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Item 5 of the provisional agenda

Review of sufficiency and effectiveness of the Protocol to Abate Acidification, Eutrophication and Ground-level Ozone**Executive Body for the Convention on Long-range
Transboundary Air****Fortieth session**

Geneva, 18 December 2020

Item 5 of the provisional agenda

**Review of sufficiency and effectiveness of the Protocol to
Abate Acidification, Eutrophication and Ground-level Ozone****Preparations for the review of the Protocol to Abate
Acidification, Eutrophication and Ground-level Ozone as
amended in 2012*****Submitted by the Gothenburg Protocol review group***Summary*

The amendment to the Protocol to Abate Acidification, Eutrophication and Ground-level ozone (the Gothenburg Protocol) of 2012 entered into force on 7 October 2019. At its thirty-ninth session (Geneva, 9–13 December 2019), the Executive Body launched the review of the Gothenburg Protocol, as amended, and, in its decision 2019/4, requested the Working Group on Strategies and Review to develop a plan for the review, including its scope and content, and to produce a detailed work schedule for the review, including the procedure for undertaking it.

The current document was prepared by the Gothenburg Protocol review group convened by the Chair of the Working Group on Strategies and Review. The document sets out a proposed approach for the preparation for the review, including its plan and work schedule. It is aimed to facilitate discussions by the Working Group on Strategies and Review at its fifty-eighth session and by Parties at the fortieth session of the Executive Body.

* The present document is being issued without formal editing.



I. Introduction

1. The amendment to the Protocol to Abate Acidification, Eutrophication and Ground-level ozone (Gothenburg Protocol), adopted in 2012, entered into force on 7 October 2019. Pursuant to article 10 of the Protocol as amended, Parties shall keep under review the obligations set out in the present Protocol, including the adequacy of the obligations and the progress made toward the achievement of the objective of the present Protocol¹. In December 2019, the Executive Body decided to launch the review of the Gothenburg Protocol and to task the Working Group on Strategies and Review with elaborating a plan for the review that included its scope and content and with producing a detailed work schedule for the review, including the procedure for undertaking it, that included a prioritization, as needed, of the elements to be considered in the review.

2. At the request of the Chair of the Working Group on Strategies and Review and with the support of the Executive Body Bureau, the Gothenburg Protocol review group was formed to develop a plan for the review. The review group includes Vice-Chairs of the Working Group on Strategies and Review together with invited experts². The group was tasked with developing a preparatory document to address the scope and content of the review of the Protocol, as well as to continue to elaborate elements for, and inputs to, the review on the basis of Annex I to the report of the Working Group on Strategies and Review at its fifty-seventh session (ECE/EB.AIR/WG.5/122). The work of the review group will help facilitate discussions by the Working Group at its fifty-eighth session to produce a detailed work schedule for the review, including the procedure for undertaking it, that includes a prioritization, as needed of the elements to be considered in the review.

3. In accordance with Executive Body decision 2019/4, the present document provides information on the elements that should be taken into consideration by Parties for the review of the Gothenburg Protocol that have been highlighted by the 2016 scientific assessment of the Convention³, the policy response to the 2016 scientific assessment of the Convention (ECE/EB.AIR/WG.5/2017/3 and Corr.1) and prioritized in the long-term strategy for the Convention for 2020–2030 and beyond (ECE/EB.AIR/142/Add.2, decision 2018/5, annex). It also takes into account additional proposals presented at the thirty-ninth session of the Executive Body (Geneva, 9–13 December 2019), as well as the elements submitted by interested parties to the secretariat as invited by the Executive Body. The purpose of the forthcoming review will be to assess and evaluate whether the goals and objectives of the present amended Gothenburg Protocol can be met in the long term. Based on the identified elements, this document includes a detailed work schedule with proposed milestones and anticipated timing of completion of work. As part of the work schedule of the review, a compilation of questions to be answered by subsidiary bodies, task forces and centres is included in annex I to the document.

4. The key priorities⁴ of the scope and content of the review should include an initial focus on the legally required elements pursuant to the provisions of article 10 of the Protocol. The review, the outcome of which will help Parties determine if an update to the Gothenburg Protocol is necessary, should include an evaluation of mitigation measures for black carbon and ammonia emissions. It should also take into account the sufficiency and effectiveness of

¹ Present Protocol refers to the Gothenburg Protocol, as amended in 2012.

² The review group was chaired by Ms. Kimber Scavo and included the Vice-Chairs of the Working Group on Strategies and Review Ms. Dominique Pritula, Mr. Till Spranger, and Mr. Ivan Angelov, together with the following experts – Mr. Richard Ballaman, Mr. Peter Meulepas, and Mr. Noe Megrelishvili acting on the basis of personal expertise; and the Co-Chairs of Task Force on Integrated Assessment Modelling Mr. Rob Maas and Mr. Stefan Astrom, the Task Force on Techno-economic Issues Mr. Tiziano Pignatelli and Mr. Jean-Guy Bartaire, and the Task Force on Reactive Nitrogen Ms. Claudia Marques dos Santos Cordovil, Mr. Mark Sutton and Mr. Tommy Dalgaard. Ms. Anna Engleryd and Ms. Susanne Lindahl served as advisors.

³ 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).

⁴ The priorities referenced in this paragraph have been taken from paragraphs 49 and 50 of the long-term strategy for the Convention for 2020-2030 and beyond.

current obligations and the Parties' success in achieving the Protocol's objectives. Given the high importance of increasing ratification and implementation of the Protocol, the review should include steps to gather information from Parties that have not yet ratified it in order to help inform recommendations and conclusions of the review.

5. This document provides as much clarity and direction to subsidiary bodies (the Working Group on Strategies and Review, the Working Group on Effects, and the EMEP Steering Body) as is possible at this time. These bodies may need to adjust their 2020–2021 workplan, as appropriate, to be able to undertake some of the work required for the review. Also, the Implementation Committee, in support of the review work to be carried out by the subsidiary bodies, may need to adjust its 2020–2021 workplan.

II. Elements included in the review

A. Legally required elements

6. Article 10 of the Gothenburg Protocol requires that Parties keep under review the obligations of the Protocol and broadly specifies the modalities of such reviews. Paragraphs 2 (a) and (b) of article 10 are important in determining some of the content and structure of the review report, while paragraph 2 (c) deals with procedural matters for the review. Although paragraphs 2 (a) and 2 (b) include information on a broader review of the Gothenburg Protocol, paragraphs 3 and 4 refer to specific elements that shall be included in the review, i.e., measures to address black carbon and ammonia, respectively.

1. Timing of the review

7. Paragraph 2 (c) of article 10 stipulates that the procedures, methods and timing for reviews shall be specified by the Parties at a session of the Executive Body and that the first such review shall commence no later than one year after the present Protocol (meaning the Protocol as amended) enters into force. Article 10 also requires that a review should include an evaluation and assessment of mitigation measures for black carbon emissions no later than at the second session of the Executive Body after entry into force of the amended Protocol (paragraph 3) and that Parties should, also no later than at the second session of the Executive Body after the entry into force of the amended Protocol, evaluate ammonia control measures and consider the need to revise annex IX (paragraph 4). The second session of the Executive Body after the entry into force of the amended Protocol corresponds to the fortieth session of the Executive Body.

8. Pursuant to article 10, the Executive Body, by decision 2019/4, initiated a review of the amended Gothenburg Protocol at its thirty-ninth session, following the amended Protocol's entry into force on 7 October 2019. As per decision 2019/4, the plan and work schedule for the review will be considered at the fortieth session of the Executive Body, with a view to concluding the review at its forty-second session, unless otherwise decided by the Executive Body. All Convention bodies were invited to plan their work for the review.

2. Towards cost-effective and effects-oriented emission reductions

9. Paragraph 2 (a) of article 10 of the Protocol specifies some of the issues to be addressed by the review. According to its subparagraph (i), the Parties' obligations in relation to their calculated and internationally optimized allocations of emission reductions⁵, referred to in article 7, paragraph 5, should be assessed and reviewed. Article 7, paragraph 5 requires Parties to arrange for the preparation of revised information on calculated and internationally

⁵ The calculated and internationally optimized allocations of emission reductions referred to in article 7, paragraph 5 of the amended Gothenburg Protocol are prepared by using an integrated assessment model (IAM) or equivalent alternative. The IAM usually optimizes to reduce the difference between effects related to current or projected emissions (based on current legislation) and effects related to maximum feasible emission reductions. IAM is able to produce national emission reductions at least cost per Party or for the ECE region as a whole, for set effect reduction targets (cost-effective optimization).

optimized allocations of emission reductions for the States within the geographical scope of EMEP, using integrated assessment models, including atmospheric transport models, or such alternative assessment methods approved by the Executive Body. This means that the Parties' emission reduction commitments specified in annex II to the Protocol should be assessed and reviewed in the light of the revised information on calculated and internationally optimized emission reduction allocations. The review should evaluate the emission reduction commitments in the amended Gothenburg Protocol for 2020, not the fixed emissions ceilings in the original protocol for 2010.

3. Achieving the objective of the Protocol

10. Paragraph 2 (a) subparagraph (ii) of article 10 requires the review of the adequacy of the obligations and the progress made towards achieving the objective of the Protocol as outlined in article 2, paragraph 1 and 2. The objective of the present Protocol as outlined in article 2 is "...to control and reduce emissions of sulphur, nitrogen oxides, ammonia, volatile organic compounds and particulate matter that are caused by anthropogenic activities and are likely to cause adverse effects on human health and the environment, natural ecosystems, materials, crops and the climate in the short and long term, due to acidification, eutrophication, particulate matter or ground-level ozone as a result of long-range transboundary atmospheric transport, and to ensure, as far as possible, that in the long term and in a stepwise approach, taking into account advances in scientific knowledge, atmospheric deposition or concentrations do not exceed..." the critical loads, critical levels, acceptable levels and ambient air quality standards as described in annex I to the Protocol and as applicable for the Parties in question.

11. A further objective that is defined in article 2 is that "...Parties should, in implementing measures to achieve their national targets for particulate matter, give priority, to the extent they consider appropriate, to emission reduction measures which also significantly reduce black carbon in order to provide benefits for human health and the environment and to help mitigation of near-term climate change."

12. The assessment of the adequacy of the obligations should consider whether the Gothenburg Protocol has been sufficiently successful in the achievement of its objectives, and should also consider whether certain elements of the Protocol may no longer serve to achieve the objectives of the Protocol, as they could, for example, create overlap or duplication of efforts with other measures already in place. The assessment of the adequacy includes an assessment of the sufficiency and effectiveness. Pursuant to paragraph 2(b) of article 10, the review shall take into account 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.

4. Evaluation of mitigation measures for black carbon emissions and ammonia control measures and annex IX to the Protocol

13. As per article 10, paragraphs 3 (mitigation measures for black carbon emissions) and 4 (measures to control ammonia with a view to consider revising annex IX) of the Protocol, initial priority should be given to the review and assessment of the provisions of annex IX on ammonia and the provisions of annexes VIII and X with respect to particulate matter. For annex IX, this should include and not be limited to, a formal update of the Guidance document for preventing and abating ammonia emissions from agricultural sources (ECE/EB.AIR/120) and the United Nations Economic Commission for Europe Framework Code for Good Agricultural Practice for Reducing Ammonia Emissions (ECE/EB.AIR/129). It should be noted that when the Gothenburg Protocol was amended in 2012, annex IX was not revised at that time. The extent of progress in establishing national ammonia codes and other requirements of annex IX should also be reviewed. The guidance document on prioritizing reductions of particulate matter that are also significant sources of black carbon will be useful in this regard.

B. Elements in the existing Protocol (including expanded list of elements from Executive Body decision 2019/4 as well as from the report of the Executive Body on its thirty-ninth session⁶)

1. Sufficiency and effectiveness

14. Broadly, the review should address the sufficiency and effectiveness of obligations with respect to progress made towards achieving the objectives set for acidification, eutrophication, ozone and its precursors, and particulate matter and its precursors, and indicate whether there is a need for possible further emission reduction requirements to meet the objectives of the Protocol.

15. As such, the relevant obligations to be reviewed here (in particular with respect to ozone, particulate matter and nitrogen) could include those under:

(a) Article 3, paragraph 1 related to the achievement of emission reduction commitments in annex II, as well as the progress made in taking steps to prioritize reductions of emissions of particulate matter from those source categories known to emit high amounts of black carbon, to the extent it is considered appropriate;

(b) Article 3, paragraphs 2 (subject to paragraphs 2 bis and 2 ter) and 3 related to the application of emission limit values in annexes IV, V, VI and X for new and existing stationary sources, including the recommendatory provisions for small scale solid fuel burning in annex X;

(c) Article 3, paragraph 5 related to the application of limit values for fuels and new mobile sources (annex VIII);

(d) Article 3, paragraph 6 related to the application of best available techniques for mobile sources covered by annex VIII and stationary sources covered by annexes IV, V, VI and X, as well as measures to control black carbon as a component of particulate matter;

(e) Article 3, paragraph 7 related to the application of emission limit values for VOC contents of products (annex XI); and

(f) Article 3, paragraph 8 related to the application of measures to control ammonia emissions (annex IX) and related the application of best available techniques for preventing and reducing ammonia emissions.

16. As per article 3, paragraph 11, Canada and the United States of America are to submit their emission reduction commitments upon ratification for automatic incorporation into annex II. As per article 11bis, Canada will submit relevant emission limit values for automatic inclusion into annexes IV, V, VI, VIII, X, and XI with respect to sulphur, nitrogen oxides, volatile organic compounds. As part of this process, both countries review and submit their respective emission reduction commitments and emission limit values as appropriate. Canada and the United States of America have a long history of cooperation on environmental issues including on transboundary air pollution through the Canada-United States Air Quality Agreement. Canada and the United States of America are currently undertaking an exercise to define the scope and content of a potential review and assessment of the Air Quality Agreement, looking at covering fine particulate matter, ground-level ozone, and additional topics as appropriate.

2. Current flexibilities

17. Additionally, the review should include addressing articles 3 bis and 13, which provide provisions for flexible arrangements to ratification and implementation of the Protocol. Regarding the current flexibilities identified in the present Protocol and its annex VII, an assessment of whether the present Protocol is effective enough to allow for full implementation and increased ratification should also take place. The review of these provisions should take into consideration the adjustment procedures, timescales and deadlines and whether they are sufficient and effective to meet the objective of the Protocol.

⁶ See ECE/EB.AIR/144, paras.25–27.

3. Other articles of the Protocol

18. In addition to the specific articles and paragraphs listed above, a review of the other key articles of the amended Gothenburg Protocol should include but not be not limited to, the objectives as outlined in article 2; reporting provisions in article 7, including an assessment of the reporting of black carbon emissions; review provisions in article 10; adjustment provisions in article 13 (including current mechanisms and criteria for adjustment procedures in relation to emission inventories and reduction commitments); as well as amendments procedures in article 13bis.

C. Elements to address gaps and additional inputs

19. Under the Protocol, reviews shall take into account the best available scientific information on the effects of acidification, eutrophication, ground-level ozone and particulate matter, including assessments of all relevant health effects, 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 with a focus on best available techniques and practices, especially related to ammonia, particulate matter including black carbon, and methane, and the fulfilment of the obligations on emission levels (as appropriate). Annex I to this document includes a series of questions for the subsidiary bodies that address the important scientific and technical elements needed for the review. It also includes questions for the Working Group on Strategies and Review.

20. As per the long-term strategy for the Convention for 2020–2030 and beyond (paragraph 50), the review should look at appropriate steps towards reducing emissions of black carbon, ozone precursors not yet addressed such as methane, and emissions from shipping with due consideration for International Maritime Organization (IMO) policies and measures. The review should also include a reflection on the flexibility provisions in the amended Protocol and should consider opportunities for an integrated approach to environmental policy. Annex I to this document includes a series of questions for the subsidiary bodies, task forces and centres that address the important scientific, technical and policy-related elements needed for the review. In line with the priorities identified in the long-term strategy for the Convention for 2020–2030 and beyond, the following should specifically be considered in answering the questions in annex I:

- (a) Definition of black carbon and reducing emissions of black carbon;
- (b) Hemispheric transport of ozone and particulate matter and their precursors and advancing efforts to address air pollution on a broader scale per paragraphs 63 and 78 of the long-term strategy for the Convention for 2020–2030 and beyond; health and ecosystem impacts from outside the ECE region;
- (c) Methane and its relationship to the hemispheric transport of ozone and its contribution to ozone in the ECE region;
- (d) Integrated measures and instruments to reduce emissions of particulate matter, black carbon and polycyclic aromatic hydrocarbons;
- (e) Non-technical measures⁷;
- (f) Further flexibilities and new approaches to facilitate ratification and implementation by Parties that have not yet ratified the Protocol including countries in Eastern Europe, the Caucasus and Central Asia. Include barriers to ratification and implementation;

⁷ An informal document of work to date on non-technical measures will be made available by the Gothenburg Protocol review group for the fifty-eighth session of the Working Group on Strategies and Review.

- (g) Analysis of costs and benefits and costs of inaction;⁸
- (h) Further develop the multi-pollutant and multi-effect approach through an integrated approach per paragraph 68 in the long-term strategy for the Convention for 2020–2030 and beyond that considers interactions between ozone, nitrogen, climate change and ecosystems and addresses agricultural, transport, energy and other policies. Include how linkages with climate change and changing land management practices would impact effect indicators;
- (i) Opportunities for reduction of nitrogen oxide as part of integrated sustainable nitrogen management and for emissions of volatile organic compounds from agricultural and forest management activities, noting that these are currently excluded from the Gothenburg Protocol;
- (j) Quality and consistency of emission inventories;
- (k) Emissions from shipping with due consideration for IMO policies and measures;
- (l) Condensable part in particulate matter from residential solid fuel combustion;
- (m) Trend analysis in emissions, concentrations, deposition, health, ecosystem and material impacts;
- (n) Non-forested terrestrial ecosystems;
- (o) Air pollution effects on marine ecosystems;
- (p) Exposure and health protection of urban populations;
- (q) Update of critical loads and critical levels for the analysis of the effectiveness of policies;
- (r) Effects of air pollution on biodiversity, possible effects of biodiversity on air pollution;
- (s) Metrics for effects on crops and ecosystems;
- (t) Definition of human health impact metrics;
- (u) The World Health Organization (WHO) review report of the air quality guidelines, if available on time, to be considered for the review.

III. Outcomes and conclusions of the review

21. The results of the review should indicate whether, in view of the latest scientific knowledge, the emission reduction commitments in annex II and the obligations in the technical annexes to the Protocol remain adequate for achieving the objectives of the Protocol; and what progress has been made towards achieving the objectives. It should provide an outlook regarding expected increase of ratifications and an analysis of options for increasing those ratifications.

22. Possible conclusions or outcomes based on the information provided in the review should also be included.

IV. Draft outline of the review report

23. The most appropriate format for presenting the report on the review would be an official document in three languages for the forty-second session of the Executive Body. The

⁸ An informal document on resources, gaps and barriers will be made available by the Gothenburg Protocol review group for the fifty-eighth session of the Working Group on Strategies and Review. This document could be used to prepare for an informal or thematic session to gather additional information from countries in Eastern Europe, the Caucasus and Central Asia on overcoming barriers to ratification and implementation.

main report will be supported by additional reports from subsidiary bodies that could be official documents, separate publications, or documents posted on the ECE website. The main report could be structured as follows:

- (a) Introduction;
- (b) Legal requirements for the review;
- (c) Emissions;
- (d) Measured and modelled atmospheric concentrations and deposition levels;
- (e) Measured and modelled effects on human health, natural ecosystems, materials and crops;
- (f) Emission reduction commitments for Parties;
- (g) Emission limit values, technical annexes and the related guidance documents of the Protocol (with priority given to black carbon and ammonia measures);
- (h) Specific sector approaches (e.g., residential solid-fuel, agriculture, shipping);
- (i) Non-technical measures, best available technology and energy-efficiency requirements (see the long-term strategy for the Convention for 2020–2030 and beyond, para. 21);
- (j) Flexibility provisions;
- (k) Convention Parties that are not parties to the Protocol;
- (l) Canada and the United States of America;
- (m) Hemispheric transport;
- (n) Integrated multi-pollutant, multi-effect approach;
- (o) Synergies and interactions with other policy areas;
- (p) Progress towards achieving the objectives of the Protocol;
- (q) Conclusions.

Annex I

Questions to the subsidiary bodies of the Convention for the review of the Gothenburg Protocol

1. This annex suggests a list of questions to be addressed by subsidiary bodies of the Convention in the context of the review of the amended Gothenburg Protocol. Table 1 gives suggestions for the body responsible for answering the question with an indication of the timing for completion. Answers should refer to existing documents as appropriate, e.g. the 2016 scientific assessment of the Convention, the policy response to the 2016 scientific assessment of the Convention and supplementary information to it (informal document no.6¹ of the fifty-fifth session of the Working Group on Strategies and Review (Geneva, 31 May–2 June 2017)), the trend reports from the EMEP Steering Body and the Working Group on Effects, and recent progress reports from the subsidiary bodies and the Parties². Findings should be updated where needed in answering the questions. Where appropriate, new analysis may be required to answer some of the proposed questions. In this case, this new work should be flagged and could be added to the workplan. The questions refer to the whole ECE region. Separate analysis could be undertaken in North America as appropriate.

2. The elements for consideration in the review are elaborated in the table below. The questions in the table are organized as follows. Sections 1–5 focus on the legal requirements of the review process as defined in article 10 (paras 2–4) of the present amended Gothenburg Protocol, as well as some of the related additional elements that are listed in the report of the thirty-ninth session of the Executive Body (ECE/EB.AIR/144, paras. 25–27), and those submitted as per Executive Body decision 2019/4:

- (a) Review of obligations in relation to emission reductions;
- (b) Review of progress towards achieving the environmental and health objectives of the Protocol;
- (c) Review of adequacy of obligations in attaining the environmental and health objectives of the Protocol³;
- (d) Evaluation of mitigation measures for black carbon emissions; and
- (e) Evaluation of ammonia control measures and consideration of the need to revise annex IX.

3. Section 6 of the table reflects the remaining additional elements.

4. In addressing the questions in the table below due consideration should be given to the possible short-term and long-lasting effects of the novel coronavirus pandemic (COVID-19) crisis on inter alia emission levels and projections (including for the Gothenburg Protocol target year), environmental impacts, changes in activity levels, economic growth etc.

¹ See

http://www.unece.org/fileadmin/DAM/env/documents/2017/AIR/WGSR/INFORMAL_DOCUMENT_6_PRG_integrated_final.pdf.

² See i.a reports of the European Commission on progress of the implementation of the National Emission Ceilings Directive and the clean air outlook update; EEA status reports; and in-depth reviews of emission inventories; and the Canada-US Air Quality Agreement Progress Report (2016) – can likely use the 2018 version but at the time of writing it has not been published yet. Duplication of those efforts should be avoided. This would allow to focus the review more on other Parties (i.e. Eastern, South-Eastern Europe and Turkey, the Caucasus and Central Asia)

³ Are the Protocol requirements sufficient to protect ecosystems and human health in 2020 and beyond? What long-term air quality and what impacts would be reached if all obligations of the Protocol were fully implemented by all Parties to the Protocol and by all Convention Parties, assuming ratifications by all Parties to the Convention?

<i>N°</i>	<i>Question</i>	<i>Who</i>	<i>Timing</i>
1	Review of obligations in relation to emission reductions		
1.1	What is the status of meeting the 2020 emission reduction obligations by the Parties ⁴ ?	CEIP	Spring 2022
1.2	a. What is the quality of reported emission data by parties in terms of comparability, completeness, consistency, accuracy and transparency? ⁵ b. What are the uncertainties for key categories? c. What is the current coverage and quality of emission reporting for shipping? d. What are the key findings and recommendations of the stage 1, 2 and 3 reviews of the emission inventories reported by non-Parties to the Gothenburg Protocol? e. Is the EMEP/EEA air pollutant emission inventory guidebook sufficiently comprehensive and fit for purpose to support quality emission data? What are the main gaps and challenges? For which sectors and pollutants does the guidance need to be further improved? In what way?	CEIP, TFEIP	Spring 2021
1.3	How do updated and most recently reported emission estimates for the base year 2005 compare to the 2005 estimates listed in tables 2–6 of annex II to the amended Protocol? For which pollutants and categories have Parties submitted an adjustment application between 2014 and 2020? What are the relative differences between reported totals and adjusted totals for these pollutants and categories for the historic years between 2010 and now?	CEIP, TFEIP	Spring 2022
1.4	a. What are the emission trends of the various pollutants from 2005–2018? b. What are the main causes of emission reductions? What is the relative contribution to these reductions of climate / energy, transport and agricultural policies and measures in the ECE region? c. What are remaining large emission sources? d. What are key sectors with large reduction potentials, specifically in Eastern, South-Eastern Europe and Turkey, the Caucasus and Central Asia?	TFEIP, TFIAM	Fall 2021 - Spring 2022
1.5	a. To what extent have best available techniques and emission limit values and other technical provisions in annexes IV, V, VI, VIII, IX, X and XI been implemented by the Parties ⁶ ? b. Have Parties implemented additional or newer source- oriented measures? What are the contributions of these measures? c. Have Parties implemented other (non-technical or structural) measures that contribute in meeting the 2020 emission reduction obligations? What are the expected contributions of these measures in 2020 and beyond?	TFTEI, TFEIP CIAM, TFRN, Parties	Spring 2022

⁴ For Member States of the European Union: see the report from the European Commission on the progress made on the implementation of the National Emission Ceilings (NEC) Directive (26 June 2020): see <https://op.europa.eu/en/publication-detail/-/publication/7199e9c2-b7bf-11ea-811c-01aa75ed71a1/language-en>.

⁵ Check the in-depth-reviews of the emission inventories carried out by the European Commission under the NEC Directive and carried out under the Convention (stage 3 review reports by the Centre on Emission Inventories and Projections): https://www.ceip.at/ms/ceip_home1/ceip_home/review_process/index.html.

⁶ A questionnaire might be helpful to get the information needed. This was last done by the Task Force on Reactive Nitrogen on national ammonia code in May 2018. At the time, not many Parties were complying with their commitments.

<i>N°</i>	<i>Question</i>	<i>Who</i>	<i>Timing</i>
	d. What barriers have been identified by Parties and non-Parties to implement the obligations in the technical annexes? ⁷ e. What barriers have been identified by the Parties to meet the 2020 emission reduction obligations?		
1.6	a. Which emission limit values and other technical requirements in the technical annexes are not up to date anymore? b. Which technical annexes should be adapted to better address key sectors in Eastern, South-Eastern Europe and Turkey, the Caucasus and Central Asia? c. Where are the current technical annexes too detailed, complex and/or demanding? d. Which gaps or redundancies in technical annexes can be identified?	TFTEI, TFRN	Spring 2022
2	Review of progress made towards achieving the environmental and health objectives of the Protocol		
2.1	a. What are the observed and projected trends in air quality for ozone, sulphur dioxide, particulate matter (species) and oxidised and reduced nitrogen? b. To what extent are these trends associated with emission trends in the region or dependent on transcontinental transport of air pollutants? c. What are the observed and projected trends in urban air quality? What is the contribution of long-range transport to air pollutant concentrations in cities? What is the distance to the WHO air quality guideline values (including to updated values, if available on time)?	MSC-W, TFMM TFHTAP, TFIAM (EPCAC)	Spring 2021
2.2	a. What are the observed and projected trends in deposition of reduced and oxidised nitrogen on land and waters (including marine ecosystems)? b. What is the annual change (or change every 5 years) in exceedance of critical loads for acidification and eutrophication between 1990 and 2018/2019 in terms of percentage ecosystems with exceedances and accumulated excess, based on current critical loads ⁸ . What are projected changes up to 2030 and beyond? c. What is the annual change (or change every 5 years) in water, soil and ecosystem quality indicators between 1990 and 2018/2019? What are projected changes up to 2030 and beyond?	MSC-W WGE, ICP Modelling and Mapping and other ICPs	Fall 2021
2.3	a. What is the observed and projected trend in ozone exposure of the population above critical levels? b. What are the observed and projected trends in vegetation risk of damage due to ozone (using various metrics)?	WGE, TFH, ICP Vegetation	Fall 2021
2.4	a. What is the observed and projected trend in life years lost due to exposure to ozone, particulate matter and nitrogen dioxide? b. What are observed and projected trends for other health metrics, e.g. morbidity?	TFH, CIAM	Fall 2021
2.5	a. What is the observed and projected trend in damage to materials and cultural heritage due to air pollution above critical levels and loads?	WGE, ICP Materials	Fall 2021
2.6	What has been the influence of improved atmospheric modelling (e.g. the higher spatial resolution) on the effectiveness of emission reductions for air quality improvement and deposition? Did this increase the challenge to meet environmental quality and health targets?	MSC-W TFHTAP	Fall 2021

⁷ The Task Force on Techno-economic Issues used a questionnaire for countries in Eastern Europe, the Caucasus and Central Asia to explore the barriers and the possible facilitating factors. Results are in the report of the 2019 Berlin workshop:
http://www.unecce.org/fileadmin/DAM/env/documents/2019/AIR/Capacity_Building/BAT_workshop_2019/Report_on_EECCAWorkshop_2019_5.pdf.

⁸ Possible additional question: if updated values for critical loads will be available on time to be considered for the review report that is to be delivered by December 2022, how and where will these updated values affect the exceedances?

N°	Question	Who	Timing
2.7	Is the monitoring and modelling system of the Convention sufficient to observe, assess and project air pollution and its effects related to the Gothenburg Protocol in the ECE region? If no, what are the main challenges and what is needed to meet them?	WGE, EMEP	Fall 2022
2.8	<p>What are the expected impacts of new scientific findings on environmental and health effects assessments, for example on:</p> <ul style="list-style-type: none"> - critical loads, - critical levels of ozone, particulate matter, nitrogen dioxide and ammonia - dynamic modelling of ecosystem recovery, - inclusion of marine ecosystems protection,⁹ - interactions between air pollution, climate change, nitrogen fluxes and other stress factors for biodiversity (e.g. land use changes), - additional or new metrics on health, damage to crops, ecosystems and/or materials? 	WGE	Fall 2022
3	Review of adequacy of obligations in attaining the environmental and health objectives of the Protocol		
3.1	<p>a. What are the latest emission projections by the Parties, compared with the latest GAINS¹⁰-scenarios, taking into account recent climate, energy and agricultural policies, new source legislations and latest updated emission inventories by the Parties? Will the Protocol obligations be met based on latest emission projections?¹¹ What would be the optimized emission reduction obligations, given the updated emission inventories and projections and the same gap-closure ambitions as used in the preparation of the revised Gothenburg Protocol? The review should evaluate the emission reduction commitments in the amended Gothenburg Protocol for 2020, not the fixed emissions ceilings in the original protocol for 2010.</p> <p>b. Are emission reduction obligations adequate for meeting long term environmental and health protection targets of the protocol? E.g. what will be the outcomes for health risks from ozone and particulate matter and for nitrogen deposition in 2030 and 2050?</p> <p>c. What are the estimated reductions based on the best available emission projections for non-Parties to the revised protocol? Will these reductions contribute to meeting long term environmental and health protection targets?</p> <p>d. Will implementation of best available techniques and emission limit values and other technical provisions set in the technical annexes be adequate for meeting long term environmental and health protection targets of the protocol beyond 2020? E.g. for reducing ozone and particulate matter related health risks and nitrogen deposition?</p> <p>e. What would be the contribution to meeting environmental and health protection targets if non-Parties to the revised protocol implemented best available techniques and the emission limit values and other technical provisions set in the technical annexes?</p>	CIAM, TFIAM, TFTEI, TFRN, TFEIP	Fall 2021

⁹ Information and knowledge for this assessment to be explored with, for example, the Baltic Marine Environment Protection Commission, as discussed at the sixth joint session of the EMEP Steering Body and the Working Group on Effects, with the aim to analyse optimized emission reduction allocations with and without taking into account effects of air pollution marine ecosystems.

¹⁰ Greenhouse Gas-Air Pollution Interactions and Synergies.

¹¹ See the NEC Directive reporting status 2020 from the EEA. While not taking into account inventory adjustments and effects of the CoViD-19 crisis, it indicates that the majority of Member States of the European Union and the United Kingdom of Great Britain and Northern Ireland must make additional efforts to meet 2020 emission reduction commitments (NEC Directive and thus also the Gothenburg Protocol). <https://www.eea.europa.eu/themes/air/air-pollution-sources-1/national-emission-ceilings/national-emission-reduction-commitments-directive>.

<i>N°</i>	<i>Question</i>	<i>Who</i>	<i>Timing</i>
	f. What would be the impact on emissions reductions of climate and energy measures in the long term (2030-2050)? What would be the impact of new policies and measures on biodiversity, bioeconomy, circular economy, nitrogen management etc.? g. What are the latest improvements of the GAINS model with respect to scenario development (i.e. cost updates)? What is the state of play of the GAINS model with respect to applied data for countries in Eastern, South-Eastern Europe and Turkey, the Caucasus and Central Asia?		
3.2	What is the current contribution and will be the expected future contribution of emission sources outside the ECE-region to ecosystems and health impacts in the ECE region, in particular for ozone, particulate matter (and black carbon)? ¹²	TFHTAP, MSC-W	Fall 2021
3.3	What is the projected future trend in methane emissions? What is the impact on ozone formation? In which regions and in which sectors outside the ECE region is there potential for emission reductions that have a significant effect on reducing ozone effects in the ECE region?	TFHTAP, MSC-W	Fall 2021
3.4	What is the projected future trend in NO _x -emissions from shipping? What is impact on ozone formation and nitrogen deposition? What and where is the potential for emission reductions that have a significant effect on reducing ozone effects in the ECE region?	TFHTAP, MSC-W	Fall 2021
3.5	a. What will be the costs of additional (air pollution) measures in the ECE region that would not exceed the external costs of inaction, with due consideration of synergies and other interactions with and more cost-effective measures potentially available in other policy areas (e.g. climate, energy, nitrogen management,)? b. In which sectors can such measures be found? c. What are the best available non-technical measures, what policy instruments are effective to trigger behavioural change and what can such measures contribute to environmental and health improvement?	TFIAM, CIAM, TFTEI	Fall 2021
3.6	Are additional local air quality measures sufficient and cost-effective to reduce health risks or strive towards WHO air quality guideline values (or to strive towards updated WHO values, if available on time)?	EPCAC/TFIAM	Fall 2021
4	Evaluation of mitigation measures for black carbon¹³ emissions		
4.1	What is the current coverage and quality of black carbon (elemental carbon and organic carbon) emission reporting?	CEIP, TFEIP	Spring 2021
4.2	a. To what extent have the measures implemented to meet the emissions reduction obligations for particulate matter contributed to reduce black carbon and polycyclic aromatic hydrocarbons emissions (see art 2(2) of the amended Gothenburg Protocol on prioritization). b. What are projected trends in black carbon and PAH-emissions? c. What is the contribution of residential solid fuel burning to black carbon and PAH-emissions? ¹⁴ d. Which additional particulate matter measures (technical and non-technical) are also effective for reducing black carbon and PAH-emissions? ¹⁵ e. What are best available techniques to reduce black carbon emissions?	TFTEI, TFIAM, CIAM	Spring 2021

¹² E.g. see: Monica Crippa et al, Forty years of improvements in European air quality: regional policy-industry interactions with global impacts, *Atmos. Chem. Phys.*, 16, 3825–3841, 2016, <https://doi.org/10.5194/acp-16-3825-2016>.

¹³ Black carbon is considered to cover both elemental carbon and organic carbon (including polycyclic aromatic hydrocarbons).

¹⁴ See the code of good practice for wood-burning and small combustion installations (ECE/EB.AIR/2019/5) prepared by TFTEI.

¹⁵ A TFIAM/TFTEI guidance document on prioritization reductions of particulate matter in its sources is forthcoming in 2020-2021.

<i>N°</i>	<i>Question</i>	<i>Who</i>	<i>Timing</i>
	f. What would be appropriate definitions and calculation methods (emission factors) for black carbon and the condensable part of particulate matter?		
4.3	The formation of particulate matter from condensable compounds is currently not fully included in estimates of exposure to particulate matter. What is the contribution of condensables to the population exposure and what are associated health impacts if these can be established separately?	MSC-W, CIAM	Spring 2022
4.4	What will be the impact of the inclusion of condensables in reporting of particulate matter emissions for residential heating on the national emission trends and on the importance of the residential heating sector? What will be the effect of the inclusion of particles from condensables on the effectivity of abatement measures? What particulate matter emission reductions will be achieved between 2005 and latest reported year based on the inclusion of condensables in reporting of particulate matter emissions compared to its non-inclusion? What is the difference between optimized emission reduction allocations with and without particles from condensables?	CEIP, CIAM, TFTEI	Spring 2022
5	Evaluation of ammonia control measures and consideration of the need to revise annex IX		
5.1	What are the main barriers to effectively reduce ammonia emissions and implement annex IX or existing Guidance Documents? What barriers exist for non-Parties?	TFRN	Spring 2021
5.2	a. What are best available control measures to further reduce ammonia emissions? b. Which elements of annex IX and guidance documents need to be updated?	TFRN	Spring 2021
5.3	To what extent will new agricultural or integrated nutrient management policies (e.g. the European Union ‘Farm to Fork’ strategy and the reform of the European Union agricultural funding policies (CAP reform)) contribute to ammonia emission changes?	TFRN	Spring 2022
5.4	a. What is the potential for dietary change? b. What environmental and health benefits are associated with dietary change? c. What policy instruments are available to change diets?	TFRN, WGE	Spring 2022
6	Additional inputs for the review		
6.1	a. Are current flexibility provisions adequate and/or effective for ratification and implementation (focus on Eastern, South-Eastern Europe and Turkey, the Caucasus and Central Asia)? b. What new flexibilities and/or approaches would potentially help non-Parties to move towards ratification and implementation? c. What are other options for achieving emission reductions (in lieu of technical annexes)?	WGSR	Fall 2022
6.2	a. Are key articles on inter alia objectives, reporting obligations and amendments still fit for purpose? b. Do articles 4 (exchange of information) and 8 (research development) adequately address international cooperation and integrated environmental policy as indicated in the long-term strategy for 2020-2030 and beyond?	WGSR	Fall 2022
6.3 ¹⁶	a. What are the (best) available emission abatement techniques and measures for the reduction of methane emissions from key sources?	TFTEI, TFRN, TFIAM, WGSR, WGE	Spring 2021 (a and b)

¹⁶ Check i.a the EU strategy on methane focusing on reducing methane emissions in the energy, agriculture and waste sectors (see <https://ec.europa.eu/energy/topics/oil-gas-and-coal/methane-gas->

<i>N°</i>	<i>Question</i>	<i>Who</i>	<i>Timing</i>
	b. What is the contribution of implemented and new climate measures on the reduction of methane emissions? c. What is the projected future trend in methane emissions and subsequent improvements in air quality, human health effects and ecosystems impacts? d. How could methane be addressed in a future instrument?		Spring 2022
6.4	Which guidance documents require an update in view of new available information, new emerged challenges and in view of further contributing to meet the long term environmental and health targets of the protocol? What new guidance documents are needed?	WGSR, TFTEI, TFRN, TFIAM, WGE	Spring 2022
6.5	What are the policy implications of including particles formed from condensable compounds in particulate matter -reporting? Implications include ability to report and compliance	WGSR	May 2021

Abbreviations: CEIP, Centre on Emission Inventories and Projections; CIAM, Centre for Integrated Assessment Modelling; EEA, European Environment Agency; EPCAC, Expert panel on clean air in cities; ICP, International Cooperative Programme; ICP Materials, ICP on Effects of Air Pollution on Materials, including Historic and Cultural Monuments; ICP Modelling and Mapping, ICP on Modelling and Mapping of Critical Levels and Loads and Air Pollution Effects, Risks and Trends; ICP Vegetation, ICP on Effects of Air Pollution on Natural Vegetation and Crops; MSC-W, Meteorological Synthesizing Centre-West; TFEIP, Task Force on Emission Inventories and Projections; TFH, Task Force on Health; TFHTAP, Task Force on the Hemispheric Transport of Air Pollution; TFIAM, Task Force on Integrated Assessment Modelling; TFMM, Task Force on Measurements and Modelling; TFRN, Task Force on Reactive Nitrogen; TFTEI, Task Force on Techno-economic Issues; WGE, Working Group on Effects; WGSR, Working Group on Strategies and Review.

Annex II

Work schedule for preparation of the report(s) on the Gothenburg Protocol review

<i>Meeting</i>	<i>Title of report tabled for consideration</i>	<i>Deadline</i>
Fifty-eighth session of the Working Group on Strategies and Review and the fortieth session of the Executive Body	Preparations for the review Discussion by the Working Group at its fifty-eighth session and consideration by the Executive Body at its fortieth session Evaluation of mitigation measures for black carbon and ammonia and consideration of the need to review annex IX: Provide a two-page note as a starting point to provide an update on progress at the fifty-eighth session of the Working Group and the fortieth session of the Executive Body.	September 2020 (for the official document)
Fifty-ninth session of the Working Group on Strategies and Review (17-20 May 2021)	First draft of an annotated outline on the review	February 2021
Task Forces, scientific centres and International Cooperative Programmes	First draft of the report for the review	Feedback by June 2021
Seventh joint session of the EMEP Steering Body and the Working Group on Effects	Draft of report of the review	September 2021
Sixtieth session of the Working Group on Strategies and Review	Draft of report of the review	February 2022
Forty-second session of the Executive Body	Final report of review adopted/Conclude the Review	December 2022