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Review of sufficiency and effectiveness of the Protocol to Abate Acidification, Eutrophication and Ground-level Ozone

Draft report on the review of the Protocol to Abate Acidification, Eutrophication and Ground-level Ozone

Submitted by the Gothenburg Protocol review group

Summary [will be prepared by the secretariat]

At its thirty-ninth session (Geneva, 9–13 December 2019), the Executive Body launched the review of the Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (the Gothenburg Protocol), as amended……..

The current report was prepared by the Gothenburg Protocol review group. It is …….

I. Introduction

1. Following the entry into force of the 2012 amendment[1] to the Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (Gothenburg Protocol) on 7 October 2019, the Executive Body initiated the review of the Protocol at its thirty-ninth session (Geneva, 9–13 December 2019) (ECE/EB.AIR/144/Add.1, decision 2019/4) pursuant to article 10 of the Protocol, which stipulates that Parties shall keep under review the obligations set out in the Protocol, including the adequacy of the obligations and the progress made towards the achievement of the objective of the Protocol. The 2016 scientific assessment of the Convention[2], its policy response (ECE/EB.AIR/WG.5/2017/3 and Corr.1) and the Long-term Strategy for the Convention for 2020-2030 and beyond (decision 2018/5, annex) form the basis of the key elements that were taken into consideration for the review.

2. At its fortieth session (Geneva, 18 December 2020), based on recommendations by the Working Group on Strategies and Review, the Executive Body decided that the scope of the review should remain broad and that the review should focus on information-gathering, scientific and technical inputs and assessing the information collected (ECE/EB.AIR/146, decision 2020/2).

3. The present document has been prepared by the Gothenburg Protocol review group convened by the Chair of the Working Group on Strategies and Review. This draft report is based on the scientific and technical information provided by subsidiary bodies in accordance with decision 2020/2 following the annotated outline of the report (ECE/EB.AIR/WG.5/2021/4 and Corr.1). The full text of the inputs provided by subsidiary bodies is contained in an accompanying informal document[3]. The final report on the review based on all required inputs will be submitted for consideration by the Executive Body at its forty-second session.

4. This document outlines (amongst other issues) the legal requirements for the review; emission reduction commitments; flexibility provisions; approaches by countries outside the geographical scope of EMEP; hemispheric transport; integrated approaches and synergies with other policy areas. It will conclude with recommendations/proposals for further action.

5. Insert general statement on progress and overall need for further work based on the Review.

II. Legal requirements for the review

6. Article 2 of the Gothenburg Protocol contains its objective which is to control and reduce emissions of specific pollutants caused by anthropogenic activities which are likely to have adverse effects on human health and the environment, natural ecosystems, materials, crops and the climate in the short and long term. It also includes the implementation of measures by Parties to achieve their national targets for particulate matter, in particular giving priority to the extent considered appropriate, to emission reduction measures which also significantly reduce black carbon.

7. Article 10 requires that Parties keep under review and assess the obligations of the Protocol which are meant to achieve the objectives set out in article 2. Article 10 also broadly specifies the modalities of such reviews.

8. The broader elements that shall be included are those assessing the obligations of Parties in relation to their calculated and internationally optimized allocations of emission reductions; as well as the adequacy of the obligations and whether sufficient and efficient progress has been made towards the achievement of the objectives of the present protocol as

[1] The amendment of the text and annexes II to IX to the Protocol and the addition of new annexes X and XI, adopted by Executive Body decision 2012/2.

[2] See Rob Maas and Peringe Grennfelt, eds., Towards Cleaner Air: Scientific Assessment Report 2016 (Oslo, 2016); and United States Environmental Protection Agency and Environment and Climate Change Canada, Towards Cleaner Air: Scientific Assessment Report 2016 – North America (2016).

[3] Available at https://unece.org/info/Environmental-Policy/Air-Pollution/events/350953

described above. The review includes an evaluation of the emission reduction commitments for 2020, not the fixed emission ceilings in the original protocol for 2010.

9. Paragraphs 3 and 4 of article 10 refer to specific elements that must be included in the review. This includes an evaluation of mitigation measures for black carbon emissions and an evaluation of ammonia control measures and consideration of the need to revise annex IX. Included in these paragraphs, is also a timeline for when these evaluations were to have been completed (by the second session of the Executive Body after entry into force). It was decided by the Executive Body (EB decision 2020/2) that these evaluations would be subsumed by the broader review of the Gothenburg Protocol.

10. In undertaking the review, the best available scientific information on the effects of acidification, eutrophication and photochemical pollution, including assessments of all relevant human health effects, climate co-benefits, critical levels and loads, the development and refinement of integrated assessment models, technological developments, changing economic conditions, progress made on the databases on emissions and abatement techniques, especially related to particulate matter, ammonia and volatile organic compounds, and the fulfilment of the obligations on emission levels were taken into consideration.

III. Emissions

11. The emission inventories submitted by Parties span a very wide quality range, and technical reviews have identified which Parties regularly provide good or poor-quality submissions. There have been significant improvements in the completeness of reporting across recent years, with 48 Parties submitting inventories in 2020. However, submissions from 17 Parties were not satisfactory due to a lack of completeness (Technical Report CEIP 4/2020), and 11 Parties did not provide an Informative Inventory Report (IIR).

12.Emission inventories typically follow a similar evolution as they are developed. Initially there is a focus on the need for completeness, and then attention shifts to ensuring ever higher levels of accuracy. So even if the above completeness issues are addressed, substantial improvements will still be needed in numerous national emissions inventories before the accuracy of the emission estimates across Parties is considered to be at “good practice” quality levels.

13. Annual submissions should include an uncertainty analysis (ECE/EB.AIR/125), but less than half of the Parties reported uncertainty estimates in their 2021 submissions. It is not considered possible to estimate the uncertainty of total EMEP emissions with the information currently available.

Pollutant	Uncertainty ranges	No. of Parties		Pollutant	Uncertainty ranges	No. of Parties
NOx	9 – 59%	19		NH_3	10 – 143%	19
NMVOC	15 – 112%	19		$PM_{2.5}$	10 – 97%	17
SOx	5 – 47%	19		BC	27 – 302%	7

Table 3.1 Reported uncertainty ranges of emissions (national totals)

14. Black carbon emissions are reported on a voluntary basis, but the number of Parties providing emission estimates has increased to 40. Significant inconsistencies exist between national BC emission estimates, suggesting that the accuracy of the submissions needs to be improved. Emission trends are expected to be more reliable, and data for the EU28 show emissions halving from 1990 to 2018. Emissions from the residential sector account for approximately a third of the EU28 total emissions of BC.

15. Across the 1990s emission reductions for a number of pollutants arose from fuel switching from coal to natural gas fuels, particularly in the residential sector in European countries. The impact of reduced use of coal in electricity generation still continues and is accentuated by the increased use of renewables. By contrast, emission reductions across the last twenty years have primarily been driven by targeted emissions reduction policies.

16. Further emission reductions are considered possible in shipping, and within UNECE countries: NH_3 emissions from agriculture, $PM_{2.5}$ emissions from residential solid fuel burning and agricultural waste burning, and CH_4 emissions from waste treatment. 17. Additionally, in EECCA/SEE countries emission reductions are possible from coal burning, transport, and waste treatment.

18. The EMEP/EEA Air Pollutant Emissions Inventory Guidebook is considered to be comprehensive in its scope and content. However, there are a significant number of improvements which could be made:

-The current links between emissions experts managing the content of the Guidebook and research groups undertaking new emission measurements are not strong or comprehensive enough.

-Improving the Guidebook content is hampered by the funding mechanism. EMEP provides no resources, and improvements rely on in-kind contributions. This results in substantial resource constraints, and it is not possible to plan or prioritise effectively. Given that EMEP has identified emission estimates as the largest sources of uncertainty in many AQ studies, it is reasonable to ask why no funding is allocated to the Guidebook.

-Methodologies for “lower priority” pollutants, such as heavy metals and POPs have not been reviewed or updated for many years. There also remain a number of emission factors in the Guidebook that are based on literature that may no longer be representative of current emission rates.

-Emissions methodologies in the GB need to better account for climate change i.e. to better take into account the relationships between changing climatic conditions and emission factors.

19. No decision has been made regarding the metric that is to be used for reporting black carbon emissions. Also, it is not known whether future PM emissions reporting will include the condensable and/or the semi-volatile component. The EMEP scientific community have discussed the benefits of including condensables, but no decision has been made. Therefore, guidance cannot be updated/developed accordingly.

IV. Measured and modelled atmospheric concentrations and deposition levels

20. Ground-level ozone is a secondary pollutant which result from complex physico-chemical mechanisms. Therefore, observed average concentrations do not vary linearly with the reduction in regional precursor emissions (NO_x and NMVOC), and are influenced by other factors like climatic parameters, hemispheric transport, and global methane emissions. Only daily maximum ozone concentrations during June-August show a clear decrease by 0.6 ppb per year (between .. and ..), and while other metrics (averages, SOMO35) show no trend.

21. ll other pollutant concentration trends generally follow the decreasing emission trends in the UNECE region. Annual average concentrations of sulphur dioxide and particulate sulphate, and wet deposition of oxidized sulphur, have been declining 3-4% per year since the 1980s.

22. From around 1990 onwards, the total emissions of NOx declined significantly in Europe, followed by an annual decline of 1.5-2% in nitrogen dioxide concentrations and total nitrate (nitric acid plus particulate nitrate) in air and a decrease of oxidized nitrogen deposition at EMEP background sites.

23. Only modest reductions of ammonia emissions have been achieved since 2000 compared to other pollutants. Total reduced nitrogen in air (ammonia + particulate ammonium) was reduced by 1% per year from 2000-2018, but the majority of sites in air show no declining trend for ammonia.

24. Since 2000, there have been significant reductions in total $PM_{2.5}$ concentrations (on average 2.3 % per year at EMEP long term observational sites). Secondary inorganic aerosols (particulate sulphate, nitrate and ammonium) have annually decreased since 2000 by 2.9%, 1.9% and 2.8% respectively. For carbonaceous aerosols, including black carbon, there are very few sites with long term, consistent measurements. One study shows a 4 % per year decrease in elemental carbon since 2001.

25. Around half of the EMEP sites have recorded exceedances of the WHO air quality guidelines (AQG) for $PM_{2.5}$ in recent years. EMEP MSC-W model simulations show a decrease in exceedances from 2000 to 2018. As local air quality is strongly influenced by regional and even transboundary air pollution processes, urban exceedances and associated health risks can be a stimulating driver for additional air quality policy, also for countries that are not parties to the protocol. [Average population weighted exposure decreased by …]

26. The influence of transcontinental transport on European sulphur and Nitrogen concentrations and deposition is negligible. For PM, wildfires and wind-blown dust originating outside Europe influence concentration levels substantially during episodes (typically a few times a year).

27. Emission projections indicate that future ammonia emission reductions in Europe will be relatively small compared to the emission reductions of sulphur dioxide, nitrogen oxides and primary particulate matter. The regional deposition rates of sulphur and nitrogen are projected to change similarly to regional emissions of SO_x, NO_x and NH_3. Reductions of primary PM emissions, together with precursors of the secondary inorganic aerosols are projected to lead to reduced $PM_{2.5}$ concentrations by 2030. Even so, the WHO air quality guideline value for $PM_{2.5}$ (yearly and daily) is expected still to be exceeded in some areas. In the longer term, some processes may lead to increasing PM levels again, e.g. higher temperatures may increase biogenic VOC emissions (and hence formation of secondary organic aerosols), and increasing NO and NH_3 emissions from soils might also increase secondary PM formation.

28. Current monitoring and modelling systems used under the Convention to calculate ambient concentrations and deposition levels should be assessed further to see if they are fit for use in optimized reduction allocations and dealing with the increased variation in highly and less polluted regions which become visible from finer resolution approaches.

V. Measured and modelled effects on natural ecosystems, materials and crops and assessment of human health effects

29. *Population exposure and health risks*: updated WHO air quality guideline values, relative risk factors, as well as no-effect/counterfactual values will become available in autumn 2021 and will form the basis for new assessments of mortality and morbidity risks for $PM_{2.5}$, NO_2 and ozone in the EMEP-region. Preliminary EMEP assessments show a relatively high population exposure to $PM_{2.5}$ in large cities and in industrial areas, in particular in EECCA-countries. Health risks of $PM_{2.5}$ will include exposure to secondary inorganic as well as secondary organic particles caused by emissions of ammonia and volatile organic compounds.

30. *Protection of ecosystems to acidification and eutrophication*: Aquatic and terrestrial ecosystems have shown evidences of recovery from acidification since the 1990s. Moreover, many sites covered by ICP-Waters show an increase in biodiversity at sites with the most pronounced chemical recovery. Empirical results are in line with the exceedances of the critical load for acidification, which have been successfully reduced between 1990 and 2015 to only 5% of the ecosystem area in Europe.

31. Critical loads for eutrophication by nitrogen deposition remained exceeded for 62.5% of the ecosystem area in Europe in 2015. Exceedances are expected to decrease only moderately in the coming decade *[CCE will provide estimates for exceedances in 2030 (and beyond?).]*, but emission reductions of N deposition need to be greater to allow ecosystems recovery and prevent, inter alia, the effects on nutrient imbalances, on surface and

groundwater quality or affect the resilience of forests to stress factors such as drought or insect infestation.

32. Results from the ecosystems monitoring network under the WGE, provide evidences on the link between CL exceedances and empirical impacts, and confirm that emission abatement actions are having effects on CL exceedances and therefore reduce impacts.

33. To assess the potential recovery of ecosystems, according to future emission scenarios, the use of dynamic modelling tools can be considered in the coming years. To assess biodiversity and the loss of specific species that are sensitive for eutrophication, new models will have to be explored.

34. An Ad-hoc Marine Group (AMG), led by Germany, was recently established to investigate options to include marine ecosystem protection into future emission reduction strategies.

35. *Ozone damage to crops and forests*: Model results suggest that the phytotoxic ozone dose for deciduous forests has declined over the period 2000-2016 by ca. 0.7% per year at EMEP's ozone stations. The phytotoxic ozone dose for crops shows no significant decline for the majority of sites, partly because the reductions of the 'peak' concentrations are counterbalanced by the increase of the 'background', a.o. due to increased methane emissions. Also, climate change is influencing ozone concentrations. Based on current knowledge, ozone pollution has reduced wheat grain yield by a mean of 9.9% in the northern hemisphere in 2010-2012[4]. Projections based on current climate and energy policies (RCP4.5) show that ozone risks to biodiversity will still occur by 2050, as ozone exposure will remain similar to that in 2000[5]. Similarly, projections show that there will still be a significant effect of ozone on the biomass increment of trees.

36. *Damage to materials and cultural heritage*: Corrosion decreased significantly since the early 1990s due to the decrease of SO_2-levels. After 1997 the decrease in corrosion became more modest; currently a constant level seems to be reached[6]. Carbon steel and copper corrosion have decreased more pronounced in urban areas even after 1997. For soiling, there is no decreasing trend after 1997 and consequently larger areas in Europe are above acceptable levels. The main pollutant responsible for soiling of materials is particulate matter.

VI. Emission reduction commitments for Parties

37. This chapter provides an answer on the status and barriers of meeting the 2020 emission reduction commitments in annex II to the amended Gothenburg Protocol and to whether these emission reduction commitments are adequate or not. It includes answers to following Annex I questions to the preparatory review document: Q.1.1, Q. 1.3, Q 1.5(e), Q 4.4 and Q 6.5.

A. Status of meeting the 2020 emission reduction commitments

38. Tables 2-6 of Annex II to the amended Gothenburg Protocol set out the emission reduction commitments for SO_2, NO_X, NH_3, VOCs and $PM_{2.5}$ for 2020 and beyond, expressed as percentage reductions from the 2005 emission levels. 34 Parties are currently listed in tables 2-6 (27 EU Member States, EU, the UK, Canada, the US, Norway, Switzerland and Belarus), of which 24 have already ratified the amended Gothenburg Protocol (status as at 20 August 2021). Belarus and 9 EU Member States are still in the process of ratification and may soon join, as possibly will other Parties, at which time emission reduction commitments for these Parties will be proposed and adopted in accordance with the procedures of Article 13 of the amended protocol. EU Member States are also bound by the 2020 emission reduction commitments under the EU NEC Directive.

[4] Mills et al., 2018 doi.org/10.1111/GCB.14157

[5] Fuhrer et al., 2016 doi.org/10.1002/ECE3.2568

[6] Tidblad et al, Materials 2017, 10, 969; doi:10.3390/ma10080969

39. An assessment of the current status of meeting the 2020 emission reduction commitments of the amended Gothenburg Protocol based on a comparison with the last reported emissions (2019) and 2020-2030 projections by Parties (reporting year 2021), provides the following key messages.

- The collective efforts of all 34 Parties have resulted in combined emission reductions between 2005 and 2019 that already exceed the combined emission reductions envisaged by the Parties' emission reduction commitments for 2020, except for $PM_{2.5}$. However, at the level of individual Parties there is a significant difference in the progress made towards meeting the emission reduction commitments.
- The majority of the 34 Parties did not yet meet their 2020 emission reduction commitments for one or more pollutants in 2019. Most recently reported emission projections based on current legislation (WM projections) for the period 2020-2030 show that in 2030, 15 out of 34 Parties will still not meet their 2020 emission reduction commitments for one or more pollutants, in particular for NH_3.
- Additional policies and measures will be required for NH_3 and, to a lesser extent, VOC, NO_X and $PM_{2.5}$ in order for Parties to make faster progress towards meeting all their emission reduction commitments in 2020 and beyond. According to the latest reported WM projections, emission levels corresponding to the 2020 relative targets for NH_3, VOC, NO_X and $PM_{2.5}$ will still be exceeded in 2030 by up to 30% for several Parties.
- Main reasons for not meeting the reduction commitments are a lack of policies and measures, higher activity levels than foreseen at the time when the emission reduction commitments were set, slow replacement of old stock and further developments of the emission inventories. In order to further reduce emissions to meet the 2020 emission reduction commitments, additional action may be needed in particular in the agricultural sector (NH_3), the energy sector (NO_X), road transport (NO_X, VOC), shipping (NO_X), solvent use (VOC), domestic wood burning ($PM_{2.5}$ and VOC) and agricultural residue burning ($PM_{2.5}$).
- Other Parties that have not yet ratified the amended Gothenburg Protocol and for which no emission reduction commitments are proposed in tables 2-6 of Annex II to the amended Gothenburg Protocol show a mixed picture in terms of emission trends for the main pollutants between 2005 and 2019. For some of these Parties and for one or more pollutants, emissions even increased.

40. The above assessment will be extended in a subsequent draft of the review report to include a comparison of the emission reduction commitments with the reported emissions for 2020 (reporting year 2022) and the updated GAINS scenarios for the parties involved.

B. Barriers of meeting the 2020 emission reduction commitments

41. Key messages: to be completed at a later stage based on the Parties' responses to question 1.5(e) and the subsequent discussion at the next session of the WGSR.

C. Updates of the base year 2005 emission estimates

42. An analysis of how the most-up-to-date 2005 emission estimates as reported by Parties in 2021 compare to the 2005 estimates listed in tables 2-6 of Annex II to the amended Gothenburg Protocol provides the following key messages:

- The analysis points to many significant changes in the reported 2005 emission estimates between 2012 and 2021 (last reporting year), especially for $PM_{2.5}$ and VOC, and less so for NO_X and SO_2. Most changes remain within the range of +50% and -50% compared to the 2005 emission estimates listed in tables 2-6 of Annex II to the amended Gothenburg Protocol, but with some outliers to over 100% change.
- Comparing the 2005 emission estimates reported in 2012 with the most recently reported updates for the year 2005 (reporting year 2021) shows that the basis for setting the 2020 emission reduction commitments has significantly changed between 2012 and

2021. It underlines the importance and usefulness of moving from fixed (2010 ceilings) to relative targets (2020 emission reduction commitments).

- Relative targets are able to absorb many, but not all, of the effects of inventory developments and improvements. The transition from the 2010 fixed to the 2020 relative targets will therefore most likely also reduce the need and use of the adjustment procedure from 2022 onwards.

D. Use of the adjustment procedure

43. An analysis of the approved adjustment applications to date provides the following key messages:

- A total 11 Parties submitted eligible adjustment applications in the period 2014-2021 for one or more pollutants. Adjustments of national emission inventories were submitted for NH_3, NO_X an VOC and concern adjustments to account for new emission source categories as well as significant changes in emission factors or methodologies used. The majority of the adjustment applications were submitted for the following categories: road transport, agricultural soils, manure management and cultivated crops.
- The approved adjusted emission totals represent 2 to 20% of the unadjusted national emission totals for NH_3, 10 to 30% of the unadjusted national emission totals for NO_X and 10 to 40% of the unadjusted national emission totals for VOC.
- All adjustment applications approved so far relate to adjustments to emission inventories for the purpose of assessing compliance with the 2010 fixed ceilings (provisional application since 2014). Approved adjustments so far will not be applicable for use with respect to the 2020 emission reduction commitments. New applications and reviews (based on a new reference point and including adjustments for the base year 2005) will be required for the post 2020 scheme.

E. Inclusion of condensables in reporting PM emissions for residential heating

44. Including condensables would give a more complete explanation of the population exposure to $PM_{2.5}$ and could better define the effectiveness of measures for health protection. Including condensables could shift the optimal policy strategy more into the direction of tackling residential solid fuel burning.

45. At the time when the 2020 emission reduction commitments were set (2012) many Parties did not yet include condensables in their PM reporting for residential (wood) heating:

- for some Parties, including condensables could prove to be problematic, as even with adjustment of their 2005 emission data, they would not be able to deliver the emission reduction commitment for $PM_{2.5}$, without additional measures for residential heating. The adjustment procedure could be used for this circumstance.
- for other Parties, including condensables could prove to undermine the set emission reduction commitment for $PM_{2.5}$: this would be the case if the use of wood for residential heating did not significantly increase between 2005 and 2020 and the share of old stock decreased during this period. The inclusion of condensables for this specific situation would inflate PM emissions in base year 2005 much more than in 2020 (given that the share of the condensables in PM from old stoves with poorer combustion conditions is much higher than for new stoves).

46. Key messages: to be further completed

F. Adequacy of 2020 emission reduction commitments

47. To be further completed on the basis of input from CIAM/TFIAM. To be decided whether the assessment of the adequacy of the 2020 emission reduction commitments should be dealt with in chapter VI or chapter XVI.

VII. Emission limit values, technical annexes and related guidance documents of the Protocol (with priority given to black carbon and ammonia measures)

48. Assessment of the implementation rate and adequacy of the technical obligations of the amended Gothenburg Protocol and related guidance documents (their contribution in meeting the emission reduction commitments). Identification of gaps or redundancies, and technical requirements and guidance that are obsolete (i.e., assessment against new legislation and updated best available techniques since 2012). Identification of technical requirements that are too demanding or too detailed and should best be adapted to overcome barriers for ratification. Identification of additional implemented or available measures. Specific focus on black carbon (as component of particulate matter) and ammonia.

49. Under the revised mandate of the task force, TFTEI is conducting an in depth analysis of the Annexes IV, V, VI, VIII, X and XI, and their associated guidance documents, to identify the emission limit values and other technical requirements in the technical annexes, which could be potentially updated, as a consequence of the evolution of the technology, since 2012. At the same time, potential adaptations of the annexes, to better address key sectors in the EECCA regions, are investigated, along with possible gaps, complexity, excessive demanding, in collaboration with the EECCA experts. The outcome of the review, which will be completed by mid-November 2021, will highlight the critical sections of the Annexes and associated guidance documents, along with the existence of the newest technological solutions, without expressing preferences on specific ELVs values. Preliminary results (collected by August 2021) show a number of significant updates available in several pollutant/technology/sector combinations. The information, the Parties are invited to submit (deadline 30 September, 2021) on technical annexes and related guidance documents, with priority given to black carbon and ammonia measures, and barriers to implementing obligations, will provide further elements of analysis for the final report on the GP review.

50. Although many options to update Annex IX in the 2012 amendment of the Gothenburg Protocol were discussed[7], Parties did not agree on an amended text; instead, its review was prioritized for the present review via Article 10.4 in the amended Protocol. Thus, Annex IX is over 20 years old and can no longer be considered state-of-the-art. Even so, many Parties appear not to have fully implemented its requirements. Its implementation is not technically demanding, as has been demonstrated by actions taken by a few Parties. Considering substantial progress in technical capability, availability of cost-effective measures, and recognition that measures are needed to achieve ammonia emission reduction commitments, a comprehensive revision of Annex IX is overdue. When doing so, it is recommended to take into account sustainable management practices in the context of the wider nitrogen cycle.

51. The following guidance documents related to ammonia and the wider nitrogen cycle need to be kept up-to-date as follows, with details provided in the Informal Document:

a) The Ammonia Guidance Document (ECE/EB.AIR.120)

[7] See Informal Document no. yy Footnote 22 [number to be updated] [note this is the very long footnote about earlier proposals for Annex IX revision].

b) Framework (advisory) code of good agricultural practice for reducing ammonia emissions (EB.AIR_WG.5_2001_7)

c) The Guidance Document on National Nitrogen Budgets (ECE/EB.AIR/119)

d) The Guidance Document on Integrated Sustainable Nitrogen Management (ECE/EB.AIR/149)

VIII. Specific sector approaches (such as residential solid fuel, agriculture, shipping)

52. Focus on key activities that require specific attention in further reducing their emissions and impacts on human health and the environment. Review of emission reporting, future trends, available measures and emission reduction potential. Focus on following pollutants: particulate matter and black carbon (residential solid fuel burning), ammonia, methane, nitrogen oxides, volatile organic compounds (agriculture) and nitrogen oxides (shipping).

53. In a number of background technical documents, developed by TFTEI[8], key sources are identified and main measures are suggested.

54. Fossil fuel consumption, both in stationary and mobile sources and biomass burning are key sources of BC and associated PAHs (Polycyclic Aromatic Hydrocarbons) into the atmosphere. The reduction of BC and PAHs is linked to the reduction of PM.

55. **Residential solid fuel burning** remains a major issue, and many efforts still need to be made to reduce emissions, in particular $PM_{2.5}$, BC, PAH. The guidance document developed by TFTEI and adopted by EB, at its 39th session[9], may help the final users to implement a more efficient use of the appliances.

56. **In the transport sector, tyre and brake emissions** are turning dominant sources and they are also a source of BC even if these particles are mainly in the coarse mode (diameter > 2.5 µm).

57. **PM resuspension from the road** should be better addressed. This emission is responsible for a large fraction of total road traffic emissions.

58. **Gas flaring from the oil & gas industry** is an important source of black carbon emissions and particularly in areas surrounding the Artic zone. Steam-assist Flares are clearly the most efficient measure, in terms of soot emission reductions. However, high pressure-assisted flares can also be an efficient technique if water is not available on site.

59. **Methane emissions from waste landfills** are the most important non-agricultural source of methane emissions in Europe and are responsible for around 20% of overall emissions. Globally, this share is assumed to be even higher.

60. **In the Shipping Sector,** a relevant study, conducted by IIASA[10] shows that the designation of the Mediterranean as a NOx emission control area (NECA), would be efficient in reducing secondary $PM_{2.5}$, and related premature deaths, especially in the southern parts of the ECE region. Geels and others[11] conclude, similarly for Northern Europe, that the number of premature deaths due to shipping emissions can be significantly reduced by 2050 through a heavy fuel oil ban in addition to the sulphur emission control regulations.

[8] Informal documents for the 58th session of WGSR, December 2020 (https://unece.org/environmental-policy/events/working-group-strategies-and-review-fifty-eighth-session)

[9] https://unece.org/fileadmin/DAM/env/documents/2019/AIR/EB/ECE_EB.AIR_2019_5-1916518E.pdf

[10] Cofala et al. (2018) (https://iiasa.ac.at/web/home/research/researchPrograms/air/Shipping_emissions_reductions_main.pdf)

[11] Geels and others (2021) (https://acp.copernicus.org/preprints/acp-2020-1274/)

61. The **Agricultural Residue Burning** is addressed in the guidance document developed by TFTEI and TFRN, in collaboration with the experts of ICCI. The document, agreed at WGSR_59, is expected to be adopted by EB, at its 41st session (December 2021).

62. The main barrier to ammonia reduction by Parties and non-Parties appears to be a lack of political willingness. However, this willingness has improved recently as Parties realise that implementation of measures is needed to reach emission reduction commitments. In addition, the confidence in measures to control ammonia emissions has increased greatly since these were first discussed by the Convention in the 1990s, with control of ammonia emissions now seen as part of a wider strategy to reduce large amounts of otherwise wasted valuable reactive nitrogen resources.[12]

63. TFRN have already identified in 2011 a "Top Five" priority areas for ammonia emission abatement (ECE/EB.AIR/WG.5/2011/16):

i. Low-emission application of manures and fertilizers to land.

ii. Animal feeding strategies to reduce nitrogen excretion.

iii. Low emission techniques for all new stores for cattle and pig slurries and poultry manure.

iv. Strategies to improve nitrogen use efficiencies and reduce nitrogen surpluses.

v. Low emission techniques in new and largely rebuilt pig and poultry housing.[13]

IX. Non-technical measures, best available techniques and energy-efficiency requirements

64. Assessment of the emission reduction potential of (best available) non-technical and structural measures. Review of best available techniques to reduce emissions. Specific focus on black carbon (as component of particulate matter), ammonia and methane. Assessment of the need to include requirements on energy efficiency.

65. The technical annexes to the revised Gothenburg Protocol include emission limit values for installations, vehicles and products (ELVs), based on best available techniques during the preparation of the revised protocol. Due to technical progress, some of these ELVs would require an update. More recent best available techniques to reduce emissions are presented in guidance documents from TFTEI and TFRN[14].

66. Implementation of emission limit values (ELVs) is not always sufficient to meet national emission reduction obligations or air quality targets. In such cases, additional actions in the form of "non-technical" measures could be considered at the national or local level. This could include encouraging a faster substitution of old and polluting technologies by new and cleaner technologies, facilitating the use of cleaner fuels or feedstocks, or stimulating a greener behaviour of consumers, e.g., through a modal shift from private to public transport, dietary changes or domestic energy saving. Often, such measures prove to be more efficient and less costly than implementing stricter ELVs. The common feature of structural and behavioural changes is that they cannot easily be implemented via permitting of specific activities. They often require a combination of actions by producers and consumers and a

[12] Activities linked to the International Nitrogen Management System (INMS) have drawn attention to a global loss of reactive nitrogen worth US$200 billion per year, pointing to the opportunity to "halve nitrogen waste" by 2030, saving US$100 billion per year globally, as embraced as part of national action plans under the Colombo Declaration.

[13] A more comprehensive list of ammonia and nitrogen mitigation options is listed in the Informal Document (paragraph xx) [Paragraph starting "The main needs to update…"]

[14] Code of good practice for solid fuel burning and small combustion installations, 2019: https://www.unece.org/fileadmin/DAM/env/documents/2019/AIR/EB/ECE_EB.AIR_2019_5-1916518E.pdf

wider set of policy instruments, including financial incentives, infrastructural investments, and awareness raising[15].

67. The draft TFIAM/TFTEI Guidance Document on Prioritization of PM sources[16] identifies 'non-technical" measures as the main measures would reduce PM-emissions and also significantly reduce BC (and PAH) emissions: 1) Reduction of residential burning of coal and wood; 2) Reduction of open field (agricultural) residue burning; 3) Scrapping old diesel vehicles & old non-road mobile machinery.

68. According to TFRN a wide range of cost effective and reliable measures is available to Parties to achieve their national emissions reduction commitments for ammonia. These include: measures on animal housing, storage of manure, spreading of solid and liquid manures and of urea and other inorganic fertilizers to land, together with measures to promote recovery and re-use of nitrogen and other resources, with an emphasis on reducing pollution and developing the circular economy with innovation opportunities. Control of ammonia emissions can be seen as part of a wider strategy to reduce the huge amount of valuable reactive nitrogen resource that is wasted (REF). Several TFRN documents give additions to the measures in the revised Annex IX (ECE/EB.AIR/WG.5/2011/16) that is now 10 years old.[17] The challenge will be to avoid trade-offs between ammonia emission reduction and methane emission reduction.

69. Dietary change has huge potential to influence nitrogen losses to the environment, including ammonia, nitrous oxide, nitrogen oxides, nitrate and di-nitrogen. In Europe, meat and dairy consumption in excess of dietary needs is contributing substantially to pollution and waste of nitrogen resources.

70. Analysis by TFRN has shown that halving meat and dairy intake in Europe (demitarian scenario) would reduce ammonia emissions by around 40%, with co-benefits for health and climate.[18]

X.Flexibility provisions

71. The amended Gothenburg Protocol contains a wide range of flexibility provisions, some of which are addressed to all parties in order to facilitate full implementation of all requirements and some of which are specifically intended to facilitate ratification by the EECCA and other countries that have not yet ratified the Protocol. The flexibility provisions vary in type, scope and impact.

72. Some flexibility provisions were already available in the original 1999 version of the Gothenburg Protocol. Several new flexibility provisions were added to the amended 2012 version of the Gothenburg Protocol. In addition, the amended Gothenburg Protocol, like the original Protocol, contains separate provisions for Canada and the USA to address the different air quality management systems in North America. These provisions include obligations that are equivalent in terms of stringency and level of ambition. The use of a designated pollutant emission management area (PEMA) is also available, and is for the large countries (Canada, the USA and the Russian Federation).

73. The 2012 amendment to the Gothenburg Protocol introduced several flexibility provisions to specifically accelerate / encourage ratification by non-Parties (e.g., EECCA countries): see in particular article 3bis (flexible transitional arrangements), article 7(6) (reporting of limited emission inventories) and annex VII (4) (longer timescales for

[15] See: Note_on_non-technical_and_structural_measures_-201120.pdf (unece.org)

[16] ECE_EB.AIR_WG.5_2021_8-2102625E.pdf (unece.org)

[17] Guidance document on emission control techniques for mobile sources, 2016:
https://www.unece.org/fileadmin/DAM/env/documents/2016/AIR/Publications/ECE_EB.AIR_138_En.pdf)

[18] Westhoek et al., 2015 "Nitrogen on the Table" report

application of limit values). The flexibility provisions in articles 3bis and article 7(6) have expired in the meantime. The expiry date in paragraph 4 of annex VII was extended by Decision 2019/23. None of these provisions have been used so far nor have they led to further ratifications. Another important provision for non-Parties to the present protocol is given in article 13.1. This Article allows any Party to the Convention to add its name and emission reduction commitments to Annex II of the Gothenburg Protocol at a later stage, when a Party is ready to ratify (and it is able to propose meaningful emission reduction commitments on the basis of further developed emission inventories of sufficient quality). The adjustment procedure is also a new flexibility mechanism that was introduced in the amended Gothenburg Protocol (see article 3.11 quinquies) and since 2014 provisionally applied for compliance with the 2010 ceilings of the original Gothenburg Protocol. Although now used by current Parties to the Protocol for implementation and compliance purpose, it may also be an important flexibility mechanism for current non-Parties to be able to ratify.

74. Preliminary key findings

- The amended Gothenburg Protocol has only recently entered into force (7 October 2019). As a result, there is limited insight into the extent to which the new flexibility provisions are considered useful, used and potentially effective. This makes the review of these provisions difficult. Experience gained and knowledge about the use of the flexibility provisions of the original Gothenburg Protocol is helpful in this context. Parties' replies to the questionnaire on the review of current flexibilities, which are due by 30 September 2021, may provide further insight into the use and usefulness of the current flexibility provisions.
- Several of the new flexibility provisions introduced in the amended Gothenburg Protocol to facilitate further ratifications (flexible arrangements, limited reporting) have already expired and were never used.
- Article 7.1(a) requires reporting on the use of equivalent emission reduction strategies and derogations from limit values. No such reporting has ever taken place. This means that the flexibility provisions allowed under articles 3(2), 3(3) and 3(7) are either not applied or not reported. Again, the Parties' replies to the questionnaire may provide further insight into this issue. The lack of reporting on the use of these flexibility provisions impedes proper monitoring and enforcement.
- The adjustment procedure is a widely used and resource intensive mechanism and seems (for certain parties) indispensable.
- Some of the new flexibility provisions have not yet been applied (e.g. 3-year average) because the amended Gothenburg Protocol has only recently entered into force and demonstration of compliance with the 2020 emission reduction commitments will only take place for the first time in 2022.

75. Preliminary key conclusions

- To date, the current flexibility provisions have not proven adequate and/or effective in facilitating further ratifications. In particular, the additional flexibility mechanisms introduced in the amended Protocol to increase the number of ratifications (articles 3bis, 7(6) and annex VII(4)) have not met expectations.
- For the time being, however, we should remain cautious about drawing firm conclusions on the usefulness and effectiveness of the current flexibility provisions, as the amended Gothenburg Protocol has only recently entered into force. Parties' replies to the questionnaire may provide further useful information.
- A primary reason for the persistent non-ratification of the amended Gothenburg Protocol by EECCA and other countries could be that the Gothenburg Protocol and its eleven technical annexes are complicated and may be too demanding on a country.
- Options for discussion for addressing flexibility in the future is needed as part of and after the review process. The thematic session on barriers to ratifying and

implementing the Gothenburg Protocol, currently scheduled for Spring 2022, will include a broad discussion on potential options to further improve ratification.

76. Recommendations

- To increase the effectiveness of the Protocol and to facilitate ratification and implementation, consider and implement improvements to the current flexibility provisions that could be pursued under the 2012 amended Protocol itself. These could include: operational improvements to flexibility provisions to facilitate implementation/compliance such as improved reporting and monitoring of the use of current flexibility provisions, adjustments of existing guidance or EB decisions; development of new implementing guidance or EB decisions, reduction of the work load and administrative burden of the adjustment procedure.
- To consider and discuss new options for a potential revision of the 2012 amended Gothenburg Protocol that could help non-Parties overcome barriers and move towards ratification and implementation.

77. This chapter will be updated on the basis of Parties' replies to the questionnaire, the outcome of the planned thematic session on barriers and other relevant information (e.g., findings of emission inventory capacity workshops).

XI. Convention Parties that are not parties to the Protocol

78. Given the high importance of increasing ratification and implementation of the Gothenburg Protocol, this separate chapter for non-Parties to the Gothenburg Protocol summarizes the key findings for these parties resulting from the other chapters as an aid to arriving at appropriate recommendations.

XII. Canada and the United States of America

79. This section recognizes that the amended Gothenburg Protocol includes a number of commitments for parties outside the geographical scope of EMEP, which in most cases includes Canada and the United States of America, unless otherwise specified. It also recognizes that Canada and the United States are bilaterally addressing cross-border air pollution under the Canada-United States Air Quality Agreement, which includes commitments by both countries to reduce emissions of sulphur dioxide, nitrogen oxides, and volatile organic compounds. Although the review report will integrate inputs from Canada and the United States of America into the relevant chapters/sections, as appropriate to national circumstances, this section will include all other relevant information.

80. Canada and the United States of America have ratified the 1999 Gothenburg Protocol (in December 1999 and December 2018 for the United States and Canada respectively) and its 2012 amendments (in January 2017 and November 2017 for the United States and Canada respectively), and have, upon ratification, submitted their respective emission reduction commitments to annex II and relevant emission limit values into annexes IV, V, VI, VIII, X and XI. Canada and the United States of America have a long history of bilateral cooperation on transboundary air pollution through the 1991 Canada-United States Air Quality Agreement (AQA). In early 2021, the two countries initiated work on a joint review and assessment of AQA, examining whether it is meeting its environmental objectives as well as its sufficiency in addressing transboundary air pollution between Canada and the United States. The review and assessment focus on pollutants/issues covered by the Air Quality Agreement that cause acid rain and ozone formation, as well as their transboundary impacts. The review also examines pollutants/issues not currently addressed by the AQA, such as fine particulate matter, including concentrations and trends, as well as transboundary flows and impacts. The review is scheduled for completion in late 2022.

81. Ammonia is not covered by the Air Quality Agreement, but it is also of concern in Canada and the United States of America as atmospheric ammonia is a key precursor to the formation of fine particulate matter and contributes to acid deposition and eutrophication. Additional assessments are needed to quantify the impacts. Discussions are ongoing. In the context of the Gothenburg Protocol review, the US and Canada are not currently incorporated into the provisions of Annex IX (under Article 8 of the Gothenburg Protocol).

XIII. Hemispheric transport

82. The role of hemispheric transport is important in the UNECE region as global background levels of ozone and PM and their precursors, including methane emissions, contribute to air pollution within the UNECE region which has impacts on public heath, ecosystems and biodiversity.

83. The hemispheric contribution to ground-level ozone is larger than the hemispheric contribution to PM or its components due to ozone's longer atmospheric lifetime. The concentration of ozone experienced at any given location is the combination of ozone and ozone precursors transported from distant sources on hemispheric to regional scales and, depending on the photochemical regime, local photochemical ozone production or local ozone loss due to titration with nitrogen oxide. The relative influence of background ozone increased, including ozone from hemispheric transport, on local concentrations of ozone experienced in urban areas of the ECE region, but especially in Europe.

84. The contribution of anthropogenic emission sources outside the ECE region to PM species and their associated impacts within the ECE region is negligible compared with the impact of local anthropogenic sources. Wildfires and wind-blown dust emanating from outside the ECE, however, do influence PM levels and deposition in the ECE region and are sensitive to changes in climate.

85. The absolute contribution of NOx and VOC emissions outside the ECE region to annual average ground-level ozone in Europe and North America is not expected to change significantly under a business-as-usual scenario to 2050. In addition, expected increases in global methane are expected to more than offset projected reductions of NOx and VOC emissions in Europe and at least partially offset reductions of NOx and VOC emissions in North America.

86. If NOx and VOC emissions were reduced everywhere by the same percentage, the emission reductions outside of Europe would have a bigger impact on European ozone levels than the emission reductions within Europe. In North America, equal percentage emission reductions of NOX and VOC outside of North America would contribute significantly to decreases of ozone in North America, but not more than the equal percentage emission reductions in North America itself.

87. Projected trends in anthropogenic methane emissions span a very wide range, between a factor of two smaller or a factor of two larger than present-day emissions by the end of the century, depending on assumptions made about economic development and the use of emission control technology.

88. Ozone formation is strongly influenced by the atmospheric methane burden, with model studies consistently showing that higher mixing ratios of methane lead to higher background mixing ratios of ground-level ozone.

89. [Placeholder for conclusions that address the need for methane reductions globally; links to the work of the Forum for International Cooperation on Air Pollution, and further work by the Convention as per the Long-term Strategy for 2020-2030 and beyond.]

XIV. Integrated multi-pollutant multi-effect approach

90. The robust science and technical base within the Convention lays the groundwork for the continued support of a comprehensive multi-pollutant, multi-effect approach to managing air quality. An integrated multi-pollutant approach is more cost effective than the original flat

rate emission reduction agreements for individual pollutants, it increases the synergies in policy measures, makes the most efficient use of available resources, and increases the benefits associated with air quality management, such as reducing risk to public health. A primary goal of multi-pollutant planning is to identify and evaluate control strategies targeting emissions of acidification, eutrophication, ozone and $PM_{2.5}$ and their precursors. However, a multi-pollutant definition is far broader and can also incorporate other pollutants and environmental concerns such as climate change and biodiversity loss as discussed in the LTS.

91. The Convention's tools and technical expertise have the potential to support cities and air agencies in developing risk-based multi-pollutant air quality management (AQM) plans and implementing multi-level strategies that reduce air pollution emissions and improve public health. For example:

-Identifying local- and regional emission reduction measures that address multiple pollutants;

-Developing multi-level policy strategies to achieve long term targets of the Gothenburg Protocol and the WHO guidelines;

-Demonstrating the importance of selected policy measures for reducing health risks from exposure to O_3, PM and their precursors;

-Using and further developing an integrated approach to address air pollution through a multi-pollutant and multi-effect approach (e.g., GAINS model), that takes into account i.e., climate, energy and agricultural policies and measures, that considers interactions with climate change, biodiversity loss and other environmental problems and that can achieve multiple benefits and avoid trade-offs; and

[*Note: Does this belong here? If so, do we add other problems related to reactive nitrogen (e.g., nitrate leaching to waters, N2O-impacts in the last sentence of first paragraph in this section?* -Though many climate and energy measures could have benefits for air quality, it will not significantly influence air quality issues related to nitrogen. New ways to address nitrogen are reporting of National Nitrogen Budgets as this provides an opportunity to optimise for multiple benefits in relation to environment, climate, health and economy. However, nitrogen budgets have been only used by a few Parties. (The main barriers appear to be the lack of any mandatory requirement of the Gothenburg Protocol as amended in 2012, resources to provide national budgets, and resources for awareness raising on the benefits of such an approach).]

XV. Synergies and interactions with other policy areas

92. There are several synergies and interactions with *inter alia* climate change, energy, transport, agricultural and nitrogen management policies. CIAM calculations indicate that full implementation of policies and measures in these other areas could offer substantial and cost-effective emission reductions of air pollutants covered by the Gothenburg Protocol. Such measures would make attaining air quality targets more likely.

93. To limit negative effects of reducing air pollution on climate change, more focus is needed on reducing emissions of air pollutants that have a warming effect, such as black carbon and ozone precursors. Methane reduction plays a key role in reaching synergetic effects, as methane is both a greenhouse gas and an increasing determinant of ozone formation.

94. The main anthropogenic sources of methane emissions are waste treatment, oil and gas production and cattle. Cost-effective technical solutions are available to reduce methane emissions from waste treatment and oil and gas production. [19] In order to reduce methane emissions from cattle, less technological options are available. Here, behavioural change

[19] An informal paper will be produced by CIAM for WGSR60. See also e.g.: Höglund-Isaksson et al. (2020). Technical potentials and costs for reducing global anthropogenic methane emissions in the 2050 timeframe –results from the GAINS model. Environ. Res. Commun. 2 (2020) 025004 https://doi.org/10.1088/2515-7620/ab7457

leading to less (over-) consumption of meat and dairy could offer synergetic impacts on health, climate, ozone formation, as well as nitrogen pollution.

95. Black carbon has multiple environmental effects. It contributes to health effects associated with $PM_{2.5}$ and it absorbs light and heats the atmosphere, contributing to global warming. When deposited onto ice and snow, it accelerates melting - a significant issue in the Arctic and mountain glaciers. Emission scenarios that stabilize global warming at 1.5° C include global black carbon emission reductions of 40-60 per cent by 2030. Black carbon is co-emitted with other particles that reflect light and contribute to cooling. Because black carbon is emitted in population centres, it contributes to highly localized air quality issues. Black carbon concentrations are on average 2.5 times higher in populated areas compared to remote locations. The Convention should coordinate with the Artic Council and the CCAC to develop the best strategy to address black carbon.

96. Ammonia emissions are hardly influenced by climate and energy measures. Reduction of ammonia emissions can however play an important role in meeting nitrogen deposition targets and halting biodiversity loss as part of an integrated approach to reduce nitrogen pollution (i.e., including tackling other forms of nitrogen pollution, such as nitrate leaching and emissions of nitrous oxide).

97. At its sixtieth session, WGSR plans to discuss the need and potential options to address methane in a future instrument: e.g., if and how to include methane in the protocol, which emission sources to focus on, and how to link with the Forum for International Collaboration on Air Pollution, the UNFCC and the Global Methane Initiative (GMI).

98. Nitrogen losses to the environment, including ammonia emissions, are strongly dependent on agricultural policies. While abatement techniques offer a large reduction potential, agricultural funding schemes, pricing policies, and other agricultural policies are also important to ensure cost-effective emission reductions.

XVI. Progress towards achieving the objectives of the Protocol

99. Assessment of the progress towards achieving the objectives of the amended Gothenburg Protocol. The chapter should provide an answer to the question of whether the protocol obligations, if fully implemented, would lead to the desired results in reducing emissions of sulphur, nitrogen oxides, ammonia, volatile organic compounds and particulate matter, including black carbon, and their effects on human health and the environment, in view of the latest best available scientific knowledge.

100. Emissions of NOx from soils are specifically excluded from the emission reduction commitments in the revised Gothenburg Protocol (for EU Member States). This represents a barrier to progress in further reducing total NOx emissions, while not giving credit for progress with such measures. These measures also reduce total nitrogen waste, with co-benefits for climate, stratospheric ozone and water quality.[20]

101. Work to be carried out and results to be expected by Fall 2021 / Spring 2022:

- GAINS optimized emission reduction calculations based on updated emission inventories and projections and using the same gap-closure ambitions as used in the preparation of the amended Gothenburg Protocol. Calculations may include the sensitivity for including condensable PM-emissions, NOx and NMVOC from agricultural land and deposition reduction targets for marine ecosystems.
- GAINS calculations to explore what emission reductions would be needed for attainment of critical loads and levels and the WHO air quality guidelines.
- GAINS calculations to estimate the remaining risks for health, ecosystems and crops, assuming 1) full implementation of the 2020 emission reduction obligations; 2) emission projections for 2030 and possibly: 3) tentative emission projections for 2050 assuming implementation of climate policies.

[20] Guidance Document on Integrated Sustainable Nitrogen Management ECE/EB.AIR/149

- MTFR scenarios considering the BAT and ambitious ELVs as defined in the technical annexes will be developed. Concentration and deposition calculations will be performed evaluating health and environmental impacts.
- In the absence of the harmonized projections for the non-parties to the Protocol (non-EU West Balkan and EECCA) several alternative sources will be used and implemented in GAINS.
- A TFIAM/TFTEI-report on the Costs of Inaction will be available by the end of 2021.

XVII. Additional policy issues

102. Assessment of adequacy and suitability of key articles (including but not limited to objectives in article 2, reporting provisions in article 7, review provisions in article 10, adjustment provisions in article 13, and amendments procedures in article 13bis) of the amended Gothenburg Protocol. Assessment of the need and best approach to include methane in a future instrument. Description of the policy implications of including condensable particles in reporting of emissions of particulate matter.

103. Wider agricultural and integrated nutrient management policies offer great potential to reduce ammonia and other nitrogen pollution, for example through: EU Reform of agricultural funding; the EU Farm-to-Fork and Biodiversity Strategies aim to "reduce nutrient pollution by 50% by 2030", directly building on the Colombo Declaration; and the present global negotiations on biodiversity and climate to take into account the negative effects of nitrogen emissions.

104. [Concerning methane TFRN adds:] Considering agricultural sources, several measures are available to reduce methane emissions. They are mostly related to dietary change of ruminants and storage/processing of manure.

XVIII. Conclusions

105. Description of main review findings and conclusions on the adequacy of the obligations and the progress made towards the achievement of the objectives of the amended Gothenburg Protocol. Recommendations for next steps and further work.