Netherlands Informative Inventory Report 2008

Background Studies

Netherlands Environmental Assessment Agency

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The Netherlands Environmental Assessment Agency analyses spatial and social developments in (inter)national context, which are important to the human, plant and animal environment. It conducts scientific assessments and policy evaluations, relevant to strategic government policy. These assessments and evaluations are produced both on request and at the agency's own initiative.

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Rapport in het kort

Informatief Inventarisatie Rapport Nederland 2008
Dit Informatief Inventarisatie Rapport (IIR) licht de officiële emissiecijfers toe 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[1]-richtlijn. De emissiecijfers zijn te vinden op de EMEP[2]-website: http://www.emep-emissions.at/ (EMEP data) en www.emissieregistratie.nl.

Op dit moment stellen landen het IIR nog op vrijwillige basis op. Dat zal bij de revisie van de protocollen onder CLRTAP en de NEC-richtlijn van de EU hoogstwaarschijnlijk veranderen. Het belang van de verplichting van het IIR is dat landen meer inzicht geven in de manier waarop de emissies worden berekend.

De IIR-rapportage 2008 biedt een beter zicht 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.

1) National Emissions Ceilings Directive.
2) Co-operative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP).

Trefwoorden:
Inventory, LRTAP, NEC, Emission

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Summary

This report, constituting the Netherlands Informative Inventory Report (IIR), contains information on the inventories in the Netherlands, up to 2006 (see www.prtr.nl and EMEP[1] data on http://www.emep-emissions.at/). It includes descriptions of methods and data sources, QA/QC activities carried out and a trend analysis.

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

The 2008 submission includes emission data from the Netherlands for the years 1990 up to and including 2006. The emission data, with the exception of $PM_{2.5}$ emissions, are extracted from the Dutch Emission Inventory system (PRTR). These data are calculated from the PM_{10} data and have not yet been incorporated in the PRTR.

In the 1990 – 2006 period 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 2003-2006 are recalculated annually in the Dutch inventory. Data for other years (1991-1994, 1996-1999, 2001 and 2002) have been based on interpolations.

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

I 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 CLRTAP (UNECE, 2003).

The Netherlands Informative Inventory Report (IIR) 2008 contains information on the Netherlands' inventories for the years 1990-2006, including descriptions of methods, data sources, QA/QC activities carried out and a trend analysis. The inventory covers all anthropogenic emissions to be reported in the Nomenclature for Reporting (NFR), except for individual PAHs (with only total emissions reported), which are to be reported under POPs in Annex III. The publication of an IIR is part of the inventory improvement programme.

I.1 National inventory background

Emissions in the Netherlands are registered in the Pollutant Release and Transfer Register (PRTR), the national database for target group monitoring used by the Dutch government to monitor greenhouse gas emissions in conformance with United Nations Framework Convention on Climate Change (UNFCCC) requirements and the Kyoto Protocol (National System). The database is also employed to monitor pollutants within the framework of National Emission Ceilings (EU) and the Convention on Long-range Transboundary Air Pollution (CLRTAP). PRTR encompasses the process of data collection, data processing, registration and reporting on emission data for some 350 policy-relevant compounds, and compound groups 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 in 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 often applies country-specific methods, including monitoring data and emission factors.

Note that definitions for emissions accounting differ according to the guideline (EMEP/Corinair, UNFCCC and EU).

I.2 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 Release and Transfer Register (PRTR) system has been in operation in the Netherlands since 1974. Since April 2004 the Ministry of VROM has outsourced the full coordination of the PRTR to the

Emission Registration team (ER) at the Netherlands Environmental Assessment Agency (PBL). This has resulted in a clearer definition and distinction between 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 is up-to-date, complete, transparent, comparable, consistent and accurate. Emission data are produced in an annual (project) cycle (MNP, 2006) and various external agencies contribute to the PRTR by performing calculations or submitting activity data (see next section). Besides the Netherlands Environmental Assessment Agency (PBL), the following institutes contribute to the PRTR:

- Statistics Netherlands (CBS);
- TNO;
- Institute for Inland Water Management and Waste Water Treatment (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 PBL and in the annual project plan. The Informative Inventory Report (IIR) is prepared by PBL. See www.prtr.nl.

1.3 The process of inventory preparation

Data collection

For the collection and processing of data, the PRTR is organised in task forces according to pre-determined methods. The task forces are formed by sector experts of the participating institutes. 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 on agriculture and land use;
- task force on energy, industry and waste;
- task force on traffic and transport;
- task force on water and,
- task force on the consumer and service sector.

Every year, after collection of the emission data, several quality control checks are performed in the task forces during a yearly ‘trend analysis’ workshop. After approval by participating institutes, emission data are released for publication. Subsequently, emission data is 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 a database managed by the Environmental Assessment Agency. A separate database contains the information from the Environmental Annual Reports.

About 250 companies are legally obliged to submit an Environmental Annual Report (EAR). As from 1 January 2004, companies may submit their EARs electronically (e-EAR). Each of these companies has an emission monitoring and registration system in which the specifications are in agreement with the supervisory authority. The provincial authorities validate and verify the reported emissions. In addition, a number of companies are required to report information under the BEES/A legislation. Other companies (about 200) provide emission data voluntarily within the framework of environmental covenants.

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 Small and Medium-sized Enterprises (SMEs). Several methods are applied for calculating these emissions. TNO has derived emission factors for NO_x emissions from small installations, for instance (Van Soest-Vercammen et al., 2002), while, for other substances, the Implied Emission Factors (IEFs) derived from the EARs are applied to calculate sector emissions.

Emissions from the ER-I database and collectively estimated industrial as well as non-industrial sources are stored in the ER-C database (see Figure 1.1). The ER-C database, consisting of a large number of geographically distributed emission sources (about 1200), contains a complete record of Dutch emissions for a particular year. Each emission source includes information on the Standard Industrial Classification code (SBI-code) and industrial subsector, separate information in process and combustion emissions, and the relevant environmental compartment and location. These emission sources can be selectively aggregated, for example, by NFR category.

Data flow in the Netherlands Pollutant Release and Transfer Register (PRTR)

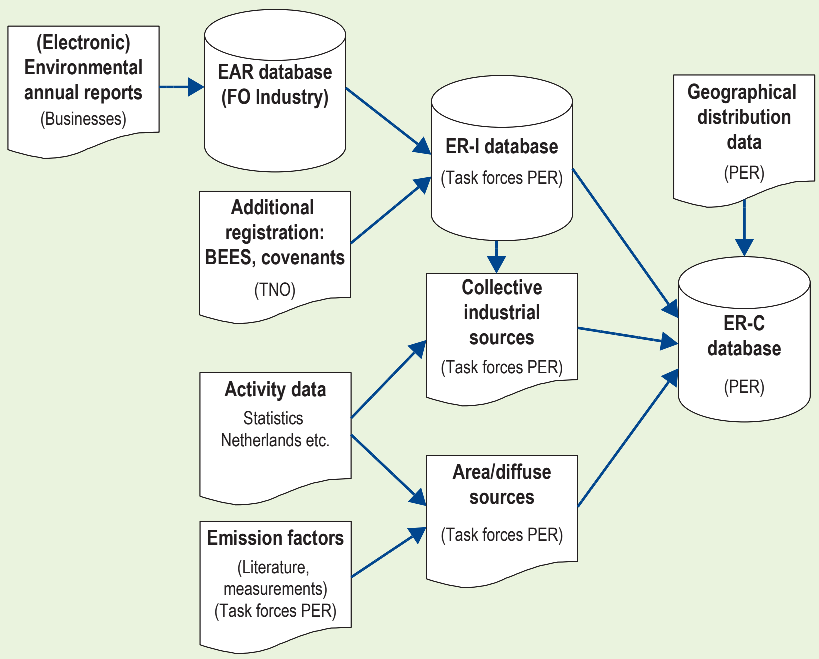

Figure 1.1 The Netherlands Pollutant Emission Register.

1.4 Methods and data sources

Methods used in the Netherlands are documented in several reports and in meta-data files, available on www.prtr.nl. However, some reports are only available in Dutch. For greenhouse gases, particulate matter and all emissions related to mobile sources, the documentation has been translated in English.

In general, two emission models are used in the Netherlands:

- A model for emissions of large *point sources* (e.g. large industrial, power plants) that are registered individually and supplemented with emission estimates for the remainder of the companies in a sector (based mainly on IEFs 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.

1.5 Key source analysis

More than 95% of national total should be covered for all key source categories. The REPDAB generated key source category list is insufficient for this purpose. Table 1.1 shows the key source categories which cover 95% of the national total for a component.

Table 1.1.a Key source categories for SO_x, NO_x, NH_3 and NMVOC

Component	SO_x		NO_x		NH_3		NMVOC	
Key source categories (Sorted from high to low from top to bottom)	1A1b	39.8%	1A3b3	21.5%	4B01a	28.6%	3D	17.5%
	1A1a	15.9%	1A1a	13.2%	4B08	25.1%	3A	15.5%
	1B2a4	10.4%	1A3b1	11.7%	4B01b	14.8%	2G	10.4%
	1A2c	6.6%	1A2f	6.7%	4B09	12.8%	1A3b1	9.4%
	1A2b	6.5%	1A3b2	6.2%	4G	9.0%	1A3b4	5.6%
	1A2f	5.3%	1A4c2	5.4%	7	3.9%	1B2a4	5.3%
	1A2a	4.8%	1A2c	4.9%	1A3b1	1.8%	1A4b1	5.2%
	1A4c2	2.4%	1A4a	4.7%			2B5	4.8%
	2A7	1.5%	1A4b1	4.6%			1B2b	3.8%
	1A3d2	1.2%	1A3d2	4.1%			2D2	2.9%
	1A4c3	1.1%	1A4c1	3.9%			1A3b5	2.5%
			1A4c3	3.9%			3B	2.3%
			1A1b	2.9%			1A3b3	2.1%
Energy			1A2a	2.0%			1A3d2	1.9%
Transport							1B2a5	1.8%
Industry							1A2f	1.4%
Solvent and product use							1A4c2	1.3%
Agriculture							1A3b2	1.3%
Waste							1A4c1	0.9%
Other								
Total (%)		95.5%		95.6%		95.9%		95.8%

Table 1.1.b Key sources for CO and particulate matter species

CO		TSP		PM_{10}		$PM_{2.5}$	
1A3b1	34.7%	4B9	11.3%	4B9	13.2%	1A3b1	10.8%
1A2a	12.7%	2C	10.1%	4B8	6.5%	1A3b2	9.2%
1A4b1	10.4%	1A4b1	7.5%	1A3b1	5.9%	1A4b1	8.2%
1A3b4	9.9%	2B5	5.9%	2G	5.9%	1A3b3	7.9%
2C	8.3%	4B8	5.6%	2C	5.2%	7	6.6%
1A2c	3.8%	2G	5.1%	1A3b2	5.0%	1A1b	6.3%
1A3d2	3.7%	1A3b1	5.0%	1A4b1	4.9%	2C	6.1%
1A3b2	2.5%	1A3b2	4.3%	1A3b3	4.3%	1A4c2	6.1%
1A3b3	2.3%	2D2	4.3%	1A1b	4.3%	1A2f	5.2%
1A4c2	2.1%	1A1b	4.0%	7	4.1%	4B9	4.9%
1A2f	2.1%	1A3b3	3.7%	1A3b6	3.8%	2B5	4.4%
1A1a	1.4%	7	3.5%	2D2	3.7%	2G	3.1%
1A2e	1.0%	1A3b6	3.2%	1A4c2	3.5%	1A3d2	2.6%
1A2b	0.8%	1A4c2	3.0%	1A3b7	3.3%	4B8	2.4%
		1A3b7	2.8%	3D	3.3%	2A7	2.3%
		3D	2.8%	1A2e	3.2%	3D	2.0%
		1A2e	2.8%	2A7	3.2%	1A3b6	2.0%
		2A7	2.7%	2B5	3.2%	1A1a	1.8%
		1A2f	2.6%	1A2f	3.0%	1A4c3	1.3%
		4B1	1.9%	4B1	2.3%	2D2	1.2%
		4G	1.7%	4G	2.0%	1A2e	1.0%
		1A1a	1.6%	1A3d2	1.5%		
	95.4%		95.5%		95.2%		95.3%

Table 1.1.c. Key sources for PB, Hg, Cd, DIOX and PAH

Pb		Hg		Cd		DIOX		PAH	
2C	60.4%	1A1a	41.2%	2B5	49.1%	3D	48.0%	3D	45.6%
1A3b6	16.4%	2C	25.7%	2C	40.2%	1A2a	19.6%	2G	20.1%
1A4b1	6.4%	2A1	12.2%	1A1a	4.2%	1A4b1	11.9%	1A4b1	14.0%
2B5	6.0%	6C	11.6%	1A4b1	3.5%	2A7	8.0%	1A3b3	5.6%
1A3a2	5.6%	2B5	5.9%			2C	3.9%	1A3b1	5.5%
2A7	3.6%					1A2c	2.1%	1A3b2	1.9%
						1A1a	1.8%	1A2f	1.5%
								1A4c2	1.4%
	98.4%		96.5%		97.0%		95.4%		95.3%

1.6 Reporting, QA/QC and archiving

Reporting
The Informative Inventory Report is prepared by PBL, with contributions from experts from the PRTR task forces.

QA/QC
PBL as well as the PRTR are ISO 9001:2000 certified. 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.

In general, the following QA/QC activities are performed:
- *QC checks*. A number of general QC checks have been introduced as part of the annual work plan of the PRTR. The QC checks built into the work plan aim at covering such issues as consistency, completeness and accuracy of the NFR data.
  The general QC for the inventory is largely performed within the PRTR as an integrated part of the working processes. For the 2006 inventory the PRTR task forces filled in a standard-format database with emission data for 1990–2006. After a first check of the emission files by PBL and TNO for completeness, the (corrected) data became available to the specific task force for checking consistency and trend analysis (comparability, accuracy). The task forces have access to information about the relevant emissions in the database. Several weeks before the data set is fixed, a trend verification workshop is organised by PBL (see Box 1.1).

Quality assurance (QA)
QA activities can be summarised as follows:
- For the energy, industry and waste sectors, emission calculation in the PRTR is based mainly on annual environmental reports by companies. The companies themselves are responsible for the data quality; the competent authorities (in the Netherlands, mainly provinces and local authorities) are responsible for checking and approving the reported data, as part of the annual quality assurance.
- As part of the evaluation process of the previous cycle, internal audits are performed within PBL as part of the ISO certification.
- Furthermore, QA checks are planned to be performed by institutes actually not involved in the PRTR system.

Archiving and documentation
Internal procedures are agreed on (for example, in the PRTR work plan) for general data collection and the storage of fixed data sets in the PRTR database at PBL, including the documentation/archiving of QC checks. Moreover, updating of monitoring protocols for substances under the Convention for Long Range Transboundary Air Pollution is one of the priorities within the PRTR system. Emphasis is put on documentation of methodologies for calculating SO_x, NO_x, NMVOC, NH_3 and PM_{10} ($PM_{2.5}$). Methodologies/ protocols, emission data (including the emissions of Large Point Sources on the basis of annual Environmental Reports), as well as such emission reports as the National Inventory Report (UNFCCC) and the Informative Inventory Report (CLRTAP), are made available on the website of the PRTR: www.prtr.nl or www.emissieregistratie.nl (Dutch version). Each institution involved in the PRTR is responsible for QA/QC aspects related to reports based on the annually fixed database.

Box 1.1. Trend verification workshops

Several weeks in advance of a trend analysis meeting, a snapshot from the database is made available by PBL in a web-based application (Emission Explorer, EmEx) for checks by the institutes involved and experts (PRTR task forces). In this way the task forces can check for level errors and consistency in the algorithm/method used for calculations throughout the time series. The task forces perform checks for relevant gases and sectors. The totals for the sectors are then compared with the previous year's data set. Where significant differences are found, the task forces evaluate the emission data in more detail. The results of these checks form the subject of discussion at the trend analysis workshop and are subsequently documented.

Furthermore, TNO provides the task forces with time series of emissions per substance for the individual target sectors. The task forces examine these time series.

During the trend analysis for this inventory the emission data were checked in two ways:
1) emissions from 1990 – 2005 from the new time series were compared with the time series of last years inventory and
2) the data for 2006 were compared with the trend development per gas since 1990. The checks of outliers are performed on a more detailed level of the sub-sources of all sector background tables:

- annual changes in emissions;
- annual changes in activity data;
- annual changes in implied emission factors and
- level values of implied emission factors.

Exceptional trend changes and observed outliers are noted and discussed at the trend analysis workshop, resulting in an action list. Items on this list have to be processed within 2 weeks or be dealt with in next year's inventory.

1.7 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 PRTR 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 PRTR 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 et al., 2004), which presents the results of a Tier-2 'Monte Carlo' uncertainty assessment.

1.1.1 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/PBL 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) was assessed according to the Tier-2 methodology (estimation of uncertainties by source category using Monte Carlo analysis). See Table 1.2 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 NO_x 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 encapsulated in the 1999 Tier-1 analysis). The differences for SO_2 and total acidifying equivalents are small. The conclusion drawn 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.

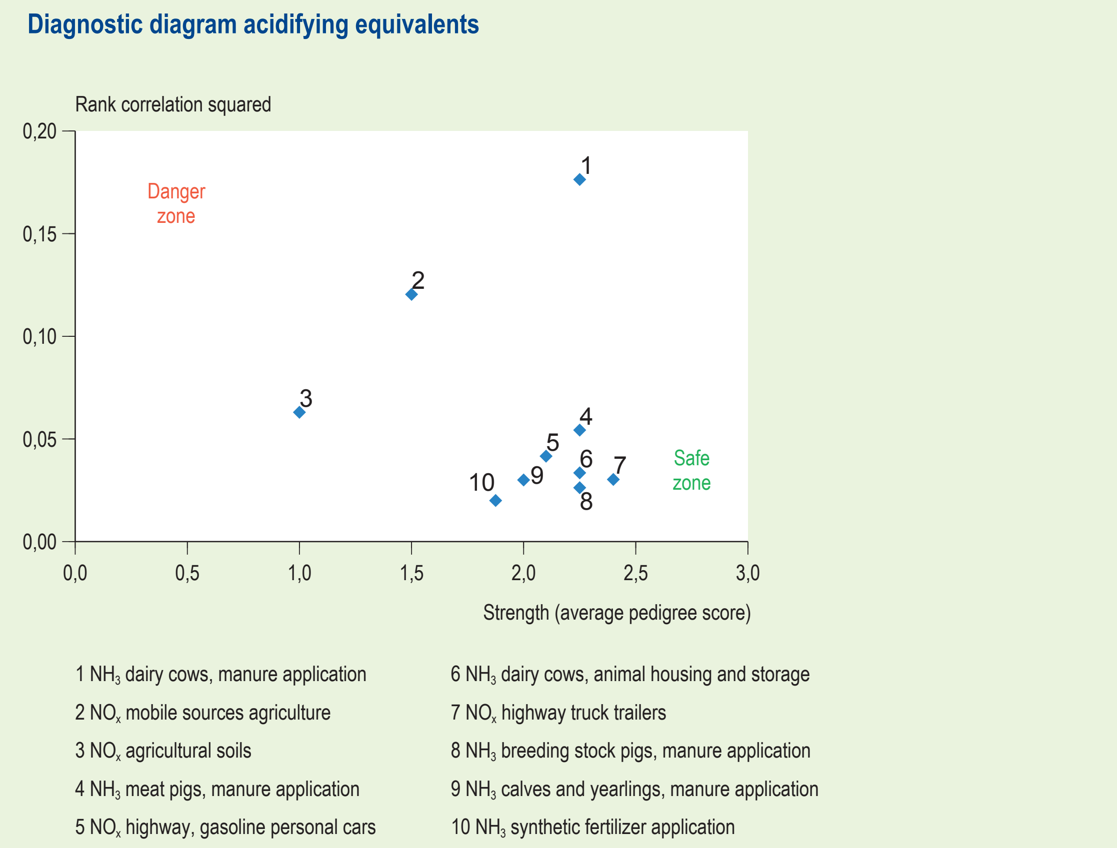

Figure 1.2 NUSAP diagnostic diagram indicating strong and weak elements in the available knowledge on acidifying substances.

Table1.2 Uncertainty (95% confidence ranges) in acidifying compounds and for total acidifying equivalents for emissions in 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. Besides providing quantitative uncertainty estimates, the study yielded important conclusions. One example was that a limited number of facilities showed high uncertainties (e.g. 50% or more for NO_x), which could be reduced 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 (2004), 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, derived from the Good Practice Guidance for CLRTAP emission inventories, were used (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; Van der Sluijs et al., 2005). The qualitative and quantitative uncertainties were combined in so-called diagnostic diagrams that can be used to identify areas for improvement, since the diagrams indicate strong and weak parts of the available knowledge (see Figure 1.2). 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).

1.8 Explanation on the use of notation keys

The Dutch emission inventory covers all relevant sources, as specified in the CLRTAP, that determine 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 why notation keys are used in the emission tables (NFR). These notation keys will be explained in Tables 1.3 – 1.5.

Table 1.3 The NE notation key explained

NFR code	Substance(s)	Reason for reporting NE
All	Benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, Indeno(1,2,3-cd) pyrene	included in total 1-4, defined as 'VROM sum of 10 PAH'.
1A3a1(ii)	All	Not estimated

Table 1.4 The IE notation key explained

NFR code	Substance(s)	Included in NFR code
1A3a2(ii)	All	No specific data are available on the (very small) domestic cruise emissions. These emissions are incorporated in 1A3a2(i) (based on total fuel use for domestic flights).
1B2c	All	Venting and flaring emissions occur almost exclusively in the natural gas sector and are therefore included in 1B2b.
4B1b	TSP, PM_{10}, $PM_{2.5}$	Since no specific data are available for this subcategory, all emissions are reported under 4B1a.

Table 1.5. Sub-sources accounted for in reporting 'other' codes

NFR code	Sub-source description	Substance(s) reported
1A2f	Combustion in the non-specified industries, machineries, services, production activities.	All
1A3e	NO/NA	
1A5a	Combustion of landfill gas	All
1A5b	NO/NA	
1B1c	NO/NA	
1B2a6	NO/NA	
2A7	Process emissions in construction activities and production of building materials	All
2B5	Process emissions during production of chemicals, paint, pharmaceutics, soap, detergents, glues and other chemical products	All
2G	Process emissions during production of wood products, plastics, rubber, metal, textiles and paper	All
3D	Use of products, not in 3A-C, venting transport and storage facilities; use of products by consumers, in commercial activities, tobacco products for smoking (NMVOC only), cooling, freezing and air-conditioning	All
4B13	Pets	NH_3
4G	Handling agricultural-based materials and products	NH_3, TSP, PM_{10}, $PM_{2.5}$
6D	Handling waste	all
7	Tobacco products for smoking Transpiration, breathing	All substances, excl NMVOC NH_3
5E	NO/NA	

1.9 Missing sources

The Netherlands emission inventory covers all important sources. However, no data is available for individual PAHs. The reason for this is the less restrictive requirements on the individual PAHs to be reported in environmental reports from companies, in such a way that it is 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 for improving reporting speciated PAHs (Alkemade et al., 2005). These recommendations are further elaborated by TNO at the moment and will be implemented in the NL-PRTR in the course of 2008. The Netherlands aims at including the speciated substances in the submission of 2009.

2 Trends in emissions

2.1 Trends in national emissions

The emissions of all substances showed a downward trend in the 1990 – 2006 period (see Table 2.1). The major overall drivers for this trend are:

- emission reductions in the industrial sectors,
- cleaner fuels and
- cleaner cars.

European regulations for road traffic emissions have caused a decrease in vehicle emissions of 78% since 1990 for NMVOC, 44% for particulate matter, 49% for NO_x and about 96% for SO_2, despite a growth in traffic of 33%. For particulate matter and NO_x, standards have been set for installations by tightening up the extent of emission stocks of heating installations (BEES). 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 substances will be elaborated in more detail in the next section.

Table 2.1 Total national emissions, 1990 -2006

	Main Pollutants					Particulate Matter			Priority Heavy Metals		
	NO_x	CO	NMVOC	SO_x	NH_3	TSP	PM_{10}	$PM_{2.5}$	Pb	Cd	Hg
Year	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Mg	Mg	Mg
1990	536	1066	450	190	250	95	74	45	338	2.1	3.5
1995	440	802	315	128	193	71	54	33	162	1.1	1.2
2000	377	652	220	72	152	51	44	26	37	1.0	0.9
2003	358	576	175	63	135	50	39	23	41	2.4	0.7
2004	338	575	168	65	134	49	39	21	43	1.8	1.0
2005	325	543	169	65	133	44	38	21	39	1.7	0.8
2006	311	519	164	64	133	44	37	20	39	1.7	0.8
period 1990-2006, abs	-225	-546	-286	-126	-117	-52	-37	-25	-299	-0.4	-2.7
period 1990-2006, %1990	-42%	-51%	-64%	-66%	-47%	-54%	-50%	-55%	-88%	-18%	-77%
	POPs			Other Heavy Metals							
	DIOX	PAH	PCP	As	Cr	Cu	Ni	Se	Zn		
Year	g I-Teq	Mg	kg	Mg	Mg	Mg	Mg	Mg	Mg		
1990	742	1660	34000	1.5	9.9	70.7	75.3	0.4	225.2		
1995	66	879	29000	1.0	6.7	72.1	86.6	0.3	146.9		
2000	31	544	24000	1.1	3.2	77.2	19.5	0.5	98.2		
2003	26	404	22050	1.0	2.9	81.5	12.6	0.7	95.0		
2004	28	466	21400	1.5	3.1	82.7	13.7	1.1	101.1		
2005	36	474	20750	1.5	2.3	82.0	10.8	2.4	91.5		
2006	35	462	20100	1.5	2.3	82.7	10.6	2.4	84.8		
period 1990-2006, abs	-707	-1197	-13900	0.1	-7.7	12.1	-64.7	2.0	-140		
period 1990-2006, %1990	-95%	-72%	-41%	5%	-77%	17%	-86%	516%	-62%		

2.2 Trends for sulphur dioxide (SO_2)

The Dutch SO_x emissions (reported as SO_2) decreased by 126 Gg, in the 1990 – 2006 period, corresponding to 66% of the national total in 1990 (Figure 2.1). Main contributions to this decrease came from the energy, industry and transport sectors. 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 was also reduced. Currently, the energy sector is responsible for almost three-quarters of the national SO_2 emission.

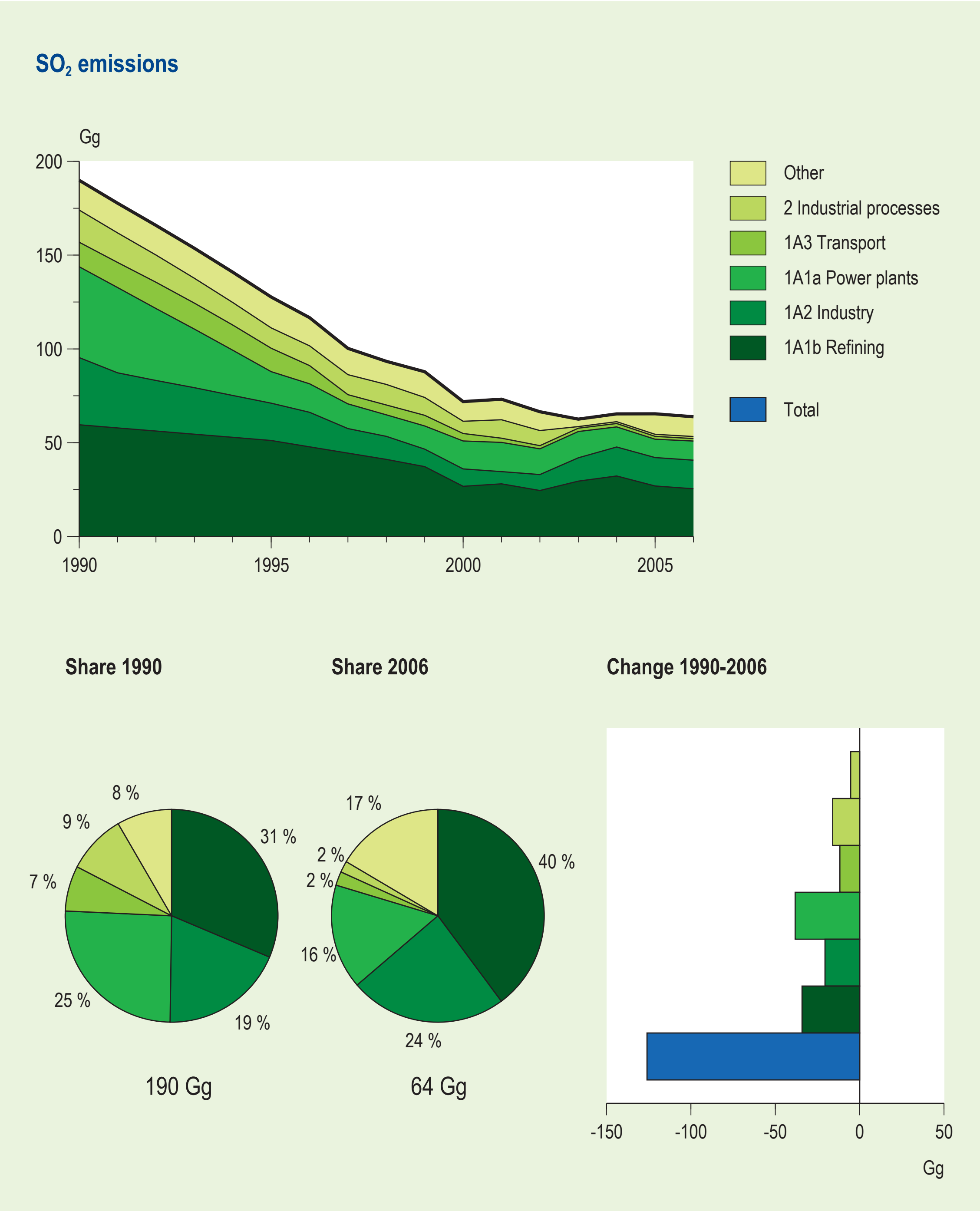

Figure 2.1 SO_2, emission trend 1990-2006 and share by sector in 1990 and 2006.

2.3 Trends for nitrogen oxides (NO_x)

The Dutch NO_x emissions (NO and NO_2, expressed as NO_2) decreased by 225 Gg, in the 1990 – 2006 period, corresponding to 42% of the national total in 1990 (Figure 2.2). Main contributors to this decrease were the road-transport and energy sectors. The emissions per vehicle decreased significantly in this period, but the effect on total emissions was partially 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.

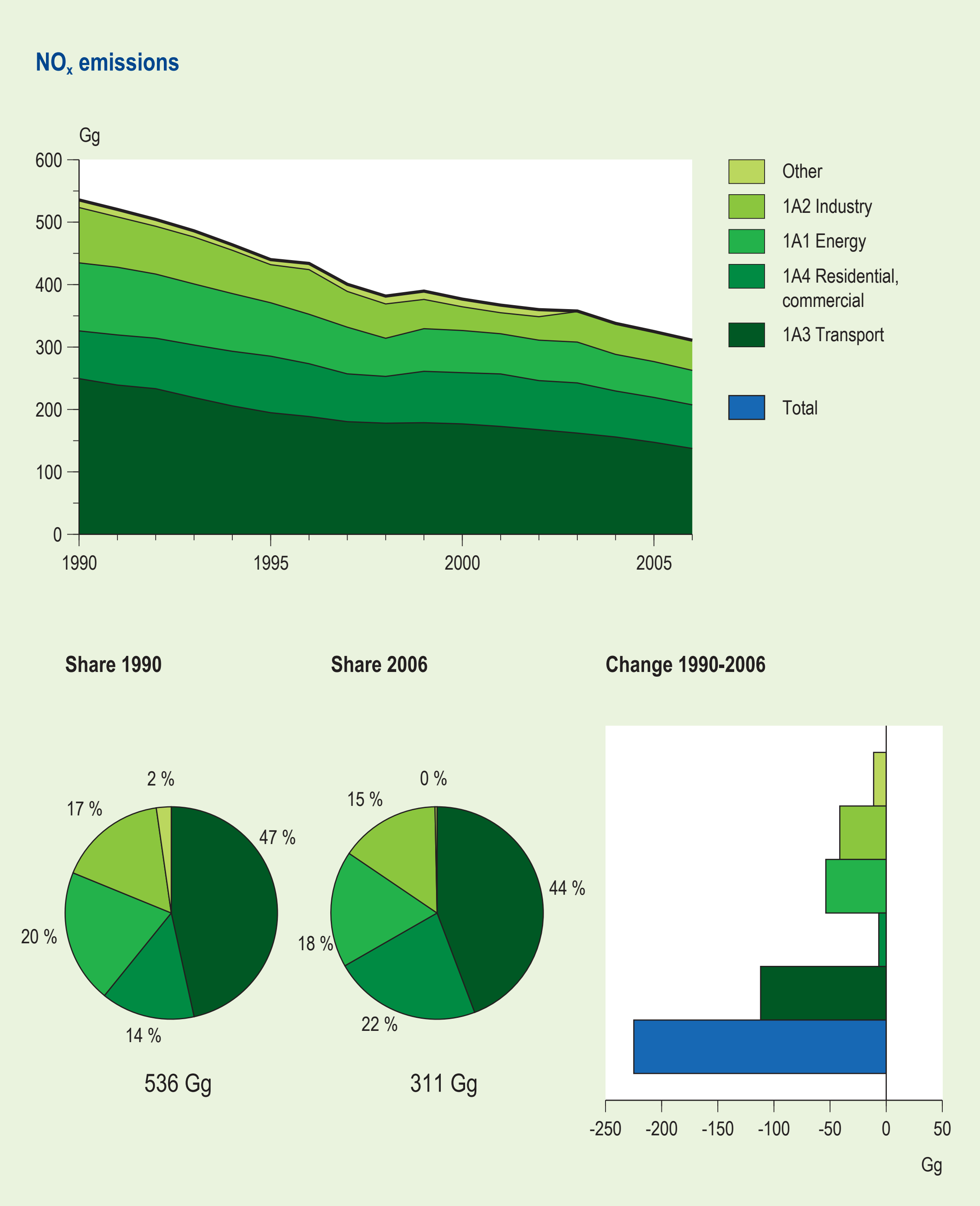

Figure 2.2 NO_x, emission trend 1990-2006 and share by sector in 1990 and 2006.

2.4 Trends for ammonia (NH_3)

The Dutch NH_3 emissions decreased by 117 Gg, in the 1990 – 2006 period, corresponding to 47% of the national total in 1990 (Figure 2.3). This decrease was due to 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.

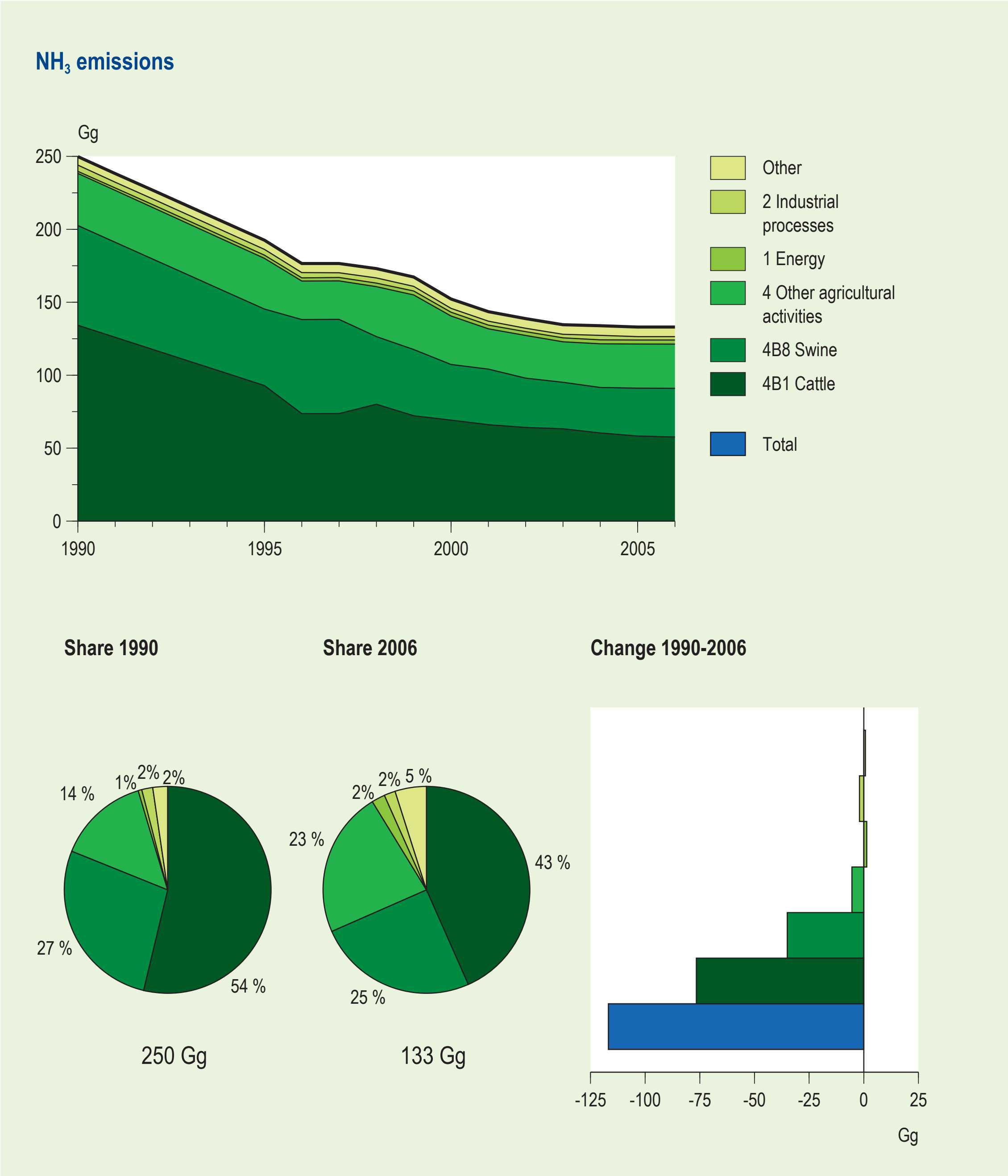

Figure 2.3 NH_3, emission trend 1990-2006 and share by sector in 1990 and 2006.

2.5 Trends for non-methane volatile organic compounds (NMVOC)

The Dutch NMVOC emissions decreased by 286 Gg, in the 1990 – 2006 period, corresponding to 64% of the national total in 1990 (Figure 2.4). All major source categories contributed to this decrease, for example, transport (introduction of catalyst and cleaner engines), product use (intensive programme to reduce NMVOC content in consumer products and paints) and industry (introducing emission abatement specific for NMVOC).

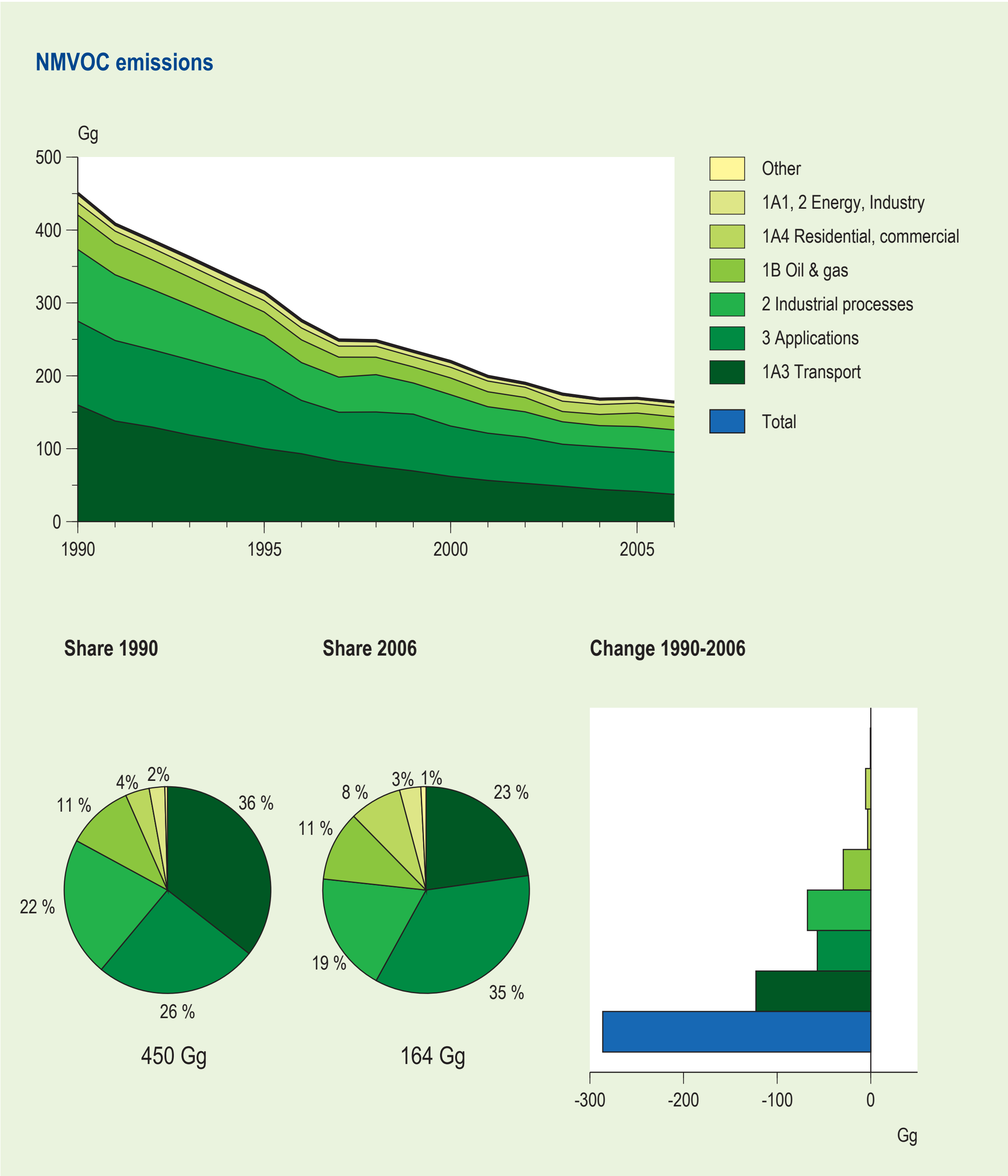

Figure 2.4 NMVOC, emission trend for 1990-2006 and share by sector in 1990 and 2006.

2.6 Trends for particulate matter (PM_{10})

The Dutch PM_{10} emissions decreased by 37 Gg, in the 1990 – 2006 period, corresponding with 45% of the national total in 1990 (Figure 2.5). The major source categories contributing to this decrease are:

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

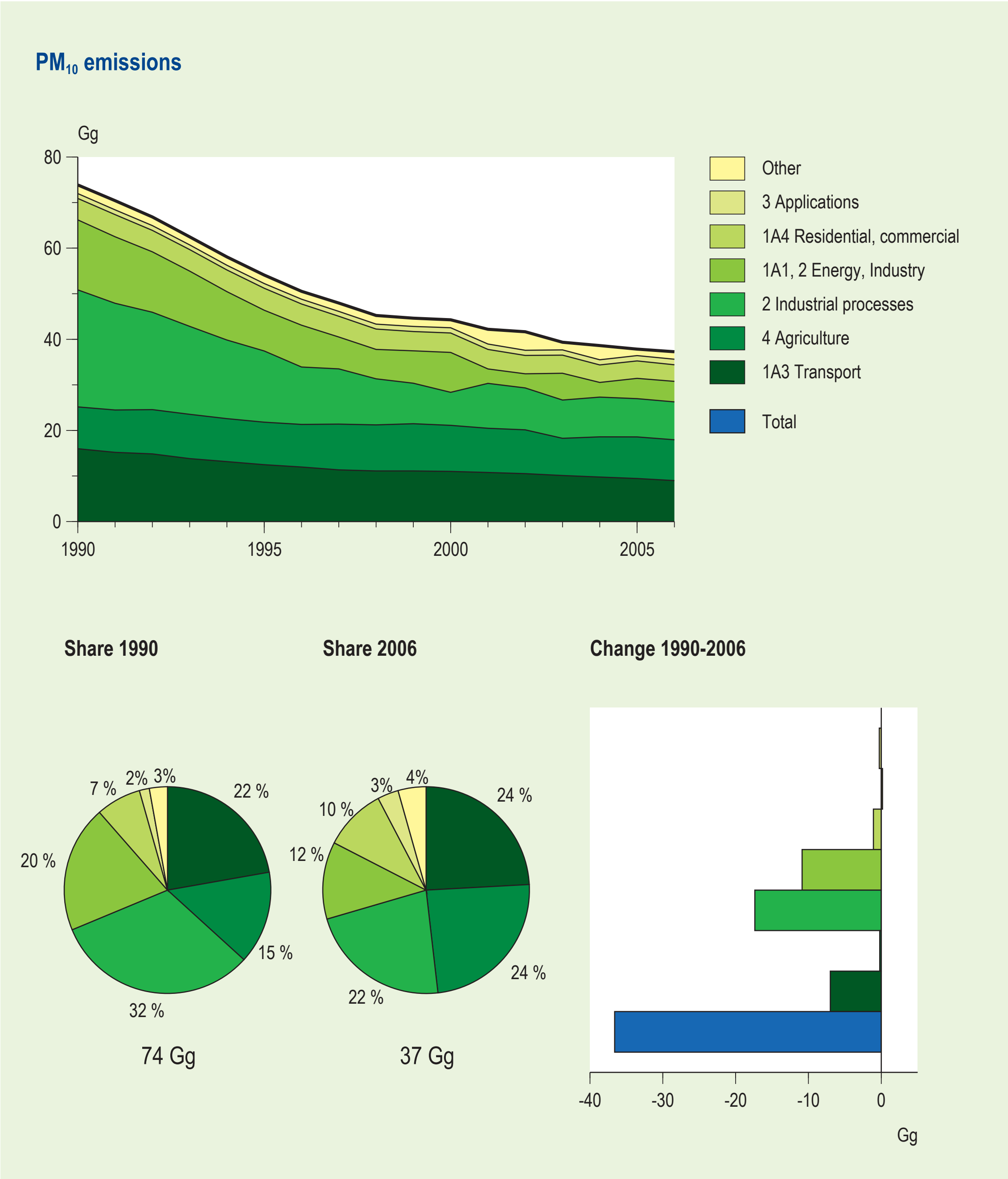

Figure 2.5 PM_{10}, emission trend 1990-2006 and share by sector in 1990 and 2006.

The emissions from animal husbandry in agriculture did not change significantly; neither did the emissions from consumers (1A4b1). The share of the emissions from residential wood stoves increased from 42% for 1A4 in 1990, to 45% in 2006. $PM_{2.5}$ emissions are also included in the 2007 submission to UNECE. These emissions are calculated as a specific fraction of PM_{10} by sector (based on Wesselink et al., 1998).

2.7 Trends for heavy metals (Pb and Cd)

The Dutch lead (Pb) emissions decreased by 299 Gg, in the 1990 – 2006 period, corresponding to 88% of the national total in 1990 (Figure 2.6). This decrease is solely attributable to the transport sector, where, due to the removal of Pb from petrol, lead emissions have collapsed. The remaining sources for Pb are the iron and steel industry, and industry (combustion and process emissions).

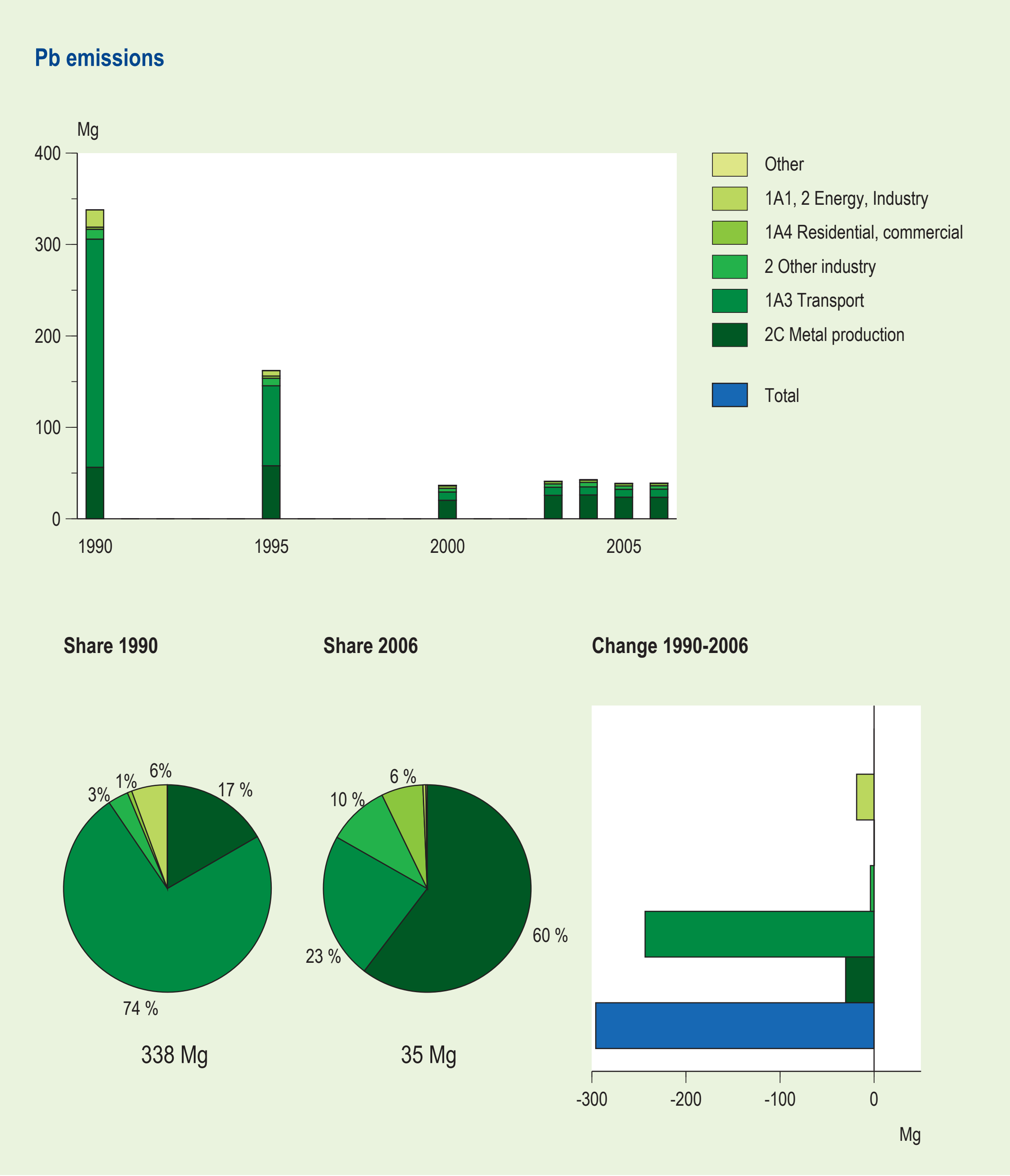

Figure 2.6 Lead (Pb), emission trend 1990-2006 and share by sector in 1990 and 2006.

The Dutch cadmium (Cd) emissions decreased by nearly 400 kg, in the 1990 – 2006 period, corresponding to 18% of the national total in 1990 (Figure 2.7). This decrease is caused mainly by the large decrease in the emissions from waste combustion. Between 1990 and 2006 old incinerators without flue gas cleaning were closed, and state-of-the-art emission abatement was installed in both the remaining incinerators and, sometimes, in the newly built ones. The remaining major sources for Cd emissions in the Netherlands are the chemical industry and the iron and steel industry.

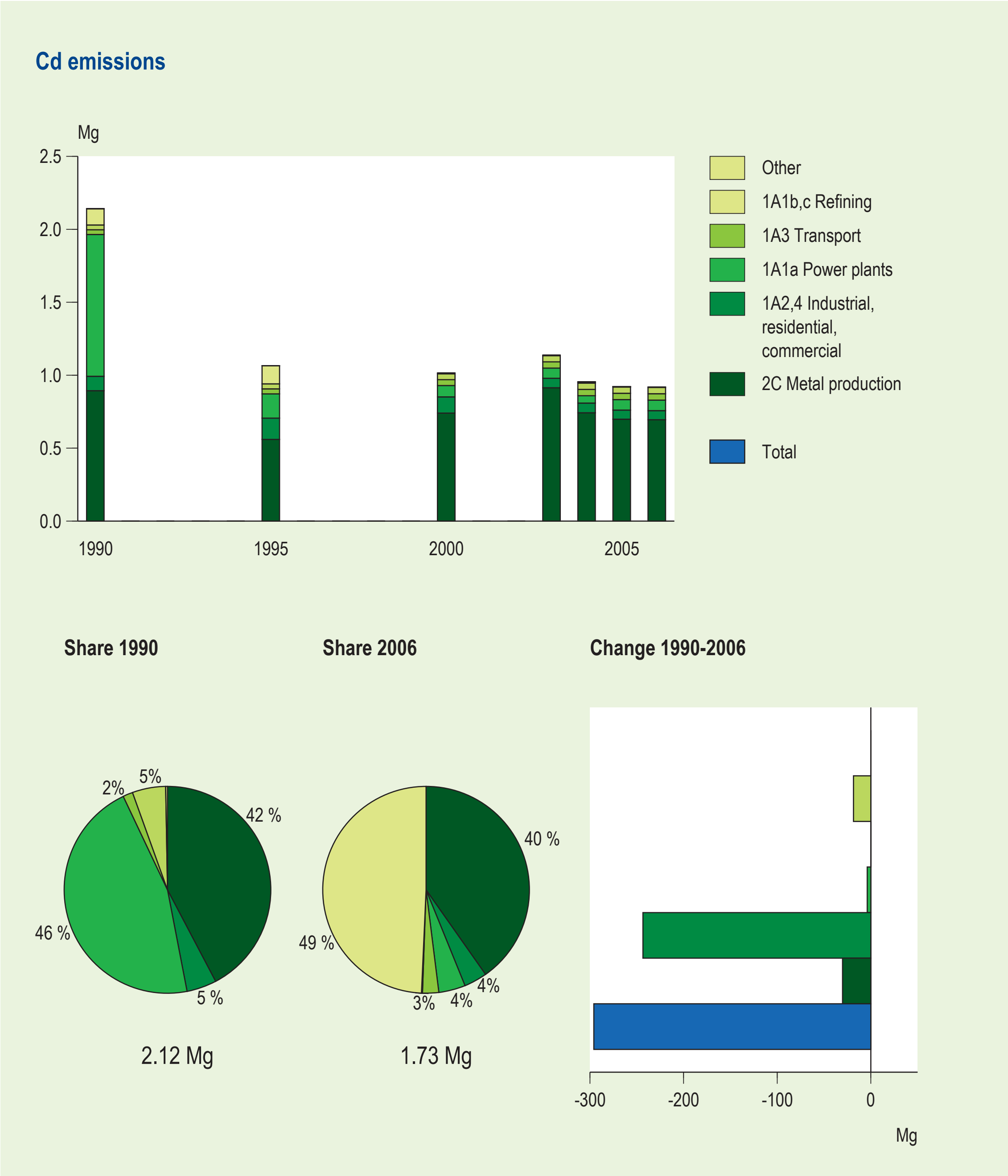

Figure 2.7 Cadmium (Cd), emission trend 1990-2006 and share by sector in 1990 and 2006.

2.8 Trends for PAH and dioxins

The Dutch polycyclic aromatic hydrocarbons (PAH) emissions decreased by 1.2 Gg, in the 1990 – 2006 period, corresponding to 72% of the national total in 1990 (Figure 2.8). 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 - like former submissions - the Netherlands reports only the total PAH emissions according to a specific Dutch definition, namely, the 'sum 10 PAH of VROM'. This definition does not only include the four PAH substances stated in NFR, but also six others.

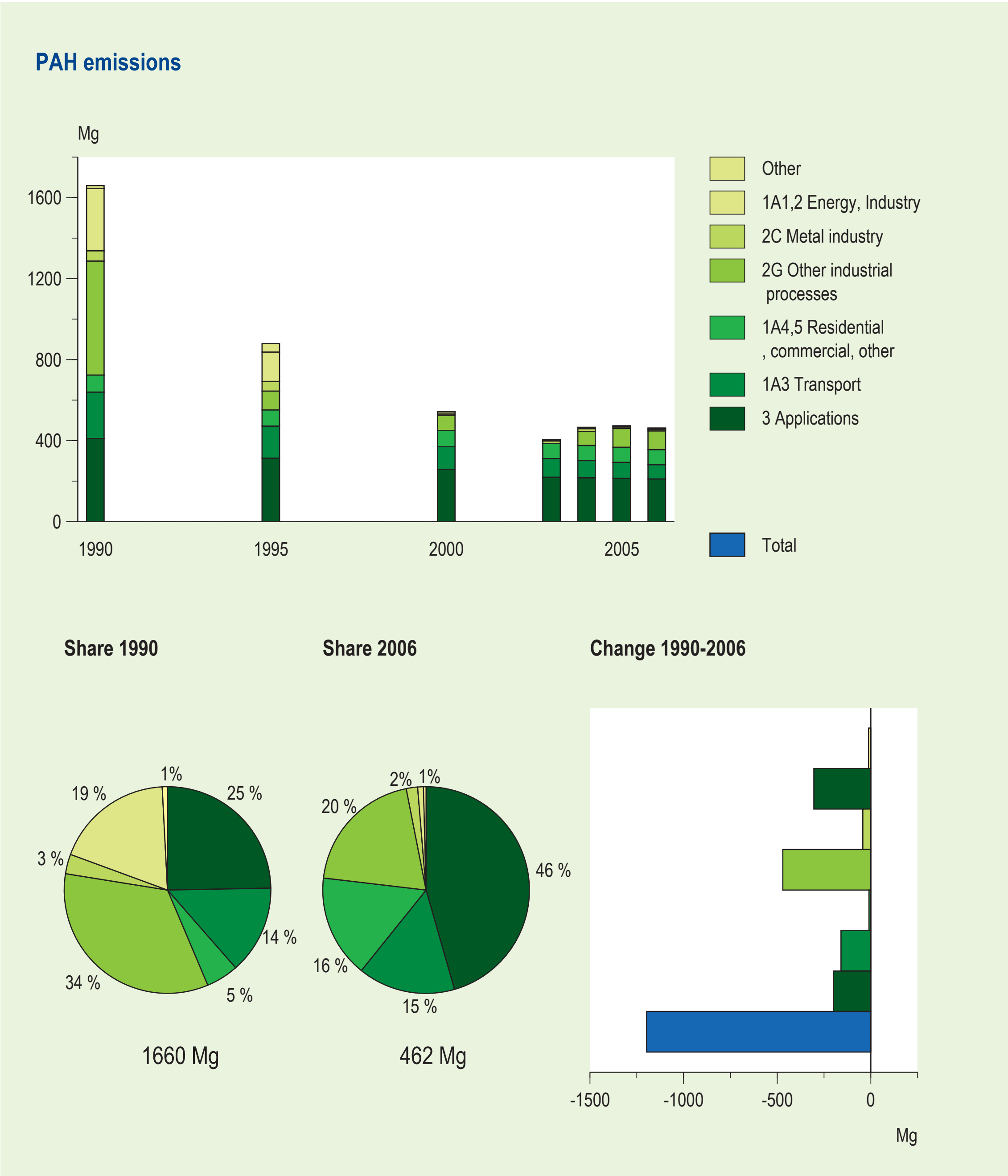

Figure 2.8 PAH, emission trend 1990-2006 and share by sector in 1990 and 2006.

The Dutch total PAH emissions are, therefore, by definition higher than the total emissions according to the NFR definition. The recommended detailed speciation is not yet available, but further actions for deriving detailed information on the individual PAH, from the PAH total, will soon be implemented, see section 1.9.

Dioxin emissions decreased by 707 g I-Teq, in the 1990 – 2006 period, corresponding to 95% of the national total in 1990 (Figure 2.9). In the period after 1990 specific emission abatement, introduced into all waste-incineration plants, 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).

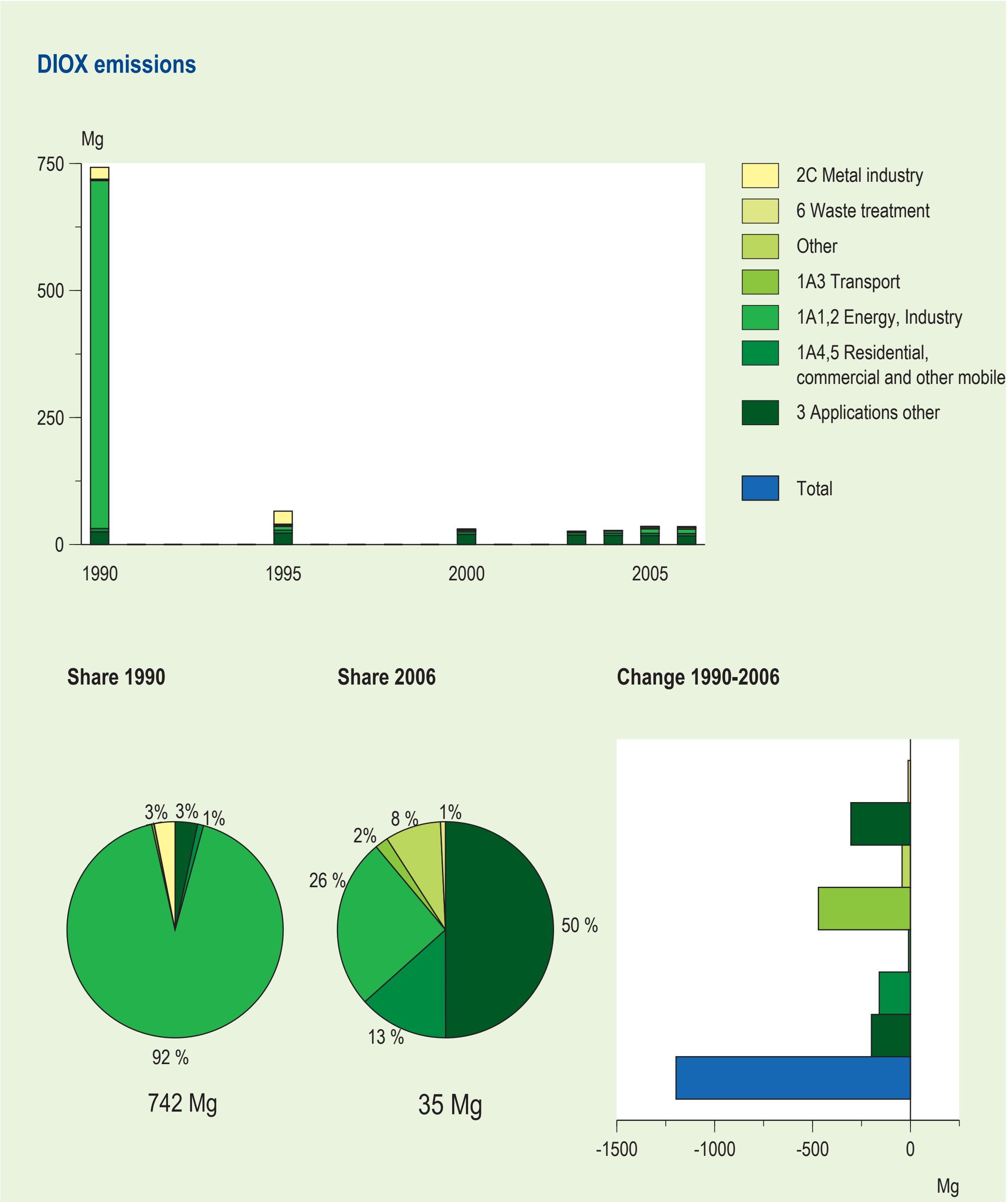

Figure 2.9 Dioxins, emission trend in 1990-2006 and share by sector in 1990 and 2006.

3 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.

Emission = [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; for diffuse emissions: calculation of 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.

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

where:

EF = emission factor

ER-I = Emission Registration database for individual companies

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

$$\text{ER-I\_SBI\_emission}_{\text{(SBI category, fuel type)}} = \text{EF ER-I}_{\text{(SBI category, fuel type)}} \times \text{Energy NEH}_{\text{(SBI category, fuel type)}}$$

For sectors without individual registration of emissions (e.g. residential and agricultural sectors), a set of specific emission factors is used (see section 3.3).

3.1 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 2006):

SO_x	(15.9%)
NO_x	(13.2%)
CO	(1.4%)
TSP	(1.6%)
$PM_{2.5}$	(1.8%)
Hg	(41.2%)
Cd	(4.2%)
DIOX	(1.8%)

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 in 2006):

SO_x	(39.8%)
NO_x	(2.9%)
TSP	(4.0%)
PM_{10}	(4.3%)
$PM_{2.5}$	(6.3%)

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

3.2 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 in 2006):

SO_x	(4.8%)
NO_x	(2.0%)
CO	(12.7%)
DIOX	(19.6%)

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 in 2006):

SO_x	(6.5%)
CO	(0.8%)

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 in 2006):

SO_x	(6.6%)
NO_x	(4.9%)
CO	(3.8%)
DIOX	(2.1%)

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.
Category 1A2e is a key source for the following components (% of national total in 2006):

CO	(1.0%)
TSP	(2.8%)
PM_{10}	(3.2%)
$PM_{2.5}$	(1.0%)

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 in 2006):

SO_x	(5.3%)
NO_x	(6.7%)
NMVOC	(1.4%)
CO	(2.1%)
TSP	(2.6%)
PM_{10}	(3.0%)
$PM_{2.5}$	(5.2%)
PAH	(1.5%)

3.3 Other sectors (IA4)

Commercial / institutional (1A4a)

Combustion emissions from the commercial and institutional sector are based on fuel consumption data (Statistics Netherlands) and emission factors (see Table 3.1.).

Table 3.1 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 Van Soest-Vercammen et al. (2002)

Category 1A4a is a key source for the following components (% of national total in 2006):

NO_x	(4.7%)

Residential (1A4b)

1A4b1 Residential plants

Combustion emissions of central heating, hot water and cooking are based on fuel consumption data (Statistics Netherlands) and emission factors (see Table 3.2.). 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 3.2 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 Van Soest-Vercammen et al. (2002)

Category 1A4b1 is a key source for the following components (% of national total in 2006):

NO_x	(4.6%)
NMVOC	(5.2%)
CO	(10.4%)
TSP	(7.5%)
PM_{10}	(4.9%)
$PM_{2.5}$	(8.2%)
Pb	(6.4%)
Cd	(3.5%)
DIOX	(11.9%)
PAH	(14.0%)

1A4b2 Household and gardening (mobile)
Emissions are included in category 1A4b1 and can not be separated due to lack of specific fuel data on this level.

Agriculture / forestry / fishing (1A4c)

1A4c1 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 3.3).

Table 3.3 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

See table on NO_x emission factors in Van Soest-Vercammen et al. (2002)

Category 1A4c1 is a key source for the following components (% of national total in 2006):

NO_x	(3.9%)
NMVOC	(0.9%)

1A4c2 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 fuel consumption and emission factors (g/kg fuel). Fuel consumption data for private farm machinery is provided by the Agricultural Economics Research

Institute LEI, while data for agricultural machinery from rental agencies is provided by Statistics Netherlands. Fuel consumption in the construction 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 gas oil used according to the Netherlands Energy Statistics minus the gas oil use 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 1A4c2 is a key source for the following components (% of national total in 2006):

SO_x	(2.4%)
NO_x	(5.4%)
NMVOC	(1.3%)
CO	(2.1%)
TSP	(3.0%)
PM_{10}	(3.5%)
$PM_{2.5}$	(6.1%)
PAH	(1.4%)

1A4c3 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 vessel movements. Emission factors for CO, NO_x, (NM)VOC, CH_4, SO_2, and PM_{10} are derived from national research (Hulskotte and Koch, 2000; Van der Tak, 2000). NH_3 emission factors are derived from Ntziachristos and 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 1A4c3 is a key source for the following components (% of national total in 2006):

SO_x	(1.1%)
NO_x	(3.9%)
$PM_{2.5}$	(1.3%)

3.4 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.

3.5 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, vehicle and engine type and driving behaviour. These emissions are calculated on the basis of 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, emission legislation 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 vehicle emission monitoring programme by TNO (Science and Industry). The VERSIT+ model (Smit et al., 2006) is used to calculate emission factors from the emission measurement database. 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. (2007).

Traffic volume 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 consumed). 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.

1A3b1 Road transport, passenger cars
Category 13b1 is a key source for the following components (% of national total in 2006):

NO_x	(11.7%)
NH_3	(1.8%)
NMVOC	(9.4%)
CO	(34.7%)
TSP	(5.0%)
PM_{10}	(5.9%)
$PM_{2.5}$	(10.8%)
PAH	(5.5%)

1A3b2 Road transport, light duty vehicles

Category 1A3b2 is a key source for the following components (% of national total in 2006):

NO_x	(6.2%)
NMVOC	(1.3%)
CO	(2.5%)
TSP	(4.3%)
PM_{10}	(5.0%)
$PM_{2.5}$	(9.2%)
PAH	(1.9%)

1A3b3 Road transport, heavy duty vehicles

Category 1A3b3 is a key source for the following components (% of national total in 2006):

NO_x	(21.5%)
NMVOC	(2.1%)
CO	(2.3%)
TSP	(3.7%)
PM_{10}	(4.3%)
$PM_{2.5}$	(7.9%)
PAH	(5.6%)

1A3b4 Road transport, mopeds and motorcycles

Category 1A3b4 is a key source for the following components (% of national total in 2006):

NMVOC	(5.6%)
CO	(9.9%)

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 derived from the widely used method of the US Environmental Protection Agency for calculating 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 engines: idle 7%, take-off 100%, climb-out 85% and approach 30%. The equation for calculating the emissions is presented next:

$$\textbf{emission} = SUM_{p,m,f} (LTO_{p,m} \times N_p \times FUEL_{m,f} \times TIM_{p,f} \times EF_{m,f})$$

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 aircraft, as reported in the Statistical Annual Review of Amsterdam Airport Schiphol. The 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 are derived from various sources, including the DERA database (DERA, 1999) and the Federal Aviation Agency Engine Emission Database of the EPA (FAA, 1996); for smaller engines emission factors are based on EPA publication AP42 (EPA, 1985). Emissions from military use of aviation fuel are reported under the source category 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 by civilian aviation form other airports are calculated similarly to the method described above, now taking into account the number of flights per regional airport. The aircraft types were derived from their ICAO-codes and allocated to the most appropriate type present in the EMASA model. If no aircraft types are available for a certain year, the movements were indexed with the total number of flight movements as published by Statistics Netherlands. 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, 2000) 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).

1A3a2(1) Civil aviation (domestic, LTO)
No key source categories are found in this category.

1A3a2(2) Civil aviation (domestic, cruise)
Emissions are included in 1A3a2(1) 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). Emission factors for CO, VOC, NO_x and PM_{10} were derived by PBL (The Netherlands Environmental Assessment Agency) in consultation with the NS (Railways Netherlands). 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 (1A3d2)
For inland navigation energy consumption for 28 different vessel classes is calculated for the various inland waterway types and rivers in the Netherland, based on the load factor of the vessels and the speed of the vessels relative to the water. Emission factors dependent on energy consumption were derived by Oonk et al. (2003). Emission factors are dependent on year of construction of the engine 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. The above calculation is done with the EMS-model, which is managed by TNO (Hulskotte et al., 2003).

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 1A3d2 is a key source for the following components (% of national total in 2006):

SO_x	(1.2%)
NO_x	(4.1%)
NMVOC	(1.9%)
CO	(3.7%)
PM_{10}	(1.5%)
$PM_{2.5}$	(2.6%)

Other (1A3e)
No emissions are reported in this category and the subcategories 1A3e1 *Pipeline compressors* and 1A3e2 *Other mobile sources and machinery*.

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

Road transport, gasoline evaporation (1A3b5)

VOC emissions from gasoline evaporation originate from diurnal losses, hot soak losses and running losses. The calculation of evaporative emissions is based on the simpler (Tier 2) methodology from the Emission Inventory Guidebook 2007 (EEA, 2007). The Guidebook provides specific emission factors for different vehicle size classes, temperature ranges in winter and summer and fuel vapour pressures. Data on vehicle numbers and vehicle use are derived from Statistics Netherlands. 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 3.4).

Table 3.4 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 1A3b5 is a key source for the following components (% of national total in 2006):

NMVOC	(2.5%)

Road transport, automobile tyre and brake wear (1A3b6)

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 49%. Heavy metal emissions are calculated using a speciation profile on total particulate emissions.

Category 1A3b6 is a key source for the following components (% of national total in 2006):

TSP	(3.2%)
PM_{10}	(3.8%)
$PM_{2.5}$	(2.0%)
Pb	(16.4%)

Road transport, automobile road abrasion (1A3b7)

The same method is applied as for category 1A3b6 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 1A3b7 is a key source for the following components (% of national total in 2006):

TSP	(2.8%)
PM_{10}	(3.3%)

3.7 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 in 2006):

NMVOC	(3.8%)

4 Industry (2)

Industrial process emissions are based on environmental reports of large industries or extrapolations to total emissions per SBI category, using implied emission factors and production data (method 1), or they are based on sectoral reports on emissions (method 2), or they are based on 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 PRTR on their measurement systems or emission model or which emission factors are used in the calculation model. Therefore, in some cases the PRTR 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.

4.1 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 emissions in the category 2A1 Cement production could be reported separately, because emissions in this category are derived from the environmental reports of the corresponding companies.

Cement clinker production (2A1)
Category 2A1 is a key source for the following components (% of national total in 2006):

Hg	(12.2%)

Other mineral products, including non-fuel mining and construction (2A7)
Category 2A7 is a key source for SO_2 and Pb emissions. The SO_2 emissions reported in this category originate 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 the 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 in 2006):

SO_x	(1.5%)	SBI 261 Glass production (1Gg) and SBI 264 production of roof tiles (0.9 Gg in 2004)
TSP	(2.7%)	
PM_{10}	(3.2%)	
$PM_{2.5}$	(2.3%)	
Pb	(3.6%)	SBI 261 Glass production
DIOX	(8.0%)	

4.2 Chemical industry (2B)

The PRTR 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 in 2006):

NMVOC	(4.8%)
TSP	(5.9%)
PM_{10}	(3.2%)
$PM_{2.5}$	(4.4%)
Pb	(6.0%)
Hg	(5.9%)
Cd	(49.1%)

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.

4.3 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 in 2006):

CO	(8.3%)
TSP	(10.1%)
PM_{10}	(5.2%)
$PM_{2.5}$	(6.1%)
Pb	(60.4%)
Hg	(25.7%)
Cd	(40.2%)
DIOX	(3.9%)

4.4 Pulp and paper production (2D1)

Particulate matter emissions in this category are derived from the environmental reports of the companies and completed with calculations of specific emission factors multiplied by production figures (supplied by CBS).

Category 2D1 is a key source for the following component (% of national total in 2006):

PM_{10}	(1.0%)

4.5 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 components (% of national total in 2006):

NMVOC	(2.9%)
TSP	(4.3%)
PM_{10}	(3.7%)
$PM_{2.5}$	(1.1%)

4.6 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 in 2006):

NMVOC	(10.4%)
TSP	(5.1%)
PM_{10}	(5.9%)
$PM_{2.5}$	(3.1%)
PAH	(20.1%)

5 Solvents and product use (3)

5.1 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, 2007).

Category 3A is a key source for the following components (% of national total in 2006):

NMVOC	(15.5%)

5.2 Degreasing and dry cleaning (3B)

Category 3B is a key source for the following components (% of national total in 2006):

NMVOC	(3.2%)

5.3 Chemical products, manufacture and processing (3C)

No key sources in this category.

5.4 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.

Based on Bremmer et al. (1993) dioxin emissions by wooden house frames are determined for 1990. Since PCP has been banned from 1989, a linear reduction of dioxin emission has been assumed from ca 25 g I-TEQ in 1990 to ca 20 g I-TEQ in 2000.

Category 3D is a key source for the following components (% of national total in 2006):

NMVOC	(17.5%)
TSP	(2.8%)
PM_{10}	(3.3%)
PM_{25}	(2.0%)
DIOX	(48.0%)
PAH	(45.6%)

6 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).

6.1 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 in 2006):

NH_3	(28.6%)

6.2 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 in 2006):

NH_3	(14.8%)

6.3 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 in 2006):

NH_3	(25.1%)
TSP	(5.6%)
PM_{10}	(6.5%)
$PM_{2.5}$	(2.4%)

6.4 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 in 2006):

NH_3	(12.8%)
TSP	(11.3%)
PM_{10}	(13.2%)
$PM_{2.5}$	(4.9%)

6.5 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 in 2006):

NH_3	(9.0%)
TSP	(1.7%)
PM_{10}	(2.0%)

7 Waste (6)

7.1 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 in 2006):

Hg	(11.6%)

7.2 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 used to contain some of the emissions from waste incineration. This has been corrected in the latest submission, and emissions have been transferred to the 1A1a category.

No key sources in this category.

8 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.

Category 7 is a key source for the following components (% of national total in 2006):

NH_3	(3.9%)
TSP	(3.5%)
PM_{10}	(4.1%)
$PM_{2.5}$	(6.6%)

9 Recalculations and other changes

9.1 Recalculations compared to 2007 submission

In the preparation of the 2008 submission, some methodological improvements were included in the PRTR system. This led to some recalculations, aimed at the improvement of the accuracy of the emission data for the Netherlands. Emissions were also updated on the basis of more accurate statistical information. Some emissions were reallocated (i.e. to another NFR sector). Compared to the 2007 submission, the following major changes can be distinguished:

- New data on the engine age distribution of inland shipping vessels became available from questionnaires held under barge captains. These questionnaires resulted in a downward adjustment of fuel consumption and related emissions from inland shipping.
- New measurement results of NO_x emissions from inland shipping vessels became available, which led to a downward adjustment of the NO_x emission factors used.
- A new methodology was used for calculating NMVOC evaporative emissions from road vehicles. This led to an upward adjustment of the NMVOC emissions.
- PM_{10} emission factors for storage and handling of dry bulk products were improved.
- NMVOC emissions from refineries are recalculated on the basis of improved emission factors;
- New activity data have become available on the market penetration of high efficiency boilers in households. This led to lower NO_x emissions.

Other changes result from the availability of improved statistical (activity) data.

The 2008 submission also includes $PM_{2.5}$ data. These data are derived from the PM_{10} data in the NL-PRTR. Results from a study by Visschedijk et al. (2007) have been applied for calculating the $PM_{2.5}$ fraction in PM_{10} emissions.

9.2 Developments in emission insights and estimates

Since committing to the goals of the NEC ceiling directive, in 2001, the insights into 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 this discussion.

In the IIR 2007 (Jimmink et al., 2007) it was noted that when all evolving insights between 2000 and 2006 (new policy excluded) were totaled over the sectors, the remaining policy efforts for all NEC substances had decreased, since 2000.

In February 2008, the Netherlands submitted a revised prognosis to UNECE (Table 9.1)

Table 9.1 2008 Submission of the Netherlands prognosis

Pollutant	unit		Current legislation projections			Current reduction plans	
		2010	2015	2020	2010	2015	2020
Sulphur oxides (SO_x as SO_2)	Gg	51 [a]	55	57	49	50	51
Nitrogen oxides (NO_x as NO_2)	Gg	261	233	218	261	228	205
Non-methane volatile organic compounds (NMVOC) [b]	Gg	157	161	165	NA	NA	NA
Ammonia (NH_3)	Gg	123	133	143	123	133	143

a) According to the Netherlands Environmental Assessment Agency (PBL), the projected emission for 2010 for SO_2 is 53 Gg.

b) Projections for NMVOC are under construction (only available for current legislation)

- Compared to the prognosis submitted in 2007, NMVOC current legislation projections for 2015 and 2020 have been added and minor improvements were noted for other substances.

9.3 Improvements

In the IIR 2007 (Jimmink et al., 2007) – and in response to the review of the 2007 submission to the LRTAP Convention – the Netherlands reported a number of planned improvements for the following submissions. The status of these improvements is given below.

Improvements included in 2008 submission and IIR 2008:
Results of the new VERSIT+ model for calculating the emissions from the traffic and transport sector have been included. NO_x, PM_{10} and NMVOC emissions have decreased by about 5%. New activity data for this sector has also been included.

Emission series for inland shipping have been adjusted on the basis of new insights into the engine age distribution for the inland shipping fleet and new NO_x emission factors from recent measurements. These new insights make that NO_x emissions from inland shipping for the 1990 – 2006 period are 10-20% lower than those reported in 2007. In total the emission reduction amounts 3 to 7 Gg.

The PM emission series for sea shipping have been improved by application of new emission factors from recent measurements. PM emissions for the 1990 – 2006 period are about 10-20% lower than those reported in the 2007 submission. This amounts to an emission reduction of 1-1.5 Gg.

PM_{10} emission factors for storage and handling of dry bulk products were improved. This led to an emission reduction of 1 Gg for the whole period.

NMVOC emissions from refineries are recalculated on the basis of improved emission factors.

As a result , NMVOC emissions have increased by 2 Gg.

New activity data for high efficiency boilers in households have become available. As a result, NO_x emissions have decreased by about 1 Gg, in 1995, and about 4 Gg, in 2005.

Documentation of methods for all key sources of PM_{10} and $PM_{2.5}$: (Visschedijk et al., 2007)

Documentation of the emission factors (e.g., English translation of the 'Methodological report for Traffic') is available on www.prtr.nl.

Documents describing the methodologies applied in the PRTR are available on the website www.prtr.nl. At this time, improved protocols are developed, especially for SO_2, NO_x and NMVOC.

Speciation profiles for NMVOC and particulate matter: TNO has been working on this speciation on the basis of a literature search. The report is still in preparation.

Planned improvements to the inventory
A number of new insights/ improvements will be included in the upcoming inventory. As mentioned above, some of these new insights have already been included in the prognosis submitted by the Netherlands in February 2007.

In horticulture and arable farming market penetration of gas engines and use of Biox power stations was noted to be faster than previously assumed. For monitoring purposes other EFs are used than for "normal, big installations". These EFs are periodically updated.

B(a)P emissions by creosote oil application have reduced since 2000.

Based on literature research, the calculation of $_{2,5}$ emissions will be further improved.

Based on research in 2007/2008, the Netherlands expects to be able to report the individual PAH emissions, instead of total PAH emissions.

NMVOC emissions from road traffic have been changed by application of an updated European methodology for calculation of evaporative emissions from vehicles. NMVOC emissions are, therefore, about 15-20% higher than those in the 2007 submission.

The consistency in the use of notation keys for the NFR agriculture submission will be further improved.

The submission of PM_{10} in category 4G contains a doubling. This will be corrected.

Recalculations of agricultural NH_3 emissions from 1998 and before are available.

Animal numbers and implied emission factors will be added to improve documentation of agricultural NH_3 emissions.

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Emissions from the Netherlands:
"How are we doing?"

The Netherlands' Informative Inventory Report (IIR) contains information on emission inventories in the Netherlands up to 2006, describing methods, data sources, QA/QC activities carried out and a trend analysis. Its aim is to provide a better view on applicability (transparency between countries, modelled air quality) and accountability (transparency, completeness, consistency, strengths and weaknesses in methods, uncertainties) of emission data. So basically, it's useful for inventory reviewers, modellers and emission experts in general.

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