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The Netherlands' Informative Inventory Report 2006

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Rapport in het kort

The Netherlands' Informative Inventory Report 2006

Dit Informative Inventory Report (IIR) geeft een toelichting op de officiële emissiecijfers die Nederland heeft geleverd aan het UNECE-secretariaat in het kader van de verplichtingen onder de *Convention on Long-range Transboundary Air Pollution* (CLRTAP), en aan de Europese Commissie in het kader van de verplichtingen onder de *NEC-richtlijn*. De emissiecijfers kunt u vinden op de EMEP[1]-website: http://www.emep.int (EMEP data). Deze toelichtende IIR is nog niet verplicht, maar zowel internationaal als nationaal is toenemende behoefte aan uitleg over hoe emissiecijfers worden bepaald. Voor de invulling hiervan wordt samenhang gezocht met de rapportage onder het Klimaatverdrag, het National Inventory Report (NIR).

Met deze IIR rapportage wordt een beter zicht verkregen op de toepasbaarheid (vergelijkbaarheid tussen landen, modelberekeningen voor luchtkwaliteit door EMEP) en afrekenbaarheid (transparantie, compleetheid, consistentie tussen jaren, sterkte en zwaktes in methoden, onzekerheden) van emissiecijfers. De afgelopen jaren is veel geïnvesteerd in verbetering van methoden voor het bepalen van de emissies van broeikasgassen. De komende jaren wil het MNP in de Emissieregistratie de methoden verbeteren voor de verzurende stoffen, vluchtige organische stoffen, fijn stof (PM_{10}, $PM_{2,5}$), zware metalen en persistente organische verbindingen. Daarnaast zal ook de vulling van de emissietabellen worden verbeterd door aanvullen van ontbrekende data en betere allocatie van emissies naar sectoren en subsectoren. De documentatie (onder andere deze rapportage, maar ook de protocollen) wordt de komende jaren verbeterd, uitgebreid en publiek toegankelijk gemaakt via de website www.emissieregistratie.nl.

[1] Co-operative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP).

Trefwoorden / Keywords:

Inventory, LRTAP, NEC, Emission

Contents

Summary

This report constituting the Netherlands' Informative Inventory Report (IIR) contains information on the inventories in the Netherlands up to 2004 (see EMEP data on http://www.emep.int). It includes descriptions of methods, data sources, QA/QC activities carried out and a trend analysis.

This first IIR outlines the methods for estimating emissions (e.g. extrapolation of emissions from individual companies to sectors). Estimations are given in more detail for sector and sub sector for the top ten key sources (e.g. emission calculation from road transport in vehicle categories and road types).

The 2006 submission includes emission data from the Netherlands for the years 1990, 1995, 2000, 2002, 2003 and 2004. The emission data are extracted from the Dutch Emission Inventory system (PER), with exception of $PM_{2.5}$ emissions. These data are calculated from the PM_{10} data and have not yet been incorporated in the PER.

In the period 1990 – 2004 emissions of all gases presented in this report showed a downward trend. The major overall drivers for this trend are emission reductions in the industrial sectors, cleaner fuels and cleaner cars.

Based on methodological improvements (such as improvement of activity data), the historical data for 1990, 1995, 2000 and the last three years are recalculated annually in the Dutch inventory. Remarkable in last year's submission is the notable change in data presentation due to the side-effects of a major recalculation for the greenhouse gas emissions in the Netherlands. Please note that recalculations based on methodological improvements have been limited to submitted years only.

This year the following minor changes occurred: (1) lower NO_x emissions and higher NMVOC related to road transportation due to improvement of data on car types/age classes per road category. (2) lower PM_{10} emissions from break wear due to new insights in the fraction of PM_{10} in total particulate matter from break wear. (3) higher NH_3 emissions from synthetic fertilisers due to incorporation of different types of fertilisers with different emission factors and (4) lower NO_x and NMVOC emissions from the oil and gas sector, based on more detailed information from the sector.

A report on projected emissions for 2010 and 2020 was prepared jointly in 2005 by the National Institute for Public Health and the Environment and the Netherlands Environmental Assessment Agency (RIVM-MNP), in cooperation with the Energy Research Centre of the Netherlands (ECN/RIVM-MNP, 2005). It is available via the MNP website (www.mnp.nl). The results of this study are included in the 2006 submission and discussed shortly in Chapter 7 of this 2006 Inventory Report.

1 Introduction

Reporting emission data to the Executive Body of the Convention on Long-range Transboundary Air Pollution (CLRTAP) is required to fulfil obligations in compliance with the implementation of Protocols under the Convention. Parties are required to submit reports on annual national emissions of SO_2, NO_X, NMVOC, CO and NH_3 , and various heavy metals and POPs using the Guidelines for Estimating and Reporting Emission Data under the Convention on Long-range Transboundary Air Pollution (UNECE, 2003).

The Netherlands' Informative Inventory Report (IIR) contains information on the Netherlands' inventories for the year 2004, including descriptions of methods, data sources, QA/QC activities carried out and a trend analysis. The inventory accounts for anthropogenic emissions of SO_2, NO_X, NH_3, NMVOC, CO, TSP (Total Suspended Particulate matter), PM_{10} (particles of size <10 µm), $PM_{2.5}$ (< 2.5µm), Pb, Cd, Hg, As, Cr, Cu, Ni, Se and Zn, PAH and dioxins.

Emissions in the Netherlands are registered in the Pollutant Emission Register (PER). The PER is the national database for target group monitoring used by the Dutch government for the monitoring of greenhouse gas emissions in conformance with UNFCCC requirements and the Kyoto Protocol (National System), and the monitoring of pollutants within the framework of National Emission Ceilings (EU) and the Convention on Long-range Transboundary Air Pollution (CLRTAP). The PER encompasses the process of data collection, data processing, registering and reporting emission data for some 170 policy relevant compounds and compound groups present in air, water and soil.

Emission estimates are based mainly on official statistics of the Netherlands, e.g. energy and agricultural statistics, environmental reports of companies from the industrial sector and emission factors (nationally developed factors and internationally recommended ones).

The Netherlands uses the 'Guidelines for Estimating and Reporting Emission Data' for reporting to the Economic Commission for Europe (UNECE) Convention on Long-range Transboundary Air Pollution (CLRTAP). However, instead of using the EMEP/CORINAIR Emission Inventory Guidebook (EEA, 2005), the Netherlands mostly uses country-specific methods, including monitoring data and emission factors.

1.1 Institutional arrangements for inventory preparation

The Dutch Ministry of Housing, Spatial Planning and the Environment (VROM) has the overall responsibility for the emission inventory and submissions to CLRTAP. A Pollutant Emission Register (PER) system has been in operation in the Netherlands since 1974. The PER in the Netherlands is co-ordinated by the Netherlands Environmental Assessment Agency (MNP).

The emission data are produced in an annual (project) cycle (MNP, 2005). Since April 2004, full co-ordination of the PER has been outsourced by the Ministry of VROM to the Emission Registration team (ER) at the Netherlands Environmental Assessment Agency (MNP). This has resulted in a clearer definition and distinction of responsibilities, as well as a concentration of tasks.

The main objective of the emission inventory is to produce an annual set of unequivocal emission data, which are up-to-date, complete, transparent, comparable, consistent and accurate. Various external agencies contribute to the PER by performing calculations or submitting activity data (see next section). Besides the MNP, the following institutes contribute to the PER:

- Statistics Netherlands (CBS);
- TNO Built Environment and Geosciences (TNO);
- Institute for Inland Water Management and Waste Water Treament (RIZA);
- several institutes related to Wageningen University and Research Centre (WUR);
- SenterNovem (Waste management division);
- Agricultural Economics Research Institute (LEI);
- Facilitating Organisation for Industry (FO-I), which coordinates annual environmental reporting by companies.

Each of the contributing institutes has its own responsibility and role in the data collection, emission calculations and quality control. These are laid down in general agreements with MNP and in the annual project plan (MNP, 2006). The Informative Inventory Report (IIR) was prepared by MNP.

1.2 The process of inventory preparation

Data collection

For the collection and processing of data, the ER is organised in task forces according to pre-determined methods. The task forces are formed by sector experts of the participating institutes. The methods are compiled on the basis of the best available scientific views. Changes in scientific views lead to changes in methods, and to recalculation of the historical emissions. The following task forces are recognised:

- Task force Agriculture and Land use;
- Task force Energy, Industry and Waste;
- Task force Traffic;
- Task force Water;
- Task force Consumer and Service Sector.

Every year, after collection of the emission data, several quality control checks are performed within the task forces and during a yearly ‘trend analysis’ workshop. After the approval by participating institutes, emission data will be released for publication. Subsequently, emission data is also des-aggregated to regional emission data for national use (e.g. 5x5 km grid data for provinces).

Data storage

In cooperation with the contributing research institutes, emission data are collected and stored in two linked information systems, the Emission Registration for Individual Companies (ER-I) and the Emission Registration for Collective data (ER-C).

About 250 companies are legally obligated to submit an environmental annual report (EAR). Since 1 January 2004, companies may submit their EARs electronically (e-EAR).

Each of these companies has an emission monitoring and registration system for which the specifications find agreement with the supervisory authority. The provincial authorities validate and verify the reported emissions. The (e-)EARs are then processed by FO-Industry into the EAR database.

In addition, a number of companies are required to report information under the BEES/A legislation. Other companies provide emission data voluntarily within the framework of environmental covenants.

Next, the point source emission data in the EAR database is validated by the task forces. The result is a selection of validated point source emissions and activity data, which are then stored in the ER-I database. The ER-I data is combined with supplementary estimates for companies that are not registered individually (the so-called collectively estimated industrial sources) and emissions from collectively estimated non-industrial (area) sources and then stored in the ER-C database (see Figure 1.1). The ER-C database contains a complete record of Dutch emissions for a particular year and consists of a large number emission sources (about 1200), which are geographically distributed. Each emission source includes information on the Standard Industrial Classification code (SBI-code) and industrial subsector, separate information in process and combustion emissions, the relevant environmental compartment and location. These emission sources can be selectively aggregated, for example, by NFR category.

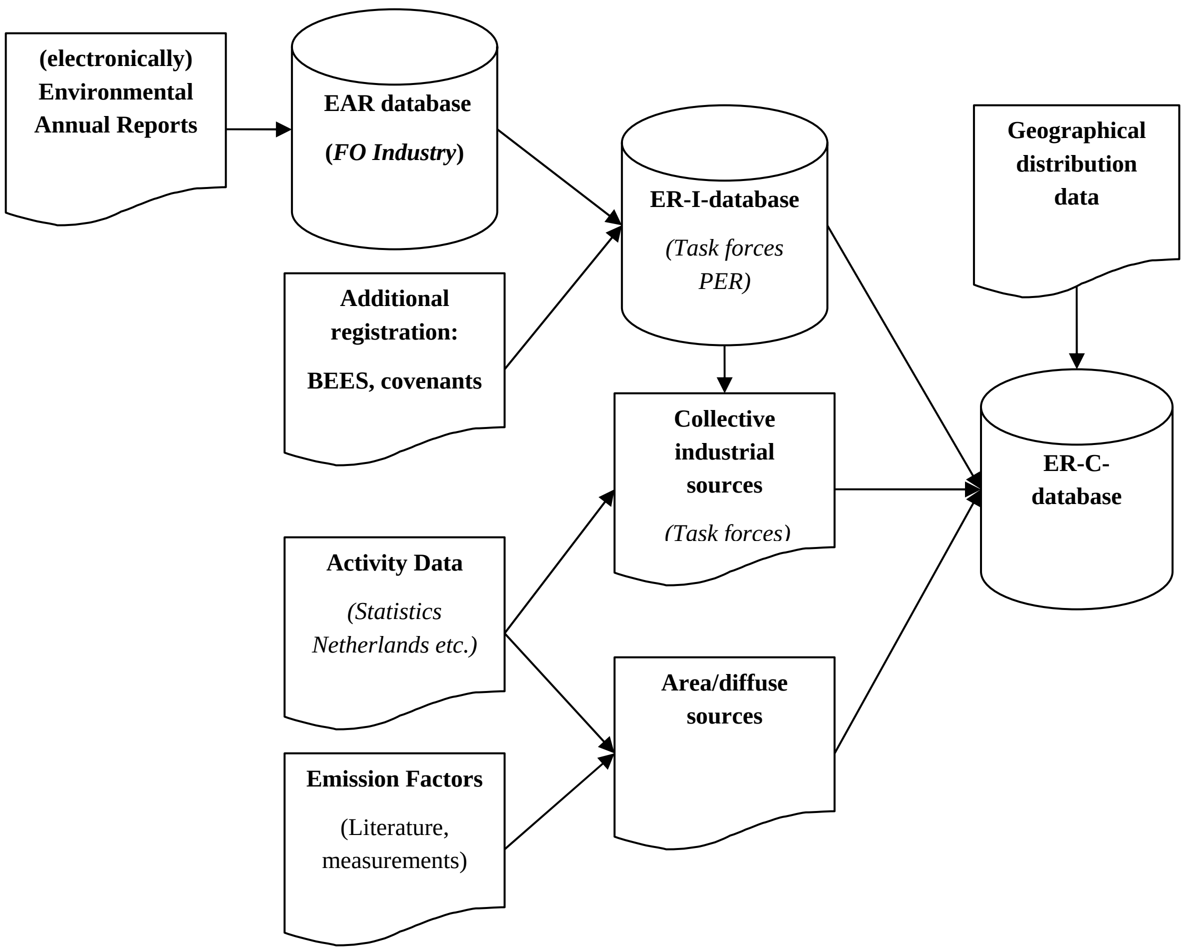


Figure 1.1. The Netherlands Pollutant Emission Register.

1.3 Reporting, QA/QC and archiving

The Informative Inventory Report is prepared by MNP, with contributions from experts from relevant ER Task forces. The Ministry of VROM formally approves the IIR before it is submitted; in some cases approval follows consultation with other ministries.

The MNP is an ISO 9001:2000 certified institute. QA/QC, documentation and archiving is done according to procedures of the quality manual. Arrangements and procedures for the contributing institutes are described in the yearly project plan (MNP, 2005).

2 Assessment of completeness

The Dutch emission inventory covers all relevant sources as specified in the CLRTAP and which are determining the emissions to air in The Netherlands. Because of the long history of the inventory it is not always possible to specify all subsectors in detail. This is the reason notation keys are used in the emission tables (NFR). These notation keys will be explained in the following section.

2.1 Explanation on the use of Notation keys

Table 2.1. Explanation on Notation key NE

NFR code	**Substance(s)**	**Reason for reporting NE**
All	Benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene	Currently, the inventory does not provide data on individual compounds. These are included in the category Total 1-4, which is filled with total PAH emissions according to the Dutch definition of the 'VROM sum of 10 PAH'.
Total, domain	Reported as 'NE', but should be equal to National Total	Error

Table 2.2. Explanation to the Notation key IE

NFR code	**Substance(s)**	**Included in NFR code**
1 A 3 a ii (ii)	All	No specific data are available on the domestic (very small) cruise emissions. These emissions are incorporated in 1 A 3 a ii (i) (based on total fuel use for domestic flights).
1 B 2 c	All	Venting and flaring emissions almost exclusively occur in the natural gas sector and are therefore included in 1 B 2 b.
4 B 1 b	TSP, PM_{10}, $PM_{2.5}$	Since no specific data are available for this subcategory, all emissions are reported under 4 B 1 a.

Table 2.3. Sub-sources accounted for in reporting codes "other"

NFR code	Sub-source description	Substance(s) reported
1A2f	Combustion in the non specified industries, machineries, services, production activities.	all
1A3 e	NO/NA	
1A5a	Combustion of landfill gas	all
1A5b	NO/NA	
1B1 c	NO/NA	
1B2 a vi	NO/NA	
2 A 7	Process emissions, in building activities and production of building materials	all
2 B 5	Process emissions during production of chemicals, paint, pharmaceutics, soap, detergents, glues and other chemical products	all
2 G	Process emissions during production of wood products, plastics, rubber, metal, textiles, paper	all
3 D	Use of products, not in 3A-C, venting transport and storage facilities, use of products by consumers, commercial activities, smoking tobacco products (NMVOC only), cooling, freezing, air-conditioning	all
4 B 13	Pets	NH_3
4 G	Handling agricultural-based materials and products	NH_3, TSP, PM_{10}, $PM_{2.5}$
6 D	Handling waste	all
7	Smoking tobacco products Transpiration, breathing	All substances, excl NMVOC NH_3
5E	NO/NA	

2.2 Missing sources

The Netherlands emission inventory covers all important sources. However, no data is available for individual PAHs. The reason for this are less restricted requirements on the individual PAHs to be reported in environmental reports from companies; it is therefore not possible to speciate the total PAH emissions. A study performed on priority substances (PAH emissions; Heavy Metals; (other) Persistent Organic Pollutants) in 2005 included a number of recommendations to improve reporting in this respect (Alkemade et al., 2005). After incorporation of these recommendations in the national inventory system, the Netherlands may be able to provide individual PAH data.

3 Key source analysis

For this first IIR, we used the results of the key source analysis as part of the REPDAP report, which is generated and send by the secretariat after sub-mission of NFR spreadsheets. The REPDAP report only shows the top 10 key sources by sub-stance (see Table 3.1). As can be seen in this table, the top 10 key sources for SO_x, NH_3, Pb, Hg, dioxins and PAH contribute more than 95% to total national emissions. The top 10 key sources for NOx, CO and NMVOC contibute about 80-90%. For particulate matter emissions (TSP, PM_{10} and $PM_{2.5}$), however, it is recommended to extend the list of key sources, as only 60-70% are covered by the top 10 key emission sources. In the next IIR, we will present and discuss all key sources. The table also shows that for NO_x, SO_2, CO, $PM_{2.5}$ and Cd most key sources can be found in the Energy sector, while more sectors are important for other substances (e.g., NMVOC, PM_{10} and PAH). In the following sections, the methodology issues of the above mentioned key sources are discussed for the particular NFR sector.

Table 3.1. REPDAP Report: top 10 key sources, based on NFR table for 2003 (Dutch submission, 2006)

Component	**Key source categories (Sorted from high to low from left to right)**										**Total (%)**	**Not listed**
SO_x	1A1b (46.6%)	1A1a (22.1%)	1A2a (5.8%)	1A2c (5.7%)	1A2b (4.4%)	1A2f (3.2%)	2A7 (2.9%)	1A4c ii (2.5%)	1A4c iii (1.3%)	1A3d ii (1.1%)	95.6	0
NO_x	1A3b iii (23.3%)	1A3b i (14.2%)	1A1a (13.6%)	1A2f (6.0%)	1A3b ii (5.6%)	1A4c ii (5.5%)	1A4b i (5.4%)	1A4a (4.3%)	1A2c (4.0%)	1A4c iii (3.8%)	85.7	4
NH_3	4B1a (30.4%)	4B8 (24.4%)	4B1b (18.1%)	4B9 (9.9%)	4G (7.0%)	7 (3.9%)	1A3b i (1.9%)				95.7	0
NMVOC	1A3b v (14.5%)	1A3b i (14.4%)	3D (13.9%)	3A (11.8%)	2G (6.2%)	1B2b (6.0%)	2B5 (4.5%)	1A3b iv (4.4%)	1A4b i (3.9%)	2D2 (2.2%)	81.8	9
CO	1A3b i (41.5%)	1A2a (9.9%)	1A4b i (8.5%)	1A3b iv (8.4%)	2C (6.3%)	1A2c (3.3%)	1A3d ii (3.0%)	1A3b ii (2.9%)	1A3b iii (2.9%)	1A1a (2.4%)	89.1	4
TSP	3D (12.3%)	4B9 (8.5%)	1A4b i (6.8%)	1A1b (5.7%)	1A3b i (5.5%)	2B5 (5.1%)	4B8 (5.0%)	1A3b iii (4.9%)	1A3b ii (4.7%)	1A3b vi (4.4%)	62.9	12
PM_{10}	4B9 (10.0%)	3D (7.7%)	1A1b (6.7%)	1A3b i (6.4%)	4B8 (5.8%)	1A3b iii (5.7%)	1A3b ii (5.5%)	1A3b vi (5.2%)	1A4b i (4.5%)	2C (4.4%)	62.1	12
$PM_{2.5}$	1A3b i (10.6%)	1A3b iii (9.4%)	1A3b ii (9.1%)	1A3b vi (8.6%)	1A4b i (7.4%)	1A4 c ii (6.7%)	1A1b (6.7%)	7 (6.4%)	1A3b vii (4.9%)	2C (3.6%)	73.5	10
Pb	2C (77.1%)	2A7 (8.6%)	1A4b i (5.7%)	2B5 (1.8%)	1A2c (1.7%)	1A3aii(i) (1.6%)					96.5	0
Hg	2B5 (45.6%)	6C (17.5%)	1A1a (17.0%)	6D (8.0%)	1B2b (4.6%)	1A4b i (4.2%)					96.8	0
Cd	2C (71.8%)	1A2c (12.2%)	1A4b i (5.2%)	1A1a (4.4%)	1A3b i (2.4%)						96.0	0
DIOX	3D (46.4%)	2C (17.6%)	1A4b i (10.6%)	6D (9.9%)	1A1a (8.1%)	1A2c (2.5%)					95.1	0
PAH	3D (35.6%)	2G (21.3%)	1A4b i (10.5%)	2C (8.7%)	1A3b i (8.1%)	1A3b iii (5.3%)	1A3b ii (3.2%)	2B5 (1.5%)	1A3b iv (1.1%)		95.4	0

Color codes:

1 Energy	3 Solvent and product use	6 Waste
2 Industry	4 Agriculture	7 Other

4 Uncertainties

Uncertainty assessments constitute a means to either provide the inventory users with a quantitative assessment of the inventory quality or to direct the inventory preparation team to priority areas, where improvements are warranted and can be made cost-effective. For these purposes, quantitative uncertainy assessments have been carried out for these purposes since 1999. However, awareness of uncertainties in emission figures was expressed earlier in the PER in so-called quality indices and in several studies on industrial emissions and generic emission factors for industrial processes and difuse sources. To date, the Dutch PER gives only one value for emissions (calculation result, rounded off to three significant digits).

The information on the quality of emission figures presented here is based on the TNO report 'Uncertainty assessment of NO_x, SO_2 and NH_3 emissions in the Netherlands' (Van Gijlswijk, 2004), which presents the results of a tier 2 'Monte Carlo' uncertainty assessment.

4.1 Quantitative uncertainty

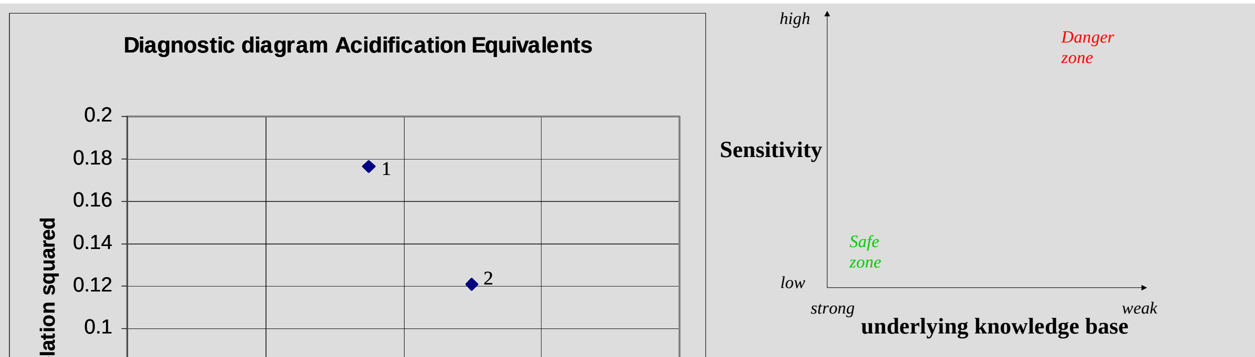
Uncertainty estimates in national total emissions have been reported in the Environmental Balances since 2000 (RIVM, 2001). These estimates were based on uncertainties by source category using simple error propagation calculations (Tier 1). Most uncertainty estimates are based on the judgement of RIVM/MNP emission experts. A preliminary analysis on NMVOC emissions showed an uncertainty range of about 25%. In a recent study by Van Gijlswijk et al. (2004), the uncertainty in the contribution of the various emission sources to total acidification (in acidification equivalents) has been assessed according to the Tier-2 methodology (estimation of uncertainties by source category using Monte Carlo analysis). See Table 4.2 for results. A comparison was also made between the Tier-1 and Tier-2 methodologies. This is not straightforward as the two studies use a different knowledge collection. The 2000 Tier-1 analysis used CLRTAP default uncertainties for several NOx processes, which explains the difference with the 1999 Tier-1 results. For NH_3, the difference between the 2000 Tier-1 and Tier-2 can be explained by taking non-normal distributions and dependencies between individual emission sources for each animal type into account (both are violations of the Tier-1 assumptions: effects that were encapsulated in the 1999 Tier-1 analysis). The differences for SO_2 and total acidifying equivalents are small. The conclusion from this comparison is that focusing on the order of magnitude of the individual uncertainty estimates, as in the RIVM-2001 study, provides a reasonable first assessment of the uncertainty of source categories.

Table 4.1. Uncertainty (95% confidence ranges) in acidifying compounds and for total acidifying equivalents for emissions in the year 1999 (RIVM, 2001) and 2000 (Van Gijlswijk et al., 2004)

Component	**Tier-1 for 1999**	**Tier-1 for 2000**	**Tier-2 for 2000**
NH_3	± 17%	± 12%	± 17%
NO_x	± 11%	± 14%	± 15%
SO_2	± 8%	± 6%	± 6%
Total acid equivalents	**± 9%**	**± 8%**	**± 10%**

The RIVM 2001 study draws on the results of an earlier study on the quality of nitrogen oxides (NO_x) and sulphur dioxide (SO_2) emissions, as reported by individual companies for point sources under their national reporting requirements (Engelen et al., 2001). Besides providing quantitative uncertainty estimates, the study yielded important conclusions: for example, that a limited number of facilities showed high uncertainties (e.g., 50% or more for NO_x), which could be improved with little extra effort, and that companies generally have a lack of knowledge on the uncertainty about the emissions they report.

In the study by Van Gijlswijk, emission experts were systematically interviewed on quantitative uncertainties, which provided simultaneous information on the reliability and quality of the underlying knowledge base. For processes not covered by interviews, standard default uncertainties were used; these were derived from the Good Practice Guidance for CLRTAP emission inventories (Pulles and Van Aardenne, 2001). The qualitative knowledge (on data validation, methodological aspects, empirical basis and proximity of data used) has been combined into a score for data strength, based on the so-called NUSAP approach (Van der Sluijs et al., 2003; Risbey, 2001). The qualitative and quantitative uncertainties were combined in so-called diagnostic diagrams that can be used to identify areas for improvement, as the diagrams indicate strong and weak parts of the available knowledge (see Figure 4.1). Sources with a relatively high quantitative uncertainty and weak data strength are thus candidates for improvement. To effectively reduce the uncertainty, the nature of uncertainties must be known (e.g. random, systematic or knowledge uncertainty). A general classification scheme on uncertainty typology is given in Van Asselt (2000).



Rank	Label
1	NH3 dairy cows, application of manure
2	NOx mobile sources agriculture
3	NOx agricultural soils
4	NH3 meat pigs, application of manure
5	NOx highway: gasoline personal cars
6	NH3 dairy cows, animal housings and storage
7	NOx highway: truck trailers
8	NH3 breeding stock pigs, application of manure
9	NH3 calves, yearlings, application of manure
10	NH3 application of synthetic fertilizer

Figure 4.1. NUSAP diagnostic diagram indicating strong and weak elements in the available knowledge on acidifying substances.

5 Trends in emissions

5.1 Trends in national emissions

The emissions of all gases showed a downward trend in the period 1990 – 2004 (see Table 5.1). The major overall drivers for this trend are:

– emission reductions in the industrial sectors;
– cleaner fuels;
– cleaner cars.

European regulations for road traffic have caused a decrease in vehicle emissions of 65% since 1990 for NMVOC, 40% for particulate matter, 30% for NO_x and about 60% for SO_2, despite the growth in traffic of 37%. For particulate matter and NO_x, standards have been set for installations by tightening up the extent of emission stocks of heating installations (BEES), and the Netherlands Emission Guidelines (NER). In meeting these requirements Dutch industrial plants have realised a reduction of 70% in particulate matter emissions and 50% in NO_x emissions since 1990. The drivers for the downward emission trend for specific gases will be elaborated in more detail in the next section .

Table 5.1. Total national emissions, 1990 -2004

	Main Pollutants					Particulate Matter			Priority Heavy Metals		
	NOx	CO	NMVOC	SOx	NH3	TSP	PM10	PM2.5	Pb	Cd	Hg
Year	Gg NO_2	Gg	Gg	Gg SO_2	Gg	Gg	Gg	Gg	Mg	Mg	Mg
1990	552	1145	491	189	249	98	77	46	335	2.1	3.4
1995	466	872	364	127	193	72	58	35	159	1.1	1.1
2000	389	740	267	73	152	57	48	29	44	1.2	0.6
2002	368	658	236	66	136	52	44	26	44	1.2	0.6
2003	367	638	222	63	130	49	41	25	44	1.2	0.5
2004	360	612	216	66	134	48	41	24	44	1.2	0.5
period 1990-2004 (abs)	-193	-532	-275	-123	-115	-50	-36	-22	-291	-1.0	-2.9
period 1990-2004 (%)	-35%	-47%	-56%	-65%	-46%	-51%	-47%	-48%	-87%	-45%	-84%

	Persistent Organic Pollutants (POPs) Annex I									POPs Annex II		
	Aldrin	Chlordane	Chlordecone	Dieldrin	Endrin	Heptachlor	Hexabromo-biphenyl	Mirex	Toxaphene	HCH	DDT	PCB
Year	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg
1990	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1995	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2000	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2002	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2003	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2004	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
period 1990-2004 (abs)												
period 1990-2004 (%)												

	POPs Annex III							Other Heavy Metals						Other POPs	
		PAH													
	DIOX	benzo(a)pyrene	benzo(b)fluoranthene	benzo(k)fluoranthene	Indeno(1,2,3-cd)pyrene	Total 1-4	HCB	As	Cr	Cu	Ni	Se	Zn	PCP	SCCP
Year	g I-Teq	Mg	Mg	Mg	Mg	Mg	kg	Mg	Mg	Mg	Mg	Mg	Mg	kg	kg
1990	743	NE	NE	NE	NE	1711	0.0	1.5	11	19	76	0.4	221	34000	NO
1995	66	NE	NE	NE	NE	901	0.0	1.2	8	20	88	0.4	144	29000	NO
2000	42	NE	NE	NE	NE	679	0.0	1.3	5	21	43	0.1	102	24000	NO
2002	40	NO	NO	NO	NO	626	0.0	1.3	6	21	43	0.1	104	22700	NO
2003	40	NE	NE	NE	NE	616	0.0	1.3	6	21	43	0.1	104	22050	NO
2004	39	NO	NO	NO	NO	606	0.0	1.3	6	21	43	0.1	105	21400	NO
period 1990-2004 (abs)	-703					-1105	0	-0.2	-5.6	2.2	-33	-0.3	-116	-12600	
period 1990-2004 (%)	-95%					-65%		-13%	-50%	12%	-44%	-69%	-53%	-37%	

Notes: PAH emissions for 2000 and 2004 are wrongly reported as NO (not occurring), PAH emissions should be NE and HCB emissions should be NO.

5.2 Emission trends for gases

5.2.1 Sulphur dioxide (SO_2)

The Dutch SO_x emissions (reported as SO_2) decreased by 123 Gg in the period 1990 – 2004, corresponding to 65% of the national total in 1990 (Figure 5.1). Main contributions to this decrease came from the energy sector, industry and transport. The use of coal declined and major coal-fired electricity producers installed flue gas desulphurisation plants. The sulphur content in fuels for the (chemical) industry and traffic were also reduced. Currently, the energy sector is responsible for almost three-quarters of the national SO_2 emission. Traffic has gained in share because of the increase in diesel-powered vehicles.

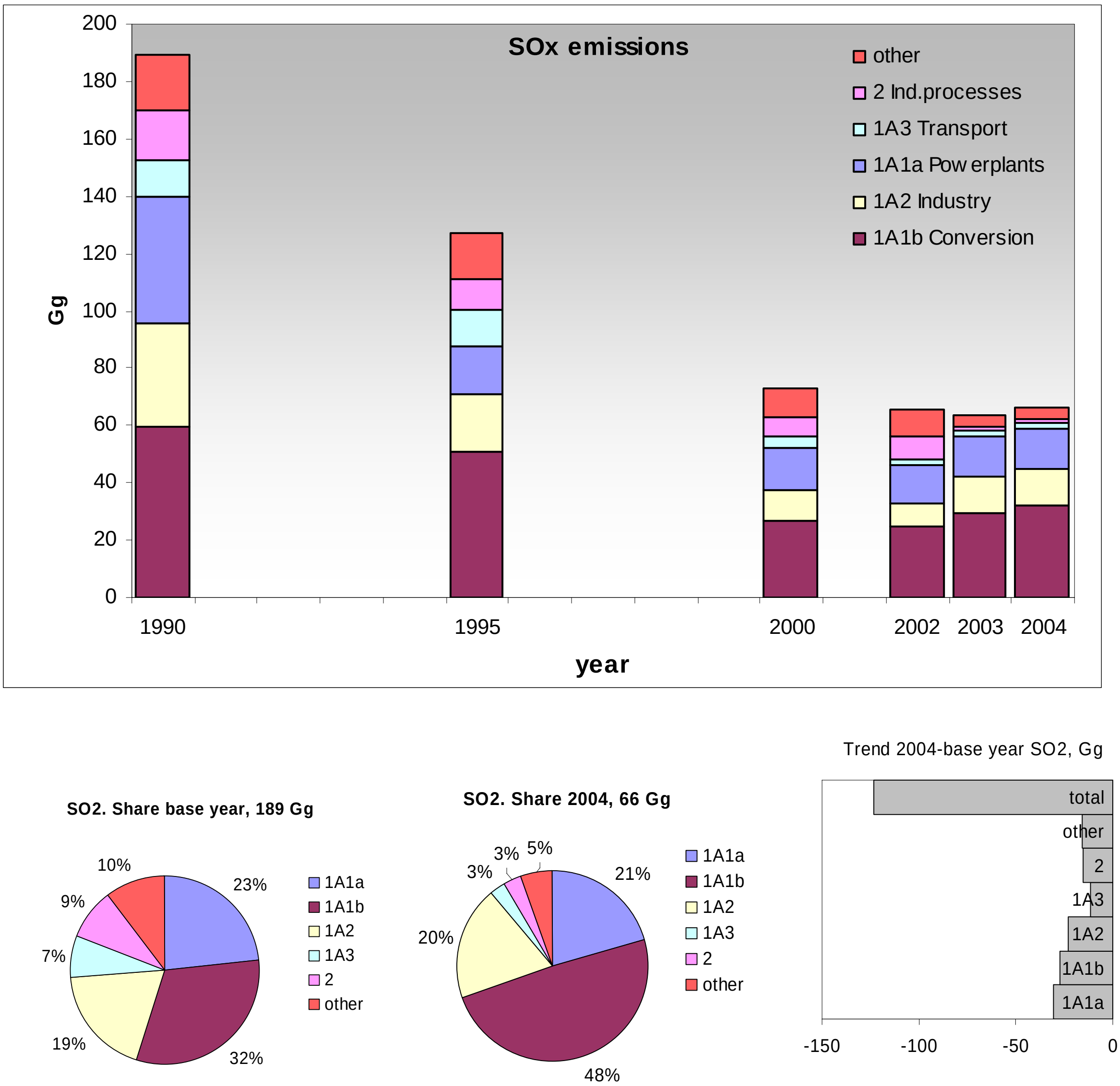


Figure 5.1. SO_2, emission trend 1990-2004 and share by sector in 1990 and 2004.

5.2.2 Nitrogen oxides (NO_x)

The Dutch NO_x emissions (NO and NO_2, expressed as NO_2) decreased by 193 Gg in the period 1990 to 2004; this corresponded to 35% of the national total in 1990 (Figure 5.2). Main contributors to this decrease were road transport and the energy sector. The emissions per vehicle decreased significantly in this period, but were counterbalanced by an increase in number and mileages of vehicles. The share of the different NFR categories in the national total did not change significantly.

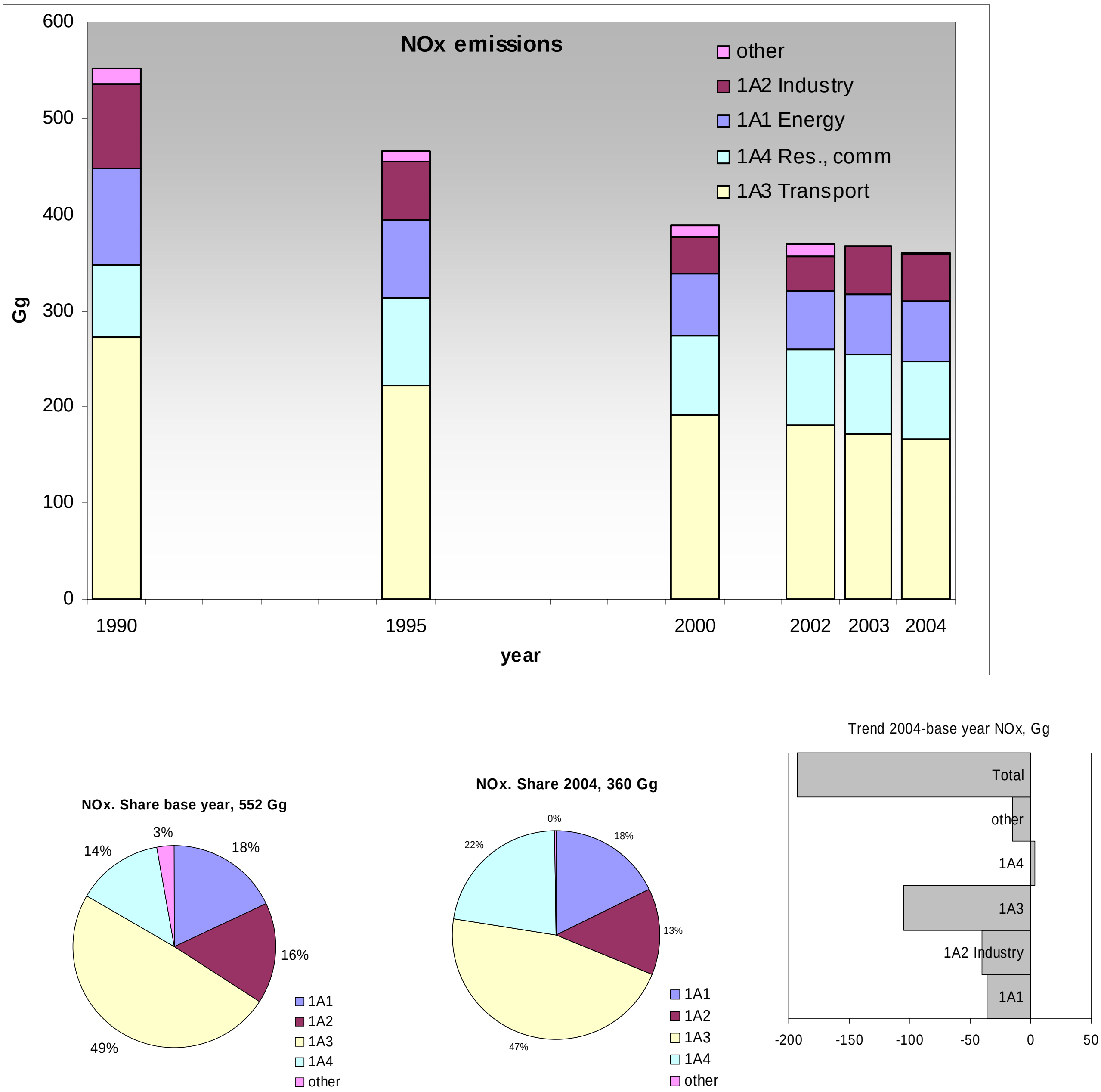


Figure 5.2. NO_x, emission trend 1990-2004 and share by sector in 1990 and 2004.

5.2.3 Ammonia (NH_3)

The Dutch NH_3 emissions decreased by 115 Gg in the period 1990 to 2004, corresponding to 46 % of the national total in 1990 (Figure 5.3). This decrease was caused by the agricultural sources. The direct emissions from animal husbandry increased but measures were taken to reduce the emissions during application of manure to the soil. Now, over 90 % of the Dutch NH_3 emissions come from agricultural sources.

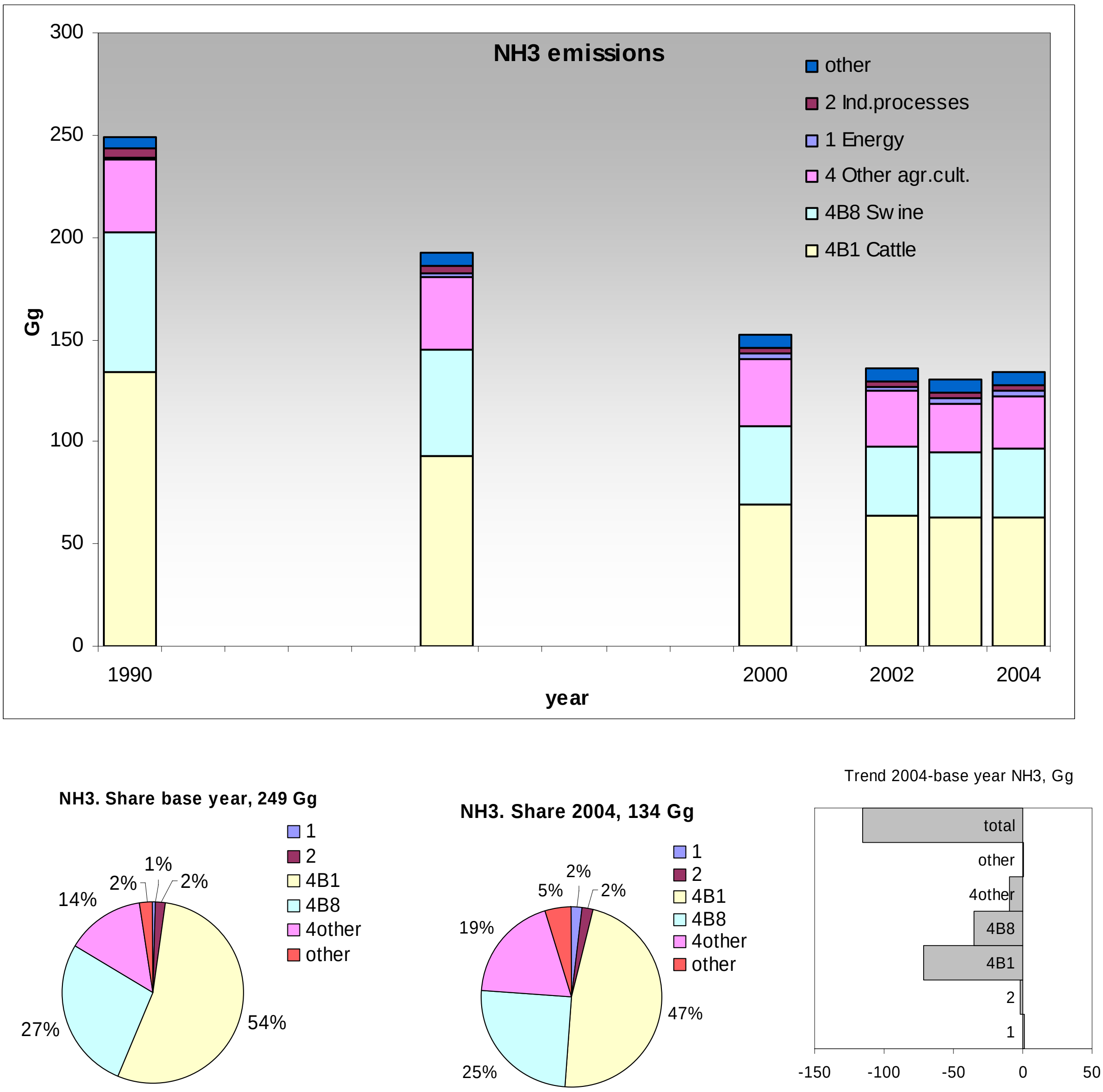


Figure 5.3. NH_3, emission trend 1990-2004 and share by sector in 1990 and 2004.

5.2.4 Non-methane volatile organic compounds (NMVOC)

The Dutch NMVOC emissions decreased by 275 Gg in the period 1990 to 2004, corresponding to 56% of the national total in 1990 (Figure 5.4). All major source categories contributed to this decrease, for example:

- Transport, due to the introduction of catalyst and cleaner engines
- Product use, due to an intensive programme to reduce NMVOC content in consumer products and paints
- Industry, by introducing emission abatement specific for NMVOC

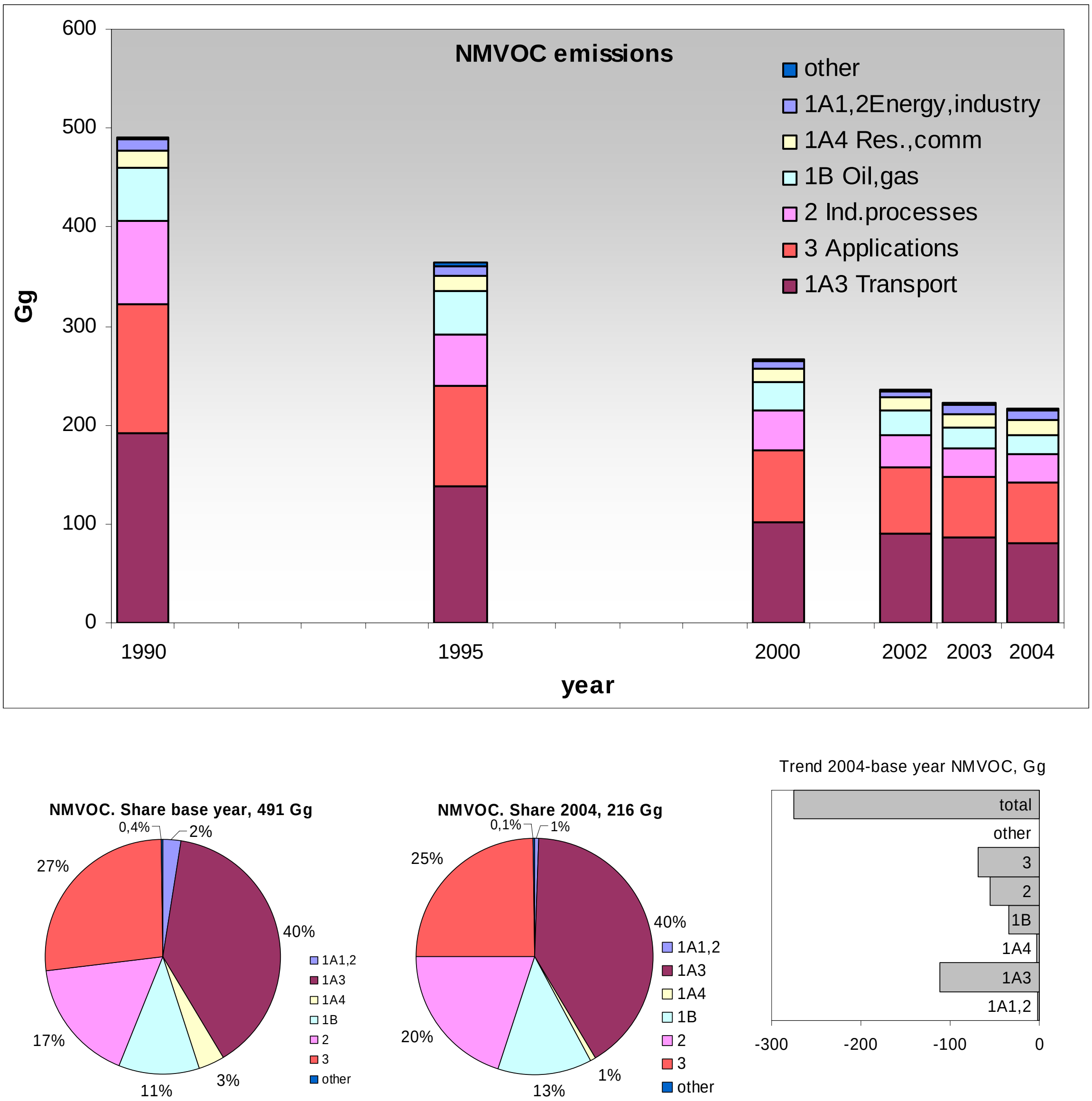


Figure 5.4. NMVOC, emission trend for 1990-2004 and share by sector in 1990 and 2004.

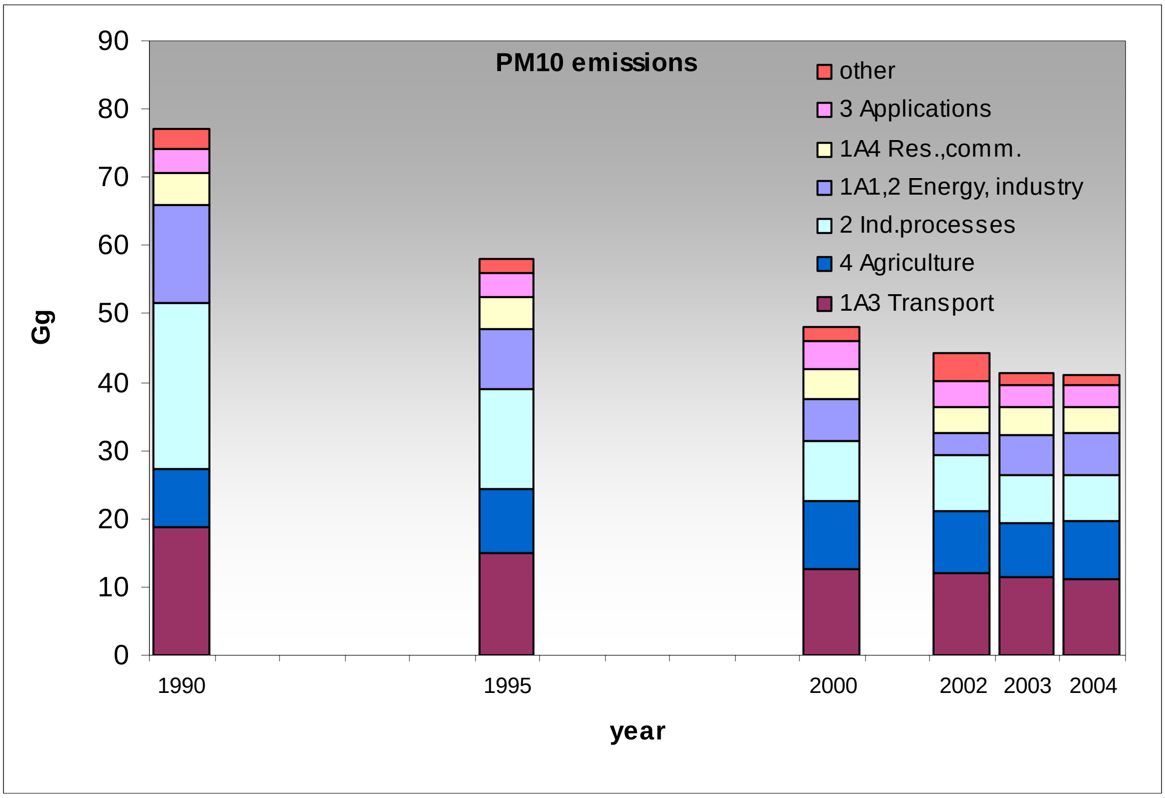
5.2.5 Particulate Matter (PM_{10})

The Dutch PM_{10} emissions decreased by 36 Gg in the period 1990 to 2004, corresponding with 47 % of the national total in 1990 (Figure 5.5). The major source categories contributing to this decrease are:

– traffic and transport;
– introduction of cleaner diesel engines;
– industry (combustion and process emissions), due to cleaner fuels in refineries and the side-effect of emission abatement for SO_2 and NO_x .

The emissions from animal husbandry in agriculture did not change significantly, neither did the emissions from consumers (1A4). The share of the emissions in residential wood stoves increased from 11% in 1990 to 24% in 2004.

$PM_{2.5}$ emissions are also included in the 2006 submission to UNECE. These emissions are calculated as a specific fraction of PM_{10} by sector (based on Wesselink et al., 1998). About 75% of the $PM_{2.5}$ emissions stem from combustion processes, especially from mobile combustion (road transport).



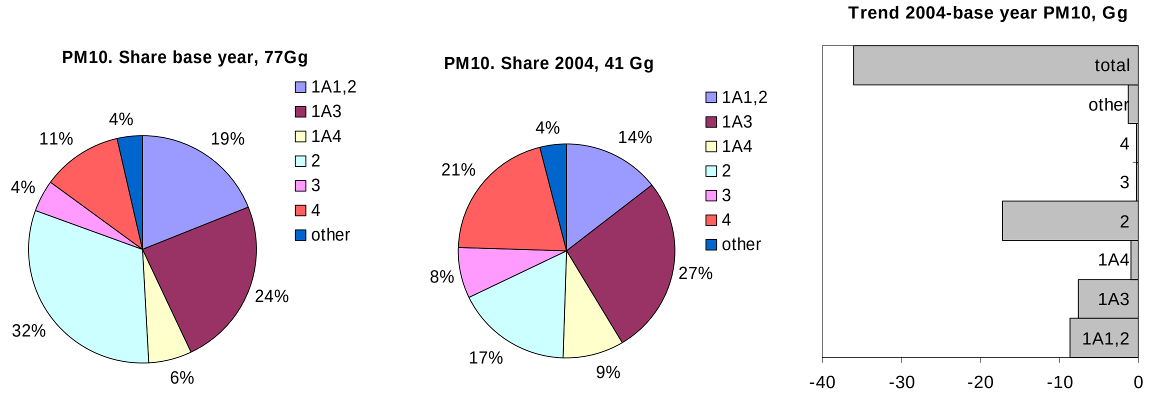


Figure 5.5. PM_{10}, emission trend 1990-2004 and share by sector in 1990 and 2004.

5.2.6 Heavy metals (Pb and Cd)

The Dutch lead (Pb) emissions decreased by 291 Gg in the period 1990 to 2004, corresponding with 87% of the national total in 1990 (Figure 5.6). This decrease is solely attributable to the transport sector, where, due to the removal of Pb from petrol, the Pb emissions collapsed. The remaining sources for Pb are the iron and steel industry, and industry (combustion and process emissions).

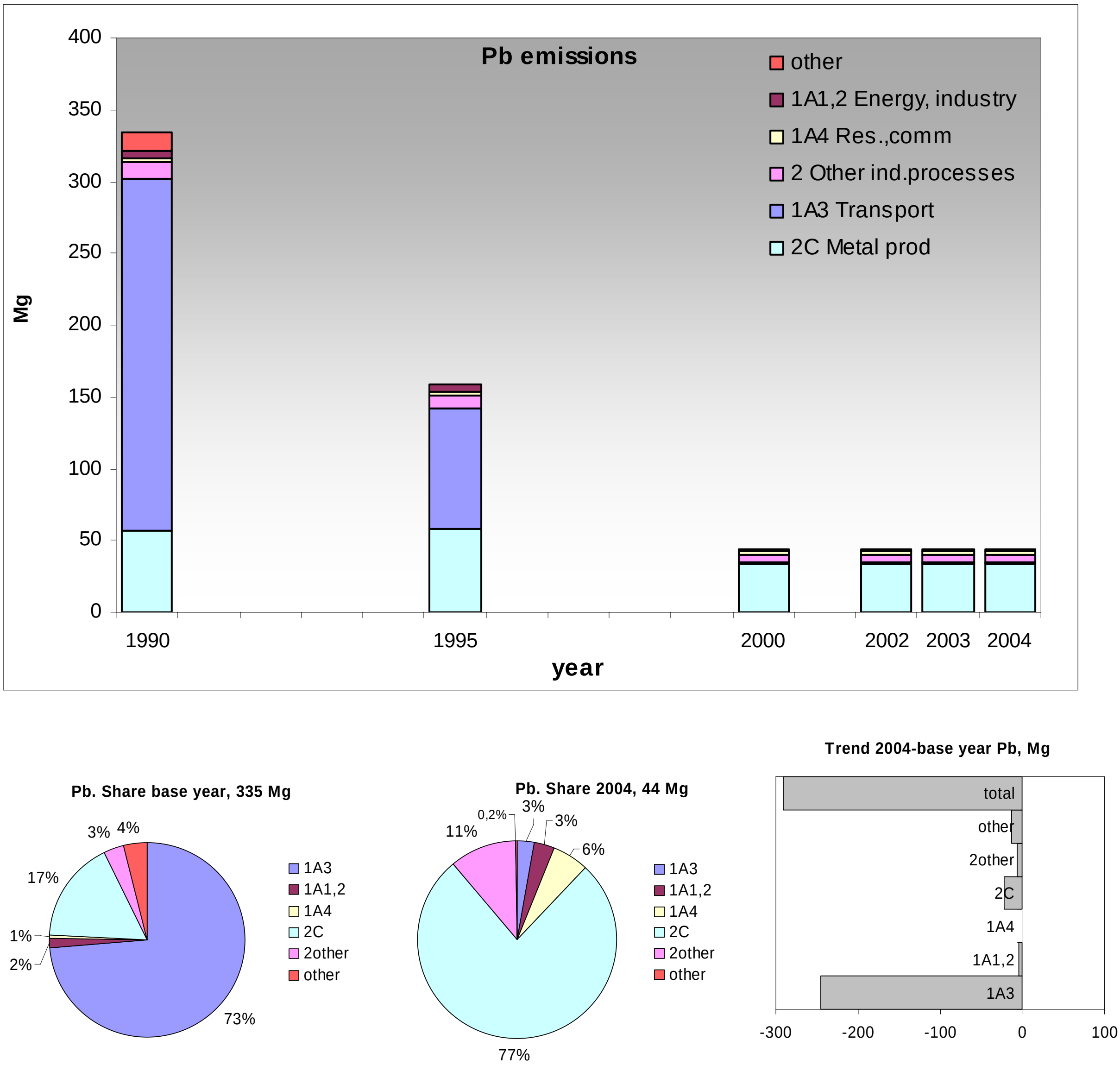


Figure 5.6. Pb, emission trend 1990-2004 and share by sector in 1990 and 2004.

The Dutch cadmium (Cd) emissions decreased by nearly 1000 kg in the period 1990 to 2004, corresponding with 45 % of the national total in 1990 (Figure 5.7). This decrease is caused mainly by the large decrease in the emissions from waste combustion. Between 1990 and 2004 old incinerators without flue gas cleaning were closed; state of the art emission abatement has been installed in the both the remaining incinerators and, sometimes, the newly built ones. The remaining major source for Cd emissions in the Netherlands is the iron and steel industry.

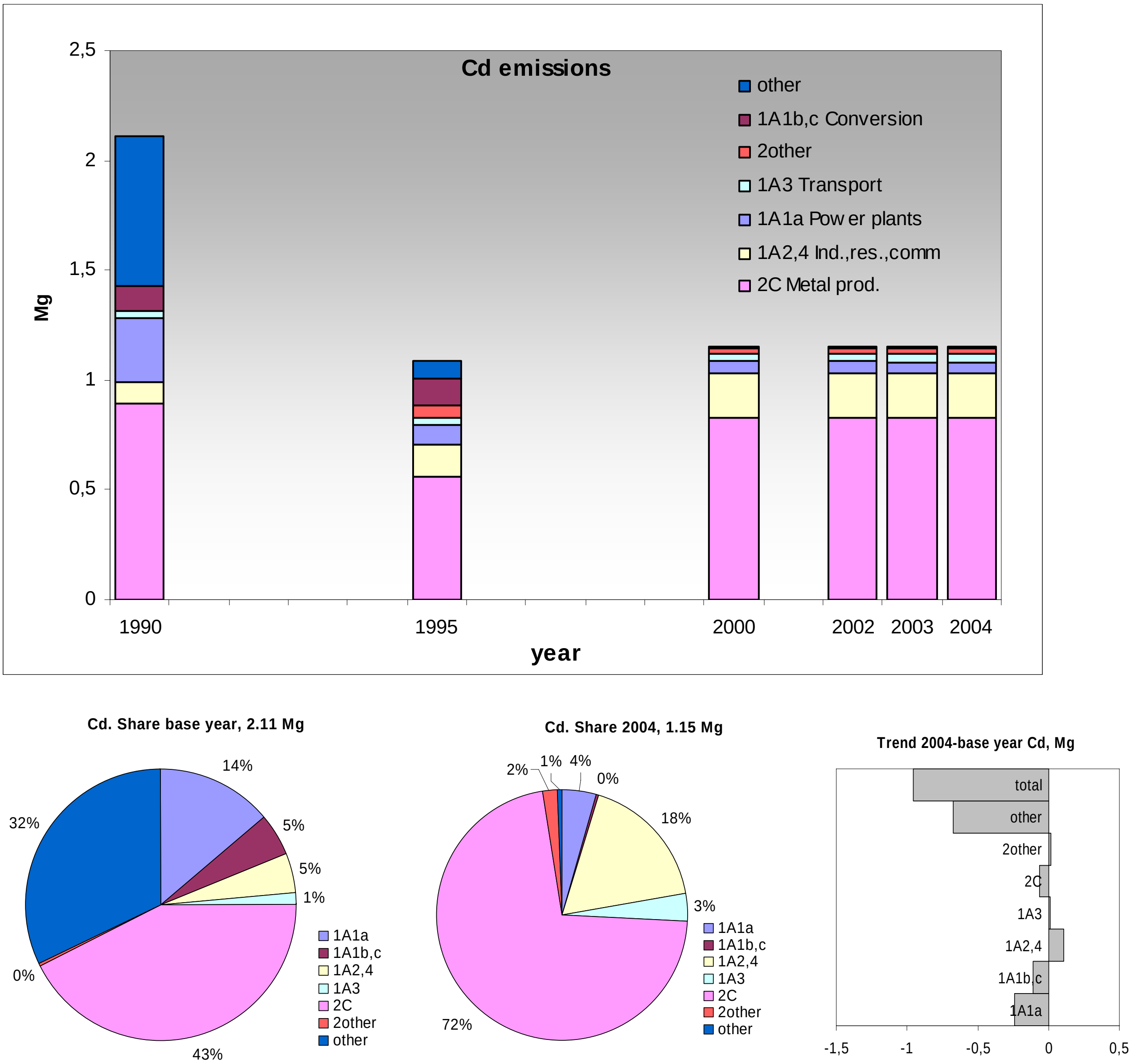


Figure 5.7. Cd, emission trend 1990-2004 and share by sector in 1990 and 2004.

5.2.7 Polycyclic aromatic hydrocarbons (PAH) and dioxins

The Dutch PAH emissions decreased by 1.1 Gg in the period 1990 to 2004, corresponding to 65 % of the national total in 1990 (Figure 5.8). Please note that the Netherlands reports its PAH emissions according to a specific Dutch definition, namely ‘sum 10 PAH of VROM’. This definition not only includes the four PAH substances stated in NFR, but also six others. The Dutch PAH emission is therefore by definition higher than according to the NFR definition. The major contributors to this decrease are the:

– (metal) industry (general emission reduction); and
– product use (ban on creosoted wood in several applications).

Please note that the Netherlands reports only the total PAH emission. The recommended detailed speciation is not yet available. Further actions to derive the detailed figures from the individual PAH from the PAH total are necessary, see section 2.2.

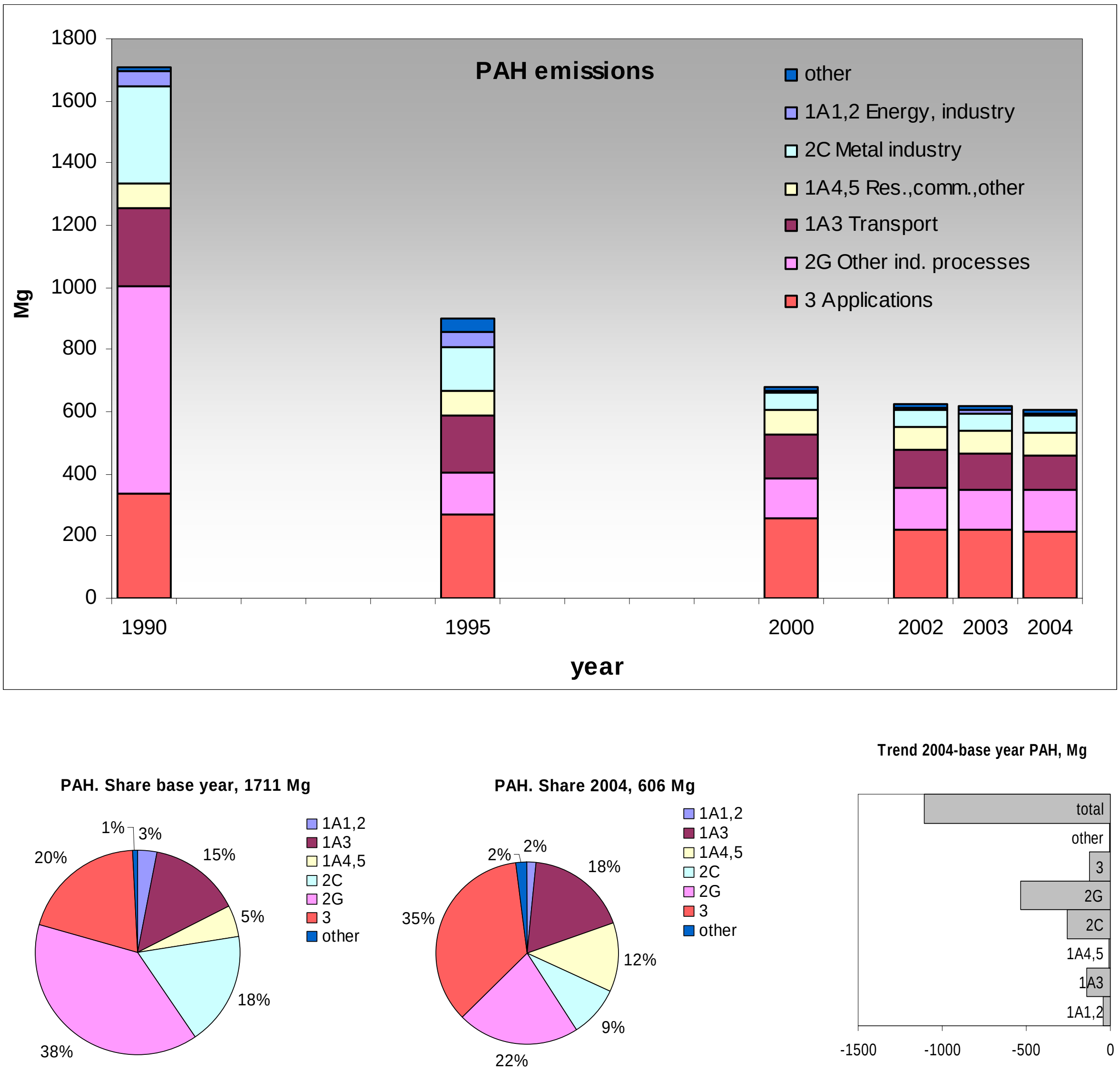


Figure 5.8. PAH, emission trend 1990-2004 and share by sector in 1990 and 2004.

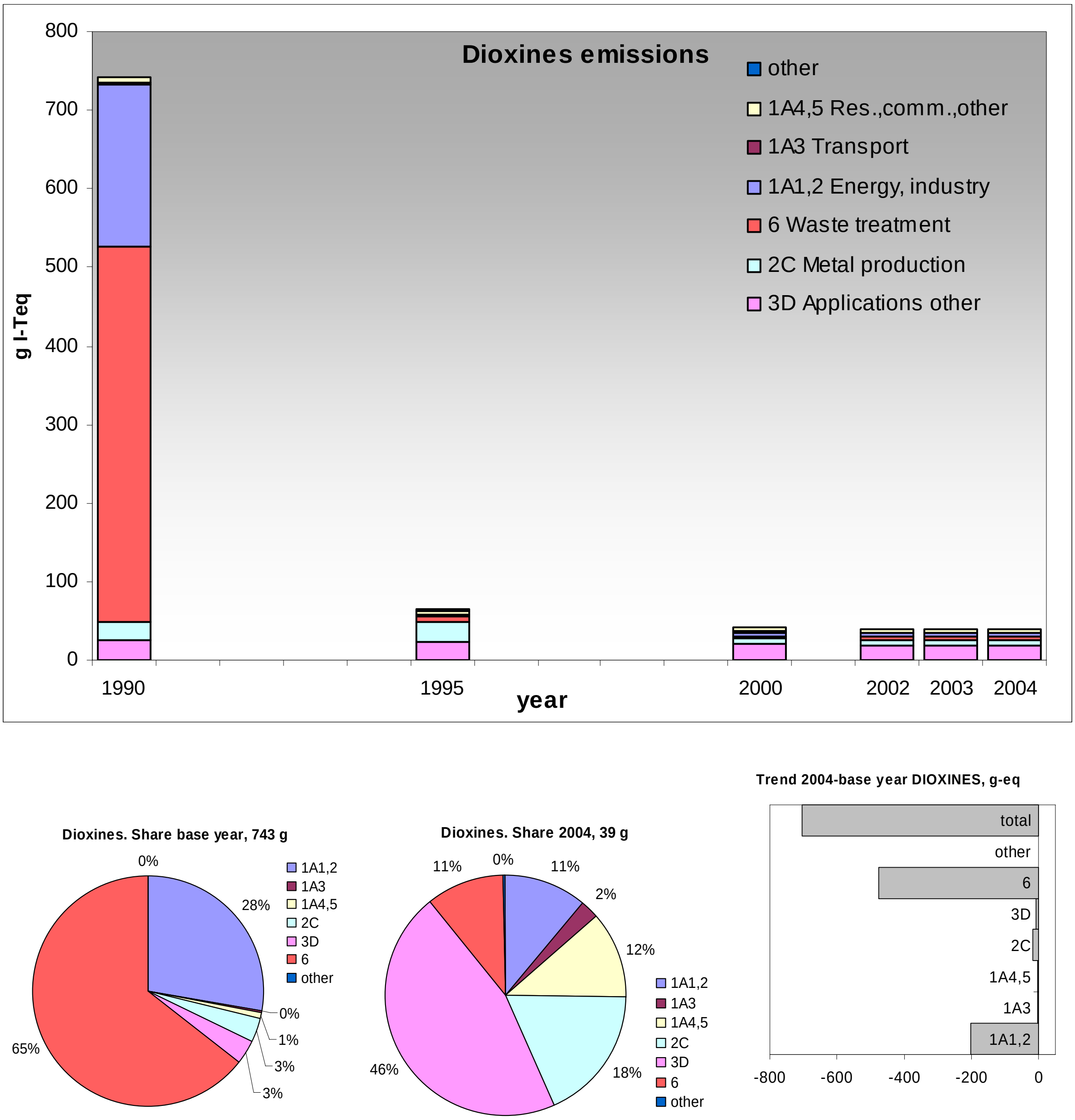


Figure 5.9. Dioxins, emission trend 1990-2004 and share by sector in 1990 and 2004.

Dioxin emissions decreased by 703 g I-Teq in the period 1990 to 2004, corresponding to 95% of the national total in 1990 (Figure 5.9). In the period after 1990 specific emission abatement was introduced in all waste incineration plants and was specifically targeted to reduce dioxin emissions. Furthermore, measures were taken to reduce dioxin emissions in the energy and industrial sectors. Currently, the major source for dioxin emission is the category product use (3).

6 Methodological issues

Methods used in the Netherlands are documented in several reports and in meta-data files, available on www.emissieregistratie.nl. However, most of these reports are only available in Dutch. There are, however, two reports in English, which are of special interest:

- Spakman (ed.), 1997. *Method for calculation greenhouse gas emissions.* Here, the 'bottom up' method for estimating emissions in the industrial sector is described.
- Van Harmelen et al., 2004. *Particulate matter in the Dutch Pollutant Emission register: State of Affairs*.

Generally speaking, two emission models are used in the Netherlands:

- A model for emissions of point sources (e.g. large industrial, power plants) that are registered individually and supplemented with emission estimations for the remainder of the companies in a sector (based mainly on implied emission factor from the individually registered companies. This is the so called 'bottom up' method.
- A model for emissions of diffuse sources (e.g. road transport, agriculture) that are calculated from activity data and emission factors from sectoral emission inventory studies in the Netherlands (e.g. SPIN documents produced by the 'Cooperation project on industrial emissions').

The following sections sketch these methods, which are discussed in more detail by sector or subsector for the top ten key sources mentioned in Chapter 3.

6.1 Methodological issues: Energy, Stationary fuel combustion (1A)

About 80-100% of the NO_x, SO_2, PM_{10} and NH_3 emissions from stationary combustion (categories 1A1, 1A2, 1A4 and 1A5) are based on environmental reports of large industrial companies. The emission data in the Environmental Annual Reports (EARs) are based on direct emission measurements (see formula below) or calculations based on fuel input and emission factors. The emission factors used in the calculations are also based on measurements according to this formula.

[Concentration]*Flow*Duration of emission

where:

[Concentration] =	Online (semi-)continuous measurement: frequency - seconds to daily Discontinuous measurement: several times a year, directly in air flow Off line: sampling and analysis in laboratory
Flow =	Flow-speed measurement in air flow; surface of flow channel; calculation based on fuel or raw materials/production quantities; At diffuse emissions: calculation or air flow over source
Duration =	Calculation based on process-control data

The emissions and fuel consumption data in the EARs are systematically examined for inaccuracies by checking the resulting implied emission factors. If the environmental report provides data of high enough quality (see section 1.3 on QA/QC), the information is used to calculate an ‘implied emission factor’ for a cluster of reporting companies (aggregated by SBI code) and the Emission factor ER-I. These emission factors are fuel and sector dependent.

Emission factor ER-I $_{\text{(SBI category, fuel type)}}$ =

Emissions ER-I $_{\text{(SBI category, fuel type)}}$ / Energy use ER-I $_{\text{(SBI category, fuel type)}}$

Where:

ER-I = Emission Registration database for individual companies

Next, the total combustion emissions in this SBI category are calculated from the energy use, as provided in the Netherlands Energy Statistics (Statistics Netherlands), multiplied by the implied emission factor.

ERI_SBI_Emission $_{\text{(SBI category, fuel type)}}$ =

Emission factor ER-I $_{\text{(SBI category, fuel type)}}$ * Energy use NEH $_{\text{(SBI category, fuel type)}}$

For sectors with no individual registration of emissions (e.g. residential and agricultural sectors), a set of specific emission factors is used (see section 6.1.3).

6.1.1 Energy industries (1A1)

Public electricity and Heat production (1A1a)

Emission data are based on environmental annual reports and collectively estimated industrial sources. For this source category, the percentages of emissions based on annual reports are: 90% for NO_x, 80% for SO_2, 90% for CO and 100% for Hg, Cd and dioxins.

Category 1A1a is a key source for the following components (% of national total in 2003):

SO_x	(22.1%)
NO_x	(13.6%)
CO	(2.4%)
Hg	(17.0%)
Cd	(4.4%)
DIOX	(8.1%)

Petroleum refining (1A1b)

All emission data are based on environmental annual reports and registered in the ER-I database.

Category 1A1b is a key source for the following components (% of national total):

SO_x	(46.6%)
TSP	(5.7%)
PM_{10}	(6.7%)
$PM_{2.5}$	(6.7%)

Manufacture of Solid fuels and other energy industries (1A1c)
No key sources in this category.

6.1.2 Manufacturing industries and Construction (1A2)

Iron and Steel (1A2a)
All emission data are based on environmental annual reports and registered in the ER-I database.

Category 1A2a is a key source for the following components (% of national total):

SO_x	(5.8%)
CO	(9.9%)

Non-ferrous metals (1A2b)
Emission data are based on environmental annual reports and collectively estimated industrial sources. For this source category, the percentage of SO_2-emissions based on annual reports is 100%.

Category 1A2b is a key source for the following components (% of national total):

SO_x	(4.4%)

Chemicals (1A2c)
Emission data are based on environmental annual reports and collectively estimated industrial sources. For this source category, the percentages of emissions based on annual reports are about 100% for SO_2, 90% for NO_x, 75% for CO and 100% for Pb, Cd and dioxins.

Category 1A2c is a key source for the following components (% of national total):

SO_x	(5.7%)
NOx	(4.0%)
CO	(3.3%)
Pb	(1.7%)
Cd	(12.2%)
DIOX	(2.5%)

Pulp, Paper and Print (1A2d)
All emission data are based on environmental annual reports and registered in the ER-I database. No key sources are found in this category.

Food processing, Beverages and Tobacco (1A2e)
Emission data are based on environmental annual reports and collectively estimated industrial sources. No key sources are found in this category.

Other (1A2f)
This sector includes all combustion emissions from the industrial sectors not belonging to the categories 1A2a to 1A2f. Emission data are based on environmental annual reports and collectively estimated industrial sources.

Category 1A2f is a key source for the following components (% of national total):

SO_x	(3.2%)
NO_x	(6.0%)

6.1.3 Other sectors (1A4)

Commercial / Institutional (1A4a)

Combustion emissions from the commercial and institutional sector are based on fuel consumption data (Statistics Netherlands) and emission factors (see Table 6.1.).

Table 6.1. Emission factors for stationary combustion emissions of the services sector (g/GJ)

	Natural gas	Domestic fuel oil	LPG	Paraffin oil	Coal	Oil fuel
VOC	30	10	2	10	35	10
SO_2	0.22	87	0.22	4.6	460	450
NO_x	1)	50	40	50	300	125
CO	10	10	10	10	100	10
Carbon black		5	10	2		50
Fly ash					100	
PM_{10}	0.15	4.5	2	1.8	2	45
PM coarse		0.5		0.2	80	5

1) see Table on NO_x emission factors in Soest-Vercammen et al. (2002).

Category 1A4a is a key source for the following components (% of national total):

NO_x	(4.3%)
CO	(3.0%)

Residential (1A4b)

1A4bi Residential plants

Combustion emissions of central heating, hot water and cooking are based on fuel consumption data (Statistics Netherlands) and emission factors (see Table 6.2.). The major fuel used in this category is natural gas. The use of wood in stoves and fireplaces for heating is almost negligible.

Combustion emissions of (wood) stoves and fireplaces are calculated by multiplying the fuel consumption by apparatus type and by fuel type (Statistics Netherlands) with emission factors per house (Hulskotte et al., 1999).

Table 6.2. Emission factors for combustion emissions of households (g/GJ)

	Natural gas	Domestic fuel oil	LPG	Paraffin oil	Coal
VOC	6.3	15	2	10	60
SO_2	0.22	87	0.22	4.6	420
NO_x	1)	50	40	50	75
CO	15.8	60	10	10	1500
Carbon black	0.3	5	10	2	
Fly ash					200
PM_{10}	0.3	4.5	2	1.8	120
PM coarse		0.5		0.2	80

1) See Table on NO_x emission factors in Soest-Vercammen et al. (2002).

Category 1A4b i is a key source for the following components (% of national total):

NO_x	(5.4%)
NMVOC	(3.9%)
CO	(8.5%)
TSP	(6.8%)
PM_{10}	(4.5%)
$PM_{2.5}$	(7.4%)
Pb	(5.7%)
Hg	(4.2%)
Cd	(5.2%)
DIOX	(10.6%)
PAH	(10.5%)

1A4bii Household and gardening (mobile)

Emissions are included in category 1A4bii and can not be separated due to lack of specific fuel data on this level.

Agriculture / Forestry / Fishing (1A4c)

1A4ci Stationary

Stationary combustion emissions are based on fuel consumption obtained from Statistics Netherlands, which is, in turn, based on data from the Agricultural Economics Research Institute, and emission factors (Table 6.3).

Table 6.3. Emission factors for stationary combustion emissions from agriculture (g/GJ)

	Natural gas	Domestic fuel oil	LPG	Paraffin oil	Coal	Oil fuel
VOC	30	10	2	10	35	10
SO_2	0.22	87	0.22	4.6	460	450
NO_x	1)	50	40	50	300	125
CO	10	10	10	10	100	10
Carbon black		5	10	2		50
Fly ash					100	
PM_{10}	0.15	4.5	2	1.8	2	45
PM coarse		0.5		0.2	80	5

1) See Table on NO_x emission factors in Soest-Vercammen et al. (2002).

No key sources are found in this category.

1A4cii Off-road vehicles and other machinery

Combustion emissions of CO, VOC, NO_x, PM_{10}, SO_2 and heavy metals from off-road vehicles and other machinery are based on diesel fuel consumption and emission factors (g/kg fuel). Fuel consumption data from private farm machinery is provided by the Agricultural Economics Research Institute LEI, while data for agricultural work contractors is provided by Statistics Netherlands. Fuel consumption in the building sector is based on production statistics of this sector, provided by

Statistics Netherlands. The fuel consumption of other machinery is highly uncertain, as it is based on the difference between the total amount of diesel oil used according to the Netherlands Energy Statistics minus the use of diesel oil in the agricultural and construction sector. Combustion emissions of NH_3 are based on EEA emission factors (Ntziachristos and Samaras, 2000) and total fuel consumption by off-road vehicles and other machinery. VOC and PAH combustion emissions are calculated using VOC profiles (VROM, 1993 and Shareef et al. 1988).

Category 1A4c ii is a key source for the following components (% of national total):

SO_x	(2.5%)
NO_x	(5.5%)

1A4ciii National fishing

Combustion emissions are based on fuel sales to cutters operating within national waters and fuel specific emission factors. Since fuel sales to cutters are not recorded separately in the Netherlands Energy Statistics (these are contained in the bunker fuel sales) an estimate of fuel use is made on the basis of ship movements. Emission factors for CO, NO_x, (NM)VOC, CH_4, SO_2, and PM_{10} are derived from national research (Hulskotte & Koch, 2000 & Van der Tak, 2000). NH_3 emission factors are derived from Ntziachristos & Samaras (2000). It is assumed that all four-stroke engines use diesel oil, while all two-stroke engines use heavy fuel oil. VOC and PAH combustion emissions are calculated using VOC profiles (VROM, 1993 and Shareef et al. 1988).

Category 1A4c iii is a key source for the following components (% of national total):

SO_x	(1.3%)
NO_x	(3.8%)

6.1.4 Other (1A5)

Other, Stationary (including Military) (1A5a)

Emissions in this category are wrongly reported in category 1A5b. This will be corrected in the next submission.

Other, Mobile (Including military) (1A5b)

For military vessels and aircraft only emissions of CO_2, N_2O and CH_4 are calculated. Other compounds relating to NEC ceilings can not be calculated, since it is unknown where fuel is used. The Ministry of Defence regards information on the location of military activity as classified.

No key sources are found in this category.

6.1.5 Mobile combustion (1A3)

Road transportation (1A3b)

Exhaust emissions of CO, NMVOC, NO_x, NH_3 and PM_{10} in these source categories are dependent on fuel type, emission reduction technology, and vehicle type and vehicle use. These emissions are calculated on the basis of traffic performance (vehicle kilometres) and specific emission factors for a variation of different vehicle classes and for three different road types. The vehicle classes are defined by the vehicle category (passenger car, van, etc.), fuel type, weight class, environmental class and in some instances the engine type and/or the emission reduction technology. The emission factors for passenger cars are based on a yearly monitoring programme by TNO (Built Environment and Geosciences). The specific emission factors per vehicle class are aggregated to emission factors by year of construction (in grams per vehicle kilometre). The emission factors by year of construction are published in Statline, the central database of Statistics Netherlands. The method is described in detail in Klein et al. (2006).

Traffic performance data is based on the following data by Statistics Netherlands: 'Survey on movement behaviour', 'Statistics on road freight transport', 'Motor cycling statistics' (based on a survey in 1993) and 'Mobility of Dutch residents'. The characteristics of the Dutch vehicle fleet are based on 'Statistics on motor vehicles', which in turn is based on data provided by the Dutch road traffic department (RDW). Passenger car movements by non-residents are based on the following data by Statistics Netherlands: 'Statistics on registered overnight stays', commuter traffic by foreign workers and number of day trips. Foreign freight transport kilometres are based on 'Statistics on road freight transport' and similar statistics from other EU countries provided by Eurostat.

Emissions of SO_2 and heavy metals (and CO_2) are dependent on fuel consumption and fuel type. These emissions are calculated by multiplying fuel use with emission factors (gram per litre fuel consumption). The emission factors are based on the sulphur, carbon and heavy metal contents of the fuels. It is assumed that 75% of the lead is emitted as particles and 95% of the sulphur is transformed to sulphur dioxide. The data on fuel consumption of mobile sources is collected by Statistics Netherlands.

Emissions of VOC components (alkanes, alkenes, aromates , such as benzene and formaldehyde, polycyclic aromatic hydrocarbons PAHs and chlorinated hydrocarbons) are calculated by multiplying the total VOC emission by a VOC speciation profile.

1A3bi Road transport, Passenger cars

Category 13bi is a key source for the following components (% of national total):

NO_x	(14.2%)
NH_3	(1.9%)
NMVOC	(14.4%)
CO	(41.5%)
TSP	(5.5%)
PM_{10}	(6.4%)
$PM_{2.5}$	(10.6%)
Cd	(2.4%)
PAH	(8.1%)

1A3bii Road transport, Light duty vehicles

Category 1A3b ii is a key source for the following components (% of national total):

NO_x	(5.6%)
CO	(2.9%)
TSP	(4.7%)
PM_{10}	(5.5%)
PM2.5	(9.1%)
PAH	(3.2%)

1A3biii Road transport, Heavy duty vehicles

Category 1A3b iii is a key source for the following components (% of national total):

NO_x	(23.3%)
CO	(2.9%)
TSP	(4.9%)
PM_{10}	(5.7%)
$PM_{2.5}$	(9.4%)
PAH	(5.3%)

1A3biv Road transport, Mopeds & Motorcycles

Category 1A3biv is a key source for the following components (% of national total):

NMVOC	(4.4%)
CO	(8.4%)
TSP	(4.4%)
PM_{10}	(5.2%)
PAH	(1.1%)

1A3a Civil Aviation

Combustion emissions – Amsterdam Airport Schiphol

Combustion emissions of CO, VOC, NO_x, PM_{10}, SO_2 and heavy metals from aviation are calculated with the EMASA model on a yearly basis (TNO Built Environment and Geosciences). This model is consistent with the US Environmental Protection Agency model for aviation emissions.

The Landing and Take-off cycle (LTO) can be divided into four LTO cycle phases: Idle, Take-off, Climb-Out and Approach from 3000 feet. The four modes in the LTO cycle correspond to different power settings of the jet engines: Idle 7%, Take-off 100%, Climb-out 85% and Approach 30%. The equation for calculating the emissions is presented next:

$$\text{Emission} = \text{SUM}_{p,m,f}\,(\text{LTO}_{p,m} * N_p * \text{FUEL}_{m,f} * \text{TIM}_{p,f} * \text{EF}_{m,f})$$

where:

Emission	= Emission (kg/yr)
$LTO_{p,m}$	= number of LTO cycles per aircraft with jet engine type (m) per year
N_p	= number of engines per aircraft
$FUEL_{m,f}$	= fuel consumption of jet engine type (m) in LTO cycle phase (f)
$TIM_{p,f}$	= Time in Mode in LTO cycle (f) for aircraft (p)
$EF_{m,f}$	= Emission factor of jet engine type (m) in LTO cycle (f) (kg/kg)

The EMASA model takes into account about 100 types of aircrafts, as reported in the Statistical Annual Review of Amsterdam Airport Schiphol. The jet engine types of these aircrafts are based on the aircraft/engine combinations of the so-called Home-carriers (e.g. KLM, Martinair and Transavia). The emission factors originate in the DERA database (DERA, 1999), the Federal Aviation Agency Engine Emission Database (FAA, 1996); for smaller engines these are based on EPA publication AP42 (EPA, 1985). Emissions from military use of aviation fuel are reported under Other mobile sources (NFR 1A5b).

Emissions from auxiliary power units and general power units for aircraft at Schiphol are based on an estimated fuel consumption of 500 gram per passenger multiplied with emission factors.

Combustion emissions other airports

Emissions are calculated similarly to the method described above, now taking into account the number of flights per regional airport. Due to lack of data, splitting the flights according to aircraft type is done by the emission expert. Furthermore, emissions in the period 1995-1999 are calculated by indexing the 1994 emissions with the flights per airport in this period.

NH_3 emissions are based on emission factors from EEA (Ntziachristos and Samaras, 2002) and total fuel consumption during the LTO cycle at Dutch airports.

VOC and PAH combustion emissions

First, the VOC emissions are calculated as described above. Second, the VOC and PAH components are calculated using VOC profiles (VROM, 1993 and Shareef et al. 1988).

1A3aii(i) Civil Aviation (Domestic, LTO)

Category 1A3aii(i) is a key source for the following components (% of national total):

Pb	(1.6%)

Emissions are calculated similarly to the method described above.

1A3aii(ii) Civil Aviation (Domestic, Cruise)

Emissions are included in 1A3aii(i) and cannot be separated due to missing fuel data at this level.

Railways (1A3c)

Combustion emissions of CO, VOC, NO_x, PM_{10}, SO_2 and heavy metals from railways are based on diesel fuel consumption and emission factors. Fuel consumption data is provided by NS Reizigers

(Dutch rail passenger organisation). Combustion emissions of NH_3 are based on EEA emission factors (Ntziachristos and Samaras, 2000). VOC and PAH combustion emissions are calculated using VOC profiles (VROM, 1993 and Shareef et al., 1988).

No key sources are found in this category.

National navigation (1A3dii)

For inland ships energy consumption is calculated with a resistance model that is specific for the combination of waterway, boat type, direction of navigation and ship loading (Hulskotte et al., 2003). Emission factors dependent on energy consumption were derived by Oonk et al. (2003). Emission factors are dependent on year that ship was built and on maximum RPM for recently built engines. Energy consumption data is calculated using ship movements and divided into inland shipping and international shipping using the data of Statistics Netherlands.

Combustion emissions of leisure boats are based on fuel consumption data, which are estimated by multiplying boat numbers by specific yearly fuel consumption per boat type. Specific fuel consumption was determined by means of a questionnaire. The calculation procedure is described in a fact sheet (Hulskotte et al., 2005). Some of the emissions of some substances (e.g. PAH and NMVOC species) are specified as waterborne emissions.

Category 1A3dii is a key source for the following components (% of national total):

SO_x	(1.1%)
CO	(3.0%)

Other (1A3e)

No emissions are reported in this category and the subcategories 1A3ei *Pipeline compressors* and 1A3eii *Other mobile sources and machinery*.

6.1.6 Evaporation, tyre and brake wear, road abrasion (1A3b)

Road Transport, Gasoline evaporation (1A3bv)

VOC emissions from gasoline evaporation originate from diurnal losses, hot soak losses and running losses. The emission factors for gasoline evaporation are based on formulas from the CORINAIR project (Egglestone, 1989) and reported in Klein, 1992. Since 1993, cars have been equipped with a charcoal canister in the fuel system. This has reduced the VOC emissions by 80%. For Euro 3 and Euro 4 vehicles, the reduction is assumed to be 90%. The emissions of VOC components are calculated on the basis of VOC speciation profiles. The evaporation VOC profile has, since 2000, been adjusted for the change in benzene and aromatics content of gasoline since 2000, due to stricter EU legislation (see Table 6.4).

Table 6.4. VOC profile for gasoline and gasoline evaporation (mass %)

	Gasoline		Gasoline vapour	
	1999 and before	2000 and after	1999 and before	2000 and after
Benzene	2.5	0.8	1	0.3
Toluene	15	12.5	3	2.5
Xylene	-	-	0.5	0.5
Aliphatic hydrocarbons (non-halogenated)	35	60	95	97
Aromatic hydrocarbons (non-halogenated)	65	40	5	3

Category 1A3bv is a key source for the following components (% of national total):

NMVOC	(14.5%)

Road Transport, Automobile tyre and brake wear (1A3bvi)

Particulate matter emissions (TSP) from tyre wear and brake wear are based on vehicle kilometres and emission factors. The fraction PM_{10} in total particulate matter for tyre wear is assumed to be 5% (highly uncertain) and for brake wear 100%. Heavy metal emissions are calculated using a speciation profile on total particulate emissions.

Category 1A3bvi is a key source for the following components (% of national total):

TSP	(4.4%)
PM_{10}	(5.2%)
$PM_{2.5}$	(8.6%)

Road Transport, Automobile road abrasion (1A3bvii)

The same method is applied as for category 1A3bvi Tyre and brake wear. The fraction PM_{10} in total particulate matter for road abrasion is assumed to be 5% Heavy metal emissions are calculated using a speciation profile on total particulate emissions.

Category 1A3bvii is a key source for the following components (% of national total):

PM2.5	(4.9%)

6.2 Methodological issues: Energy, fugitive emissions from fuels (1B)

The fugitive NMVOC emissions from category 1B2b comprise non-fuel combustion emissions from oil and gas production, emissions from gas transport (compressor stations) and gas distribution networks (pipelines for local transport).

The NMVOC emissions from oil and gas production and gas transport are derived from the environmental reports of the companies, which cover 100% of the emissions. The NMVOC emissions from gas distribution are calculated on the basis of a VOC profile with the CH_4 emission from the yearly report of the sector as input.

Category 1B2b is a key source for the following components (% of national total):

NMVOC	1B2b (6.0%)
Hg	1B2b (4.6%)

6.3 Methodological issues: Industry (2)

Industrial process emissions are based either on environmental reports of large industries or extrapolations to total emissions per SBI category, using implied emission factors and production data (method 1), or on sectoral reports on emissions (method 2), or specific emission factors and production statistics (CBS and trade organisations) (method 3).

Method 1 Extrapolation from emission data of individual companies

Emission factor ER-I $_{\text{(SBI category)}}$ = Emissions ER-I $_{\text{(SBI category)}}$ / Production ER-I $_{\text{(SBI category)}}$

where

ER-I = Emission Registration database for individual companies

Production ER-I = activity data or proxy for the production process

Next, the total process emissions in this SBI category are calculated from the production data, as provided in the Production Statistics (Statistics Netherlands), multiplied by the implied emission factor.

ERI_SBI_Emission $_{\text{(SBI category)}}$ = Emission factor ER-I $_{\text{(SBI category)}}$ * Production $_{\text{(SBI category)}}$

Note: Companies do not provide specific information to the PER on their measurement systems or emission model or which emission factors are used in the calculation model. Therefore, in some cases the PER can not use the data from the environmental reports in the extrapolation to the total emissions of a sector.

Method 2 Sectoral emission reports

Some trade organisations provide (yearly) emission reports as part of their agreements in covenants with the government, see http://www.fo-industrie.nl (Dutch only). Emissions reported by individual companies are subtracted from the total emissions reported by the trade organisation.

Method 3 Sectors with no individual registration

A set of specific emission factors is used for sectors with no individual registration of emissions, mostly based on the so-called SPIN documents, the ‘Cooperation project on industrial emissions’.

In this project the RIVM, assisted by consultant firms, revised and extended the original material (individual registration of about 6000 companies collected by TNO between 1974 and 1983); they also added proposals for abatement methods. These reports document about 90 industrial processes in the Dutch industry. The emission factors are combined with production statistics from CBS or activity data reported by specific trade organisations.

6.3.1 Mineral production (2A)

This category comprises emissions related to the production and use of non-metallic minerals in:

- 2A1 Cement clinker production;
- 2A3 Limestone and dolomite use;
- 2A4 Soda ash production and use;
- 2A7 Other (the production of glass and other mineral production and use).

Emissions from 2A2 Lime production are not estimated due to the lack of consistent activity data (lime production is located at four sites); those from 2A5 Asphalt roofing and 2A6 Road paving with asphalt are not estimated since no methodology is available.

Due to allocation problems, total emissions from mineral products (2A) are reported in category 2A7. Only particulate matter emissions could be reported separately in the category 2A1 Cement Production. Particulate matter emissions in this category are derived from the environmental reports of the companies.

Other mineral products, including Non-fuel Mining & Construction (2A7)

Category 2A7 is a key source for SO_2 and Pb emissions. The SO_2 emissions reported in this category originates in glass production and production of roof tiles. The Pb emissions in this category are from glass production only. The SO_2 and lead emissions from glass production are calculated with the extrapolation method (1), see section 5.1, based on m^2 glass produced by individual companies and total glass production, as reported by CBS. The SO_2 emission from the production of roof tiles is based on production statistics and a specific emission factor (method 3)

Category 2A7 is a key source for the following components (% of national total):

SO_x	2A7 (2.9%)	SBI 261 Glass production (1Gg) and SBI 264 production of roof tiles (0.9 Gg in 2004)
Pb	2A7 (8.6%)	SBI 261 Glass production

6.3.2 Chemical industry (2B)

The PER comprises emissions related to three source categories as belonging to this category:

- 2B1 Ammonia production (SBI 24.15 ‘Manufacture of artificial fertilisers’)
- 2B2 Nitric acid production (included in SBI 24.1 ‘Manufacture of basic organic chemicals’)
- 2B5 Emissions from ‘Other chemical product manufacture’:
  - Manufacture of chemicals for agricultural use;
  - Manufacture of other chemical products (glue, photo chemicals, pharmaceuticals, fibres, paint and ink, soap and detergents).

Adapic acid (2B3) and calcium carbide (included in 2B4) are not produced in the Netherlands. Emissions are not reported under 2B2 Nitric acid production (only the greenhouse gas N_2O is reported here). Due to allocation problems, all emissions from the chemical industry (2B) are reported in category 2B5.

Other chemical industry (2B5)

Category 2B5 is a key source for the following components (% of national total):

NMVOC	2B5 (4.5%)
TSP	2B5 (5.1%)
Pb	2B5 (1.8%)
Hg	2B5 (45.6%)
PAH	2B5 (1.5%)

All emissions are calculated by extrapolation of activity data and emissions of the individual companies to totals in the subsectors, using production volume or production value as a proxy.

6.3.3 Metal production (2 C)

The national inventory of the Netherlands comprises emissions from Iron and steel production and Aluminium production. The Netherlands has one integrated iron and steel plant (Corus, formerly known as Hoogovens). Integrated steelworks convert iron ores into steel by means of sintering, producing pig iron in blast furnaces and converting pig iron to steel in basic oxygen furnaces. For the purpose of the inventory, emissions from integrated steelworks are estimated for these three processes, as well as for some other minor processes. Emissions from sintering are included in 1A. A portion of the coke oven gas and blast/oxygen furnace gas produced during these processes is sold to a nearby power plant to be used as fuel. These emissions are included in category 1B. Aluminium is produced at two primary aluminium smelters (Pechiney and Aldel).

The above-mentioned companies report their emissions in environmental reports. Extrapolations to total emissions of the sector (method 1, see section 5.3) are very small, except for PM_{10} and $PM_{2.5}$. CO, Pb, Cd, dioxins and PAH emissions in Category 2C are covered for more than 96% by individual registration. For PM_{10}, this is 83%.

Category 2C is a key source for the following components (% of national total):

CO	2C (6.3%)
PM_{10}	2C (4.4%)
$PM_{2.5}$	2C (3.6%)
Pb	2C (77.1%)
Cd	2C (71.8%)
DIOX	2C (17.6%)
PAH	2C (8.7%)

6.3.4 Food and Drink production (2D2)

NMVOC emissions in this category are derived from the environmental reports of the companies. Particulate matter emissions are calculated by multiplying specific emission factors by production figures (supplied by CBS).

Category 2D2 is a key source for the following component (% of national total):

NMVOC	2D2 (2.2%)

6.3.5 Other production (2G)

See 2D2 Food and Drink production for NMVOC. Most of the PAH emissions are emitted in the electrical engineering sector. The emission figures come from the environmental reports of the involved companies.

Category 2G is a key source for the following components (% of national total):

NMVOC	2G (6.2%)
PAH	2G (21.3%)

6.4 Methodological issues: Solvents and product use (3)

6.4.1 Paint application (3A)

VOC emissions from paint are calculated from national paint sales statistics (defined as paint that is both produced and sold in the Netherlands), provided by the Netherlands Association of Paint Producers VVVF (VVVF, 1999) and from paint imports, estimated by VVVF. The VVVF (through its members) directly monitors VOC in paint, while an assumption of the VVVF is used for the VOC in imported paint. Estimates have also been made for paint-related thinner use and the (reduction) effect of afterburners. For more information, see the protocol ‘Calculation of VOC emissions from Paint in the Netherlands’ (Peek, 2004).

Category 3A is a key source for the following components (% of national total):

NMVOC	3A (11.8%)

6.4.2 Degreasing and dry cleaning (3B)

No key sources in this category

6.4.3 Chemical products, manufacture and processing (3C)

No key sources in this category

6.4.4 Other, including products containing HMs and POPs (3D)

The most relevant emission sources in this category are the companies for storage and transfer of oil products, chemicals and dry bulk commodities. These activities are major sources for NMVOC, TSP and PM_{10} emissions in the Netherlands. The emissions are estimated on the basis of data from the sector (environmental reports from large companies).

This category also includes the emissions from the use of creosoted wood products (PAH) and dioxin emissions from PCP treated wood. The emission is estimated using a specific Dutch method (described in a Dutch metadata file).

Category 3D is a key source for the following components (% of national total):

NMVOC	3D (13.9%)
TSP	3D (12.3%)
PM_{10}	3D (7.7%
DIOX	3D (46.4%)
PAH	3D (35.6%)

6.5 Methodological issues: Agriculture (4)

The sector Agriculture is a major source category for ammonia and particulate matter emissions. See section 5.2.3 on emission trends. For ammonia emission from agriculture two different sources are distinguished: animal manure and synthetic fertiliser. The main source of agricultural particulate matter emissions is formed by animal housing systems. A description of the calculation method is provided in Van der Hoek, 2002.

Ammonia emissions from animal manure

Ammonia emissions from animal manure are calculated using the Manure and Ammonia model developed by the Dutch Agricultural Economics Research Institute (LEI). Input data for this model are divided into general and specific. General input data are animal numbers taken from the annual agricultural census. Specific input data concern the nitrogen and phosphate excretion by different animal categories and the ammonia volatilisation rates from animal housing systems and soil application systems for animal manure. The average nitrogen excretion per animal category is calculated annually as the difference between absorbed nitrogen from feeding and the capture in animal products. This so-called ‘balance’- method takes into account annual changes in food consumption, food nitrogen content, etc. The excreted nitrogen partly volatilises as ammonia in stables, in pasture, during storage and during application to the soil. The share of housing and manure application systems with low ammonia volatilisation rates is taken into account. The rate of volatilisation of ammonia from animal manure depends on such aspects as the nitrogen content of the manure, the chemical balance between ammonia and ammonium in the manure and, finally, the contact surface manure – air and the exposure time.

Ammonia emissions from synthetic fertiliser

Ammonia emissions from synthetic fertiliser are calculated using data on the amounts of applied nitrogen fertiliser. These data are recorded by LEI and reported in Landbouwcijfers (Agricultural Data); these are also available via www.lei.wur.nl. Several types of nitrogen - each with their own specific ammonia emission factor fertiliser- are distinguished.

Particulate matter emissions from Agriculture

The main source for particulate matter emissions from agriculture are animal housing systems. Some other smaller sources include application of synthetic fertiliser, application of pesticides, supply of concentrates, hay making and harvesting of arable crops. The general input data for calculating the emissions from animal housing systems are animal numbers taken from the annual agricultural census. The share of poultry in free range housing systems with relative high emission factors is taken into account in these calculations. For several sources country-specific emission factors are available (Chardon and Van der Hoek, 2002).

6.5.1 Dairy Cattle (4B1A)

Ammonia emission from dairy cattle (adult female cows) is calculated by multiplying the activity number with the emission factor. For dairy cattle the activity number is based on the animal number count from the annual agricultural census. Emission factors are calculated from the excretion and volatilisation rates for dairy cows.

Excretion rate

The excretion rate depends on feed intake and milk yield. Distinction is made between type of feed in two regions in the Netherlands and for two periods (summer and winter period).

Volatilisation rate

There are four different sources for ammonia emissions from animal manure: animal housing (manure production and storage), outside storage facilities (manure storage), meadow (manure production) and soils (manure application. For this reason also four different volatilisation rates are distinguished. Approximately 40% of dairy cattle ammonia emissions are derived from application of manure to the soil. Another 40% derives from animal houses and the rest is from animals grazing and from storage of manure.

Category 4B1a is a key source for the following component (% of national total):

NH_3	(30.4%)

6.5.2 Non-dairy cattle (4B1b)

Emission data for non-dairy cattle is based on the non-dairy cattle number count from the agricultural census and on emission factors calculated from excretion and volatilisation rates for these specific cows. There is, however, no distinction made between young and full-grown animals. Young dairy cattle are also included in this category.

Category 4B1b is a key source for the following component (% of national total):

NH_3	(18.1%)

6.5.3 Swine (4B8)

Emission data is based on agricultural data from the agricultural census and on emission factors calculated from excretion and volatilisation rates for two specific types of pigs. Distinction is made between animals for meat production (fattening pigs) and animals used for breeding (breeding sows). Three types of volatilisation rates are distinguished for the two swine categories: the animal house, manure storage and soil application. Housing systems with high and low ammonia emission are also distinguished.

Emission of particulates comes mainly from skin, manure, feed and mulch particles ventilated from animal housing and have been calculated using an average emission factor per pig, deducted from the PM_5 (respirable fraction of PM) emission factor.

Category 4B8 is a key source for the following component (% of national total):

NH_3	(24.4%)
TSP	(5.0%)
PM_{10}	(5.8%)

6.5.4 Poultry (4B9)

Ammonia emission data is based on agricultural data from the agricultural census and on emission factors calculated from excretion and volatilisation rates for two specific types of poultry. Distinction is made between animals for meat production (broilers) and animals for egg production (laying hens). For both poultry categories, three types of volatilisation rates are distinguished: for the animal house, manure storage and soil application. Five different housing systems are distinguished for laying hens.

Emission of particulates comes mainly from skin, manure, feed and mulch particles ventilated from animal housing; these have been calculated using an average emission factor per chick, deducted from the PM_5 (respirable fraction of PM) emission factor. A distinction is made between free-range housing systems (with high particulate matter emission factors) and housing systems based on cages (with a low particulate matter emission factor).

Category 4B9 is a key source for the following component (% of national total):

NH_3	(9.9%)
TSP	(8.5%)
PM_{10}	(10.0%)

6.5.5 Other agricultural emissions (4G)

Emission data is based on amounts of different types of synthetic fertiliser and specific emission factors.

Category 4G is a key source for the following component (% of national total):

NH_3	(7.0%)

6.6 Methodological issues: Waste (6)

6.6.1 Waste incineration (6C)

The combustion emissions from waste incineration are included in the category 1A1a because nearly all the energy from waste incineration is converted into electricity. The emissions from crematoria are reported in this category. Mercury (Hg) emissions are estimated on the basis of the number of corpses cremated and a average amalgam content.

Category 6C is a key source for the following components (% of national total):

Hg	6C (17.5%)

6.6.2 Other waste (6D)

The emissions from the waste sector are reported in this category and coded as process emissions in the database. For historical reasons this category contains some of the emissions from waste incineration. This will be corrected in the next sub-mission, and the emissions will then be transferred to the 1A1a category.

Category 6D is a key source for the following components (% of national total):

Hg	6D (8.0%)
DIOX	6D (9.9%)

6.7 Methodological issues: Other (7)

The emissions from burning candles, smoking of cigarettes and lighting of fireworks are reported in this category. This also includes the emissions of NH_3 from human perspiration. Please note that the Netherlands include this NH_3 sources in the national total, whereas other parties do not. There is no clear guidance yet whether or not these emissions should be included in the national total for NH_3.

7 Recalculations and other changes

7.1 Recalculations compared to the last submission

In preparing the 2004 inventory some recalculations were performed to improve the emission figures for the Netherlands. The following recalculations can be distinguished:

- NMVOC emissions from Traffic and Transport (evaporation from passenger cars and small vans) were recalculated on the basis of lower emission factors derived from the COPERT model.
- PM_{10} emissions from brake wear were recalculated on the basis of new insight that not all emitted particulate matter is PM_{10}. This resulted in lower emissions.
- Ammonia emissions from fertilisers have now been calculated for the different types of synthetic fertilisers which led to an increase in emissions.
- Emissions from the Oil and Gas sector were recalculated, which resulted in a reduction of NO_x and NMVOC emissions over the total time series.

7.2 Developments in emission insights and estimates

Since committing to the goals of the NEC ceiling directive in 2001, the insights in historical emissions and future estimates for 2010 have changed. Both the EU and the UNECE/CLRTAP state that countries should report their emissions according to best knowledge, even when this leads to other policy demands than accounted for at the time of drawing up the goals. The EU is clearly aware that evolving knowledge on emissions could lead to extra efforts, but still has not stated how this will be dealt with when assessing the NEC ceilings directive. Presenting the differences between the emissions calculated with old and new insights can facilitate the discussion on this.

Evolving insights can be listed as follows:

- insights in scenario assumptions on future economic, social and technological developments;
- insights through evolving scientific knowledge, such as new insights in emission factors of sources or a changed method (model) for making an inventory of emissions;
- insights by formal adaptation within a sector definition, through which a certain source is moved to another sector;
- insights by new policies.

The starting point for the Dutch analysis is the GC (i.e. Global Competition scenario) estimates from the Environmental Outlook 5 for the year 2000 (MV5-GC), [RIVM, 2000]. These estimates were also used as a base for negotiations on the ceilings of the NEC directive. In Table 7.1 the remaining policy efforts are given according to the insights in 2000.

Table 7.1. Estimates for 2010 according to the MV5 GC-scenario per sector (million kg) from 2000

Sector	**SO_2**	**NO_x**	**NH_3**	**NMVOC**	**PM_{10}**
Industry, Energy and Refineries	55	76[4)]	4.1	84,7	10.9
Transport	15	180	NE[1)]	53	10.2
Trade, Services, Government, Construction	3[2)]	9[5)]	0.7	38.3	0.7
Consumers	[2)]	15.4	7.3	37,8	6.5
Agriculture	[2)]	9.8	137[3)]	2.4	[1)]
Total	**72**	**290**	**149**	**216**	**28**
NEC ceiling	50	260	128	185	-
Remaining policy effort in 2000	22	30	21	31	-

[1)] Not estimated
[2)] Including consumers and agriculture
[3)] EC scenario
[4)] Including waste
[5)] Excluding waste

Table 7.1 presents a detailed synopsis on the main evolving insights per sector per NEC substance introduced since the MV5-GC estimates from 2000. The most important new insights concern the traffic emission factors (cycle bypassing in road traffic), scenario assumptions in traffic (lower volume expectations for freight on road and water), exclusion of the international sea-ship emissions for NEC compliance, the lower volatilisation of NH_3 from manure and lower fugitive NMVOC emissions from gasoline fuelled vehicles. A summary of these evolving insights is given in Table 7.2.

Table 7.2. Summary of new insights into emission estimates (million kg) for 2010 according to type of evolving insight observed in the period 2000-2006

Type of evolving insight	**SO_2**	**NO_x**	**NH_3**	**NMVOC**	**PM_{10}**
1) Scenario assumptions	+4	-6	+4	-5 to -26	+14
2) Emission factors	-	+12	-11	-13	
3) Formal definitions	-9	-17	0	0	0
Other[1)]	-1	+4	+4	+2	+1
Total evolving insights	**-6**	**-7**	**-3**	**-16 to -37**	**+15**
New policy in 2000-2006	-	-6	-20	-37 to -16	-2
Total	-6	-13	-23	-53	+13

1) Not every evolving insight can contribute to one of the four distinct types as good as another. Furthermore, through interdependencies between new insights the total within a sector can deviate somewhat from the sum of parts.

From Table 7.2 it appears that when all evolving insights between 2000 and 2006 (new policy excluded) are totaled over the sectors, the remaining policy efforts for all NEC substances have decreased since 2000. For SO_2 this totals -6 million kg, NO_x -7 million kg, NH_3 -3 million kg and NMVOC -16 to -37 million kg. The effects of new policy have been presented separately in Table 7.2 since new policy concerns the sphere of influence from the Dutch government.

7.3 Planned improvements

During the compilation of the current IIR and as a response to the review, the Netherlands planned improvements for the following submissions:

Improvements to the Inventory

- Improvement of consistency in the use of notation keys;
- Removal of inconsistencies in the source allocation over the years. For historical reasons, for example, the emissions from waste incineration could not be allocated in 1A1a for all years. The category 3D currently holds the emissions from the companies for storage and transfer of oil products, chemicals and dry bulk commodities. These sources could better be allocated in category 2 (industry);
- Time series consistency. In the current submission system the Netherlands only submits data for 1990, 1995, 2000, 2002, 2003 and 2004. The years in between are not reported because they are not recalculated. In the next submission, these years will be resubmitted using an interpolation of the data based on the data (years) recalculated every year.

Improvements to the Informative Inventory Report

- Quantitative effect of recalculation for above mentioned inventory years and for projected years;
- Overview of new or expected evolving insights in the emission data;
- Documentation of the emission factors (e.g., English translation of the *'Methodological report for Traffic'*
- Documentation of methods for all key sources for PM_{10} and $PM_{2.5}$;
- Speciation profiles for NMVOC and particulate matter.

Based on the review report, further work will be undertaken to improve the consistency and transparency of the Dutch submission.

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