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**Options for revising the annexes to the Gothenburg Protocol to
Abate Acidification, Eutrophication and Ground-level Ozone:
technical annexes**

Draft revised annex V

Note by the secretariat

Introduction

Summary

This document presents proposals for amendments to annex V to the Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone for consideration by the Working Group on Strategies and Review at its forty-ninth session. It is based on documents ECE/EB.AIR/WG.5/2009/18 and Corr.1, ECE/EB.AIR/WG.5/2011/2, and further proposals made by the European Union and provisionally agreed at the forty-eighth session of the Working Group in April 2011.

Proposed new text is indicated in bold. Text in square brackets that is not marked for deletion has not been provisionally agreed by the Working Group.

Limit values for emissions of nitrogen oxides from stationary sources

1. Section A applies to Parties other than Canada and the United States of America, section B applies to Canada and section C applies to the United States of America.

A. Parties other than Canada and the United States of America

2. For the purpose of **this** section [A – ~~delete~~] “**emission limit value**” (ELV) means the quantity of [a gaseous substance – ~~delete~~] **NO_x (sum of NO and NO₂, expressed as NO₂)** contained in the waste gases from an installation that is not to be exceeded. Unless otherwise specified, it shall be calculated in terms of mass of [pollutant – ~~delete~~] **NO_x** per volume of the waste gases (expressed as mg/m³), assuming standard conditions for temperature and pressure for dry gas (volume at 273.15 K, 101.3 kPa). With regard to the oxygen content of the [exhaust – ~~delete~~] **waste** gas, the values given in the tables below for each source category shall apply. [Limit values generally address NO together with NO₂, commonly named NO_x, expressed as NO₂. – ~~delete~~] Dilution for the purpose of lowering concentrations of pollutants in waste gases is not permitted. Start-up, shutdown and maintenance of equipment are excluded.

3. Emissions shall be monitored in all cases **via measurements or through calculations achieving at least the same accuracy**. Compliance with **ELVs** [limit values – ~~delete~~] shall be verified **through** [The methods of verification can include – ~~delete~~] continuous or discontinuous measurements, type approval, or any other technically sound method. In case of continuous measurements, compliance with the [emission standards – ~~delete~~] **ELVs** is achieved if the validated [daily/ – ~~delete~~] monthly emission average does not exceed the limit values. In case of discontinuous measurements or other appropriate determination procedures, compliance with the [emission standards – ~~delete~~] **ELVs** is achieved if the mean value based on an appropriate number of measurements under representative conditions does not exceed the **ELV** [value of the emission standard – ~~delete~~]. The inaccuracy of the [continuous and discontinuous – ~~delete~~] measurement methods may be taken into account for verification purposes.

4. [Sampling and analysis – ~~delete~~] **Monitoring** of relevant polluting substances and measurements of process parameters, as well as the quality assurance of automated measuring systems and the reference [measurement methods – ~~delete~~] **measurements** to calibrate those systems, shall be carried out in accordance with CEN standards. If CEN standards are not available, ISO standards[– ~~delete~~] **or** national or international standards which will ensure the provision of data of an equivalent scientific quality shall apply.

5. Special provisions for combustion plants **referred to in paragraph 7** [with a rated thermal input exceeding 50 MWth and for combustion plants when combined to a common stack with a total rated input exceeding 50 MWth: – ~~delete~~]:

5.1 The competent authority may grant derogation from the obligation to comply with the **ELVs** provided for in paragraph [5 – ~~delete~~] 7 in the following cases:

(a) For combustion plants [only/mainly – ~~delete~~] **normally** using gaseous fuel which have to resort exceptionally to the use of other fuels because of a sudden interruption in the supply of gas and for this reason would need to be equipped with a waste gas purification facility;

[(b) For **existing** combustion plants not operated more than **17,500** operating hours, starting from **1 January 2016** and ending no later than **31 December 2023**;

[(c) For existing combustion plants **other than on shore gas turbines (covered by paragraph 7)** using solid or liquid fuels not operated more than **1,500** operating hours per year as a rolling average over a period of five years[;– ~~delete~~], instead **the** following **ELVs** apply:

(i) For solid fuels: **450 mg/m³**; [option 1 and 2 = 450 mg/Nm³; option 3 = 600 mg/Nm³ – ~~delete~~]

(ii) For liquid fuels: **450 mg/m³**. [option 1, 2 and 3 = 450 mg/Nm³ – ~~delete~~]

5.2 Where a combustion plant is extended by at least 50MWth, the **ELV** specified in paragraph 6 [7 – ~~delete~~] for new installations shall apply to the extensional part [and to the part of the plant – ~~delete~~] affected by the change.

5.3 Parties shall ensure that provisions are made in the permits for procedures relating to malfunction or breakdown of the abatement equipment.

5.4 In the case of a multi-fuel firing combustion plant involving the simultaneous use of two or more fuels, the competent authority shall **determine the ELV as the weighted average of the ELVs for the individual fuels, on the basis of the thermal input delivered by each fuel** [provide rules for setting the emission limit values – ~~delete~~]. [6. – ~~delete~~] **Parties may apply rules by which combustion plants and process plants within [Mineral – ~~delete~~] a mineral oil refinery [refineries – ~~delete~~] may be exempted from compliance with the individual NO_x limit values set out in this annex, provided that they are complying with [the overall – ~~delete~~] a bubble NO_x limit value [,- ~~delete~~] determined on the basis of the best available techniques.** [set in table 1. Following alternative bubble NO_x limit value may be used, referring to the sum of the emissions from all combustion plants and process installations expressed as an average concentration and at a reference oxygen content of [3%]. – ~~delete~~]

[Table 1. Suggested options for limit values for NO_x emissions released from refineries using the bubble concept:

	Suggested ELV for NO _x [(mg/Nm ³)]		
	Option 1	Option 2	Option 3
Mineral oil refinery	150	300	400

Oxygen reference: dry basis, 3% for combustion, 15 % for gas turbines – ~~delete~~]

6. [7. – delete] Combustion plants [(boilers and process heaters) – delete] with a rated thermal input exceeding 50 MWth [or combustion plants when combined to a common stack with a total rated input exceeding 50 MWth – delete]:¹

Table 1. [2. Suggested options for – delete] Limit values for NO_x emissions released from [boilers and process heaters – delete] **combustion plants**^{a/}

Fuel type	Thermal input [(MWth)]	ELV for NO _x (mg/m ³)[mg/Nm ³ – delete] ^{b/}		
		[Option 1 – delete]	Option 2	Option 3
Solid fuels	50–100	[New plants: 250 (coal, lignite) 200 (biomass, peat) – delete]	New plants: 300 (coal, lignite and other solid fuels) (pulverized lignite: 450) 250 (biomass, peat)	[New plants: 400 (coal, lignite) (pulverized lignite: 450) 400 (biomass, peat) – delete]
		[Existing plants: 250 (coal, lignite) 250 (biomass, peat) – delete]	Existing plants: 300 (coal, lignite and other solid fuels) (pulverized lignite: 450) 250 (biomass, peat)	[Existing plants: 600 (coal, lignite) 600 biomass, peat) – delete]
	100–300	[New plants: 150 (coal, lignite) 150 (biomass, peat) – delete]	New plants: 200 (coal, lignite and other solid fuels) 200 (biomass, peat)	[New plants: 200 (coal, lignite) 300 (biomass, peat) – delete]
		[Existing plants: 200 (coal, lignite) 200 (biomass, peat) – delete]	Existing plants: 200 (coal, lignite and other solid fuels) 250 (biomass, peat)	[Existing plants: 600 (coal, lignite) 600 biomass, peat) – delete]
	>300	[New plants: 100 (coal, lignite) 100 (biomass, peat) – delete]	New plants: 150 (coal, lignite and other solid fuels) (general) 150 (biomass, peat)	New plants: 200 (pulverized lignite) [200 (biomass, peat) – delete]
		[Existing plants: 100 (coal, lignite) 100 (biomass, peat) – delete]	Existing plants: 200 (coal, lignite and other solid fuels) 200 (biomass, peat)	[Existing plants: 200 (coal, lignite) 200 biomass, peat) – delete]

¹ The rated thermal input of the combustion plant is calculated as the sum of the input of all units connected to a common stack. Individual [combustion plants – delete] units below 15 MWth shall not be considered when calculating [to calculate – delete] the total rated input.

Fuel type	Thermal input [(MWth)]	ELV for NO_x (mg/m^3)[mg/Nm^3 – delete] ^{b/}		
		[Option 1 – delete]	Option 2	Option 3
Liquid fuels	50–100	[New plants: 250 – delete]	New plants: 300	[New plants: 400 – delete]
		[Existing plants: 300 – delete]	Existing plants: 450	[Existing plants: 450 – delete]
	100–300	[New plants: 100 – delete]	New plants: 150	[New plants: 200 – delete]
		[Existing plants: 150 – delete]	Existing plants: 200 (general)	Existing plants: 450 for firing of distillation and conversion residues from crude oil refining for own consumption in combustion plants and for firing liquid production residue as non-commercial fuel
		[New plants: 80 – delete]	New plants: 100	[New plants: 200 – delete]
		[Existing plants: 100 – delete]	Existing plants: 150 (general) 450 for firing of distillation and conversion residues from crude oil refining for own consumption in combustion plants and for firing liquid production residue as non-commercial fuel (< 500 MWth)	[Existing plants: 400 – delete]
>300	[New plants: 80 – delete]	New plants: 100	[New plants: 150 – delete]	
	[Existing plants: 80 – delete]	Existing plants: 100	[Existing plants: 300 – delete]	
Natural gas	50–300	[New plants: 60 – delete]	New plants: 100	[New plants: 100 – delete]
		[Existing plants: 80 – delete]	Existing plants: 100	[Existing plants: 200 – delete]
	>300	[New plants: 200 – delete]	New plants: 200	[New plants: 200 – delete]
		[Existing plants: 300 – delete]	Existing plants: 300	[Existing plants: 300 – delete]
Other gaseous fuels [^{c/} – delete]	>50	[New plants: 200 – delete]	New plants: 200	[New plants: 200 – delete]
		[Existing plants: 300 – delete]	Existing plants: 300	[Existing plants: 300 – delete]

^{a/} In particular, the ELVs [limit values – delete] shall not apply to:

- Plant where the combustion process is an integrated part of a specific production, for example the coke oven used in the Iron and Steel industry and glass and ceramics production plants; – ~~delete~~

- Plants in which the products of combustion are used for direct heating, drying, or any other treatment of objects or materials;
- Post-combustion plants designed to purify the waste gases by combustion which are not operated as independent combustion plants;
- Facilities for the regeneration of catalytic cracking catalysts;
- Facilities for the conversion of hydrogen sulphide into sulphur;
- Reactors used in the chemical industry;
- Coke battery furnaces;
- Cowpers;
- [Recovery boilers[for black liquor – ~~delete~~] within installations for the production of pulp;]
- Waste incinerators; and
- Plants powered by diesel, petrol or gas engines or by combustion turbines, irrespective of the fuel used.

^{b/} [These values do not apply to combustion plants running less than 500 hours a year. – ~~delete~~] The O₂ reference content is 6% for solid fuels and 3% for [others – ~~delete~~] **liquid and gaseous fuels**.

^{c/} inter alia refinery gases, coke oven gases, blast furnace gases, BOF gases – ~~delete~~

7. [8. – ~~delete~~] Onshore combustion turbines with a rated thermal input exceeding 50MWth: the NO_x ELVs [limit values – ~~delete~~] expressed in mg/Nm³ (at a **reference** O₂ content of 15%) are to be applied to a single turbine. The **ELVs** [limit values – ~~delete~~] in table 2 [3 – ~~delete~~] apply only above 70% load.

Table 2. [3. Suggested options for – ~~delete~~] Limit values for NO_x emissions released from onshore combustion turbines (including CCGT)

Fuel type	Thermal input [(MWth)]	ELV for NO _x (mg/m ³) [mg/Nm ³ – delete] ^{a/}		
		Option 1	Option 2	[Option 3 – delete]
Liquid fuels (light and medium distillates)	> 50	New plants: 50	[New plants: 100 – delete]	[New plants: 120 – delete]
		Existing plants: 90 200 in case of plants operating less than 1,500 hours a year	[Existing plants: 120 – delete]	[Existing plants: 120 – delete]
Natural gas ^{b/}	> 50	[New plants: 50 – delete]	New plants: 50 (in general) ^{d/}	[New plants: 50 – delete]
		Existing plants: 50 (general) ^{c/, d/} 150 in case of plants operating less than 1,500 hours per year	[Existing plants: 90 – delete]	[Existing plants: 120 – delete]
Other gases [^{e/} - delete]	> 50	[New plants: 50 – delete]	New plants: 50	[New plants: 50 – delete]
		[Existing plants: 75 – delete]	Existing plants: 120 200 in case of plants operating less than 1,500 hours a year	[Existing plants: 120 – delete]

^{a/} Gas turbines for emergency use that operate less than 500 hours per year are not covered.

^{b/} Natural gas is naturally occurring methane with not more than 20% (by volume) of inert gases and other constituents.

^{c/} [e.g. for supplementary firing with other gases] – ~~delete~~

^{c/} 75 mg/Nm³ in the following cases, where the efficiency of the gas turbine is determined at ISO base load conditions:

- (i) Gas turbines, used in combined heat and power systems having an overall efficiency greater than 75%;
- (ii) Gas turbines used in combined cycle plants having an annual average overall electrical efficiency greater than 55%;
- (iii) Gas turbines for mechanical drives.

^{d/} For single gas turbines not falling into any of the categories mentioned under footnote c/, but having an efficiency greater than 35% — determined at ISO base load conditions — the ELV for NO_x shall be $50 \times \eta / 35$ where η is the gas-turbine efficiency at ISO base load conditions expressed as a percentage.

8. [9. – ~~delete~~] Cement production:

Table 3. [4. Suggested options for – ~~delete~~] Limit values for NO_x emissions released from cement **clinker** production ^{a/}

Plant type	ELV for NO _x [(mg/Nm ³)]		
	[Option 1– delete]	Option 2	Option 3
[New installations – delete]			
[- preheater kilns – delete] General (existing and new installations) [- other kilns – delete]	[300 – delete]	[400 – delete]	500
Existing lepol and long rotary kilns in which no waste is co-incinerated	[400 – delete]	800	[800 – delete]
[Existing installations – delete]	[400 – delete]	[800 – delete]	[1200 – delete]

^{a/} Installations for the production of cement clinker in rotary kilns with a capacity >500 Mg/day or in other furnaces with a capacity >50 Mg/day. The O₂ reference content is 10%.

9. [10. – ~~delete~~] Stationary engines:

Table 4. [5. Suggested options for – ~~delete~~] Limit values for NO_x emissions released from new stationary engines

ENGINE TYPE, POWER, FUEL SPECIFICATION	ELV 1 ^{a/, b/, c/} [(mg/Nm ³)]	ELV 2 ^{a/, b/, c/} [(mg/Nm ³)]	ELV 3 ^{a/} [(mg/Nm ³)]
GAS ENGINES > 1 MWth Spark ignited (=Otto) engines all gaseous fuels	[35 – delete]	95 (enhanced lean burn)	190 Standard lean burn or rich burn [with catalyst]
DUAL FUEL ENGINES > 1 MWth In gas mode (all gaseous fuels) In liquid mode (all liquid fuels)	[35 ^{e/} – delete]	190 [^{e/} – delete]	[380 ^{e/}]
1–20 MWth	225	[750 – delete]	[1850] [2000]
>20 MWth	225 [^{e/} – delete]	[450 – delete]	[1850] [2000] – delete]

ENGINE TYPE, POWER, FUEL SPECIFICATION	ELV 1 ^{a/, b/, c/} [(mg/Nm ³)]	ELV 2 ^{a/, b/, c/} [(mg/Nm ³)]	ELV 3 ^{a/} [(mg/Nm ³)]
DIESEL ENGINES > 5 MWth (compression ignition) <i>Slow (< 300 rpm)/ Medium (300-1,200 rpm)/ speed</i> 5–20 MWth HFO and bio-oils	225	[[450] [750] – <u>delete</u>]	[[1300] ^{d/} [1600] – <u>delete</u>]
LFO and NG >20 MWth HFO and bio-oils	[150 – <u>delete</u>]	190	[[1300] ^{d/} [1600] – <u>delete</u>]
LFO and NG	[150 – <u>delete</u>]	190	[[750] [1850] – <u>delete</u>]
<i>High speed (>1,200 rpm)</i>	[[130] [150] – <u>delete</u>]	190	[[750] [900] – <u>delete</u>]

Note: The reference oxygen content is 15%².

^{a/} These ELVs [values – delete] do not apply to engines running less than 500 hours a year.

^{b/} Where SCR cannot currently be applied **for technical and logistical reasons** [for certain geographical areas, – delete] [like **on** remote islands] or **where** the [unavailability – delete] **availability of sufficient amounts of** [good – delete] **high quality** fuel [or raw material quality – delete] **cannot be** guaranteed, a transition period of **10 years after the entry into force of the Protocol** [can – delete] **may be applied** [granted – delete] **for diesel engines and dual fuel engines during which the following ELVs apply:** [During this transition period the upper value of ELV3 can be applied. – delete]

(i) **Dual fuel engines: 1,850 mg/Nm³ in liquid mode;**

(ii) **Diesel engines — Slow (< 300 rpm) and Medium (300 – 1,200 rpm)/ speed: 1,300 mg/Nm³ for engines between 5 and 20 MWth and 1,850 mg/Nm³ for engines > 20 MWth;**

(iii) **Diesel engines — High speed (> 1200 rpm): 750 mg/Nm³;**

^{c/} [A flexibility option for – delete] Engines **running** between 500 [to – delete] and 1,500 operational hours per year **may be exempted from compliance with these ELVs in case they are applying** [is to apply [the upper values of ELV3] [achievable with – delete] primary measures to **limit NO_x emissions and meet the ELVs set out in footnote b/;**

^{d/} Limit of primary measures under development (Currently only first laboratory tests done on some engine type.) – delete]

² The conversion factor from the limit values in the current Protocol (at 5% oxygen content) is 2,66 (16/6).

Thus, the limit value of:

- 190 mg/Nm³ at 15 % O₂ corresponds to 500 mg/Nm³ at 5 % O₂,
- 95 mg/Nm³ at 15 % O₂ corresponds to 250 mg/Nm³ at 5 % O₂,
- 225 mg/Nm³ at 15 % O₂ corresponds to 600 mg/Nm³ at 5 % O₂.

[^{c/} A derogation from the obligation to comply with the emission limit values can be granted to combustion plants using gaseous fuel which have to resort exceptionally to the use of other fuels because of a sudden interruption in the supply of gas and for this reason would need to be equipped with a waste gas purification facility. The exception time period shall not exceed 10 days except where there it is an overriding need to maintain energy supplies. – ~~delete~~]

[[Since engines running with higher energy efficiency consume less fuel and emit therefore less CO₂ and since higher efficiency of the engines can lead to higher temperatures and therefore to higher NO_x concentrations in the flue gases, a NO_x bonus using the formula [ELV x actual efficiency / reference efficiency] could be justified .] – ~~delete~~]

10. [11. – ~~delete~~] [Production and processing of metals – ~~delete~~] Iron ore sinter plants:

Table 5. [6. Suggested options for – ~~delete~~] Limit values for NO_x emissions released from [primary iron and steel ^{a/} production – ~~delete~~] iron ore sinter plants

Plant type	[Suggested – delete] ELV for NO _x [(mg/Nm ³)] [^{b/} – delete]		
	Option 1	Option 2	[Option 3 – delete]
Sinter plants: New installation	[... ^{c/}]	400	[400 – delete]
Sinter plants: Existing installation	[... ^{c/} – delete]	400	[400 – delete]

[^{a/} Production and processing of metals: metal ore roasting or sintering installations, installations for the production of pig iron or steel (primary or secondary fusion) including continuous casting with a capacity exceeding 2.5 Mg/hour, installations for the processing of ferrous metals (hot rolling mills > 20 Mg/hour of crude steel)

^{b/} As an exemption to paragraph 3, these ELVs should be considered as averaged over a substantial period of time

^{c/} SCR is considered as part of the BAT in the European Reference document but no BAT-AEL is reported – ~~delete~~]

11. [12. – ~~delete~~] Nitric acid production:

Table 6. [7. Suggested options for – ~~delete~~] Limit values for NO_x emissions from nitric acid production excluding acid concentration units

Type of installations	ELV for NO _x [(mg/Nm ³)]		
	[Option 1 – delete]	Option 2	[Option 3 – delete]
New installations	[40 – delete]	[154 – delete] 160	[200 – delete]
Existing installations	[100 – delete]	[185 – delete] 190	[200 – delete]

B. Canada

12. [13. – ~~delete~~] [Limit values for controlling emissions of nitrogen oxides (NO_x) from new stationary sources in the following stationary source categories will be determined on the basis of available information on control technology and levels including limit values applied in other countries and the following documents: – ~~delete~~] **[Limit values for controlling emissions of nitrogen oxides (NO_x) will be determined for stationary sources, as appropriate, taking into account information on available control technologies, limit values applied in other jurisdictions, and the documents below. These documents vary in the degree to which they are mandatory, and in some cases the authority for implementation is not at the federal level, but rests with sub-national jurisdictions. The inclusion of a particular document should not be understood to imply that Canada agrees to be bound by it under the Gothenburg Protocol:**

(a) [Canadian Council of Ministers of the Environment (CCME). National Emission Guidelines for Stationary Combustion Turbines. December 1992. PN1072 – ~~delete~~] **New Source Emission Guidelines for Thermal Electricity Generation;**

(b) [Canada Gazette, Part I. Department of the Environment. Thermal Power Generation Emissions – National Guidelines for New Stationary Sources. May 15, 1993. pp. 1633-1638; and – ~~delete~~] **National Emission Guidelines for Stationary Combustion Turbines. PN1072;**

(c) [CME. – ~~delete~~] National Emission Guidelines for Cement Kilns. [March 1998. – ~~delete~~] PN1284;

(d) **National Emission Guidelines for Industrial/Commercial Boilers and Heaters. PN1286;**

(e) **Operating and Emission Guidelines for Municipal Solid Waste Incinerators. PN1085;**

(f) **Management Plan for Nitrogen Oxides (NO_x) and Volatile Organic Compounds (VOCs) - Phase I. PN1066; and**

(g) **Operating and Emission Guidelines for Municipal Solid Waste Incinerators. PN1085.]**

C. United States of America

13. [14. – ~~delete~~] Limit values for controlling emissions of NO_x from new stationary sources in the following stationary source categories are specified in the following documents:

(a) Coal-fired Utility Units — 40 Code of Federal Regulations (C.F.R.) Part 7;

(b) Electric Utility Steam Generating Units — 40 C.F.R. Part 60, Subpart D, and Subpart Da;

(c) Industrial-Commercial-Institutional Steam Generating Units — 40 C.F.R. Part 60, Subpart Db;

(d) Nitric Acid Plants — 40 C.F.R. Part 60, Subpart G;

(e) Stationary Gas Turbines — 40 C.F.R. Part 60, Subpart GG;

(f) Municipal Waste Combustors — 40 C.F.R. Part 60, Subpart Ea, and Subpart Eb; [and – ~~delete~~]

- (g) Hospital/Medical/Infectious Waste Incinerators — 40 C.F.R. Part 60, Subpart Ec; and
 - (h) Petroleum Refineries — 40 C.F.R. Part 60, Subpart J, and Subpart Ja;
 - (i) Stationary Internal Combustion Engines — Spark Ignition, 40 C.F.R. Part 60, Subpart JJJJ;
 - (j) Stationary Internal Combustion Engines — Compression Ignition, 40 C.F.R. Part 60, Subpart IIII;
 - (k) Stationary Combustion Turbines — 40 C.F.R. Part 60, Subpart KKKK; and
 - (l) Small Municipal Waste Combustors — 40 C.F.R. Part 60, Subpart AAAA.
-