



**Economic and Social
Council**

Distr.
GENERAL

ECE/EB.AIR/WG.5/2009/9
18 June 2009

Original: ENGLISH

ECONOMIC COMMISSION FOR EUROPE

**EXECUTIVE BODY FOR THE CONVENTION ON LONG-RANGE
TRANSBOUNDARY AIR POLLUTION**

Working Group on Strategies and Review

Forty-fifth session

Geneva, 31 August–4 September 2009

Item 4 of the provisional agenda

OPTIONS FOR REVISING THE GOTHENBURG PROTOCOL

TECHNO-ECONOMIC ISSUES

Report by the Co-Chairs of the Expert Group on Techno-economic Issues

INTRODUCTION

1. This report presents the results of the work carried out by the Expert Group on Techno-economic Issues in accordance with item 1.7 of the 2009 workplan for the implementation of the Convention (ECE/EB.AIR/96/Add.2) adopted by the Executive Body at its twenty-sixth session, including the results of its fifteenth meeting, held on 6 and 7 April 2009 in Rome.

2. The Expert Group prepared a revised version of the guidance documents (ECE/EB.AIR/WG.5/2009/15), revised technical annexes IV, V, VI and VIII (ECE/EB.AIR/WG.5/2009/17, ECE/EB.AIR/WG.5/2009/18, ECE/EB.AIR/WG.5/2009/19 and ECE/EB.AIR/WG.5/2009/20), elaborated new technical annexes on dust (ECE/EB.AIR/WG.5/2009/21) and on limit values for the solvent content of products

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(ECE/EB.AIR/WG.5/2009/22) to the 1999 Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (Gothenburg Protocol).

3. Experts from the following Parties to the Convention contributed to the preparation of the above documents: Austria, Belgium, Czech Republic, Finland, France, Germany, Italy, Netherlands, Norway, Sweden, Switzerland, United Kingdom of Great Britain and Northern Ireland and the European Commission. Industry experts from the following organizations also contributed: the European Chemical Industry Council (CEFIC), the European Cement Association (CEMBUREU), the European Council of Producers and Importers of Paints, Printing inks and Artists' Colours (CEPE), the European Ceramics Industry (CERAME UNIE), the oil companies' European association for environment, health and safety in refining (CONCAWE), the European Coil Coating Association (ECCA), the European Carbon and Graphite Association (ECGA), the European Sulphuric Acid Association (ESA), the European Solvents Industry Group (ESIG), the European Tyre and Rubber Manufacturing Industry (ETRMA), the Association of the Electricity Industry in Europe (EURELECTRIC), the Association of European Ferro-alloy Producers (EURO ALLIAGES), the European Confederation of Iron and Steel Industries (EUROFER), the European Association of Metals (EUROMETAUX), EUROMINES, the Industrial Minerals Association (IMA), the Standing Committee of the European Glass Industries (SPIV), and the Federation of the Owners of Large Boilers (Verband der Großkessel-Besitzer e. V. (VGB)).

4. Mr. J.-G. Bartaire (France) and Mr. T. Pignatelli (Italy) co-chaired the fifteenth meeting of the Expert Group. The main issue for discussion at that meeting was the finalization of the draft technical annexes and guidance documents prepared by the Expert Group. Participants in the meeting also considered cooperation with other bodies under the Convention, in particular with the Task Force on Integrated Assessment Modelling and the Task Force on Heavy Metals, and discussed further work on large combustion plants. A representative of the Italian Agency for New Technologies (ENEA) delivered a presentation on new approaches to support energy saving measures in the residential sector.

5. In order to achieve the goals set by the Executive Body, work to revise technical annexes and guidance documents began in the second half of 2008. A special working group led by Finland has been set up to make proposals for emission limit values (ELVs) from stationary engines to be included in an updated technical annex V, and developed a chapter of the guidance document on this matter.

6. First versions of the guidance documents and technical annexes were prepared at the end of September 2008. The workplan and schedule for the exchange of information within the group, receiving comments from experts on draft documents and the delivery of updated

versions of documents, was agreed at the fourteenth meeting of the Expert Group (Sorrento, Italy, 13–14 October 2008)¹. Due to the large amount of information provided in the guidance documents and technical annexes, comments by national and industry experts were collected until mid-January 2009. Revisions of the guidance documents and technical annexes were prepared by mid February 2009, and a second comment round was completed by the beginning of March 2009. Third versions of guidance documents and technical annexes were prepared and discussed at the Expert Group's fifteenth meeting. These were also presented as informal documents at the forty-fourth session of the Working Group on Strategies and Review. Final comments were received until 15 May and subsequently reflected in the documents submitted to the Working Group's forty-fifth session. The Expert Group held two working meetings in Paris (17 March and 27–28 May 2009).

7. The iterative process of drafting and revising guidance documents and technical annexes to reflect the comments received enabled the Expert Group to better anticipate the range of technical issues that the Working Group on Strategies and Review may wish to discuss during its forty-fifth session. Therefore, the revised documents offer 3 alternative approaches for setting ELVs (see chapter IV).

I. GUIDANCE DOCUMENTS

8. The Expert Group was requested to revise the three guidance documents in the current Gothenburg Protocol and to address control techniques for dust emissions and ways of reducing the solvent content of products. These existing guidance documents were developed on a pollutant per pollutant principle, as follows:

- (a) Guidance document I on the control techniques for emissions of sulphur from stationary sources;
- (b) Guidance document II on the control techniques for emissions of nitrogen oxides from stationary sources;
- (c) Guidance document III on the control techniques for emissions of volatile organic compounds (VOCs) from stationary sources.

9. In view of the addition of new pollutants and the characteristics of reduction techniques and activities, the Expert Group agreed that an activity-oriented guidance document would be a better approach. Consequently, a single guidance document is now proposed covering sulphur,

¹ See the report of the fourteenth meeting of the Expert Group on Techno-economic Issues (ECE/EB.AIR/WG.5/2009/2), available at: <http://www.unece.org/env/documents/2009/EB/wg5/wgsr44/ece.eb.air.wg.5.2009.2.e.pdf>

nitrogen oxides (NO_x), VOCs and dust emissions from stationary sources. The activity oriented structure of the new guidance document enables a better consideration of possible synergies and trade-offs between reduction techniques and technologies.

10. The proposed Guidance document on control techniques for emissions of sulphur, NO_x, VOCs, dust (TSP, PM₁₀ and PM_{2.5})² from stationary sources (ECE/EB.AIR/WG.5/2009/15), covers the four pollutants above and all activities previously covered by the existing guidance documents attached to the Gothenburg Protocol for sulphur dioxide (SO₂), NO_x and VOCs as well as the activities in annex II of 1998 Protocol on Heavy Metals for abating heavy metal emissions for dust. It is structured into seven chapters, including introduction. Chapter II addresses general issues for the four pollutants. Chapters II to V cover general issues for sulphur, NO_x, VOCs and dust emissions (TSP, PM₁₀ and PM_{2.5}) respectively. Chapter seven includes 42 sectoral sub-chapters.

II. TECHNICAL ANNEXES

11. The Expert Group was requested to revise annexes IV, V, VI and VIII to the Gothenburg Protocol and to elaborate proposals for new technical annexes for dust emissions and the solvent content of products. The Expert Group worked only on section A of technical annexes related to Parties other than Canada and United States of America and not on section B related to Canada and the United States of America. Both Canada and the United States were invited to contribute to the revision.

12. The Expert Group cooperated with the European Commission (DG Enterprise) in compiling data with a view to making proposals for the revision of annex VIII related to mobile sources, both road vehicles and off-road vehicles. The proposed ELVs in the revised annex VIII correspond to the most recent regulation stages implemented in the European Union (EU) depending on the type of engines considered.

13. The list of activities covered by the current technical annexes to the Gothenburg Protocol for sulphur, NO_x and VOCs has not been extended, as was decided in 2007 following the review of existing technical annexes made by the Expert Group (see table).

14. With regard to dust, the Expert Group considered the activities covered by annex V of the Protocol on Heavy Metals, setting up ELVs for dust and heavy metals, the activities covered by the document "Assessment of technical developments: BAT and limit values of April 2006"

² TSP – total suspended particulates; PM – particulate matter.

prepared by the Task Force on Heavy Metals, and certain relevant dust emitters not linked to heavy metal emissions.

Table: Activities and pollutants for which emission limit values are suggested in the proposed technical annexes

	SO ₂	NO _x	TSP	VOCs	Technical annexes previously concerned	Proposals of technical annexes for the [new] Gothenburg Protocol
Sulphur content of gasoil	Y				Annex IV for SO ₂	Proposal of updated annex IV for SO ₂
Combustion plants > 50 MWth Boilers and process heaters	Y	Y	Y		Annex IV for SO ₂ Annex V for NO _x Protocol on Heavy Metals (annex V for particulate matter and heavy metals)	Proposal of updated annex IV for SO ₂ Proposal of updated annex V for NO _x
Combustion plants > 50 MWth Gas turbines		Y	Y		Only solid fuels	Proposal of new annex for dust All types of fuels
Stationary engines		Y			Annex V for NO _x	Proposal for updated annex V for NO _x
Mineral oil and gas refineries	Y for Claus plants		Y		Annex IV for SO ₂ and Claus plants	Proposal of updated annex IV for SO ₂ for Claus plants Proposal of new annex X for dust for the different furnaces such as fluid catalytic crackers (FCC)
Production of iron and steel (Primary and secondary production - sinter plants, pelletisation plants, blast furnaces, basic oxygen steelmaking plants, casting)		Y	Y		Annex V for NO _x for new and existing sinter plants Protocol on Heavy Metals (annex V for particulate matter and heavy metals) for sinter plants, pellet plants, blast furnaces, electric arc furnaces	Proposal of updated annex V for NO _x Proposal of new annex for dust for major dust sources in iron and steel production (primary and secondary processes)
Ferrous metal processing industry (rolling mills...)			Y		Not considered	Proposal of new annex for dust
Non ferrous metal processing industry (primary and secondary aluminium production, primary and secondary lead production, primary and secondary zinc production and other large non ferrous metals)			Y		Protocol on Heavy Metals (annex V for particulate matter and heavy metals) for production of lead, zinc and copper	Proposal of new annex for dust for major dust sources in these activities (primary and secondary processes)
Titanium dioxide	Y				Annex IV on SO ₂ for titanium dioxide	Proposal of updated annex IV for SO ₂
Cement production		Y	Y		Annex V for NO _x , Protocol on Heavy Metals (annex V for particulate matter and heavy metals)	Proposal of updated annex V for NO _x Proposal of new annex for dust
Glass manufacturing industry			Y		AP, annex V for particulate matter and heavy metals	Proposal of new annex X for dust
Ceramics manufacturing industry			Y		Not considered	Proposal of new annex for dust

	SO ₂	NO _x	TSP	VOCs	Technical annexes previously concerned	Proposals of technical annexes for the [new] Gothenburg Protocol
Paper pulp production			Y		Not considered	Proposal of new annex for dust
Nitric acid ...		Y			Annex V for NO _x	Proposal of updated annex V for NO _x
Domestic waste and industrial waste incineration			Y		Protocol on Heavy Metals (annex V for particulate matter and heavy metals)	Proposal of new annex for dust
Wood processing			Y		Not considered	Proposal of new annex for dust
Storage and distribution of petrol				Y	Annex VI for VOCs	Proposal of updated annex VI for VOCs
Adhesive coating Footwear manufacture Other adhesive applications				Y	Annex VI for VOCs	Proposal of updated annex VI for VOCs
Wood and plastic lamination				Y	Annex VI for VOCs	Proposal of updated annex VI for VOCs
Car coating Truck cabin coating Truck and van coating Bus coating				Y	Annex VI for VOCs	Proposal of updated annex VI for VOCs
Coating processing in various industrial processes				Y	Annex VI for VOCs	Proposal of updated annex VI for VOCs
Coil coating				Y	Annex VI for VOCs	Proposal of updated annex VI for VOCs
Dry cleaning				Y	Annex VI for VOCs	Proposal of updated annex VI for VOCs
Manufacturing of coatings, varnishes, inks and adhesives				Y	Annex VI for VOCs	Proposal of updated annex VI for VOCs
Printing processes				Y	Annex VI for VOCs	Proposal of updated annex VI for VOCs
Production of pharmaceutical products				Y	Annex VI for VOCs	Proposal of updated annex VI for VOCs
Solvent content of products				Y	Not considered	Proposal of new annex on the solvent content of products (paints)

III. PROPOSALS FOR IMPROVEMENT OF DEFINITIONS TO BE USED IN THE PROTOCOL

15. A series of proposals for definitions has been prepared by the Expert Group in order to support the revision of the Protocol.

A. Pollutants covered by the Protocol

1. Sulphur

16. In the Gothenburg Protocol, sulphur is defined as follows:

“‘Sulphur’ means all sulphur compounds, expressed as sulphur dioxide (SO₂).”

The [new] guidance document addresses the control of oxidized sulphur emissions considered as “the sum of sulphur dioxide (SO₂) and sulphur trioxide (SO₃), expressed as SO₂.”

2. Nitrogen oxides

17. In the Protocol, NO_x are defined as follows:

“‘Nitrogen oxides’ means nitric oxide and nitrogen dioxide, expressed as nitrogen dioxide (NO₂).”

18. The Expert Group suggests using nitrogen monoxide instead of nitric oxide in the Protocol to avoid possible confusion with the definition used in the guidance document and technical annexes based on nitrogen monoxide. The [new] guidance document and the revised technical annex V address “the control of NO_x emissions considered as

“the sum of nitrogen monoxide (NO) and nitrogen dioxide (NO₂) expressed as NO₂.”

3. Volatile organic compounds

19. In the Protocol, VOCs are defined as follows:

“‘Volatile organic compounds’, or ‘VOCs’, means, unless otherwise specified, all organic compounds of an anthropogenic nature, other than methane, that are capable of producing photochemical oxidants by reaction with nitrogen oxides in the presence of sunlight.”

20. As it was already done in the existing Gothenburg Protocol, the Expert Group suggests including additional definitions in the technical annexes IV and XI, to be consistent with relevant EU regulations². The following definitions are used in the proposal of updated technical annex VI:

(a) “Volatile organic compound (VOC) shall mean any organic compound having at [273.13 K - delete] 293.15 K a vapour pressure of 0.01 kPa or more, or having a corresponding volatility under the particular conditions of use. The fraction of creosote which exceeds this value of vapour pressure at 293.15 K shall be considered as a VOC”.

(b) “Organic compound shall mean any compound containing at least the element carbon and one or more of hydrogen, halogens, oxygen, sulphur, phosphorus, silicon or nitrogen, with the exception of carbon oxides and inorganic carbonates and bicarbonates”.

(c) “Organic solvent shall mean any VOC which is used alone or in combination with other agents, and without undergoing a chemical change, to dissolve raw materials, products or waste materials, or is used as a cleaning agent to dissolve contaminants, or as a dissolver, or as a

dispersion medium, or as a viscosity adjuster, or as a surface tension adjuster, or a plasticiser, or as a preservative”.

21. “273.15 K” was used in the current guidance document³ to the Gothenburg Protocol. EGTEI suggests to use “293.15 K” to be consistent with the definition used in the Directive 1999/13/EC on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain activities and installations³.

22. The following definitions are used in the proposal of new technical annex on the solvent content of products:

(a) “Volatile organic compound (VOC) shall mean any organic compound having an initial boiling point less than or equal to 250°C measured at a standard pressure of 101.3 kPa”.

(b) “Organic compound shall mean any compound containing at least the element carbon and one or more of hydrogen, oxygen, sulphur, phosphorus, silicon, nitrogen, or a halogen, with the exception of carbon oxides and inorganic carbonates and bicarbonates”.

(c) “Organic solvent shall mean any VOC which is used alone or in combination with other agents to dissolve or dilute raw materials, products, or waste materials, or is used as a cleaning agent to dissolve contaminants, or as a dispersion medium, or as a viscosity adjuster, or as a surface tension adjuster, or as a plasticiser, or as a preservative”.

23. These definitions are suggested by the Expert Group in order to be consistent with the definition used in the Directive 2004/42/EC on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain paints and varnishes and vehicle refinishing products and amending Directive 1999/13/EC⁴.

24. The Expert Group agreed that the definition of VOCs provided in the United States Federal Register 40 CFR Part 51.100, “All carbon compounds, except carbon monoxide, carbon dioxide, carbonic acid, carbures and metal carbonates and ammonium carbonate, which participate to photochemical reactions” is not inconsistent with the definition used by the United Nations Economic Commission for Europe (UNECE).

³ Council directive 1999/13/EC of 11 March 1999 on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain activities and installations – OJEC L85.

⁴ Directive 2004/42/EC of the European parliament and of the Council of 21 April 2004 on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain paints and varnishes and vehicle refinishing products and amending Directive 1999/13/EC – OJEC L143.

4. Dust

25. The Expert Group supports the definition of PM as in document ECE/EB.AIR/WG.5/2009/4, para.[12]. It has also used the term “dust” in the guidance document because it is synonymous with TSP and is widely used in EU legislation and international standardisation.

26. The ELVs suggested in the proposal for a new technical annex on dust (ECE/EB.AIR/WG.5/2009/21) refer to dust. The Expert Group agreed that it was premature to define ELVs expressed as PM_{2.5} and/or PM₁₀ as there was insufficient data of adequate quality to support such definitions. Furthermore, the added value of additional ELVs for PM_{2.5} and PM₁₀ is not clear as mass emission levels of PM_{2.5} and PM₁₀ will automatically be reduced by setting an ELV for dust.

27. Measuring and monitoring of PM_{2.5} and PM₁₀ is possible following prEN ISO 23210-1 using manual techniques but emission levels are not comparable with the automatic methods in use for dust. As in document ECE/EB.AIR/2008/4⁵, reporting of PM₁₀ and PM_{2.5} emissions should be encouraged.

B. Best available techniques

28. The Expert Group reviewed the definition of best available techniques (BAT) used in the current guidance documents to the Gothenburg Protocol. The Expert Group agreed that the following definition could be used either in the core text of the [new] Protocol or in the guidance document:

(a) “Best available techniques” means the most effective and advanced stage in the development of activities and their methods of operation which indicate the practical suitability of particular techniques for providing the basis for emission limit values (and other permit conditions) designed to prevent and, where that is not practicable, to reduce emissions and the impact on the environment as a whole:

(i) “Techniques” includes both the technology used and the way in which the installation is designed, built, maintained, operated and decommissioned;

⁵ Guidelines 2008 for reporting emission data under the Convention on Long Range Transboundary air pollution (see ECE/EB.AIR/2008/4, available at: <http://www.unece.org/env/documents/2008/EB/EB/ece.eb.air.2008.4.e.pdf>)

- (ii) “Available” techniques means those developed on a scale which allows implementation in the relevant industrial sector, under economically and technically viable conditions, taking into consideration the costs and advantages, whether or not the techniques are used or produced inside the member State in question, as long as they are reasonably accessible to the operator;
- (iii) “Best” means most effective in achieving a high general level of protection of the environment as a whole.

29. The criteria are used for determining BAT:

- (a) The use of low-waste technology;
- (b) The use of less hazardous substances;
- (c) The furthering of recovery and recycling of substances generated and used in the process and of waste, where appropriate;
- (d) Comparable processes, facilities or methods of operation which have been tried with success on an industrial scale;
- (e) Technological advances and changes in scientific knowledge and understanding;
- (f) The nature, effects and volume of the emissions concerned;
- (g) The commissioning dates for new or existing installations;
- (h) The length of time needed to introduce the BAT;
- (i) The consumption and nature of raw materials (including water) used in the process and energy efficiency;
- (j) The need to prevent or reduce to a minimum the overall impact of the emissions on the environment and the risks to it;
- (k) The need to prevent accidents and to minimize the consequences for the environment;
- (l) Information published by national and international organizations⁶.

C. Best available technique associated emission levels

30. The Expert Group suggests adding a definition of BAT associated emissions levels (BAT AELs), as most of the data reported in the [new] guidance document refer to these levels, as defined in the BAT reference (BREF) documents:

⁶ This item has been added for consistency with the recast of the EU Integrated Pollution Prevention and Control (IPPC) Directive Proposal for a Directive of the European Parliament and of the Council on Industrial Emissions (Recast) [COM(2007) 843 final] [SEC(2007) 1679] [SEC(2007) 1682] /* COM/2007/0844 final - COD 2007/0286. It is slightly different from the definition used in the IPPC Directive in that it includes information published by national organizations.

- (a) BAT AELs are levels that an operator can expect to achieve when using the BAT, and are appropriate reference points to assist in the determination of permit conditions;
- (b) BAT AELs represent average emission levels achievable during a substantial period of time in normal operating and/or design conditions (well-proven technology);
- (c) BAT AELs are neither emission nor consumption limit values.

31. BAT AELs are based on normal operating conditions and may vary with changing input materials or for varying outputs. BAT AELs are also based on a range of averaging periods and represents a typical load situation. Therefore, when taking account of BAT AELs in the context of setting ELVs, proper consideration should always be given to the reference period to which the described BAT AEL pertains. For peak load, start-up and shut down periods, as well as for operational problems of the flue gas cleaning systems, short-term peak values – which could be higher – have to be considered.

32. Where a level is described as “achievable” using a particular technique or combination of techniques, this should be understood to mean that the level may be expected to be achieved over a substantial period of time in a well-maintained and well-operated installation or process using those techniques.

IV. OPTIONS FOR EMISSION LIMIT VALUES

33. The Expert Group was requested to provide the Working Group on Strategies and Review with options for ELVs. Three different options for ELVs, corresponding to different ambition levels were suggested by the Expert Group, as follows:

- (a) ELV1 is a demanding but technically feasible option with the objective of achieving a high level of reduction. The ELV1 is based on a value between the lower and upper BAT AEL, (where available);
- (b) ELV2, while technically demanding, pays greater attention to the costs of the measures for achieving reduction. The ELV2 is a value based on the upper BAT AEL (where available);
- (c) ELV 3 represents current [good] practices based on the legislation of a number of Parties to the Convention.

34. Averaging periods are stated in [new] technical annexes: start up, shut down and maintenance periods are clearly excluded.

35. In defining the different options for ELVs, the Expert Group made use of the following information:

- (a) ELVs that the Expert Group members reported as currently being applied in their countries for the different activities covered by the current annexes IV, V, VI and proposed new annexes on dust and on the solvent content of products;
- (b) ELVs present in the Gothenburg Protocol and the Protocol on Heavy metals,
- (c) ELVs implemented according to existing EU Directives;
- (d) ELVs present in new EU directive proposals;
- (e) Current guidance documents to the Gothenburg Protocol and annex II of the Protocol on Heavy Metals;
- (f) Documents prepared by the Task Force on Heavy Metals⁷;
- (g) BREF⁸ documents that provide a state-of-the-art of BAT available per sector and their AELs.

V. TECHNICAL OPPORTUNITIES FOR INTRODUCING GREAT POLICY FLEXIBILITY:

36. The Working Group may wish to consider the following technical means of introducing greater flexibility in a revised Gothenburg Protocol:

- (a) Making a distinction between new and existing plants;
- (b) Recognizing regional differences in applicable technologies;
- (c) Granting a longer period of time for existing plants to achieve compliance;
- (d) Considering different plant characteristics (e.g. plant size, operational regime, remaining lifetime);
- (e) Using the bubble concept for some complex activities⁹;
- (f) Setting different ambition levels according to the techno-economic situation of Parties.

⁷ Background document: assessments of the technological developments: Best available technique (BAT) and limit values – Task Force on Heavy Metals – April 2006.

Options for updating BAT from a technical point of view and implications for annexes – Michael Suhr, German UBA - Task Force on Heavy Metals - London, June 2008. See http://www.unece.org/env/lrtap/TaskForce/tfhtm/Fifth%20meeting_London.docs/Michael%20Suhr_.pdf

⁸ <http://eippcb.jrc.es/reference/>

⁹ Limit values set on the emissions of the whole plant rather than imposing limits on individual units constituting the plant.

VI. FURTHER WORK

37. The Expert Group agreed to hold its sixteenth meeting on 15 and 16 October 2009 in Nice, France to continue work related to the technical annexes and guidance documents, as necessary, and to continue to address items included in its 2009 workplan.
