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Executive Body for the Convention on Long-range Transboundary Air Pollution

Working Group on Strategies and Review

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Item 5 of the provisional agenda
Options for revising the Gothenburg Protocol

Draft revised annex I on critical loads and levels

Note by the secretariat

Summary

At its forty-fifth session in September 2009, the Working Group on Strategies and Review expressed its wish to have technical annex I of the 1999 Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone Protocol (Gothenburg Protocol) updated by the Working Group on Effects and for it to present the proposed amendments to annex I at the forty-sixth session of the Working Group on Strategies and Review in April 2010 (ECE/EB.AIR/WG.5/98, para. 46 (k)). That decision was subsequently endorsed by the Executive Body for the Convention on Long-range Transboundary Air Pollution at its twenty-seventh session in December 2009. The following text shows the amendments proposed to the original text of annex I of the Gothenburg Protocol, reflecting also the comments and suggestions made during the forty-sixth and forty-seventh sessions of the Working Group. New text in the body of the annex is indicated in bold.

The Working Group is expected to discuss and agree on the amendments to annex I with a view to presenting amendment proposals to the Parties to the Gothenburg Protocol meeting within the twenty-ninth session of the Executive Body in 2011. Furthermore, it is invited to consider a draft guidance document on impacts of the emission reductions (recovery of ecosystems and environmental and health improvements), as presented in an informal document prepared by the Working Group on Effects.

Annex I

Critical loads and levels

I. Critical loads of acidity

A. For Parties within the geographical scope of EMEP

1. Critical loads (as defined in article 1) of acidity for ecosystems are determined in accordance with the Convention's [*Manual on methodologies and criteria for mapping critical levels/loads and geographical areas where they are exceeded* - delete] **[*Manual on Methodologies and Criteria for Modelling and Mapping Critical Loads and Levels and Air Pollution Effects, Risks and Trends*]**. They are the maximum amount of acidifying deposition [an ecosystem can tolerate in the long term without being damaged. Critical loads of acidity in terms of nitrogen take into account of within-ecosystem nitrogen removal processes (e.g. uptake by plants). Critical loads of acidity in terms of sulphur [do not - delete] **[— in the long term — will not cause adverse effects to the structure and functions of ecosystems]**. A combined sulphur and nitrogen critical load of acidity considers nitrogen only when the nitrogen deposition is greater than ecosystem nitrogen removal processes **[, such as uptake by vegetation]**. All critical loads reported by Parties **[, and approved by the Executive Body to the Convention,]** are summarized for use in the integrated assessment modelling employed to provide guidance for setting the emission ceilings in annex II.

B. For Parties in North America

2. [For eastern Canada, critical sulphur plus nitrogen loads for forested ecosystems have been determined with scientific methodologies and criteria (1997 Canadian Acid Rain Assessment) similar to those in the Convention's *Manual on methodologies and criteria for mapping critical levels/loads and geographical areas where they are exceeded*. Eastern Canada critical load values (as defined in article 1) of acidity are for sulphate in precipitation expressed in kg/ha/year. Alberta in western Canada, where deposition levels are currently below the environmental limits, has adopted the generic critical load classification systems used for soils in Europe for potential acidity. Potential acidity is defined by subtracting the total (both wet and dry) deposition of base cations from that of sulphur and nitrogen. In addition to critical loads for potential acidity, Alberta has established target and monitoring loads for managing acidifying emissions. - delete] **[In Canada, critical acid deposition loads and geographical areas where they are exceeded are determined and mapped for lakes and upland forest ecosystems using scientific methodologies and criteria similar to those in the Convention's *Manual on Methodologies and Criteria for Modelling and Mapping Critical Loads and Levels and Air Pollution Effects, Risks and Trends* (available online at www.icpmapping.org/). Critical load values for total sulphur plus nitrogen and exceedance levels have been mapped across Canada (south of 60°N latitude) and are expressed in acid equivalents per hectare per year (eq/ha/yr) (2004 Canadian Acid Deposition Science Assessment; 2008 Canadian Council of Ministers of the Environment). The province of Alberta has also adapted the generic critical load classification systems used for soils in Europe for potential acidity to define soils as highly sensitive, moderately sensitive and not sensitive to acidic deposition. Critical, target and monitoring loads are defined for**

each soil class and management actions are prescribed as per the Alberta Acid Deposition Management Framework, as appropriate.]

3. For the United States of America, the effects of acidification are evaluated through an assessment of the sensitivity **[and response]** of ecosystems **[to]** the [total] loading [within ecosystems – delete] of acidifying compounds, **[using peer-reviewed scientific methodologies and criteria,]** and **[accounting for]** the [uncertainty – delete] **[uncertainties]** associated with nitrogen [removal processes – delete] **[cycling processes]** within ecosystems.

4. These loads and effects are used in integrated assessment [modelling – delete] **[activities, including providing data for international efforts to assess ecosystem response to loading of acidifying compounds,]** and provide guidance for setting the emission ceilings and/or reductions for Canada and the United States of America in annex II.

II. Critical loads of nutrient nitrogen

[A.] For Parties within the geographical scope of EMEP

5. Critical loads (as defined in article 1) of nutrient nitrogen (eutrophication) for ecosystems are determined in accordance with the Convention's [*Manual on methodologies and criteria for mapping critical levels/loads and geographical areas where they are exceeded* - delete] **[*Manual on Methodologies and Criteria for Modelling and Mapping Critical Loads and Levels and Air Pollution Effects, Risks and Trends*]**. They are the maximum amount of eutrophying nitrogen deposition [an ecosystem can tolerate in the long term without being damaged - delete] **[that —in the long term — will not cause adverse effects to the structure and functions of ecosystems]**. All critical loads reported by Parties are summarized for use in the integrated assessment modelling employed to provide guidance for setting the emission ceilings in annex II

[B. For Parties in North America

5 bis. For the Unites States of America, the effects of nutrient nitrogen (eutrophication) for ecosystems are evaluated through an assessment of the sensitivity and response of ecosystems to the loading of nitrogen compounds, using peer-reviewed scientific methodologies and criteria, and accounting for uncertainties associated with nitrogen cycling within ecosystems.]

III. Critical levels of ozone

A. For Parties within the geographical scope of EMEP

6. Critical levels (as defined in article 1) of ozone are determined to protect plants in accordance with the Convention's [*Manual on methodologies and criteria for mapping critical levels/loads and geographical areas where they are exceeded* - delete] **[*Manual on Methodologies and Criteria for Modelling and Mapping Critical Loads and Levels and Air Pollution Effects, Risks and Trends*]**. They are expressed [as a cumulative exposure over a threshold ozone concentration of 40 ppb (parts per billion by volume). This exposure index is referred to as AOT40 (accumulated exposure over a threshold of 40 ppb). The AOT40 is calculated as the sum of the differences between the hourly

concentration (in ppb) and 40 ppb for each hour when the concentration exceeds 40 ppb. - delete] **[in terms of the cumulative value of either stomatal fluxes or concentrations at the top of the canopy. Critical levels based on stomatal fluxes are considered more biologically relevant than those based on concentrations since they take into account the modifying effect of climate, soil and plant factors on the uptake of ozone by vegetation.]**

7. [The long-term critical level of ozone for crops of an AOT40 of 3000 ppb.hours for May-July (used as a typical growing season) and for daylight hours was used to define areas at risk where the critical level is exceeded. A specific reduction of exceedances was targeted in the integrated assessment modelling undertaken for the present Protocol to provide guidance for setting the emission ceilings in annex II. The long-term critical level of ozone for crops is considered also to protect other plants such as trees and natural vegetation. Further scientific work is under way to develop a more differentiated interpretation of exceedances of critical levels of ozone for vegetation.- delete] **[Critical levels of ozone have been derived for a number of species of crops, (semi-)natural vegetation and forest trees. The critical levels selected are representative of the most important environmental effects, e.g., loss of security of food supplies, loss of carbon storage in the living biomass of trees and adverse effects on forest and (semi-)natural ecosystems.]**

8. [A critical level of ozone for human health is represented by the WHO Air Quality Guideline level for ozone of 120 µg/m3 as an 8-hour average. In collaboration with the World Health Organization's Regional Office for Europe (WHO/EURO), a critical level expressed as an AOT60 (accumulated exposure over a threshold of 60 ppb), i.e. 120 µg/m3, calculated over one year, was adopted as a surrogate for the WHO Air Quality Guideline for the purpose of integrated assessment modelling. This was used to define areas at risk where the critical level is exceeded. A specific reduction of these exceedances was targeted in the integrated assessment modelling undertaken for the present Protocol to provide guidance for setting the emission ceilings in annex II.- delete] **[The critical level of ozone for human health is determined in accordance with the World Health Organization (WHO) air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulphur dioxide to protect human health from high ozone concentration and leading to a wide range of health effects, including increased risk of premature death. It is expressed by the cumulative index based on the maximum daily ozone concentration (maximum daily eight-hour mean) integrated over all the days in a year, being proportional to the health risks.]**

B. For Parties in North America

9. [For Canada, critical levels of ozone are determined to protect human health and the environment and are used to establish a Canada-wide Standard for ozone. The emission ceilings in annex II are defined according to the ambition level required to achieve the Canada-wide Standard for ozone. - delete] **[For Canada, it is understood that there is no lower threshold for human health effects from ozone. That is, adverse effects have been observed at all ozone concentrations experienced in Canada. The Canadian standard for ozone was set to aid management efforts nationally, and by jurisdictions, to significantly reduce the effects on human health and the environment.]**

10. For the United States of America, critical levels **[are established in]** [of ozone – delete] **[the form of national ambient air quality standards for ozone in order to]** [are determined to – delete] protect public health with an adequate margin of safety, **[and]** [as well as – delete] to protect [the – delete] public welfare **[including vegetation]** from any known or expected adverse effects [, and are used to establish a national ambient air quality

standard – delete]. Integrated assessment modelling and the air quality standard**[s]** are used in providing guidance for setting the emission ceilings and/or reductions for the United States of America in annex II.

[IV. Critical levels of particulate matter

A. For Parties in the geographical scope of EMEP

11. The critical level of particulate matter (PM) for human health is determined in accordance with the WHO air quality guidelines as the mass concentration of PM2.5 (particles with aerodynamic diameter less than 2.5 µm). Attainment of the guideline level is expected to effectively reduce health risks. The long term PM2.5 concentration, expressed as an annual average, is proportional to the risk to health, including reduction of life expectancy. This indicator has been used in integrated modelling to provide guidance for emission reduction. In addition to the annual guideline level, a short-term (24-hour mean) limit has been recommended. It should protect against peaks of pollution that would lead to substantial excess morbidity or mortality.

B. For Parties in North America

12. For the United States of America, critical levels are established in the form of national ambient air quality standards for particulate matter in order to protect public health with an adequate margin of safety, and to protect public welfare (including visibility and man-made materials) from any known or expected adverse effects. Integrated assessment modelling and the air quality standards are used in providing guidance for setting the emission ceilings and/or reductions for the United States of America in annex II.

13. For Canada, it is understood that there is no lower threshold for human health effects from particulate matter. That is, adverse effects have been observed at all concentrations of particulate matter experienced in Canada. The Canadian national standard for particulate matter was set to aid management efforts nationally, and by jurisdictions, to significantly reduce the effects on human health and the environment.

V. Critical levels of ammonia

14. Critical levels (as defined in article 1) of ammonia are determined to protect plants in accordance with the Manual on Methodologies and criteria for Modelling and Mapping Critical Loads and Levels and Air Pollution Effects, Risks and Trends.

VI. Acceptable levels for materials

15. Acceptable levels (as defined in article 1) of acidifying pollutants and PM are determined to protect materials and cultural heritage in accordance with the Convention's *Manual on Methodologies and Criteria for Mapping Critical Loads and Levels and Air Pollution Effects, Risks and Trends*. The acceptable levels of pollutants are the maximum a material can tolerate in the long term without resulting in damage above specified target corrosion rates. These damages, which can be calculated by available dose-response functions, are the result of several pollutants acting together

in different combinations depending on the material: acidity (SO_2, nitric acid (HNO_3)), ozone and PM.

VII. Recovery of ecosystems

Acidification

16. Recovery from the adverse effects of acidification can be achieved when the critical load is not exceeded. When recovery is required by a specified year (target year) a deposition value (target load) is required to enable the chemical criterion to attain a non-critical value in the target year. The chemical criterion used for the critical loads calculations is linked to biological effects.

Eutrophication

17. Recovery from the adverse effects of eutrophication may be achieved when the critical load is not exceeded. When recovery is required by a target year, a target load is required to enable the chemical criterion to attain a non-critical value in the target year. The chemical criterion used for critical load calculations is linked to biological effects.]