for WGSR to consider whether the options in these cases are suitably ambitious.

7. The Task Force noted that the options proposed represent the basic steps of good agricultural management needed by the Parties to make significant progress towards the national emissions ceilings. It expected that the Parties would complement these basic actions with additional measures and structural changes in order to meet the national emissions ceilings.

8. The Task Force noted that ammonia has many effects on the environment, both through effects on ecosystems through eutrophication and acidification, and on human health through particulate matter production. The Task Force noted results presented at recent expert workshops showing that, per kilogram of nitrogen deposited to sensitive habitats, ammonia was more damaging than nitrogen oxides and wet deposited nitrate. The Task Force noted that this finding emphasises the need to make progress reducing ammonia emissions in addition to the progress in reducing emissions of nitrogen oxides.

9. The Task Force noted that there are many co-benefits to reducing ammonia emissions. In particular, measures to reduce ammonia emissions focus on retaining valuable fertilizer nitrogen within the farming system. This includes the nitrogen in animal feeds and in the resulting manures. Reducing ammonia emission has the potential to make better use of on-farm nitrogen sources (e.g. manure) and of imported fertilizer nitrogen, and to reduce farmer exposure to fertilizer price fluctuation. At the same time, increasing nitrogen use efficiency can have significant greenhouse gas benefits, also because nitrogen fertilizer production is energy intensive. When accounting for both CO_2 and N_2O produced during fertilizer production, estimates suggest that about 5 (2.5 to 10) kilogram CO_2 equivalent may be saved for every kilogram of decreased nitrogen consumption. Increasing nitrogen use efficiency will also decrease water pollution by nitrates from agriculture. Nevertheless, the Task Force recognized that more work was needed on this topic to form firm conclusions of the net effect of reducing nitrogen emissions, due to the existence of many trade offs regarding the fate of nitrogen in the environment (e.g., interactions with forest growth, with secondary emissions of nitrous oxide, with ozone, and with particulate matter formation).

10. The Task Force agreed to revise the Guidance Document on Control Techniques for Preventing and Abating Emissions of Ammonia **(**ECE/EB.AIR/WG.5/2007/13, hereinafter Guidance Document). It is recalled that the Guidance Document classifies different abatement techniques according to three categories:

(a) Category 1 techniques: These are well researched, considered to be practical, and there are quantitative data on their abatement efficiency, at least on the experimental scale.

(b) Category 2 techniques: These are promising, but research on them is at present inadequate, or it will always be difficult to quantify their abatement efficiency. This does not mean that they cannot be used as part of an NH_3 abatement strategy, depending on local circumstances.

(c) Category 3 techniques: These have been shown to be ineffective or are likely to be excluded on practical grounds.

11. Category 1 techniques provide the basis for meeting the options in revising annex IX. The options are phrased so as to allow that other techniques may be used by Parties where justified.

12. The Task Force agreed that farm size thresholds, below which firm mandatory measures are not required, are a useful approach to vary the options for different levels of ambition. For example, at a high level of ambition (level A), the techniques needed may be justified for large farm sizes as a result of the economies of scale. For this reason, ambition level A may include more ambitious mandatory requirements for large farms. By contrast, at a low level of ambition (level C), for some farming activities, it may be appropriate to exclude small farms from firm mandatory requirements. The Task Force also agreed that the use of farm size thresholds could increase administrative complexity. For this reason, where it is considered feasible, options are also provided without any farm size threshold.

13. The Task Force noted two possible indicators to defining farm size thresholds. In a simpler approach, thresholds could be defined based on the number of animal places (as currently used in Annex IX for large pig and poultry farms) or on the number of livestock units for cattle. A more detailed alternative indicator for farm size would be to use the amount of manure nitrogen (N) produced during periods of animal housing. This indicator is more closely linked to ammonia and other N emissions, but would need additional data. The two approaches are described in Annex A and Annex B to this document.

14. The Task Force agreed that the choice of farm size thresholds and the indicator used would need to be decided by the Working Group on Strategies and Review. Properly chosen thresholds might encourage ratifications by countries in Eastern Europe, the Caucasus and Central Asia (EECCA).

15. The Task Force noted that in the current Annex IX, there are no provisions for farms with cattle and animal types other than pigs and poultry, except for manure application to land, while cattle housing and cattle manure storage systems are significant sources of ammonia. The Task Force therefore gave attention to specify options for cattle housing and manure storage that would complement the options for manure application and overall management of the nitrogen cycle.

16. The Task Force noted that tentative cattle farm size thresholds of 50 or 100 livestock units would cover a large part of total ammonia emissions from cattle, and address a limited

number of farms where future economic investment would be most likely. About 13 per cent of cattle farms are larger that 50 livestock units, with these farms comprising 72 per cent of the cattle herd in the European Union in 2007. About 6 per cent of cattle farms are larger than 100 livestock units, with these farms comprising 50 per cent of the cattle herd. Further national data for EU-27 are summarized in Annex A. The Task Force did not have access to available data for Eastern Europe, the Caucasus and Central Asia (EECCA), but the values are expected to be similar to those specified for some of the new member states of the European Union.

17. The Task Force proposed to keep the existing farm sizes for pigs and poultry, also applied in the Integrated Pollution Prevention and Control (IPPC) Directive[1] in force within the European Union. These size thresholds cover 70 per cent of poultry, although the Task Force noted that they only cover 20 per cent of pigs in the European Union. However, as the mean farm size increases quite rapidly in practice, the percentage of livestock covered by these size thresholds will also increase rapidly.

18. The Task Force noted that the existing Annex IX includes a differentiation of target dates for some measures, with a longer delay specified for countries with economies in transition. Where a lead-in time to measures is considered by the Task Force as being justified, such as to develop economies of scale and allow gradual accommodation by the sector, the same differentiation has been retained. Any alteration of this differentiation is a matter for discussion by WGSR.

19. In the following, the section numbering refers to respective sections in Annex IX.

A. Advisory code of good agricultural practice

20. The Task Force agreed to revise the Framework Code on Good Agricultural Practice for Reducing NH_3 Emissions (hereinafter the Framework Code), which is used as guidance for the national advisory codes. The revision of the Framework Code will be based on the revised version of the Guidance Document. The proposed modification of the text allows for regular updating of the national advisory codes.

B. Nitrogen management, taking account of the whole nitrogen cycle

21. The Task Force noted that Annex IX provides no means to take account of the whole N cycle. The Task Force agreed to propose a specific provision on integrated N management as key to improve nitrogen use efficiency (NUE) to decrease the difference between the N input and output in useful products at farm level, and to prevent pollution swapping. NUE is an indicator for the overall nitrogen resource use efficiency, and was defined as the ratio between the total N

[1] Directive 2008/1/EC of the European Parliament and of the Council of 15 January 2008 concerning integrated pollution prevention and control.

output in useful products and the total nitrogen input at farm level. The N input-output balance (NIOB) relates to the difference between total N input and output in useful products at farm level. It is a pressure indicator for the total N losses to the environment. The Task Forces agreed that NUE and NIOB were two complementary indicators to be jointly used.

22. The Task Force noted that there was scope for improving NUE at farm level and that this improvement can make a contribution to reducing ammonia emissions. NUE indicates how well the imported N on the farm is used to produce crops and animal products (milk, meat and egg). Improving NUE should be done through increasing the output of N in useful products (improved management, breeding, technology), through decreasing N losses (improved management) and or through decreasing N inputs, while maintaining productivity.

23. The Task Force noted that there is a relative wealth of experience with using NUE and NIOB as indicators for the performance of nitrogen management in practice. However, there was relatively less experience with using NUE and NIOB as regulatory instruments. Also, different countries often use different methodologies, with the consequence that values of NUE and NIOB were difficult to compare between different countries. The Task Force agreed to propose to WGSR the setting up of continuous learning and improvement programs aimed at the further development and testing of NUE and NIOB at farm level in practice. The implementation of these continuous learning and improvement programs should start at representative (demonstration) farms so as to gain experience and to harmonize procedures for the estimation of NIOB at farm level. Based on the experiences gained during the first five years following its implementation, NIOBs should be established across the farming sector, at least on all farms larger than a size threshold to be agreed by the WGSR.

24. The Task Force agreed on the proposal of implementing NIOBs at farm level together with targets for increasing NUE and decreasing the values of NIOB. It was agreed that a relative increase in NUE and a relative decrease in NIOB of 30% (ambition level A), 20% (ambition level B) or 10% (ambition level C) can be achieved over a five years period in demonstration farms. This improvement should be continued for subsequent five-year periods under a continuous improvement program until a level of high efficiency and low nitrogen input – output balances have been achieved, as specified in the Guidance Document. A five years period accounts for both the required learning time and annual variations in meteorological conditions. These targets hold for all farms defined by the WGSR under the previous paragraph (paragraph 22).

25. The Task Forces noted that the ‘high efficiency levels’ for NUE are farm-type specific and therefore should be derived for various categories of livestock farms, as indicated in the Guidance Document. High efficiency levels also depend on the level of technology and genetic resources, and as these may improve over time, the set ‘high efficiency levels’ in the Guidance Document may be updated in future. These ‘high efficiency levels’ set in the Guidance Document are therefore expected to require revision and approval by the Parties every 5 to 10 years.

26. The Task Force noted that achieving the improvement targets for NUE is relatively easy for farms with a large gap between the actual NUE and the defined high efficiency level of NUE. The same holds for NIOB. When the actual NUE approaches the high efficiency level of NUE, and when the actual NIOB approaches the target NIOB, further improvements will become increasingly difficult, as follows from the law of diminishing returns.

C. Livestock feeding strategies

27. The Task Force noted that in the current Annex IX, there are no specific provisions for 'livestock feeding strategies', apart from a mention in the Framework Code for good agricultural practice. The Task Force agreed to propose a specific provision on livestock feeding strategies, as livestock feeding is one of the most cost-effective and strategic ways of reducing nitrogen excretion and reducing associated NH_3 emissions. For each percent (absolute value) decrease in protein content of the animal feed, NH_3 emissions from animal housing, manure storage and the application of animal manure to land are decreased by 5 to 15%, depending also on the pH of the urine and dung. Low-protein animal feeding also decreases N_2O emissions and NO_3 leaching losses, and increases the efficiency of nitrogen use in animal production. Some of the strategies also lead to a decrease in CH_4 emissions. The Task Force noted that, there are no animal health and animal welfare implications as long as the animal requirements for all amino acids are met, as specified in the Guidance Document.

28. The Task Force agreed that livestock feeding strategies for mitigation of NH_3 emissions are most applicable to housed livestock and less applicable for grassland-based systems with grazing livestock. It noted that the nitrogen in dung and urine from grazing livestock has a relatively low NH_3 volatilization potential, because of the rapid infiltration of urine in soil and the subsequent adsorption of ammonium to the soil.

29. The Task Force agreed options for livestock feeding strategies to be implemented for housed livestock and that these feeding strategies would result into a relative decrease of the nitrogen excretion and the ammonia emission potential of the dung and urine of 15% (ambition level A), 10% (ambition level B) or 5% (ambition level C) over a five years period. As with the discussion on NUE, this improvement should continue for subsequent five-year periods under a continuous improvement program until the target low levels of nitrogen excretion and ammonia emission potentials have been achieved as specified in the Guidance Document. The five year period accounts for both the required learning time and annual variations in meteorological conditions.

30. The Task Forces noted that the target levels of nitrogen excretion and ammonia emission potentials are livestock-type specific and therefore have to be derived for various categories of livestock, as indicated also in the Guidance Document. Low-protein / amino acid-supplemented diets are key to achieving low levels of nitrogen excretion and ammonia emission potentials, and feed additives/supplements like benzoic acid can facilitate the lowering of the ammonia emission

potential without lowering the N excretion. Setting targets for both nitrogen excretion and ammonia emission potentials minimizes the risks of pollution swapping and possible conflict with animal welfare issues.

31. The Task Forces noted that the economic costs of low-protein / amino acid-supplemented diets and feed additives/supplements depend on the world market prices for soya beans and the level of technology for producing synthetic amino acids. Implementation of targets for livestock feeding may lead to market adjustments and hence price changes. It is foreseen that the technology for producing and supplementing synthetic amino acids in livestock feed will improve when the demand for these feeds increases steadily. This, in turn, may lead to a drop in the price per unit of synthetic amino acid, due to developing economy of scale.

32. The Task Forces noted that nitrogen excretion and ammonia emission potentials also decrease when the animal production efficiency increase. Nitrogen excretion and ammonia emission potentials also depend on the genetic potential of the herd and, as these may improve over time, the target low nitrogen excretion and ammonia emission potentials specified in the Guidance Document should therefore be reviewed every 5 to 10 years.

D. Animal housing

33. The Task Force noted that ammonia emissions from animal housing may be most easily reduced for new or largely rebuilt housing systems. Requirements for new or largely rebuilt housing can be made 1 year from the date of entry into force of the Protocol. Because of the larger associated costs, none of the options listed here have requirements for existing livestock houses. The term ‘largely rebuilt’ refers to drastic renovation and modernization of existing housing systems; the result may be similar as ‘new’, though in essence the housing is not ‘new’ (but largely rebuilt).

34. The Task Force noted that the implementation of existing and new animal welfare legislation in some parts of the UNECE will, in many cases, require livestock farms to be rebuilt or substantially modified. In general, the changes to meet the new animal welfare standards tend to increase ammonia emissions (e.g., by increasing the area of dirty surfaces). Animal welfare legislation is, therefore, to some extent in conflict with the need to reduce ammonia emissions. Nevertheless, the changes for animal welfare can also be seen as an opportunity to reduce ammonia emissions. This is because introducing ammonia emission reduction measures at the same time as making the changes needed to meet animal welfare requirements substantially reduces the cost of ammonia mitigation. The Task Force noted that is important that the animal welfare requirements are matched by parallel mandatory action to reduce ammonia emissions from new or largely rebuilt farm buildings.

35. The Task Force noted that in case of new animal housing, there is no reason for considering for farm size thresholds, since the cost of the proposed low-emission techniques are not much higher (or in some cases lower) than that of the reference system, irrespective of the

farm size. Moreover, most new housing systems are (much) larger than current housing systems. The Task Forces noted that the costs of monitoring compliance is largely unrelated to the size of farm.

36. The Task Force noted that biological and chemical air scrubbing systems provide a suitable approach to achieve maximum reductions in ammonia emissions from mechanically-ventilated buildings. Such scrubbing systems also provide co-benefits in reducing particulate matter emissions and in-house air quality, and thereby lead to increased animal productivity. These systems are especially well justified to reduce emissions from large farm units when these are located near sensitive ecosystems. Because of the significant associated costs (investments and operational costs), a requirement to use these methods for all new mechanically ventilated buildings (mainly for pigs, broilers and laying hens) would represent a high level of ambition. At present, the Task Force has not reached agreement on their possible inclusion in the options for a revised Annex IX, though the Task Force expects to continue this discussion during 2010. There is a need for Parties to share best practice experiences with such systems, since developing economies of scale may be expected to reduce costs in the future.

1. Housing systems for Cattle

37. The Task Force noted that there is a recognized need to include measures on cattle housing because of their large share on the total budget of ammonia emissions. Nevertheless, at present there is only one Category 1 technique described in the Guidance Document and the experience with this technique is currently restricted to a limited number of countries. Some new techniques are in development in the Netherlands, so it is expected that in the next years more information will be available. For this reason a new paragraph on cattle housing is inserted, but with a phrasing to make the percentage of reduction “flexible mandatory” (i.e., where technically possible and economically feasible). It is intended that exercise yards and hard standings for cattle are included in the housing systems.

38. The Task Force noted that in the current Guidance Document, there are two reference systems for cattle housing: cubicle housing (reference 1) and tied housing system (reference 2). The reason for this is that the tied housing systems, which are still fairly common in many countries, emit less ammonia than cubicle housing systems where the animals are free to move. Since the tied housing systems are already prohibited in some countries for animal welfare reasons, the Task Force agreed that in revising the Guidance Document the reference for new buildings should be the cubicle house. As the new housing reference system (reference 1) has higher emissions than the reference system for existing housing (reference 2), this has the consequence that mandatory percentage reductions in relation to the reference will be easier to achieve.

2. Housing systems for Pigs

39. The Task Force agreed that there are a number of options, with varying reduction efficiencies, considered as Category 1 techniques for pig houses in the Guidance Document. Hence, there is scope in differentiating three levels of ambition. The lower level (ambition level C) is the minimum reduction level that in the Guidance Document is still considered by the Best Available Techniques Reference documentation (BREF) of the European Union as BAT. The 50% reduction can be achievable in new houses with partly slatted floors and reduced manure pit. However, use of the partly slatted floor in regions with hot summers can cause the pigs to lay on the slatted part of the floor to get the refreshment of ventilation, so impeding the access of the other pigs to the manuring area. In this way, the ammonia emissions increase to a higher level than with a fully slatted floor. The Task Force agreed that a relaxation of the requirement is specified for locations where the long-term average temperature of the warmest month exceeds 20 °C. A temperature map is shown below.

40. The Task Force noted that in practice there are different housing systems for (i) mating and gestating sows, (ii) farrowing/lactating sows with piglets, (iii) weaners, and (iv) growers/finishers. This differentiation relates also the possibilities for emission reduction. The potential for emission reduction in housing systems with mating and gestating sows is more or less similar to that for weaners and growers/finishers. Housing systems for farrowing/lactating sows have less potential for emission reduction, especially in regions with warm summer months. The Task Force agreed to make a differentiation between housing systems for farrowing/lactating sows and those for all other pigs. The Task Force noted that the contribution of housing systems with farrowing/lactating sows with piglets to the total ammonia emissions from all pig houses is relatively small. The Task Force also noted that housing systems for mating and gestating sows, farrowing/lactating sows and weaners are commonly found on one and the same farm. For this reason, the Task Force expects to consider proposals during 2010 which could allow the housing options for different pig categories to be combined.

Figure: Mean temperatures of the warmest month (long term climatological average), distinguishing above and below 20 °C.

3. Housing systems for Broilers

41. The Task Force noted that the Reference System in the Guidance Document for broiler housing systems is the fully littered floor, mechanically ventilated. The only two Category 1 techniques listed are houses with fully littered floor and non-leaking drinking water systems with 1) natural ventilation, and 2) mechanical ventilation+well-insulation. It is proposed that a measure should be listed with a minimum reduction level (20%).

42. The Task Force noted that broiler production is the most rapidly growing animal production system in the world and that mechanically-ventilated buildings with biological or chemical air scrubbing systems are highly effective in reducing ammonia emissions. However, the Task Force was not able at this stage to agree on more than one ambition level, i.e. a low level of ambition. Currently, air scrubbing techniques for broiler systems (and for laying hens) with forced ventilation are listed as Category 2 techniques, mainly due to cost considerations and a relative lack of experience in some parts of the UNECE (which is in part due to lack of regulations).

4. Housing systems for Layer hens

43. The Task Force noted that the conventional cage systems will be prohibited within the European Union by January 2012 at the latest according to the Animal Welfare Directive for laying hens of the European Union. Therefore, it is appropriate to consider only alternative systems (enriched cages or non-cage systems) for this part of the UNECE. So far, there is little experience on emissions from enriched cages on “non-aerated open manure storage under cages” which is the reference system for the conventional cage. Furthermore there is a limited number of studies on the other systems listed in the Ammonia Guidance Document, if applied to enriched cages (while they are quite experienced in the case of conventional cages). The Task Force noted that the reduction level achievable in the case of the techniques for conventional cages could be transferred to enriched cages. Experimental data on new housing exists for the Netherlands, and new data will be available from Spain in 2010.

44. The Task Force agreed to set aerated open manure storage under the cages as the new reference system, when considering the animal welfare legislation for the new housing systems for laying hens with enriched cages. The Task Force noted that the Guidance Document has to be updated both for the reference system and for different abatement options. For non-caged hens and for aviaries the old reference values are still valid.

5. Housing systems for other livestock categories

45. The Task Force noted that housing systems for other housed animal categories than poultry, pigs and cattle can be significant sources of ammonia emissions regionally. These other animal categories may include turkeys, geese, ducks and fur animals. The Task Force agreed to include an additional heading for 'other livestock categories' in the options for revising Annex IX. The Task Force noted that the reduction of ammonia emissions from large housing systems with these other livestock categories, using mechanically-ventilated systems should have priority. Livestock housed in naturally-ventilated systems would not be included in this provision.

E. Manure storage

46. The Task Force agreed that, in principle, all livestock farms are included in provisions dealing with reducing ammonia emissions from manure storage systems, i.e. including also cattle farms and other livestock categories, irrespective of farm size. The Task Force noted that a differentiation is needed for existing and new storage systems. Storage facilities have normally a working life of ca. 20 years and modifying the storage facilities structurally is usually not easy. The Task Force agreed on one ambition level for existing manure stores. The Task Force noted that differentiation in ambition levels for existing manure stores may be achieved through differentiating the timescale for implementation and through differentiating farm size (size thresholds discussed in Annex A and Annex B).

47. The Task Force noted that achieving a minimum of 40% emission reduction on existing stores is feasible via the formation of a natural crust (in the case of cattle slurry) or the addition of chopped straw in the case of pig slurry, in cost-effective ways. Alternatively, a simple, floating plastic sheet, or surface layer of bark, peat, or 'Leca' achieves a similar abatement. The Task Force noted that these techniques are cost-effective as they save nitrogen from emissions to air and thereby decrease the need for purchasing additional fertilizer nitrogen. Depending on the ambition level, an exemption would be needed for large open lagoons where strong winds may blow the above mentioned covers to one side of the lagoon. The alternatives here are an eventual phasing out of such lagoons (options A and B) or exemption, applied here for farm holdings based on economic considerations (option C).

48. The Task Force proposed options for new stores minimum ammonia emissions reduction targets of more than 80% (option A), 60% (option B) and 40% (option C). The Task Force recommended that new large open lagoons, where the low-cost covers of option C are less feasible, should be prohibited. The essence of each of the options, A, B and C is that uncovered open storage (the reference system) would no longer be acceptable for new manure stores after the date specified. The Task Force noted that a high ambition level is more easily achieved on large farms.

F. Slurry spreading measures / Land application of manure

49. The Task Force noted that most of the options to reduce ammonia emissions from livestock farming focus on retaining ammoniacal nitrogen in solid manures and slurries. Each of the stages of manure management need to be considered, in order that reductions in ammonia emissions during animal housing and manure storage do not translate into larger emissions when the manure is applied to land. For this reason the Task Force noted that the reduction of ammonia emissions following the land application of slurries and solid manure is an essential foundation of any ammonia emission control policy. Such measures are also often cheaper than many other technical ammonia reduction measures.

50. The Task Force noted that, although low emission slurry spreading methods have been mandatory in a few European countries since the 1990s (i.e., Netherlands, Denmark), it has only been over the last decade that these techniques have become much more widely available. The need for precautions when spreading sewage wastes to land, together with the increased use of farm contractors, have led to widespread use of these methods. At the same time, farmers have increasingly realised the benefits of low emission application methods in reducing the nuisance of odour, in reducing water pollution, in improving agronomic flexibility, and in maximizing the nitrogen fertilizer value of manures. The last point has been increasingly recognized as mineral fertilizer prices (linked to oil prices) have fluctuated, especially as low emission techniques can both reduce emissions and reduce the variation in nitrogen losses, allowing the nitrogen savings to be credited more reliably.

51. The Task Force noted that a possible trade off with nitrous oxide emissions is now considered to be less important than previously thought. Although reducing ammonia tends to retain more nitrogen in the field and therefore increase nitrous oxide emissions, this must be set against a parallel reduction in indirect nitrous oxide emissions from atmospheric ammonia deposition to other ecosystems. The Task Force noted that the associated reduction in odour emissions provided by many low-emission spreading approaches also implies a reduction in emissions of volatile organic compounds (VOCs). The quantitative proportionality between reduction of ammonia and VOC emissions offered by these low-emission spreading techniques remains an issue for further investigation.

52. The Task Force noted that available data suggest that the costs of using low-emission slurry spreading methods, such as trailing hose, trailing shoe and open slot injection have decreased with time. Depending on which national data are used, these methods have the potential to be cost neutral, or to save the farmer money, by reducing the requirement for additional mineral fertilizers. Information on the actual costs charged by contractors (from the UK) provided the smallest costs, highlighting that the main cost was in travelling time (and labour time), which did not differ significantly between the reference method and the low emission techniques. The Task Force noted that these methods are expected to become cheaper in the future, based on developing economies of scale.

53. The Task Force proposed various timescales for implementation of the options (8-10 years lead-in time), to reduce overall costs by allowing gradual accommodation within the sector. The Task Force concluded that the option of whether to alter the allowance of an extended lead-in time for countries with economies in transition is a matter for discussion by WGSR.

54. The Task Force noted that the intention of the proposed Annex IX is that unabated, broadcast application slurries and solid manures (the reference method) is avoided. The phrasing of the options allows for flexibility between the use of : a) low-emission spreading methods, such as band spreading and manure injection, and b) improved timing of manure application to reduce emissions, according to the principles of 'Application Timing Management Systems' (ATMS) described in proposed revisions to the Guidance Document.

55. The Task Force noted that an advantage of the ATMS approach is that it can reduce the requirement for Parties to invest in new technologies. ATMS methods hold a good potential, building on the use of already-existing modelling approaches. By contrast, it is essential to verify that farm holdings implementing any such ATMS methods achieve the target emission reduction levels set under Annex IX. For this reason, the Task Force agreed that the ATMS approach remains a Category 2 method. The need for verification is incorporated into a new overall requirement for verification of the measures used by Parties to implement Annex IX (see Reporting and Verification requirements). A disadvantage of the ATMS approach compared with technical measures is that it does not typically provide the co-benefit of reducing odour.

56. The Task Force noted that the debate on the relative merits of the ATMS approach has focused on its potential to reduce emissions with low costs, versus the challenge for Parties to implement suitable verification procedures as outlined in the Guidance Document.

57. The Task Force recognized that there is current debate on the quantitative effectiveness of slurry dilution for irrigation as a means of reducing ammonia emissions. Slurry dilution is currently listed in the existing Guidance Document as a Category 2 method. During 2010, the Task Force will consider a proposal that the dilution of slurry for irrigation (e.g., managed dilution from at least 5% dry matter content to less than 2% dry matter content) be considered as a Category 1 method.

58. The Task Force noted that in the proposed revision, the options for solid manure parallel those specified for slurry, allowing the text requirements for solid manure to be incorporated into a revised version of annex IX, paragraph 16. It should be noted that the text description of paragraph 16 is the same for each of the ambition levels, A, B, and C. The different ambition levels are reflected in Table 2 which follows the main text.

59. The Task Force noted that option A for slurry and manure application requires the most detailed version of Table 2. This is because the overall high level of ambition needs to be

matched by a correspondingly longer list of exemptions to the default requirement. It is noted that, while 60% may be considered less than the maximum feasible reduction, this is identified as suitable for option A because it is an abatement percentage that is widely achievable for different soils. The relaxation from the 60% reduction requirement for smaller farms is included in ambition level A because it increases the flexibility of measures to encourage eventual possible ratification.

60. The Task Force noted that option B only requires a simple version of Table 2 because it applies to all farms, avoiding the need to specify a farm size threshold. A wide range of low-emission techniques and approaches are available to achieve the 30% reduction target. The only relaxation needed is for the application of solid manure to grassland or arable crops after sowing where it is not possible to incorporate the manure. No technical exemption is required for steep slopes, where low emission approaches can be used. In order to prevent the pollution of water courses, the application of manures to steeply sloping ground should anyway be avoided where possible. Similarly, no technical exemption is needed for stony soils with this option.

61. The Task Force noted that option C includes a threshold in Table 2 below which the default mandatory requirement would not apply (i.e., Parties to implement the measures as far as they consider it feasible). The farm size exemption is phrased as applying to holdings which are mainly livestock farms. Using this phrasing, it is intended that large arable farms receiving animal manures from other farms would not be included in the exemption. The exemption for small livestock farms is justified because economies of scale would imply additional costs unless contractors are used. The rationale for other possible exemptions is the same as for option B.

62. The Task Force noted that under Options A and C, the relaxations and exemptions for smaller farms apply to farms less than 50 or 100 livestock units for cattle, 40000 places for poultry, 2000 places for fattener pigs and 750 places for sows. The choice of these thresholds is affected by economic and structural considerations, including the needs of EECCA countries, and is a matter for WGSR to consider.

G. Mineral fertilizers

63. The Task Force noted that mandatory requirements for the application of mineral fertilizers are technically appropriate and feasible.

64. The Task Force proposed to include abatement measures when using ammonium phosphate and ammonium sulphate on calcareous soils. This proposal is included here, but it is noted that this topic requires further evaluation to be fully documented as a basis for possible inclusion in options to revise the Gothenburg Protocol. Fertilizer trials regarding ammonium sulphate have recently been commissioned within the industry in response to this discussion, the results of which will be available in 2011.

65. The Task Force noted that an indication of the relative contribution of urea, ammonium phosphate (mono-ammonium phosphate plus di-ammonium phosphate, MAP+DAP) and ammonium sulphate (AS) in Europe is provided by the following figures which refer to sales within the EU-27 for agricultural use (averaged for 2006/07, 2007/08, 2008/09 as volume of pure nitrogen): 1990 thousand tonnes (kt) straight urea (19% of total nitrogen use in EU-27); 1200 kt for urea as part of urea ammonium nitrate solution (11% of total nitrogen use); 270 kt for MAP+DAP (3% of total nitrogen use), 310 kt for AS (3% of total nitrogen use). Total nitrogen sales in EU-27 were 10500 kt. The sum of AS+MAP+DAP is therefore equivalent to approximately 20% of the total urea sales.

66. The Task Force noted that it remains a matter of discussion whether, at ambition level C, the paragraph on ammonium phosphate and ammonium sulphate application to calcareous soils would be included. Calcareous soils are here defined as those with (>0.5%) free calcium carbonate.

67. The Task Force discussed the need for an exemption to the requirement for urea under ambition level C, for grassland that is not irrigated. If that were accepted, the requirement for this situation would be to take such steps to achieve the specified reduction as far as the Party considers it reasonable.

68. The Task Force noted that a delayed implementation date for each fertilizer type may reduce costs of implementation of these options. For example, it was suggested that the high ambition option (option A) should be linked to an implementation date of 2019 rather than upon immediate ratification. A delayed implementation date could also be considered by WGSR for options B, particularly if the requirement to include emission reductions for ammonium phosphate and ammonium sulphate is included.

69. The Task Force noted that the exact phrasing of the options for mineral fertilizers remains a matter of discussion. In principle, the intention of the proposed wording is that unabated, free broadcast of urea (the reference method) is avoided. The debate between alternative phrasing approaches may depend on the extent to which ATMS approaches are considered applicable to reduce ammonia emissions following urea application.

70. The Task Force noted that the phrasing of the options for mineral fertilizers requires an updating of the section in the Guidance Document, where further measures to reduce ammonia emissions following urea application may also be included.

71. The Task Force noted that the existing Protocol text includes a complete prohibition of ammonium carbonate use as a fertilizer. In principle, a prohibition of urea use could also be considered as there are alternative nitrate-N fertilizers with minimal NH_3 losses. It was noted that a ban on urea fertilizers was discussed when originally negotiating the Gothenburg Protocol prior to 1999. The Task Force does not propose a prohibition of urea fertilizer because of both technical and market reasons. Firstly, major reductions in ammonia emissions from urea can be

achieved by technical measures. Secondly, market mechanisms result in urea acting as a buffer in the European market price and volume of other nitrogen fertilizers. Thirdly, urea has a very large share in the global market of N fertilizer (around 56%; in Europe around ~30%). Recognizing that a prohibition of urea use could provide an artificial barrier to international trade, it is concluded that the focus in mitigating ammonia emissions from urea use should be on technical measures.

72. The Task Force agreed on technical grounds that all three ambition levels would apply to all farm sizes, since this would ease implementation, and because other available fertilizers can be used as an alternative to urea.

H. Reporting and verification requirements

73. The Task Force agreed to propose reporting requirements for Annex IX to be carried out during the bi-annual questionnaires, focusing on specification of the emission abatement methods used and description of the methods used to implement the emission reductions. This reporting is especially important given the known challenges in reducing ammonia emissions and the need to share best practice information.

74. The Task Force noted that in the case of Category 1 methods, verification is considered as being already established by the Guidance Document. For other methods, parties should explain the procedures used to verify the abatement efficiencies, following the principles recommended in the Guidance Document, where these are specified. The Task Force considered that this verification requirement is particularly important where ATMS methods are used by Parties to meet their mandatory commitments. More generally, this requirement was added to make it clear that allowance is provided for Parties to use other Category 2 or Category 3 methods, or methods not described in the Guidance Document, so long as the effectiveness of these other methods is verified.

III. RESULTS FROM OTHER ACTIVITIES

A. Total abatement costs and uncertainties

75. A representative of CIAM (Mr Z. Klimont) presented the calculation of control options and costs for ammonia in the GAINS model. The options were currently categorized in line with the structure of Annex IX. The **Task Force took note** of the need to clearly identify current penetration of controls and the theoretical applicability further controls. **It also agreed** to circulate the table listing the possibilities to reduce ammonia emissions, the priority in deriving technical details on the options, their impacts on emission reduction potential and related costs, and whether the cost calculation was already included in the GAINS model or elsewhere.

76. The **Task Force decided** to initiate a review on the costs of all proposed reduction measures to provide quantitative data for input to the GAINS model. **It set up** a drafting group and invited the coordinator to report in its next meeting in May 2010.

B. Guidance document

77. The **Task Force decided** to revise the guidance document with the new material before its next meeting in May 2010 with the aim to approve them. **It agreed** to provide the draft revised guidelines as an informal document to support the proposals for annex IX submitted to the forty-sixth session of the Working Group on Strategies and Review in April 2010.

C. Nitrogen budgets

78. The **Task Force took note of** the progress in developing nitrogen budgets, inter alia the interactive spreadsheet template made available for all interested Parties to help devising national sinks, sources and flows. **It invited** the relevant experts to develop a new guidance document for the calculation of regional nitrogen budgets and to present the progress in its next meeting in May 2010, for eventual reporting to WGSR.

D. Nitrogen and human diet

79. The **Task Force welcomed** the progress in work on nitrogen and human food. It invited the relevant experts to report in detail in its next meeting in May 2010.

80. The **Task Force took note** of a round table initiative of European Food, Sustainable Consumption and Production. It aims on establishing scientifically reliable and uniform environmental life cycle assessment methodologies for food and drinks, including nitrogen. The EU-wide approach is open to all interested stakeholders and will operate in 2009–2011. The **Task Force expressed** its wish to establish links with this initiative.

E. Links to other international processes

81. The Task Force took note of the future possibilities to prepare a Special Report on nitrogen jointly with the Inter-governmental Panel on Climate Change. It was noted that the planning and resource requirements for an assessment of this scale would mean that such an assessment could not be expected before 2014.

82. The **Task Force took note** of the tentative results from the Workshop on air pollution – climate interactions, held in October in Gothenburg, Sweden. While welcoming the invitation for the Task Force to examine the links between nitrogen and climate, **it noted** the limited resources for carrying out such possible extra work and agreed to emphasize the need to have adequate additional resources made available to carry out such work.

83. The Task Force **took note** of the progress of the European Nitrogen Assessment, which will be published during 2011. The Task Force also **took note** of a proposal to initiate a Global Nitrogen Assessment linked to the programme of the International Nitrogen Initiative.

84. The **Task Force took note** of the results of the meeting in November in Edinburgh, United Kingdom, between experts of the Convention on Long-range Transboundary Air Pollution and the Convention on Biological Diversity. **It noted** the need to be involved in possible resulting technical collaboration.

Annex A: Information on possible farm-size thresholds in relation to mandatory measures for land application of manures

Background

1. Under both the low and high ambition options for land application of manures, exemptions/relaxations are specified that apply only to farm holdings under a certain size. For the high ambition option (Option A), a relaxation is given to allow approaches that achieve a 30% rather than 60% abatement for farm holdings smaller than the threshold. For the low ambition option (Option C), an exemption is given, specifying no firm mandatory requirements for farms smaller than the threshold (i.e., as far as the Party considers it feasible).

2. In the case of pig and poultry farms, thresholds have already been established in the original Annex IX, consistent with the European Directive on Integrated Pollution, Prevention and Control (IPPC): 40000 bird places for poultry, 750 places for sows and 2000 places for fattening pigs. Overall, around 70% of the poultry flock and around 20% of the pig herd across the EU are held in farm holdings larger than these thresholds. In the case of poultry farming, most of the European flock is therefore covered by the threshold. By contrast, only a small fraction of the European pig herd is covered by these thresholds.

3. In the case of cattle farming, under options A and C, a new farm size threshold would need to be agreed. There are various indicators which could be used to establish this threshold, from simple approaches, such as total cattle numbers, to more detailed approaches, for example based on total nitrogen excretion and the proportion of the year that cattle spend housed or grazing on each farm (see Appendix B). The approach used in this appendix applies total livestock units (LU)[2] as the farm size indicator, which provides a simple yet relatively equitable approach, for

[2] The Livestock unit (LU) is a unit used to compare or aggregate numbers of animals of different species or categories. Equivalences based on the food requirements of the animals are defined. By definition, a cow weighing 600 kg and producing 3000 litres of milk per year = 1 LU, a calf for slaughter = 0.45 LU, a nursing ewe = 0.18 LU, a sow = 0.5 LU and a duck = 0.014 LU.

Data on animals are converted into livestock units using the following coefficients: Equidae: 0.8. Bovine animals: Under one year old: 0.4; One year or over but under two years: Male animals: 0.7; Female animals: 0.7; Two years old and over: Male animals: 1.0; Heifers: 0.8; Dairy cows: 1.0; Other cows: 0.8. Sheep (all ages): 0.1. Goats (all ages): 0.1. Pigs: Piglets having a live weight of under 20 kg per 100 head: 2.7; Breeding sows weighing 50 kilograms and over: 0.5; Other pigs 0.3 FAO (2003) Compendium of Agricultural - Environmental

which European statistics are widely available. Nevertheless, it is noted that even these simple statistics may not currently be available for all cattle farm sizes across the whole of the UNECE area.

4. For simplicity with the approach taken in this annex, the thresholds are taken to apply both to housed and to grazing cattle. Where cattle are grazed all year round, by definition there is no requirement for the land application of manures.

5. Although the initial focus of this appendix applies to the farm size thresholds for land application, in principle this approach could be used to develop standard thresholds for all mandatory measures to reduce ammonia emission related to cattle farming (i.e., where thresholds are defined for integrated N management, animal feeding, livestock housing and manure storage). The possibilities for application across the sector will be discussed at TFRN-3 (24-25 November 2009).

Criteria for setting cattle thresholds

6. Under recent negotiations for a revision of the IPPC directive, possible farm size thresholds were considered for inclusion of cattle farms. As the IPPC directive represents a comprehensive regulatory regime, relatively large farm-size thresholds were considered (e.g., >350 to >450 cattle). This had the disadvantage that only a small fraction of the European cattle herd (around 10% - 12%) would have been included, giving rise to questions over the merit of the approach.

7. By contrast to the complex regulatory regime of IPPC, the Options A, B, and C focus on the application of simple basic requirements to reduce ammonia emissions, aiming to minimize the regulatory overhead. In this context, a possible farm size threshold may be considered as affected by the following criteria:

a. the aim to include farms where future investment in environmental technology would be most likely, while excluding the smallest farms (including 'hobby farms') where future investment would be less likely.
b. the applicability of low-emission spreading techniques that can be implemented by specialist contractors, recognizing that this is typically the approach taken for small farms

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Indicators (Annex 2, p 34). http://www.fao.org/es/ess/os/envi_indi/default.asp http://www.fao.org/es/ess/os/envi_indi/default.asp)

where the capital costs of owning low-emission spreading technology make purchasing this equipment economically less attractive.

c. the aim to include a sufficiently large fraction of the European cattle herd to make significant progress in reducing ammonia emissions, while focusing on a smaller fraction of cattle farm holdings, thereby minimizing requirements across the sector.
d. the aim to select a threshold that is acceptable to Parties based on the structure of their agricultural industry and the availability of relevant agricultural statistics.

Scenarios investigated

8. In the following tables, the following cattle farm-size thresholds for Options A and C are investigated:

Scenario 1: Exemptions for cattle farms with less than 20 livestock units (LU)

Scenario 2: Exemptions for cattle farms with less than 50 livestock units (LU)

Scenario 3: Exemptions for cattle farms with less than 100 livestock units (LU)

Scenario 4: Exemptions for cattle farms with less than 500 livestock units (LU).

These scenarios are selected to provide a wide range of variation in addressing the criteria listed, while being based on farm size information that is easily available from Eurostat.

9. Table 1 shows the percentage of the European cattle herd as animal numbers in 2007 that would be included in (i.e., not be excluded from) mandatory requirements under the four scenarios listed. To illustrate the trends with time, in comparison with Table 1, Table 2 shows the percentage values for cattle numbers in 2000. Table 3 shows the percentage numbers of farm holdings in 2007 that would be included in (i.e., not be excluded from) mandatory requirements under the four scenarios.

Table 1: Percentages of cattle herd as animal numbers that occur on farms exceeding the size thresholds for Scenarios 1 to 4 for the EU-27 (source Eurostat, heading J02_08). Data are for 2007. Note that the statistics are considered most reliable for larger countries with many cattle farms.

Country	% no. cattle on farms > threshold (Scenario 1: 20 LU)	% no. of cattle on farms > threshold (Scenario 2: 50 LU)	% no. of cattle on farms > threshold (Scenario 3: 100 LU)	% no. of cattle on farms > threshold (Scenario 4: 500 LU)
Austria	71%	22%	4%	0%
Belgium	97%	88%	62%	3%
Bulgaria	41%	25%	14%	3%

Cyprus	99%	98%	90%	0%
Czech Republic	95%	90%	85%	63%
Denmark	95%	86%	74%	8%
Estonia	87%	78%	71%	42%
Finland	90%	48%	17%	1%
France	97%	87%	55%	2%
Germany	95%	79%	54%	11%
Greece	87%	64%	30%	1%
Hungary	86%	76%	69%	54%
Ireland	93%	70%	38%	1%
Italy	87%	70%	50%	13%
Latvia	53%	35%	25%	9%
Lithuania	42%	28%	20%	10%
Luxembourg	99%	93%	70%	2%
Malta	97%	90%	65%	0%
Netherlands	98%	91%	67%	6%
Poland	53%	20%	10%	4%
Portugal	82%	65%	47%	10%
Romania	14%	8%	5%	1%
Slovakia	94%	93%	90%	59%
Slovenia	41%	12%	4%	0%
Spain	89%	70%	49%	10%
Sweden	92%	73%	45%	4%
UK	97%	90%	76%	11%
Average EU-27	**87%**	**72%**	**50%**	**8%**
Inter-country coeff of variation	**29%**	**44%**	**58%**	**154%**

Table 2: Percentages of cattle herd as animal numbers that occur on farms exceeding the size thresholds for Scenarios 1 to 4 for the EU-17+1 (source Eurostat). Data are for the year 2000. Note that the statistics are considered most reliable for larger countries with many cattle farms.

Country	% cattle LU> threshold (Scenario 1: 20 LU)	% cattle LU> threshold (Scenario 2: 50 LU)	% cattle LU> threshold (Scenario 3: 100 LU)	% cattle LS> threshold (Scenario 4: 500 LU)
Austria	65%	14%	2%	0%
Belgium	96%	84%	54%	2%
Denmark	95%	84%	59%	3%
Finland	80%	23%	4%	0%
France	96%	81%	45%	1%
Germany	93%	74%	44%	11%
Greece	78%	51%	24%	2%
Ireland	92%	69%	37%	1%
Italy	85%	65%	45%	10%
Latvia	30%	21%	17%	8%
Luxembourg	98%	91%	60%	0%
Netherlands	97%	89%	58%	4%
Norway	83%	26%	5%	0%
Portugal	71%	51%	34%	6%
Slovenia	32%	10%	5%	3%
Spain	84%	59%	39%	9%
Sweden	89%	62%	28%	1%
UK	97%	89%	72%	7%
Average EU-17+1	**91%**	**73%**	**45%**	**5%**

Table 3: Percentage numbers of farm holdings that exceed the thresholds for Scenarios 1 to 4 for EU member states and for the EU-27 (source Eurostat, heading J02_08). Data are for the year 2007. Note that the statistics are considered most reliable for larger countries with many cattle farms.

Country	% no. of cattle farm holdings > threshold (Scenario 1: 20 LU)	% no. of cattle farm holdings > threshold (Scenario 2: 50 LU)	% no. of cattle farm holdings > threshold (Scenario 3: 100 LU)	% no. of cattle farm holdings > threshold (Scenario 4: 500 LU)

Austria	38%	7%	1%	0%
Belgium	75%	56%	31%	1%
Bulgaria	3%	1%	0%	0%
Cyprus	86%	79%	62%	0%
Czech Republic	33%	19%	13%	6%
Denmark	61%	42%	30%	3%
Estonia	15%	8%	5%	1%
Finland	68%	20%	4%	0%
France	76%	55%	25%	1%
Germany	67%	39%	18%	1%
Greece	43%	20%	5%	0%
Hungary	19%	7%	4%	2%
Ireland	69%	35%	12%	0%
Italy	38%	18%	7%	1%
Latvia	6%	2%	1%	0%
Lithuania	3%	1%	0%	0%
Luxembourg	89%	72%	42%	1%
Malta	65%	52%	26%	0%
Netherlands	81%	64%	35%	1%
Poland	13%	2%	0%	0%
Portugal	21%	10%	5%	0%
Romania	1%	0%	0%	0%
Slovakia	8%	6%	5%	2%
Slovenia	11%	2%	0%	0%
Spain	44%	22%	10%	1%
Sweden	59%	32%	13%	0%
UK	73%	53%	35%	2%
Average EU-27	**24%**	**13%**	**6%**	**0.3%**

Inter-country coeff of variation	**69%**	**91%**	**111%**	**155%**

Consideration of the possible thresholds for cattle.

10. The following points should be noted:

a. The size above which cattle farms are likely to include possible future investment in environmental technology will vary across the UNECE region. However, it is likely that this would be in the region of 50 (20 to 100) LU.

b. According to the Eurostat data for 2007, less than 1% of cattle farms have more than 500 LU (Table 3), while these farms account for only around 8% of the European cattle herd (Table 1). The selection of such a large threshold (Scenario 4) would therefore not meet the criteria to include a significant fraction of the European cattle herd, and would make little contribution to regional ammonia emissions reductions.

c. Selection of the smallest thresholds of 20 LU (Scenario 1) would include nearly all of the European cattle herd (87% in 2007, Table 1). This can therefore be considered as being similar to ambition level B, which applies to farm holdings of all sizes. Nevertheless, under Scenario 1, only around a quarter farm holdings (24%) would be included.

d. Selection of the threshold of 50 LU (Scenario 2) represents significantly lower ambition than Scenario 1. This threshold is nevertheless effective in applying to most of the European cattle herd (72% in 2007, Table 1), while only applying to a small fraction of cattle farm holdings (13% in 2007, Table 3). This scenario appears to meet the criteria a, b, and c. listed under paragraph 5.

e. In terms of the European cattle herd, selection of the threshold of 100 LSU (Scenario 3) represents around half of the ambition of Scenario 1 (50% of the cattle herd included for 2007, compared with 45% for 2000, Tables 1 and 2). By contrast, under Scenario 3, only around 6% of cattle farm holdings would be included (Table 3). This scenario also appears to meet the criteria a, b, and c. listed under paragraph 5.

f. It is anticipated that both Scenarios 2 and 3 would meet the structural and statistical requirements of Parties across the UNECE region (criterion d.). This needs to be confirmed by the different Parties.

g. In principle, variation in profitability per animal is expected to differ between dairy versus beef cattle sectors. WGSR might therefore wish to consider the option to distinguish thresholds between these sectors. This could lead to a more financially equitable approach, at the expense of additional complexity in the thresholds. The present Scenarios are considered sufficient to illustrate the broad differences across Europe in relation to cattle and cattle farm holdings of different sizes. It may be noted that the percentage numbers of dairy cows included for the four scenarios are similar to the numbers shown in Table 1 for total cattle. The equivalent values in 2007 for dairy cows are: 83%, 68%, 47% and 8%, for Scenarios 1 to 4, respectively.

11. Based on these statistics, Scenarios 2 and 3 (cattle farms with more than 50 or 100 LU, respectively) appear to be the most appropriate in meeting the criteria for the cattle farm thresholds. In the case of ambition level C, these thresholds allow for a clear distinction from the goals of ambition level B. In the case of ambition level A, they provide a clear distinction that focuses the highest ambition measures on farms where future investment is most likely.

12. It is noted that cattle-farm size-distributions are expected to change substantially over the next decade at least for member states of the European Union. Following the abolition of the milk quota system in the EU, farms will have to be competitive with dairy farmers in US, New Zealand, South America, which is expected to lead to a rapid up-scaling of farm sizes.

Consideration of regional differences in cattle farm sizes

13. The tables show significant variation between Parties in regards of the percentage numbers of animals and numbers of farms above the thresholds. In 2000, Belgium, Denmark, the Netherlands and the UK were among the Parties with the largest percentage cattle herd above the thresholds (Scenario 2: 84%-89% of cattle, Scenario 3: 54%-72% of cattle). In 2007, the largest percentages of cattle included were for, the Netherlands and the Czech Republic (Scenario 2: 91%; Scenario 3: 67%-85%).

14. Relatively large fractions of the cattle herd in Czech Republic, Estonia, Hungary, and Slovakia are present on the largest farms (>500 LU), reflecting a farm structure that is also

typical for EECCE countries across the UNECE area. For these four countries, 42% to 62% of cattle are on farms with more than 500 LU. By contrast, a large number of very small farms in these countries results in them having, overall, a smaller percentage of cattle farms above the thresholds for Scenarios 2 and 3 (up to 5% to 13%), than is the case for most other countries.

15. The four scenarios can be considered as varying in their equitability between Parties. The coefficient of variation (standard deviation/mean) between Parties provides a suitable indicator, with a lower coefficient implying greater equitability. in For the percentage cattle herd included in the scenarios, the values are: 29%, 44%, 58% and 154% for Scenarios 1 to 4, respectively. Similarly, the coefficients of variation in the percentage number of holdings included are: 69%, 91%, 111% and 155% for Scenarios 1 to 4, respectively. Overall, Scenario 2 can therefore be considered as being more equitable than Scenario 3, while Scenario 4 can be considered the least equitable. Scenario 1 is the most equitable of the scenarios shown, although by definition, ambition level B, which applies to farms of all sizes, represents the most equitable distribution of mandatory action between the Parties.

16. Comparison of Tables 1 and 2 shows that cattle farm sizes have increased since 2000, giving larger percentages of the cattle herd included the scenarios for 2007. The largest increases in farm sizes for Scenarios 2 and 3 occurred for Finland, Sweden, Spain and Portugal (increases of 8% to 25%). By contrast, the values for the Ireland, UK and Slovenia were rather stable (-1% to 4% change).

A possible farm-size threshold for the application of pig manures

17. Based on Scenario 2, the fraction of the European cattle herd above the threshold would be roughly consistent with the percentage of animals above the existing threshold for poultry farms (70%). By comparison, at ~20%, only a small fraction of the European pig herd is above the existing threshold in Annex IX and IPPC. Even in the case of Scenario 3 for cattle (45% of the European herd included), when in applied ambition level C, the fraction of pigs for which mandatory measures would apply remains low compared with cattle and poultry.

18. Based on these comparisons, it would be relevant to review the options for a smaller farm size threshold for the application of pig slurries and solid manures than is currently adopted by Annex IX and the IPPC directive. In addition to the objective to ensure comparability between sectors, this would have additional benefits given the particular concern of odours from pig manures, since low ammonia emission spreading techniques also reduce odour emissions. Such thresholds could be further reviewed by TFRN, subject to feedback from WGSR on the existing

options presented. As an indication, based on Eurostat data (2000), 93% of pigs in the EU-17+1 are on holdings with more than 50 LU, 85% of pigs are on holdings with more than 100 LU, while approximately 70% of pigs are on holdings with more than 200 LU.

Annex B: An alternative approach to calculate threshold farm sizes based on amounts of nitrogen under manure management.

Background

1. The overall purpose of the Annex IX is to reduce the ammonia emission from agriculture. In the current Annex IX, pigs (sows > 750 and fattening pigs >2.000) and poultry (>40.000) are included but not cattle and other animal types. The emission of ammonia is related to the amount of manure nitrogen produced. The amount of manure nitrogen produced per livestock unit (LU) varies between livestock type and between countries (see Table 1). The amount of manure nitrogen produced on a farm can be used as an alternative to numbers of LU as an indicator of farm size, providing a closer link to the level the ammonia emission.

2. The amount of manure nitrogen produced can be estimated as the number of animals multiplied by the amount of nitrogen typically excreted by animals for that particular country and animal type, as reported by the Party in its annual GHG inventory submission to UN under the Climate Convention (UNFCCC). These nitrogen excretion rates are reviewed annually for accuracy and consistency by UNFCCCs Expert Review Team (ERT). According to this approach, the farm level thresholds for mandatory measures (under ambition level options A and C) would differ between countries and over time, according to the actual nitrogen excretion level in that particular country. For example, increased productivity per animal in the future, would tend to reduce the threshold with time, when expressed on a per animal basis.

3. For cattle, a proportion of the manure nitrogen produced will usually be deposited during grazing. The emission of ammonia from manure deposited during grazing is low in comparison with the emission from manure deposited in livestock housing or on stock yards. In addition, there are no practical measures available to reduce ammonia emission from manure deposited during grazing. It is therefore appropriate that animal manure deposited during grazing should be excluded from the calculation of farm size thresholds for mandatory options. Information on average grazing period at a country level is reported for all relevant animal categories to the UN in the Party's annual GHG inventory submission.

Calculation methodology

4. The nitrogen calculation approach for setting the farm size thresholds could be:

$N_{manure} > \sum Nex_i * No_i * (1-Frac_{PRP,i})$

where:

N_{manure} is the amount of nitrogen handled by the manure management system on the farm, kg N yr^{-1}

Nex_i is nitrogen excretion rate for animal type *I*, kg N $animal^{-1}$ yr^{-1}

No_i is number of animals or animal places

$Frac_{PRR,i}$ is the fraction of manure deposited during grazing for animal type *i*

5. Table 2 shows the consequences of setting N_{manure} to 20000, 10000 or 1000 kg N yr^{-1} for typical Danish and Portuguese situations (actual data has to be verified). The Danish and Portuguese situations were chosen to represent relatively intensive and relatively extensive management systems respectively.

Consideration of the approach and question to WGSR

6. The examples illustrated in Table 2, show that a farm threshold of 10000 kg N in manure would correspond to 73 dairy cows under typical Danish management and 115 dairy cows under typical Portuguese management. The same threshold for sows (including piglets) would amount to 357 sows in Denmark and 400 sows in Portugal. The table also illustrates differences in nitrogen excretion rates between categories already included in Annex IX and the IPPC directive. For example, 10000 kg N in manure would equate to around 14000 layers or 4000 turkeys.

7. The approach outlined here has the advantage of being more equitable between countries to take account of national differences in characteristic excretion rates and fraction of the time in which animals are not at grazing. It provides the facility to build on data already collected under the UNFCCC. Similarly, by considering the total amounts of manure handled, this approach would provide the facility to include both producer of manures (livestock farmer) and the user of

manure in land application (which may be a different farmer including arable farms). By contrast, a natural consequence of this approach is that in terms of animal numbers, thresholds defined will change with time, for example as animal productivity changes. Further work would be needed to calculate statistics for each Party on the fraction of national livestock herd and fraction of farms above thresholds.

8. In principle the approach of this Appendix is scientifically fairer than the simpler approach outlined in Appendix A, although more work would be required to manage the approach described here. TFRN invites WGSR to consider the comparison between different methods for considering farm size thresholds (Appendices A and B).

Table 1: Nitrogen excretion (Nex) per animal and LU for Denmark and Portugal. Actual figures have to be verified (as of 2007).

Denmark	**Nex**	**Nex per LU***
	kg N yr^{-1}	kg N yr^{-1} LU^{-1}
Dairy cows	137	137
Beef cattle	65	81
Sows incl. piglets	28	56
Fatteners	12	40
Layers	0.7	70
Turkeys	2.5	83
Portugal		
Dairy cows	87	87
Beef cattle	70	88
Sows incl. piglets	25	50
Fatteners	7.9	26
Layers	0.7	70
Turkeys	2.5	83

* Animal numbers converted to LU using the method described in Appendix A (for poultry, FAO)

Table 2: Threshold numbers for Denmark and Portugal at different threshold N_{manure}. Actual figures have to be verified (as of 2007).

	Thresholds: Animal number

		Target, N_{manure}, kg N yr^{-1}			
Denmark	**Frac,PRP***	***20000***	***10000***	***1000***	**Current threshold**
Dairy cows	0.05	146	73	7	none
Beef cattle	0.62	311	155	16	none
Sows incl. piglets	0	714	357	36	750
Fatteners	0	1667	833	83	2000
Layers	0	28571	14286	1429	40000
Turkeys	0	8000	4000	400	40000
Portugal					
Dairy cows	0.25	231	115	12	none
Beef cattle	0.9	289	145	14	none
Sows incl. piglets	0	800	400	40	750
Fatteners	0	2532	1266	127	2000
Layers	0	28571	14286	1429	40000
Turkeys	0	8000	4000	400	40000

* Frac,PRP = proportion of nitrogen excreted whilst the livestock are grazing