ADJUSTMENT EMISSION INVENTORY REPORT – NEC REPORTING 31.12.2014 LRTAP REPORTING 15.02.2015 LRTAP resubmission 15.03.2015 Version 1

Summary

Belgium signed and ratified the 1999 Protocol to Abate Acidification, Eutrophication and Ground-level ozone (Gothenborg Protocol) and Belgium as EU Member State adopted the National Emission Ceiling Directive (2001/81/EC) in 2001. Hereby, Belgium committed itself to reduce its emissions of NO_x, SO_2, NMVOC and NH_3 to the agreed national emission ceilings by 2010 and to respect these ceilings from 2010 onwards.

Table 1 summarizes the emission totals, based on **fuel used** for compliance under the NECD and the Gothenborg Protocol emission ceilings. Belgium exceeds its national emissions ceiling for NOx by 32% in 2010 against the NECD and by 28% against the Gothenborg Protocol ceiling. The provisional estimates for 2013 give an exceedance of 13% and 10% against NEC en Gothenborg respectively. For NMVOC, both emission ceilings were exceeded in 2010. Since 2011, the Gothenborg emission ceiling is met and since 2013 NMVOC emissions are below the NEC ceiling. The NEC and Gothenborg emission ceilings for the other pollutants were met in 2010 or earlier.

Table 1: National non-adjusted total emissions (fuel used) and national emission ceilings.

National Total (fuel used)*	NOx	NMVOC	SOx	NH3
2010	231.79	153.72	60.55	64.98
2011	216.92	141.49	53.17	64.17
2012	206.76	139.68	47.45	63.29
2013	199.49	136.68	45.55	62.16
NEC Emission ceiling 2010	**176**	**139**	**99**	**74**
% above NEC ceiling in 2013	13%	-2%	-54%	-16%
Gothenborg Emission ceiling 2010	**181**	**144**	**106**	**74**
% above Gothenborg ceiling in 2013	10%	-5%	-57%	-16%

**NOTE: The national totals (FU) reported under NECD (24/12/2014) slightly differ from the national totals reported under CLRTAP (resubmission 14/3/2015) due to little corrections made in the inventory. These changes do not affect the conclusions on compliance or non-compliance for the years 2010-2013.*

The non-compliance for NOx emissions up to 2013, as well as for NMVOC emissions in 2010 (Gothenborg Protocol) up to 2012 (NECD) are due to changes in the emission inventory, not foreseen at the time the emission ceilings were set. These changes include the partial failure of

certain EURO vehicle emission standards, especially for diesel vehicles, as well as the inclusion of new source categories.

Based on EB decision 2012/4 (*EB2012a, (1)*) allowing the provisional application of article 3, paragraph 11 quinquies of the amended Gothenborg Protocol, Belgium applies for making use of the adjustment procedure as described in Decision 2012/3 (*EB2012b, (2)*) and according the Guidance in the consolidated version of the adapted Decision 2012/12 (*EB2012c, (3)*) and additional Guidances (*11*) for its emission inventory for NOx for 2010 to 2013 and NMVOC for 2010 to 2012 in order to prove its compliance with the 2010 NEC ceilings.

For **NOx**, the adjustment application to the emission inventory is the result of two (aggregated) adjustments, both of them in accordance with one of the circumstances as described in Decision 2012/12, article 6:

1. **Road transport (1A3bi-iv)**: Significant change in emission factors (article 6(b))
2. **Agriculture (3B, 3Da1 and 3Da2a)**: new source categories (article 6(a))

For **NMVOC**, the adjustment application to the emission inventory is due to the inclusion of the emissions from agricultural soils and manure management, two source categories that were not taken into account at the time the emission ceilings were set, and therefore in accordance with circumstance a) in Decision 2012/12:

Agriculture (3B and 3De): new source categories (article 6(a)).

This report describes the different adjustment applications in detail.

Table 2 summarizes the individual adjustments as well as the adjusted national total emissions. For compliance purposes, Belgium is allowed to use national total emissions based on **fuel used**[1] *(EB2013, (4))*. **With application of the adjustments, Belgium is in compliance with its NEC emission ceilings from 2010 on for all NEC pollutants. A forteriori, the Gothenborg Protocol emission ceilings are met.**

Table 2: Total Emissions and adjustments for NOx and NMVOC.

NOx	2010	2011	2012	2013	NEC Emission ceiling 2010	Gothenborg emission ceiling 2010
National Total (fuel used)	231.79	216.92	206.76	199.49	176	181
Adjustment Road transport (1A3bi-iv)	-47.98	-47.77	-47.17	-46.54		
Adjustment Agriculture - Manure management (3B)	-0.39	-0.38	-0.38	-0.37		
Adjustment Agriculture - Inorganic N-fertilizers (3Da1)	-5.94	-5.85	-5.64	-5.73		

[1] ECE/EB.AIR/125. Guidelines for Reporting Emissions and Projections Data under the Convention on Longe-range Transboundary Air Pollution, Chapter V, A.23.

Adjustment Agriculture - Animal manure applied to soils (3Da2a)	-7.60	-7.29	-7.07	-6.95		
Adjusted national total for compliance*	169.89	155.62	146.50	139.89		
NMVOC	**2010**	**2011**	**2012**	**2013**	**NEC Emission ceiling 2010**	**Gothenborg emission ceiling 2010**
National Total (fuel used)	153.72	141.49	139.68	136.68	139	144
Adjustment Agriculture - Manure management (3B)	-36.59	-35.90	-35.60	NA		
Adjustment Agriculture - Cultivated crops (3De)	-1.22	-1.20	-1.19	NA		
Adjusted national total for compliance*	115.91	104.40	102.90	NA		

**IMPORTANT NOTE: adjusted national totals for compliance reported under NECD (24/12/2014) were lower due to the inclusion of an adjustment for the off road sector. After the NEC submission Belgium decided not to apply for an adjustment of the off road sector. Please refer to the adjustments calculated in the LRTAP resubmission 14/3/2015 and described in this report for the right adjustment under NECD and LRTAP.*

Contents

1. Introduction

Belgium signed and ratified the 1999 Protocol to Abate Acidification, Eutrophication and Ground-level ozone (Gothenborg Protocol) and Belgium as EU Member State adopted the National Emission Ceiling Directive (2001/81/EC) in 2001. Hereby, Belgium committed itself to reduce its emissions of NO_x, SO_2, NMVOC and NH_3 to the agreed national emission ceilings by 2010 based on **fuel used** and to respect these ceilings from 2010 onwards. Emission estimates are yearly reported according the recommendations of the Guidelines for Estimating and Reporting Emissions Data under CLRTAP (ECE/EB.AIR/97), revised in 2009 and in 2013 (ECE/EB.AIR/125) *(EB2013 (4))*.

When negotiating the emission ceilings in 1999, scenario modelling with RAINS was performed at IIASA for estimating emissions in 2010 *(Amman 2000, (5))*. These scenarios used specific assumptions on projected economic, energy and transport data, legislation in place or planned and the best knowledge concerning abatement technologies at that time. Between the time the emission ceilings were set and the last reporting submission, the emission inventory has continuously been improved. Examples of such improvements are the inclusion of new emission sources and a better disaggregation of source categories, revision of emission factors and changes in methodology. Unfortunately, some of these changes contributing to a more complete and accurate emission inventory also lead to higher emission levels than was foreseen when setting the ceilings at the time of the adoption of the Gothenburg Protocol (1999) and the NEC Directive (2001).

According to the Belgian emission inventory as reported in February 2015 and resubmitted in March 2015, total NO_x emissions in Belgium in 2010 based on **fuel used** were 32% higher than the NEC emission ceiling of 176 ktonnes and 28% higher than the Gothenborg Protocol emission ceiling. Also in 2013, the NEC ceiling was exceeded by 13% and the Gothenborg Protocol ceiling by 10% (see Table 1). For NMVOC, both emission ceilings were exceeded in 2010. Since 2011, the Gothenborg Protocol emission ceiling is met and since 2013 NMVOC emissions are below the NEC ceiling. The emission ceilings for the other pollutants were met from 2010 onwards.

The non compliance for NOx and NMVOC is due to changes beyond the control of the Member State and its mitigation policies, Belgium applies for making use of the adjustment procedure based on EB decision 2012/4 allowing the provisional application of article 3, paragraph 11 quinquies of the amended Gothenborg Protocol, as described in Decision 2012/3 and according the Guidance in the consolidated version of the adapted Decision 2012/12 and additional Guidances for its emission inventory for NOx and NMVOC in order to prove its compliance with the 2010 NEC and Gothenborg ceilings.

The non compliance for the NOx emission total is due to two changes in the emission inventory that were not foreseen at the time the emission ceilings were set: (1) Adoption of emission factors for new vehicles introduced after 2001, significantly different from the factors applied when the ceilings were set and (2) emissions of new sources of agricultural soils and manure management are included.

The non compliance for the NMVOC emission total is due to the inclusion of emissions from new source categories: “agricultural soils” and “manure management”.

The reasons for adjustment are described in detail in the following chapters.

2. Road transport (1A3b i-iv) - NOx

The largest adjustment for NOx lies within the road transport sector. The emissions from road transport were reduced because of the introduction of different emission standards in time for light and heavy duty vehicles, the so-called euro standards since 1992. The emission reductions expected at the time when the emission ceilings were set, were based on the relative change against emission standards for vehicles without abatement technology. However, when more vehicles were introduced on the market complying with these standards, it became clear that vehicle emission standards for some pollutants and fuel type vehicles did not perform in real driving conditions as expected. Especially in the case of diesel vehicles. Therefore, emission factors had to be reviewed to represent realistic driving conditions. More detailed information regarding the inconsistency between the official test procedures and real world traffic conditions is presented in Annex 1.

Table 3 summarizes the road transport and national total NOx emissions for the years 2010-2013 based on **fuels used** according the compliance guidelines for Reporting Emission Data under the LRTAP Convention §16 for Belgium*(12).* The fuel used road transport emission are calculated with the international road transport emission model COPERT IV, version 11.1. This model, is a bottom-up model, which calculates the real emissions on the Belgium Territory based on mobility statistics and fleet composition.
In the current national reporting of LRTAP from 15.02.2015, in the NFR code 1A3b, road transport emissions are reported on the fuel sold figures as required under §15 of guidelines for Reporting Emission Data under the LRTAP Convention (*12*). Starting from the bottom up calculation, the fuel used emissions are synchronised to comply with the energy balance statistics, the so called fuel sold statistics for road transport of Belgium.

Emissions for 2013 are preliminary. Belgium exceeds its NOx emission ceilings in the years 2010-2013. As the road transport sector accounts for almost 50% of the total emissions, an adjustment in the road transport sector greatly affects the national total and can lead to attainment of the NECD ceiling and the Gothenborg ceiling.

Table 3: NOx emissions (kton) for Road transport and National Total (Fuels used)

NFR code	NFR name	2010	2011	2012	2013
1A3bi	Passenger cars	43,57	43,34	43,00	42,39
1A3bii	Light Duty Vehicles	10,23	9,96	9,99	9,80
1A3biii	Heavy Duty Vehicles	50,08	45,38	40,32	37,23
1A3biv	Mopeds & motorcycles	0,36	0,35	0,35	0,35
	Road Transport (FU)	**104.25**	**99.04**	**93.67**	**89.77**
	National Total	**231.79**	**216.92**	**206.76**	**199.49**

According the information above, Belgium applies for an adjustment for NOx for the road transport sector, based on Decision 2012/3, under criterium 6(b): *"Emission factors used to determine emission levels for particular source categories for the year in which emission reduction commitments are to be attained are significantly different than the emission factors applied to these categories when emission reduction commitments were set;"*

The adjustment for road transport is an aggregation of different adjustments per vehicle category, per fuel type and per euro/Euro technology.

2.1. Changes in NO_x emission factors.

For road transport, the emission inventory is compiled according to the EMEP Guidelines for Estimating and Reporting Emissions Data under CLRTAP. Therefore the COPERT model is used. At the time the emission ceilings were set, scenario analysis was done by IIASA with the RAINS model. Input parameters for the road transport sector in the RAINS model were taken based on COPERT II (EEA 1997, (6)). Emissions for road transport were calculated for a total of **58.3 kton** for 2010 by the **RAINS** model in the reference scenario (IIASA 1999, (7)). When defining the emission ceilings, it was assumed that real world emission factor would be in line with the emission standards.
The emission factors used in the recent versions of COPERTIV version 11.1 are in line with the real world driving conditions. This means that different data (unabated EF, removal efficiency) are used than those used in the past when the emissions ceilings were set. For the submission of NEC 2014 and LRTAP 2015, the **COPERTIV v11.1**[2] was used. In 2010, the NO_x emissions (fuel used) for road transport are **104,25 kton**.

[2] Version received at COPERT workshop in Thessaloniki, Greece October 2014.

The difference between the reported emissions and the original RAINS results will not only include the change in emissions factors, but also will include changes in activity data and (minor) changes in methodology.
To separate the adjustment exclusively generated by the failure of the vehicle emission standards, it is important to do a calculation in which only the emission factors are the changing parameters.
This adjustment can be calculated as:

$$A_Y = AD_{Y\ Current} \times (EF_{original} - EF_{Current})$$

Where:
A_Y is the value of the adjustment for year Y.
$AD_{Y\ Current}$ are the activity data (Fuel used) for year y
$EF_{Current}$ are the emission factors (unabated EF x Removal Efficiency) used in COPERT IV v11.1
$EF_{Original}$ are the emission factors (unabated EF x Removal Efficiency) used in the original RAINS (COPERT II).

The emission factors are the result of the unabated emission factor and the removal efficiency per fuel and per technology. The original unabated emission factors used in RAINS are based on the parameters described in the CORINAIR Atmosperic Emission Inventory Guidebook (EMEP 1999, (8))) which made use of the COPERT II data *(EEA 1997, (6))*. The **original** unabated emission factors are to be found in the NOx documentation on emissions and control costs prepared by IIASA (IIASA 1998a, (9)). The **original** removal efficiencies are those from the IIASA report on RAINS scenarios (IIASA 1998b, (10)). The **new** emission factors, currently used for the reporting of the submission for NEC (31/12/2014) and LRTAP (15/2/2015) are the unabated emission factors and removal efficiencies as calculated by COPERT IV v11.1.

2.2. Quantifying the adjustment.

The RAINS model uses fuel activity data as a basis for calculating emissions from mobile sources. RAINS was used as the basis for setting the ceilings for the 1999 Gothenburg Protocol and the NEC 2010 Emission Ceiling for Belgium. In later years RAINS was updated to GAINS with extended vehicle classes and technologies. An evaluation of the NO_X emissions using the RAINS model is done below for 2010-2013 using all the parameters from the COPERT IV v11.1 on the one hand and the same COPERT IV v11.1 parameters except the emission factors on the other hand. All data except the emission factors, such as vehicle kilometers, vehicle fleet, ... are up to date and are kept constant in both calculations. Consequently, the difference only results from the change in emission factors. In the latter case, the emission factors of the original RAINS (= equal to COPERT II) are applied. For the more advanced technologies like Euro 5 and Euro 6, also all parameters from COPERT were used, except the emission factors, for which the values were used from the most advanced vehicle class in RAINS (i.e. Euro 4).

For each vehicle type an unabated emission factor for NOx and removal efficiency per technology are applied. In annex 2 the emission factors and removal efficiencies are presented for both COPERT IV v11.1 and RAINS for the years 2010-2013. Also the percentage of applied technology (i.e. control capacitities CC%) is documented in these tables. An extract of the 2010 table is shown in Table 4, for diesel passenger cars and light duty vehicles.

Table 4: Changes in abated NOx emission factors for diesel passenger cars and light duty vehicles (TRA_RD_LD4) for the year 2010 (full table in Annex 2).

2010	*Current emission factors COPERT IVvs11.1 (2014)*			*Old emission factors in RAINS (1999) (COPERT II)*		
Vehicle Class	*Unabated EF*	*Removal efficiency*	**Abated emission factor**	*Unabated EF*	*Removal efficiency*	**Abated emission factor**
	kt NOx/PJ	*%*	**kt_NOX/PJ**	*kt NOx/PJ*	*%*	**kt_NOX/PJ**
TRA_RD_LD4						
NOC	0.3232	0.00%	**0.3232**	0.35	0.00%	**0.3500**
Euro 1	0.3232	7.26%	**0.2997**	0.35	31.00%	**0.2415**
Euro 2	0.3232	1.25%	**0.3191**	0.35	50.00%	**0.1750**
Euro 3	0.3232	-1.77%	**0.3289**	0.35	60.00%	**0.1400**
Euro 4	0.3232	16.84%	**0.2687**	0.35	80.00%	**0.0700**
Euro 5	0.3232	16.85%	**0.2687**	0.35	80.00%	**0.0700**
Euro 6	0.3232	71.23%	**0.0930**	0.35	80.00%	**0.0700**

Table 4 shows that the emission factors used currently for road diesel cars and light duty vehicles are 3 to 4 times higher than the old EF used to set the emission ceilings for 2010.

NOx emissions for each vehicle class, technology and fuel type are calculated using this formula:

$$Em_{Y,i} = \sum_{j,k} \left(AD_{Y,j,k} \, x \sum_{l} \left(CC_{Y,j,k,l} \, x \, EF_{i,j,k,l}^{unabated} \, x \, (1 - RE_{i,j,k,l}) \right) \right)$$

Where:

$Em_{Y,\,i}$ is the emission estimate in the year Y, calculated with model i

$AD_{Y,\,j,\,k}$ is the new Activity Data level per vehicle class, per fuel class, aggregated over all technologies in year Y

$CC_{Y,\,j,\,k,\,l}$= Control Capacity (%/100) of technology l in year Y per vehicle class, per fuel class

$EF_{i,j,k,l}^{unabated}$ is the unabated Emission Factor used in model i for technology l, vehicle class j and fuel class k

$RE_{i,j,k,l}$ is the Removal Efficiency (% /100) used by model i for technology l, vehicle class j and fuel class k

i= RAINS (original) or COPERT (current)

j refers to the vehicle class, k refers to the fuel class and l tot the technology

The adjustment is then the difference between the NOx emission calculated with the new COPERT EF and the emission calculated with the RAINS EF:

$$A_Y = \sum_{j,k} \left(AD_{Y,j,k} \, x \sum_{l} \left(CC_{Y,j,k,l} \, x \left[EF^{unabated}_{RAINS,j,k,l} \, x \left(1 - RE_{RAINS,j,k,l} \right) - EF^{unabated}_{COPERT,j,k,l} \, x \left(1 - RE_{COPERT,j,k,l} \right) \right] \right) \right)$$

which can be written simplified as:

$$A_Y = Em_{Y,RAINS} - Em_{Y,COPERT}$$

As the activity data and the capacity controls are kept constant in the two calculations, the adjustment is the result of only the **change in emission factors**.

Table 5 shows the activity data, emission factors, emissions and adjustments for 2010 per vehicle type, fuel and Euro standard. The same information for 2011-2013 is summarized in Annex 3 and appendix B, submitted together with this report.

Table 5: Calculation of the adjustment for NOx in 2010. TRA_RD_LD4 = passenger cars and light duty vehicles; TRA_RD_HD = heavy duty vehicles and buses; TRA_RD_LD2 = mopeds and motorcycles. LF= Light fractions (gasoline, LPG,...); MD= Medium distillates (diesel,...); GAS=natural gas. NOC= No control.

Vehicle Class	Activity Level (PJ) x CC (%)	EF COPERT (kt/PJ)	EF RAINS (kt/PJ)	NOX COPERT (kt)	NOX RAINS (kt)	Adjustment (kt)
TRA_RD_LD4						
LF						
NOC	2.47	0.70	0.88	1.73	2.18	0.45
Euro 1	5.02	0.18	0.22	0.89	1.10	0.22
Euro 2	5.85	0.09	0.11	0.53	0.67	0.14
Euro 3	11.64	0.04	0.06	0.49	0.72	0.23
Euro 4	22.58	0.02	0.03	0.44	0.60	0.16
Euro 5	2.65	0.01	0.03	0.04	0.07	0.03
Euro 6	0.02	0.01	0.03	0.00	0.00	0.00
MD						
NOC	1.44	0.32	0.35	0.47	0.51	0.04
Euro 1	4.19	0.30	0.24	1.26	1.01	-0.24
Euro 2	15.34	0.32	0.18	4.90	2.68	-2.21
Euro 3	45.38	0.33	0.14	14.92	6.35	-8.57
Euro 4	89.85	0.27	0.07	24.14	6.29	-17.86
Euro 5	16.14	0.27	0.07	4.34	1.13	-3.21
Euro 6	0.20	0.09	0.07	0.02	0.01	0.00
GAS						
NOC	0.00	0.02	0.00	0.00	0.00	0.00

Euro 5	0.00	0.02	0.10	0.00	0.00	0.00
Euro 6	0.00	0.02	0.10	0.00	0.00	0.00
TRA_RD_HD						
LF						
NOC	0.05	0.63	0.86	0.03	0.04	0.01
MD						
NOC	2.80	1.00	1.05	2.79	2.94	0.15
Euro I	2.29	0.75	0.70	1.71	1.61	-0.10
Euro II	11.60	0.83	0.60	9.60	6.94	-2.65
Euro III	37.41	0.64	0.42	24.06	15.71	-8.35
Euro IV	12.91	0.45	0.16	5.83	2.03	-3.80
Euro V	23.18	0.26	0.16	6.07	3.65	-2.42
Euro VI	0.00	0.18	0.16	0.00	0.00	0.00
GAS						
NOC	0.00	0.00	0.65	0.00	0.00	0.00
Euro II	0.00	0.00	0.65	0.00	0.00	0.00
Euro III	0.00	0.00	0.65	0.00	0.00	0.00
EEV	0.00	0.00	0.10	0.00	0.00	0.00
TRA_RD_LD2						
LF						
NOC	0.01	0.04	0.20	0.00	0.00	0.00
Euro 1	0.02	0.19	0.20	0.00	0.00	0.00
Euro 2	0.03	0.18	0.20	0.01	0.01	0.00
Euro 3	0.05	0.19	0.20	0.01	0.01	0.00
Eindtotaal	**313.12**			**104.25**	**56.27**	**-47.98**

The total NOx emissions for road transport calculated with the new activity data from COPERT combined with the original emission factors used in **RAINS** results in **56.27 kton** for 2010. This amount is very close to the 58.3 kton originally calculated when the emission ceilings were set. The difference between those two values are due to the use of other activity data. With the current activity data and the original EF's, we manage to reproduce the originally calculated emissions fairly well.

The **COPERT** result for 2010 calculated (based on fuels used) for the NEC submission of December 2014 and LRTAP submission of 15/2/2015 is **104.25 kton**. This results in an adjustment of **-47.98 kton** for 2010 for the road transport sector. The main adjustments are due to the underestimation of the NO_x-emission factors of Euro 3 and 4 diesel light duty vehicles & cars and EURO III and IV diesel heavy duty vehicles in the original road transport models.

The adjustment for the years 2011, 2012 and 2013 are respectively **47.77 kton, 47.17 kton and 46.54 kton** (see Annex 3).

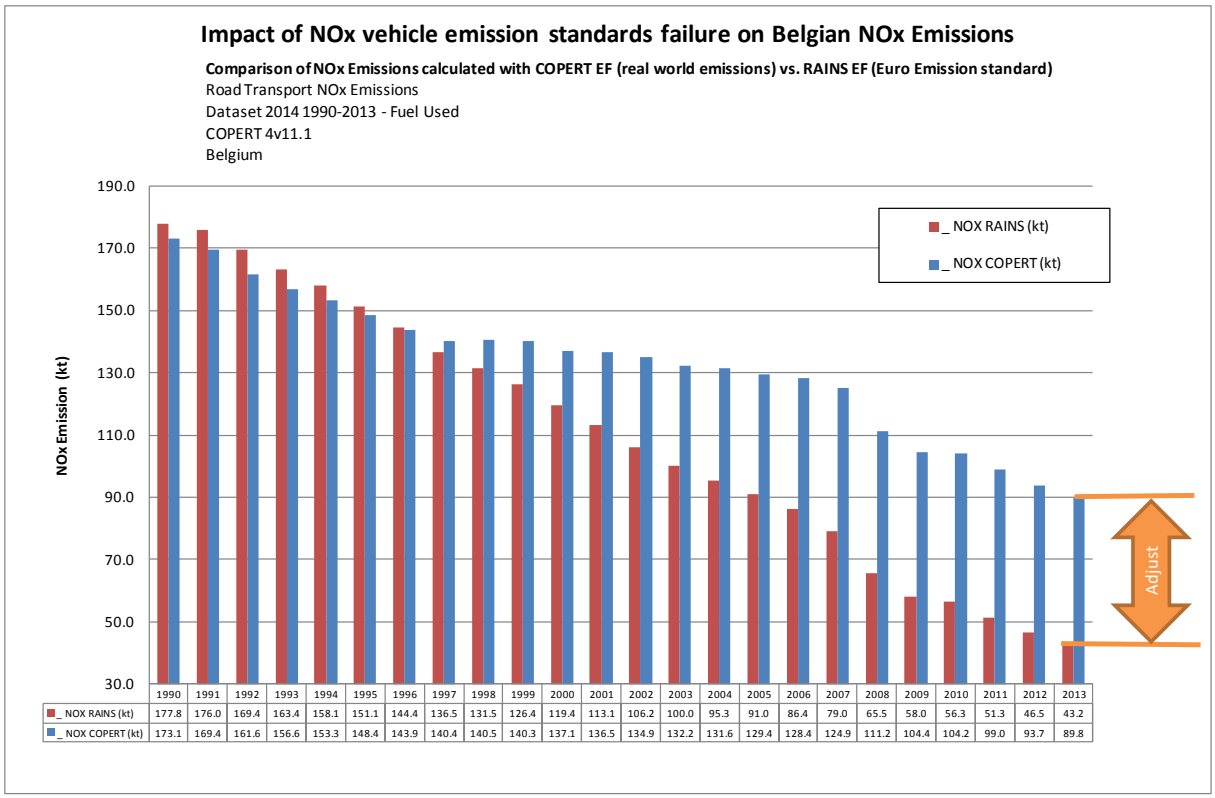
2.3. Adjustment road transport: conclusions

Table 5 summarizes the adjustments from the road transport sector for the years 2010-2013.

Table 5: Adjustments from road transport and impact on total NOx emissions (fuel used).

	2010	2011	2012	2013
Adjustment Road transport (1A3b)	-47.98	-47.77	-47.17	-46.54

At last, a summary of the results is shown in Figure 1.



	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
_ NOX RAINS (kt)	177.8	176.0	169.4	163.4	158.1	151.1	144.4	136.5	131.5	126.4	119.4	113.1	106.2	100.0	95.3	91.0	86.4	79.0	65.5	58.0	56.3	51.3	46.5	43.2
_ NOX COPERT (kt)	173.1	169.4	161.6	156.6	153.3	148.4	143.9	140.4	140.5	140.3	137.1	136.5	134.9	132.2	131.6	129.4	128.4	124.9	111.2	104.4	104.2	99.0	93.7	89.8

Figure 1: Summary of NOx road transport emissions

3. Agriculture (3B and 3D) - NOx and NMVOC

Since the 2015 reporting round (NEC - 31/12/2014 and LRTAP - 15/2/2015), NOx and NMVOC emissions from manure management (NFR sector 3B) and agricultural soils (NFR sector 3D) are included in the national emission inventory. At the time the emission ceilings were set, NOx and NMVOC emissions for the agricultural sector were not included in the emission inventory.

Therefore, Belgium applies for an adjustment for NOx (2010-2013) and NMVOC (2010-2012[3]) for the agricultural sector, based on Decision 2012/3, under criterium 6(a): *"Emission source categories are identified that were not accounted for at the time when emission reduction commitments were set;*

[3] The national total for NMVOC is below the NEC ceiling in 2013, therefore no adjustment was applied for 2013.

3.1. NOx - Manure management (3B and 3Da2a)

Nitric oxide (NO) is formed through nitrification in the surface layers of stored manure or in manure aerated to reduce odour or to promote composting. At present, few data are available describing NO emissions from manure management (Groenestein and van Faassen, 1996). Nitric oxide emission from soils is generally considered to be a product of nitrification. Increased nitrification is likely to occur following application of manures and deposition of excreta during grazing (EMEP/EEA Guidebook 2013).

NOx emissions from 3B - manure management and 3Da2a - Animal manure applied to soils were reported for the first time for NEC in December 2014 and LRTAP in February 2015 (resubmission in March 2015), and were as such not included in the Belgian emission inventory at the time the emission reduction commitments were set in 1999.

According to Decision 2012/12 2bis (a)(i) an emission source category will qualify as a new emission source category if emission estimates for that source category were introduced to the national emission inventory after the emission reduction commitment for that pollutant was set and where no methodology was provided in the EMEP/EEA air pollutant emission inventory guidebook for determining emissions from that source category at the time that the emission reduction commitment was set.
The emissions allocated in the sectors 3B (Manure management from live stock) and 3Da2a (Animal manure applied to soils)originate from manure management regarding organic compounds (included in the first and second edition of the EMEP/CORINAIR Emission Inventory Guidebook under SNAP code 100500, chapter 10 agriculture). This chapter considers the emission of ammonia (NH_3) but no methodology for NO emission estimation is provided.
Hence it can be concluded that the available guidance material for the above mentioned sector provided no methodology for estimating NO emissions from manure management. As a result the sectors 3B and 3Da2a can be considered as new emission sources. Consequently, the adjustments are simply the values of these new sources (table 7 and 8). Detailed information on activity data and emission factors is included in Appendix B, submitted together with this report.

3.2. NOx - Inorganic N-fertilizers (3Da1)

NOx emissions from 3Da1 - Inorganic N-fertilizers were reported for the first time for NEC in December 2014 and LRTAP in February 2015, and were as such not included in the Belgian emission inventory at the time the emission reduction commitments were set in 1999.

According to Decision 2012/12 2bis (a)(i) an emission source category will qualify as a new emission source category if emission estimates for that source category were introduced to the national emission inventory after the emission reduction commitment for that pollutant was set and where no methodology was provided in the EMEP/EEA air pollutant emission inventory guidebook for determining emissions from that source category at the time that the emission reduction commitment was set. According to Decision 2012/12 2bis (a)(iii) an emission source may also be qualified as a new source where a methodology was available in the EMEP/EEA air pollution emission inventory guidebook at the time that the emission reduction commitment was set, only if a Party can demonstrate that it was unable to apply the methodology due to a lack of relevant national statistical data or can provide another justification why it could not make use of this methodology.

The emissions allocated in the sector 3Da1 originate from inorganic N-fertilizer use (included in the first and second edition of the EMEP/CORINAIR Emission Inventory Guidebook under SNAP code 100100, chapter 10 agriculture). Version 2 of the EMEP/CORINAIR Atmospheric Emissions Inventory Guidebook (published in 1999) describes for the first time a methodology for the estimation of NO emissions from inorganic fertilizer use (SNAP 100100). Nevertheless it was too early to take these emissions into account at the time that the emission reduction commitment was set because first a thorough validation of the methodology by the regional experts is required.
In fact there was so much doubt about the reliability of this methodology that it was not until December 2014 that these emissions were reported by Belgium.
These emissions are also not taken into account in the RAINS/GAINS model: not in the 1999 RAINS version, nor in the current 2015 GAINS version. As a result the sector 3Da1 can be considered as a new emission source. Consequently, the adjustment is simply the value of this new source (table 7 and 8). Detailed information on activity data and emission factors is included in Appendix B, submitted together with this report.

Table 7: NOx emissions from the agricultural sectors (only the sectors with emission estimates are withheld)

NFR Code	Longname	2010	2011	2012	2013
3B1a	Manure management - Dairy cattle	0.0586	0.0536	0.0534	0.0541
3B1b	Manure management - Non-dairy cattle	0.2410	0.2382	0.2310	0.2267
3B2	Manure management - Sheep	0.0008	0.0008	0.0008	0.0008
3B3	Manure management - Swine	0.0246	0.0249	0.0256	0.0239
3B4d	Manure management - Goats	0.0002	0.0003	0.0003	0.0003
3B4e	Manure management - Horses	0.0123	0.0119	0.0125	0.0125
3B4gi	Manure mangement - Laying hens	0.0159	0.0165	0.0171	0.0173
3B4gii	Manure mangement - Broilers	0.0333	0.0338	0.0351	0.0357
3B4giv	Manure management - Other poultry	0.0011	0.0010	0.0017	0.0013
3B4h	Manure management - Other animals (please specify in IIR)	1.27E-05	1.36E-05	1.32E-05	1.40E-05
3Da1	Inorganic N-fertilizers (includes also urea application)	5.94	5.85	5.64	5.73
3Da2a	Animal manure applied to soils	7.60	7.29	7.07	6.95
Adjustment	Total Agriculture	**-13.92**	**-13.52**	**-13.09**	**-13.06**

Table 8: NOx adjustments for the agricultural sector.

NOx	2010	2011	2012	2013
Adjustment Manure Management (3B)	-0.39	-0.38	-0.38	-0.37
Adjustment Inorganic N-fertilizers (3Da1)	-5.94	-5.85	-5.64	-5.73
Adjustment Animal manure applied to soils (3Da2a)	-7.60	-7.29	-7.07	-6.95
Total Adjustment Agriculture	**-13.92**	**-13.52**	**-13.09**	**-13.06**

3.3 NMVOC - Manure management (3B)

According to the EMEP/EEA Guidebook 2013, NMVOC emissions from animal husbandry originates from feed, especially silage, degradation of feed in the rumen, and from partly digested and undigested fat, carbohydrate and protein decomposition in the rumen and in manure (Ni et al. 2012, Feilberg et al. 2010, Ngwabie et al. 2008, Amon et al. 2007, Alanis et al. 2008, 2010, Elliot-Martin et al. 1997, Trabue et al. 2010, Rumsey et al. 2011, Parker et al. 2010). Sources of emission include livestock buildings, yards, and manure stores, fields to which manure is spread and fields grazed by livestock. Emissions take place from manure managed in solid form or as slurry.

NMVOC emissions from 3B - Manure management was reported for the first time for NEC in December 2014 and LRTAP in February 2015 (resubmission in March 2015), and was as such not included in the Belgian emission inventory at the time the emission reduction commitments were set in 1999.

According to Decision 2012/12 2bis (a)(i) an emission source category will qualify as a new emission source category if emission estimates for that source category were introduced to the national emission inventory after the emission reduction commitment for that pollutant was set and where no methodology was provided in the EMEP/EEA air pollutant emission inventory guidebook for determining emissions from that source category at the time that the emission reduction commitment was set.

NMVOC emissions allocated in sector 3B originate from animal manure, waste management systems (included in the first and second edition of the EMEP/CORINAIR Emission Inventory Guidebook under SNAP code 100500, chapter 10 agriculture)In the second edition of the Guidebook (published in 1999) no methodology for estimating NMVOC emissions from animal manure and waste was available. Hence it can be concluded that the available guidance material for the above mentioned sector provided no methodology for estimating NMVOC emissions from manure management. As a result the sectors 3B can be considered as a new emission source. Consequently, the adjustments are simply the values of these new sources (table 9 and 10). Detailed information on activity data and emission factors is included in Appendix B, submitted together with this report.
The current guidance recognises that there is still a high degree of uncertainty regarding NMVOC emissions from animal waste, and that available information requires review and improvement. But when a country includes NMVOC emissions from this source in their national emission inventory totals, emissions can be considered a valid case for an adjustment application as a “new” source (according to the appendix of the adjustment guidance document *(11)*) .

3.4 NMVOC - Cultivated crops (3De)

NOTE: In the LRTAP reporting of 15 February 2015, emissions from cultivated crops were mistakenly allocated to the sector 3D1a. This was corrected in the resubmission of 15 March 2015. Consequently, no adjustment for 3Da1 for NMVOC will be applied as was formally noted to the Secretariat on 15 February 2015.

NMVOC emissions from 3De - Cultivated crops were reported for the first time for NEC in December 2014 and LRTAP in February 2015 (resubmission in March 2015), and were as such not included in the Belgian emission inventory at the time the emission reduction commitments were set in 1999.

According to Decision 2012/12 2bis (a)(i) an emission source category will qualify as a new emission source category if emission estimates for that source category were introduced to the national emission inventory after the emission reduction commitment for that pollutant was set and where no methodology was provided in the EMEP/EEA air pollutant emission inventory guidebook for determining emissions from that source category at the time that the emission reduction commitment was set. According to Decision 2012/12 2bis (a)(iii) an emission source may also be qualified as a new source where a methodology was available in the EMEP/EEA air pollution emission inventory guidebook at the time that the emission reduction commitment was set, only if a Party can demonstrate that it was unable to apply the methodology due to a lack of relevant national statistical data or can provide another justification why it could not make use of this methodology.

Emissions allocated in sector 3De originate from crop production (included in the first and second edition of the EMEP/CORINAIR Emission Inventory Guidebook under SNAP code 100100, chapter 10 agriculture).
Version 2 of the EMEP/CORINAIR Atmospheric Emissions Inventory Guidebook (published in 1999) described for the first time a methodology to estimate NMVOC emissions from crops. Nevertheless it was too early to take these emissions into account at the time that the emission reduction commitment was set because first a thorough validation of the methodology by the regional experts is required. In fact there was so much doubt about the reliability of this methodology that it was not until December 2014 that these emission were reported by Belgium.
These emissions are also not taken into account in the RAINS/GAINS model: not in the 1999 RAINS version, nor in the current 2015 GAINS version. As a result the sector 3De can be considered as a new emission source for NMVOC. Consequently, the adjustment is simply the value of this new source (table 9 and 10). Detailed information on activity data and emission factors is included in Appendix B, submitted together with this report.

Table 9: NMVOC emissions from the agricultural sectors (only the sectors with emission estimates are withheld)

NFR Code	Longname	2010	2011	2012
3B1a	Manure management - Dairy cattle	8.3271	8.1683	8.1663
3B1b	Manure management - Non-dairy cattle	19.2547	18.8191	18.2152
3B2	Manure management - Sheep	0.0292	0.0274	0.0296
3B3	Manure management - Swine	4.1724	4.1380	4.1650
3B4d	Manure management - Goats	0.0193	0.0204	0.0217
3B4e	Manure management - Horses	0.4350	0.4196	0.4432
3B4gi	Manure mangement - Laying hens	1.7211	1.6264	1.7021
3B4gii	Manure mangement - Broilers	2.3440	2.3790	2.4736
3B4giv	Manure management - Other poultry	0.2073	0.2178	0.2962
3B4h	Manure management - Other animals (please specify in IIR)	0.0816	0.0873	0.0851
3De	Cultivated crops	1.2150	1.1953	1.1877
Adjustment	Total Agriculture	**-37.81**	**-37.10**	**-36.79**

Table 10: NMVOC adjustments for the agricultural sector.

NMVOC	2010	2011	2012
Adjustment Manure Management (3B)	-36.59	-35.90	-35.60
Adjustment Cultivated crops (3De)	-1.22	-1.20	-1.19
Total Adjustment Agriculture	**-37.81**	**-37.10**	**-36.79**

4. Future evolution of emissions

According to Decision 2012/12 article 2.c. the year of expected compliance without adjustment was calculated based on fuel used emissions. For NMVOC table 1 shows that compliance without adjustment was achieved in 2013.

For NOx the compliance year depends on the used emission factor for light duty vehicle. Based on the emissions factors used in COPERT IV v 11.2, compliance will be achieved in 2015 (Göteborg)/2017 (NEC) (also taking into account emissions from agricultural soils). The emission factor for heavy duty Euro VI based on COPERT IV v11.2 is 13 times lower than Euro V. The issue of non compliance of

heavy duty vehicles has been addressed through the move to World Harmonized Test Cycles and efforts to improve real-world conformity to NOX limits in the Euro VI standard. However for light-duty vehicles, the current type-approval procedure (New European Driving Cycle) allows certification of vehicles with real-world NOX emissions far above regulatory limits. The emission factor for light duty Euro 6 vehicles based on COPERT IV v11.2 is 215 mg/km, while real world emissions for Euro 6 goes up to 600 mg/km (Real-world exhaust emissions from modern diesel cars, ICCT, Octobre 2014. Taking into account an emission factor of 600 mg/km shifts the year of compliance to 2020 (Göteborg)/2022(NEC).

5. Conclusions

The reason for non-compliance of the NECD NOx ceiling can be explained by the change in emission factors in the road transport sector not foreseen at the time when emission ceilings were set and the inclusion of the new sectors 'agricultural soils' and 'manure management'. These 2 factors result in NOx and NMVOC emissions that are above the NECD and Gothenborg Protocol ceilings.

Table 11 summarizes the adjustments for the road transport sector (NOx) and the agricultural sector (NOx and NMVOC). The sum of these adjustments is applied to the national total (fuel used) to be used for compliance under the NECD and the Gothenborg Protocol. **It is clear that the NECD ceiling of 176 kton for NOx and 139 kton for NMVOC is met if the total adjustments are accepted. A forteriori, the Gothenborg Protocol emission ceilings are met.**

Table 11: Adjustment summary

NOx	2010	2011	2012	2013	NEC Emission ceiling 2010	Gotheborg emission ceiling
National Total (fuel used)	231.79	216.92	206.76	199.49	**176**	**181**
Adjustment Road transport	-47.98	-47.77	-47.17	-46.54		
Adjustment Manure Management (3B)	-0.39	-0.38	-0.38	-0.37		
Adjustment Inorganic N-fertilizers (3Da1)	-5.94	-5.85	-5.64	-5.73		
Adjustment Animal manure applied to soils (3Da2a)	-7.60	-7.29	-7.07	-6.95		
Adjusted national total for compliance	**169.89**	**155.62**	**146.50**	**139.89**		
NMVOC	**2010**	**2011**	**2012**	**2013**	**NEC Emission ceiling 2010**	**Gotheborg emission ceiling**
National Total (fuel used)	153.72	141.49	139.68	136.68	**139**	**144**
Adjustment Manure Management (3B)	-36.59	-35.90	-35.60	NA		
Adjustment Cultivated crops (3De)	-1.22	-1.20	-1.19	NA		
Adjusted national total for compliance	**115.91**	**104.40**	**102.90**	**NA**		

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Annex 1: More detailed information on the inconsistency between the official test procedures and real world traffic conditions

Euro vehicle emission standards not reflecting emissions in real driving conditions is the main reason for Belgium not attaining its NO_X ceiling. What has been lacking so far are good vehicle emission testing procedures to guarantee that the real world emissions of vehicles are in line with the Euro emission limit standards.

The NEDC (The New European Driving Cycle) is the official driving cycle designed to assess the emission levels of car engines and fuel economy in passenger cars (excluding light trucks and commercial vehicles). Euro standards are based on this driving cycle which doesn't fit with the Common Artemis Driving Cycles (CADC) which are more realistic. The CADC are chassis dynamometer procedures based on statistical analysis of a large database of European real driving patterns. This driving cycle is more representative of real driving emissions than the NEDC. The cycle includes three driving schedules: (1) Urban, (2) Rural road and (3) Motorway. The emissions from vehicles calculated with the CADC emission factor are then much higher than expected considering the NEDC emission factor, particularly for the NO_X emissions from diesel cars and heavy duty diesel vehicles (see Figure 1).

In this context, the following figure, taken from the report of EMISIA[4] presenting the latest developments of the model Copert 4 (v9.1 => v10.0) clearly highlights the problem that many Member States are facing.

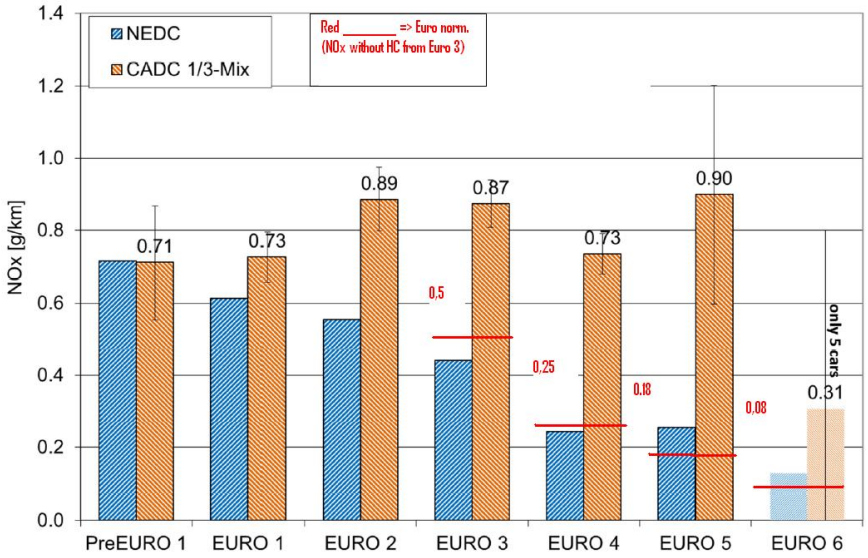

Figure 2: **Comparison of the NO_x emission factors based on NEDC, CADC and Euro standards (diesel cars)**[5]

[4] EMISIA SA is a spin-off company of the Aristotle University of Thessaloniki / Laboratory of Applied Thermodynamics. It is responsible for the maintenance and development of the model Copert (estimating emissions from road transport), based on the improvement of scientific knowledge. Copert is officially used by member states for the reporting of transport emissions in international organizations (UNECE, UNFCCC).

[5] Source: the last report of EMISIA5 presenting the latest developments of the model Copert 4 (v9.1 => v10.0).

We can see that while up to Euro 4, the regulatory standard has been easily met by the official test (NEDC), but the actual emissions (according to the CADC cycle) were always significantly higher than the standard.

The results of tests made with the CADC procedure constitute the scientific basis explaining the increase of the emission factors used in the model Copert. Indeed, the ARTEMIS driving cycles are much more representative of the way in which the vehicles are driven today ("real world driving cycle"), whereas this is not the case of NEDC (this cycle is used since 1973). The NEDC was conceived at a time when European vehicles were lighter and less powerful. The test offers a stylized driving speed pattern with low accelerations, constant speed cruises, and many idling events, however the transient accelerations are much steeper and more dynamic in practice, in part caused by the power surplus of modern engines. As a result, drivers fail to achieve the certified values in practice.

In this context, it is interesting to quote an extract from the executive summary presented in the report "OECD – European Conference of Minister of Transports (ECMT) – "Reducing NOx emissions on the road - Ensure future exhaust emission limits deliver air quality standards", presented at the meeting of the ECMT in Dublin on 17-18 May 2006 :

"(...) The gap between the exhaust emissions during type approval and during in-use operation arises in three ways:

- *Cycle by-pass measures used by the manufacturer in order to pass the type approval tests but achieve better fuel efficiency or other performance enhancement at the cost of higher emissions during operation on the road;*
- *On-board diagnostic systems (OBD) related gaps;*
- *Driver behaviour related gaps.*

Cycle by-pass measures are not so much an abuse of the regulations as a weakness of the testing system and the design of regulations. The main avenue for improving regulations is to modify test cycles to mirror real world driving more closely. Whilst tests can only ever be a rough approximation of the real world, improved tests that do not entail unreasonable costs have been developed. These should now be deployed.

For cars, introduction of an in-use compliance test using real world driving cycles in addition to the current test is recommended. The common Artemis driving cycle (CADC), developed under a European Union research programme, could be used for this. In the long term, the main test should be replaced by a more realistic driving cycle that better reflects real world driving.
(....)

It as also mentioned in the foreword of this report:
"Transport Ministers noted the conclusions and recommendations of this report at the meeting of the Council of the ECMT in Dublin on 17-18 May 2006, and asked the Secretariat to transmit the report to the UN/ECE with a request to expedite deliberations on improved vehicle certification tests for NOx emissions for adoption world-wide. This was duly done.".

If a new mandatory test had been adopted several years ago, it appears likely that NOx emissions from recent vehicles would be much lower. Negotiations on a new test cycle are currently underway

within the *"UNECE World Forum for Harmonization of Vehicle Regulations (WP.29): Working Party on Pollution and Energy (GRPE)"*. This cycle should be adopted during 2014. In order to enable Belgium to reach the NOx ceiling as soon as possible (and other Member States facing the same problem), it is desirable that European authorities ensure that this deadline will be effectively respected, and that the new test (WLTP - Worldwide harmonized Light vehicles Test Procedure) will indeed be representative of real driving conditions.

The underestimation of the NO_X emission due to the NEDC driving cycle is a problem for several European countries (France, Germany and Netherlands were reported in the ETC/AC Technical Paper 2010/20 'Road transport emissions projections in the context of the EU NEC Directive ceiling commitments. Impact of model versions' by Leonidas Ntziaxhristos, Thomas Papagergiou').

Annex 2: Unabated emission factors, removal efficiencies in COPERT and RAINS road transport emission calculation and control capacities.

Table A2-1: Changes in abated NOx emission factors for the year 2010.

Vehicle Class	Unabated EF COPERT (kt/PJ)	RE COPERT (%)	EF COPERT (kt/PJ)	Unabated EF RAINS (kt/PJ)	RE RAINS (%)	EF RAINS (kt/PJ)	CC (%)
TRA_RD_LD4							
LF							
NOC	0.6978	0.00%	0.6978	0.88	0.00%	0.8800	4.92%
Euro 1	0.6978	74.73%	0.1763	0.88	75.00%	0.2200	10.00%
Euro 2	0.6978	87.04%	0.0904	0.88	87.00%	0.1144	11.64%
Euro 3	0.6978	93.99%	0.0419	0.88	93.00%	0.0616	23.17%
Euro 4	0.6978	97.23%	0.0193	0.88	97.00%	0.0264	44.95%
Euro 5	0.6978	98.07%	0.0135	0.88	97.00%	0.0264	5.28%
Euro 6	0.6978	97.98%	0.0141	0.88	97.00%	0.0264	0.04%
MD							
NOC	0.3232	0.00%	0.3232	0.35	0.00%	0.3500	0.84%
Euro 1	0.3232	7.26%	0.2997	0.35	31.00%	0.2415	2.43%
Euro 2	0.3232	1.25%	0.3191	0.35	50.00%	0.1750	8.89%
Euro 3	0.3232	-1.77%	0.3289	0.35	60.00%	0.1400	26.30%
Euro 4	0.3232	16.84%	0.2687	0.35	80.00%	0.0700	52.07%
Euro 5	0.3232	16.85%	0.2687	0.35	80.00%	0.0700	9.35%
Euro 6	0.3232	71.23%	0.0930	0.35	80.00%	0.0700	0.12%
GAS							
NOC	0.0184	0.00%	0.0184	0	0.00%	0.0000	62.12%
Euro 5	0.0184	15.70%	0.0155	0.65	85.00%	0.0975	36.83%
Euro 6	0.0184	17.47%	0.0152	0.65	85.00%	0.0975	1.05%
TRA_RD_HD							
LF							
NOC	0.6265	0.00%	0.6265	0.86	0.00%	0.8600	100.00%
MD							
NOC	0.9966	0.00%	0.9966	1.05	0.00%	1.0500	3.10%
Euro I	0.9966	24.86%	0.7489	1.05	33.00%	0.7035	2.54%
Euro II	0.9966	16.98%	0.8274	1.05	43.00%	0.5985	12.86%
Euro III	0.9966	35.47%	0.6431	1.05	60.00%	0.4200	41.48%
Euro IV	0.9966	54.67%	0.4518	1.05	85.00%	0.1575	14.32%
Euro V	0.9966	73.73%	0.2618	1.05	85.00%	0.1575	25.70%
Euro VI	0.9966	81.66%	0.1827	1.05	85.00%	0.1575	0.00%
GAS							
NOC	0.0000	0.00%	0.0000	0.65	0.00%	0.6500	0.00%
Euro II	0.0000	0.00%	0.0000	0.65	0.00%	0.6500	0.00%
Euro III	0.0000	0.00%	0.0000	0.65	0.00%	0.6500	0.00%
EEV	0.0000	0.00%	0.0000	0.65	85.00%	0.0975	0.00%

TRA_RD_LD2							
LF							
NOC	0.0368	0.00%	0.0368	0.2	0.00%	0.2000	7.86%
Euro 1	0.0368	-416.24%	0.1898	0.2	0.00%	0.2000	17.64%
Euro 2	0.0368	-387.56%	0.1793	0.2	0.00%	0.2000	27.41%
Euro 3	0.0368	-409.25%	0.1872	0.2	0.00%	0.2000	47.10%

Table A2-2: Changes in abated NOx emission factors for the year 2011.

Vehicle Class	Unabated EF COPERT (kt/PJ)	RE COPERT (%)	EF COPERT (kt/PJ)	Unabated EF RAINS (kt/PJ)	RE RAINS (%)	EF RAINS (kt/PJ)	CC (%)
TRA_RD_LD4							
LF							
NOC	0.7043	0.00%	0.7043	0.88	0.00%	0.8800	4.63%
Euro 1	0.7043	74.89%	0.1769	0.88	75.00%	0.2200	7.82%
Euro 2	0.7043	87.02%	0.0914	0.88	87.00%	0.1144	9.69%
Euro 3	0.7043	93.73%	0.0441	0.88	93.00%	0.0616	21.61%
Euro 4	0.7043	97.25%	0.0194	0.88	97.00%	0.0264	43.17%
Euro 5	0.7043	98.05%	0.0137	0.88	97.00%	0.0264	13.05%
Euro 6	0.7043	97.98%	0.0142	0.88	97.00%	0.0264	0.04%
MD							
NOC	0.3266	0.00%	0.3266	0.35	0.00%	0.3500	0.64%
Euro 1	0.3266	8.68%	0.2983	0.35	31.00%	0.2415	1.72%
Euro 2	0.3266	2.60%	0.3181	0.35	50.00%	0.1750	7.05%
Euro 3	0.3266	-0.30%	0.3276	0.35	60.00%	0.1400	22.47%
Euro 4	0.3266	18.41%	0.2665	0.35	80.00%	0.0700	47.03%
Euro 5	0.3266	16.47%	0.2728	0.35	80.00%	0.0700	20.98%
Euro 6	0.3266	72.73%	0.0891	0.35	80.00%	0.0700	0.12%
GAS							
NOC	0.0184	0.00%	0.0184	0	0.00%	0.0000	52.11%
Euro 5	0.0184	13.09%	0.0160	0.65	85.00%	0.0975	47.19%
Euro 6	0.0184	16.98%	0.0153	0.65	85.00%	0.0975	0.70%
TRA_RD_HD							
LF							
NOC	0.6267	0.00%	0.6267	0.86	0.00%	0.8600	100.00%
MD							
NOC	0.9992	0.00%	0.9992	1.05	0.00%	1.0500	2.48%
Euro I	0.9992	25.06%	0.7488	1.05	33.00%	0.7035	2.14%
Euro II	0.9992	17.17%	0.8276	1.05	43.00%	0.5985	10.61%
Euro III	0.9992	35.63%	0.6432	1.05	60.00%	0.4200	35.68%
Euro IV	0.9992	54.82%	0.4514	1.05	85.00%	0.1575	13.82%
Euro V	0.9992	74.06%	0.2592	1.05	85.00%	0.1575	35.27%

Euro VI	0.9992	82.14%	0.1784	1.05	85.00%	0.1575	0.00%
GAS							
NOC	0.0000	0.00%	0.0000	0.65	0.00%	0.6500	0.00%
Euro II	0.0000	0.00%	0.0000	0.65	0.00%	0.6500	0.00%
Euro III	0.0000	0.00%	0.0000	0.65	0.00%	0.6500	0.00%
EEV	0.0000	0.00%	0.0000	0.65	85.00%	0.0975	0.00%
TRA_RD_LD2							
LF							
NOC	0.0346	0.00%	0.0346	0.2	0.00%	0.2000	6.03%
Euro 1	0.0346	-448.51%	0.1898	0.2	0.00%	0.2000	14.53%
Euro 2	0.0346	-418.05%	0.1792	0.2	0.00%	0.2000	25.94%
Euro 3	0.0346	-441.11%	0.1872	0.2	0.00%	0.2000	53.49%

Table A2-3: Changes in abated NOx emission factors for the year 2012.

Vehicle Class	Unabated EF COPERT (kt/PJ)	RE COPERT (%)	EF COPERT (kt/PJ)	Unabated EF RAINS (kt/PJ)	RE RAINS (%)	EF RAINS (kt/PJ)	CC (%)
TRA_RD_LD4							
LF							
NOC	0.7094	0.00%	0.7094	0.88	0.00%	0.8800	4.38%
Euro 1	0.7094	75.27%	0.1755	0.88	75.00%	0.2200	6.08%
Euro 2	0.7094	87.10%	0.0915	0.88	87.00%	0.1144	8.03%
Euro 3	0.7094	93.50%	0.0461	0.88	93.00%	0.0616	19.52%
Euro 4	0.7094	97.27%	0.0193	0.88	97.00%	0.0264	40.92%
Euro 5	0.7094	98.06%	0.0138	0.88	97.00%	0.0264	21.00%
Euro 6	0.7094	97.98%	0.0144	0.88	97.00%	0.0264	0.06%
MD							
NOC	0.3239	0.00%	0.3239	0.35	0.00%	0.3500	0.51%
Euro 1	0.3239	7.31%	0.3003	0.35	31.00%	0.2415	1.23%
Euro 2	0.3239	1.43%	0.3193	0.35	50.00%	0.1750	5.68%
Euro 3	0.3239	-1.27%	0.3280	0.35	60.00%	0.1400	19.78%
Euro 4	0.3239	17.46%	0.2674	0.35	80.00%	0.0700	42.02%
Euro 5	0.3239	15.68%	0.2731	0.35	80.00%	0.0700	30.58%
Euro 6	0.3239	75.01%	0.0810	0.35	80.00%	0.0700	0.19%
GAS							
NOC	0.0183	0.00%	0.0183	0	0.00%	0.0000	32.14%
Euro 5	0.0183	14.63%	0.0156	0.65	85.00%	0.0975	67.48%
Euro 6	0.0183	16.50%	0.0153	0.65	85.00%	0.0975	0.38%
TRA_RD_HD							
LF							
NOC	0.6274	0.00%	0.6274	0.86	0.00%	0.8600	100.00%
MD							
NOC	0.9982	0.00%	0.9982	1.05	0.00%	1.0500	2.12%

Euro I	0.9982	25.09%	0.7478	1.05	33.00%	0.7035	1.77%
Euro II	0.9982	17.03%	0.8282	1.05	43.00%	0.5985	8.41%
Euro III	0.9982	35.53%	0.6436	1.05	60.00%	0.4200	27.56%
Euro IV	0.9982	54.83%	0.4509	1.05	85.00%	0.1575	14.60%
Euro V	0.9982	74.43%	0.2552	1.05	85.00%	0.1575	45.50%
Euro VI	0.9982	87.23%	0.1275	1.05	85.00%	0.1575	0.03%
GAS							
NOC	0.0000	0.00%	0.0000	0.65	0.00%	0.6500	0.00%
Euro II	0.0000	0.00%	0.0000	0.65	0.00%	0.6500	0.00%
Euro III	0.0000	0.00%	0.0000	0.65	0.00%	0.6500	0.00%
EEV	0.0000	0.00%	0.0000	0.65	85.00%	0.0975	0.00%
TRA_RD_LD2							
LF							
NOC	0.0322	0.00%	0.0322	0.2	0.00%	0.2000	4.71%
Euro 1	0.0322	-489.85%	0.1898	0.2	0.00%	0.2000	11.58%
Euro 2	0.0322	-457.09%	0.1792	0.2	0.00%	0.2000	23.61%
Euro 3	0.0322	-481.88%	0.1872	0.2	0.00%	0.2000	60.10%

Table A2-4: Changes in abated NOx emission factors for the year 2013.

Vehicle Class	Unabated EF COPERT (kt/PJ)	RE COPERT (%)	EF COPERT (kt/PJ)	Unabated EF RAINS (kt/PJ)	RE RAINS (%)	EF RAINS (kt/PJ)	CC (%)
TRA_RD_LD4							
LF							
NOC	0.7233	0.00%	0.7233	0.88	0.00%	0.8800	4.22%
Euro 1	0.7233	75.87%	0.1746	0.88	75.00%	0.2200	4.70%
Euro 2	0.7233	87.28%	0.0920	0.88	87.00%	0.1144	6.58%
Euro 3	0.7233	93.32%	0.0483	0.88	93.00%	0.0616	17.23%
Euro 4	0.7233	97.33%	0.0193	0.88	97.00%	0.0264	38.07%
Euro 5	0.7233	98.09%	0.0138	0.88	97.00%	0.0264	28.54%
Euro 6	0.7233	98.08%	0.0139	0.88	97.00%	0.0264	0.66%
MD							
NOC	0.3272	0.00%	0.3272	0.35	0.00%	0.3500	0.44%
Euro 1	0.3272	8.19%	0.3004	0.35	31.00%	0.2415	0.88%
Euro 2	0.3272	2.15%	0.3202	0.35	50.00%	0.1750	4.49%
Euro 3	0.3272	-0.37%	0.3284	0.35	60.00%	0.1400	17.35%
Euro 4	0.3272	17.99%	0.2684	0.35	80.00%	0.0700	37.54%
Euro 5	0.3272	16.34%	0.2738	0.35	80.00%	0.0700	38.79%
Euro 6	0.3272	75.31%	0.0808	0.35	80.00%	0.0700	0.51%
GAS							
NOC	0.0184	0.00%	0.0184	0	0.00%	0.0000	18.88%
Euro 5	0.0184	13.37%	0.0159	0.65	85.00%	0.0975	80.89%
Euro 6	0.0184	16.85%	0.0153	0.65	85.00%	0.0975	0.23%

TRA_RD_HD							
LF							
NOC	0.6273	0.00%	0.6273	0.86	0.00%	0.8600	100.00%
MD							
NOC	0.9981	0.00%	0.9981	1.05	0.00%	1.0500	1.79%
Euro I	0.9981	25.07%	0.7478	1.05	33.00%	0.7035	1.38%
Euro II	0.9981	16.97%	0.8287	1.05	43.00%	0.5985	6.85%
Euro III	0.9981	35.53%	0.6435	1.05	60.00%	0.4200	22.35%
Euro IV	0.9981	54.79%	0.4512	1.05	85.00%	0.1575	15.72%
Euro V	0.9981	74.54%	0.2541	1.05	85.00%	0.1575	49.57%
Euro VI	0.9981	88.82%	0.1116	1.05	85.00%	0.1575	2.34%
GAS							
NOC	0.0000	0.00%	0.0000	0.65	0.00%	0.6500	0.00%
Euro II	0.0000	0.00%	0.0000	0.65	0.00%	0.6500	0.00%
Euro III	0.0000	0.00%	0.0000	0.65	0.00%	0.6500	0.00%
EEV	0.0000	0.00%	0.0000	0.65	85.00%	0.0975	0.00%
TRA_RD_LD2							
LF							
NOC	0.0295	0.00%	0.0295	0.2	0.00%	0.2000	3.77%
Euro 1	0.0295	-544.12%	0.1898	0.2	0.00%	0.2000	8.55%
Euro 2	0.0295	-508.35%	0.1792	0.2	0.00%	0.2000	20.67%
Euro 3	0.0295	-535.47%	0.1872	0.2	0.00%	0.2000	67.01%

Annex 3: Road transport adjustments.

Table A3-1: Calculation of the adjustment for NOx in 2010. TRA_RD_LD4 = passenger cars and light duty vehicles; TRA_RD_HD = heavy duty vehicles and buses; TRA_RD_LD2 = mopeds and motorcycles. LF= Light fractions (gasoline, LPG,...); MD= Medium distillates (diesel,...); GAS=natural gas. NOC= No control.

Vehicle Class	Activity Level (PJ) x CC (%)	EF COPERT (kt/PJ)	EF RAINS (kt/PJ)	NOX COPERT (kt)	NOX RAINS (kt)	Adjustment (kt)
TRA_RD_LD4						
LF						
NOC	2.47	0.70	0.88	1.73	2.18	0.45
Euro 1	5.02	0.18	0.22	0.89	1.10	0.22
Euro 2	5.85	0.09	0.11	0.53	0.67	0.14
Euro 3	11.64	0.04	0.06	0.49	0.72	0.23
Euro 4	22.58	0.02	0.03	0.44	0.60	0.16
Euro 5	2.65	0.01	0.03	0.04	0.07	0.03
Euro 6	0.02	0.01	0.03	0.00	0.00	0.00
MD						
NOC	1.44	0.32	0.35	0.47	0.51	0.04
Euro 1	4.19	0.30	0.24	1.26	1.01	-0.24
Euro 2	15.34	0.32	0.18	4.90	2.68	-2.21
Euro 3	45.38	0.33	0.14	14.92	6.35	-8.57
Euro 4	89.85	0.27	0.07	24.14	6.29	-17.86
Euro 5	16.14	0.27	0.07	4.34	1.13	-3.21
Euro 6	0.20	0.09	0.07	0.02	0.01	0.00
GAS						
NOC	0.00	0.02	0.00	0.00	0.00	0.00
Euro 5	0.00	0.02	0.10	0.00	0.00	0.00
Euro 6	0.00	0.02	0.10	0.00	0.00	0.00
TRA_RD_HD						
LF						
NOC	0.05	0.63	0.86	0.03	0.04	0.01
MD						
NOC	2.80	1.00	1.05	2.79	2.94	0.15
Euro I	2.29	0.75	0.70	1.71	1.61	-0.10
Euro II	11.60	0.83	0.60	9.60	6.94	-2.65
Euro III	37.41	0.64	0.42	24.06	15.71	-8.35
Euro IV	12.91	0.45	0.16	5.83	2.03	-3.80
Euro V	23.18	0.26	0.16	6.07	3.65	-2.42
Euro VI	0.00	0.18	0.16	0.00	0.00	0.00
GAS						
NOC	0.00	0.00	0.65	0.00	0.00	0.00
Euro II	0.00	0.00	0.65	0.00	0.00	0.00
Euro III	0.00	0.00	0.65	0.00	0.00	0.00

EEV	0.00	0.00	0.10	0.00	0.00	0.00
TRA_RD_LD2						
LF						
NOC	0.01	0.04	0.20	0.00	0.00	0.00
Euro 1	0.02	0.19	0.20	0.00	0.00	0.00
Euro 2	0.03	0.18	0.20	0.01	0.01	0.00
Euro 3	0.05	0.19	0.20	0.01	0.01	0.00
Eindtotaal	**313.12**			**104.25**	**56.27**	**-47.98**

Table A3-2: Calculation of the adjustment for NOx in 2011. TRA_RD_LD4 = passenger cars and light duty vehicles; TRA_RD_HD = heavy duty vehicles and buses; TRA_RD_LD2 = mopeds and motorcycles. LF= Light fractions (gasoline, LPG,...); MD= Medium distillates (diesel,...); GAS=natural gas. NOC= No control.

Vehicle Class	Activity Level (PJ) x CC (%)	EF COPERT (kt/PJ)	EF RAINS (kt/PJ)	NOX COPERT (kt)	NOX RAINS (kt)	Adjustment (kt)
TRA_RD_LD4						
LF						
NOC	2.23	0.70	0.88	1.57	1.97	0.39
Euro 1	3.78	0.18	0.22	0.67	0.83	0.16
Euro 2	4.68	0.09	0.11	0.43	0.54	0.11
Euro 3	10.43	0.04	0.06	0.46	0.64	0.18
Euro 4	20.85	0.02	0.03	0.40	0.55	0.15
Euro 5	6.30	0.01	0.03	0.09	0.17	0.08
Euro 6	0.02	0.01	0.03	0.00	0.00	0.00
MD						
NOC	1.11	0.33	0.35	0.36	0.39	0.03
Euro 1	3.00	0.30	0.24	0.90	0.73	-0.17
Euro 2	12.33	0.32	0.18	3.92	2.16	-1.76
Euro 3	39.32	0.33	0.14	12.88	5.51	-7.38
Euro 4	82.28	0.27	0.07	21.93	5.76	-16.17
Euro 5	36.70	0.27	0.07	10.01	2.57	-7.44
Euro 6	0.22	0.09	0.07	0.02	0.02	0.00
GAS						
NOC	0.00	0.02	0.00	0.00	0.00	0.00
Euro 5	0.00	0.02	0.10	0.00	0.00	0.00
Euro 6	0.00	0.02	0.10	0.00	0.00	0.00
TRA_RD_HD						
LF						
NOC	0.04	0.63	0.86	0.03	0.04	0.01
MD						
NOC	2.20	1.00	1.05	2.20	2.31	0.11

Euro I	1.89	0.75	0.70	1.42	1.33	-0.09
Euro II	9.40	0.83	0.60	7.78	5.63	-2.15
Euro III	31.61	0.64	0.42	20.33	13.28	-7.06
Euro IV	12.25	0.45	0.16	5.53	1.93	-3.60
Euro V	31.24	0.26	0.16	8.10	4.92	-3.18
Euro VI	0.00	0.18	0.16	0.00	0.00	0.00
GAS						
NOC	0.00	0.00	0.65	0.00	0.00	0.00
Euro II	0.00	0.00	0.65	0.00	0.00	0.00
Euro III	0.00	0.00	0.65	0.00	0.00	0.00
EEV	0.00	0.00	0.10	0.00	0.00	0.00
TRA_RD_LD2						
LF						
NOC	0.01	0.03	0.20	0.00	0.00	0.00
Euro 1	0.02	0.19	0.20	0.00	0.00	0.00
Euro 2	0.03	0.18	0.20	0.01	0.01	0.00
Euro 3	0.06	0.19	0.20	0.01	0.01	0.00
Eindtotaal	**312.02**			**99.04**	**51.27**	**-47.77**

Table A3-3: Calculation of the adjustment for NOx in 2012. TRA_RD_LD4 = passenger cars and light duty vehicles; TRA_RD_HD = heavy duty vehicles and buses; TRA_RD_LD2 = mopeds and motorcycles. LF= Light fractions (gasoline, LPG,...); MD= Medium distillates (diesel,...); GAS=natural gas. NOC= No control.

Vehicle Class	Activity Level (PJ) x CC (%)	EF COPERT (kt/PJ)	EF RAINS (kt/PJ)	NOX COPERT (kt)	NOX RAINS (kt)	Adjustment (kt)
TRA_RD_LD4						
LF						
NOC	2.12	0.71	0.88	1.50	1.86	0.36
Euro 1	2.94	0.18	0.22	0.52	0.65	0.13
Euro 2	3.88	0.09	0.11	0.36	0.44	0.09
Euro 3	9.43	0.05	0.06	0.44	0.58	0.15
Euro 4	19.77	0.02	0.03	0.38	0.52	0.14
Euro 5	10.15	0.01	0.03	0.14	0.27	0.13
Euro 6	0.03	0.01	0.03	0.00	0.00	0.00
MD						
NOC	0.90	0.32	0.35	0.29	0.32	0.02
Euro 1	2.16	0.30	0.24	0.65	0.52	-0.13
Euro 2	9.98	0.32	0.18	3.19	1.75	-1.44
Euro 3	34.78	0.33	0.14	11.41	4.87	-6.54
Euro 4	73.87	0.27	0.07	19.75	5.17	-14.58
Euro 5	53.75	0.27	0.07	14.68	3.76	-10.92
Euro 6	0.34	0.08	0.07	0.03	0.02	0.00

GAS						
NOC	0.00	0.02	0.00	0.00	0.00	0.00
Euro 5	0.01	0.02	0.10	0.00	0.00	0.00
Euro 6	0.00	0.02	0.10	0.00	0.00	0.00
TRA_RD_HD						
LF						
NOC	0.05	0.63	0.86	0.03	0.04	0.01
MD						
NOC	1.84	1.00	1.05	1.84	1.94	0.10
Euro I	1.54	0.75	0.70	1.15	1.08	-0.07
Euro II	7.31	0.83	0.60	6.06	4.38	-1.68
Euro III	23.96	0.64	0.42	15.42	10.06	-5.36
Euro IV	12.69	0.45	0.16	5.72	2.00	-3.72
Euro V	39.56	0.26	0.16	10.10	6.23	-3.87
Euro VI	0.03	0.13	0.16	0.00	0.00	0.00
GAS						
NOC	0.00	0.00	0.65	0.00	0.00	0.00
Euro II	0.00	0.00	0.65	0.00	0.00	0.00
Euro III	0.00	0.00	0.65	0.00	0.00	0.00
EEV	0.00	0.00	0.10	0.00	0.00	0.00
TRA_RD_LD2						
LF						
NOC	0.01	0.03	0.20	0.00	0.00	0.00
Euro 1	0.01	0.19	0.20	0.00	0.00	0.00
Euro 2	0.03	0.18	0.20	0.00	0.01	0.00
Euro 3	0.07	0.19	0.20	0.01	0.01	0.00
Total	**311.21**			**93.67**	**46.49**	**-47.17**

Table A3-4: Calculation of the adjustment for NOx in 2013. TRA_RD_LD4 = passenger cars and light duty vehicles; TRA_RD_HD = heavy duty vehicles and buses; TRA_RD_LD2 = mopeds and motorcycles. LF= Light fractions (gasoline, LPG,...); MD= Medium distillates (diesel,...); GAS=natural gas. NOC= No control.

Vehicle Class	Activity Level (PJ) x CC(%)	EF COPERT (kt/PJ)	EF RAINS (kt/PJ)	NOX COPERT (kt)	NOX RAINS (kt)	Adjustment (kt)
TRA_RD_LD4						
LF						
NOC	2.06	0.72	0.88	1.49	1.82	0.32
Euro 1	2.30	0.17	0.22	0.40	0.51	0.10
Euro 2	3.22	0.09	0.11	0.30	0.37	0.07
Euro 3	8.43	0.05	0.06	0.41	0.52	0.11
Euro 4	18.64	0.02	0.03	0.36	0.49	0.13
Euro 5	13.97	0.01	0.03	0.19	0.37	0.18

Euro 6	0.32	0.01	0.03	0.00	0.01	0.00
MD						
NOC	0.77	0.33	0.35	0.25	0.27	0.02
Euro 1	1.54	0.30	0.24	0.46	0.37	-0.09
Euro 2	7.84	0.32	0.18	2.51	1.37	-1.14
Euro 3	30.29	0.33	0.14	9.95	4.24	-5.71
Euro 4	65.52	0.27	0.07	17.59	4.59	-13.00
Euro 5	67.71	0.27	0.07	18.54	4.74	-13.80
Euro 6	0.89	0.08	0.07	0.07	0.06	-0.01
GAS						
NOC	0.00	0.02	0.00	0.00	0.00	0.00
Euro 5	0.02	0.02	0.10	0.00	0.00	0.00
Euro 6	0.00	0.02	0.10	0.00	0.00	0.00
TRA_RD_HD						
LF						
NOC	0.05	0.63	0.86	0.03	0.04	0.01
MD						
NOC	1.56	1.00	1.05	1.55	1.64	0.08
Euro I	1.20	0.75	0.70	0.90	0.84	-0.05
Euro II	5.95	0.83	0.60	4.93	3.56	-1.37
Euro III	19.41	0.64	0.42	12.49	8.15	-4.34
Euro IV	13.65	0.45	0.16	6.16	2.15	-4.01
Euro V	43.05	0.25	0.16	10.94	6.78	-4.16
Euro VI	2.03	0.11	0.16	0.23	0.32	0.09
GAS						
NOC	0.00	0.00	0.65	0.00	0.00	0.00
Euro II	0.00	0.00	0.65	0.00	0.00	0.00
Euro III	0.00	0.00	0.65	0.00	0.00	0.00
EEV	0.00	0.00	0.10	0.00	0.00	0.00
TRA_RD_LD2						
LF						
NOC	0.00	0.03	0.20	0.00	0.00	0.00
Euro 1	0.01	0.19	0.20	0.00	0.00	0.00
Euro 2	0.02	0.18	0.20	0.00	0.00	0.00
Euro 3	0.08	0.19	0.20	0.01	0.02	0.00
Total	**310.53**			**89.77**	**43.23**	**-46.54**