Netherlands Informative Inventory Report 2009

Policy Studies

Netherlands Environmental Assessment Agency

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In cooperation with:
Netherlands Organisation for Applied Scientific Research (TNO)

Netherlands Environmental Assessment Agency

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PBL publication number 500080015

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The Netherlands Environmental Assessment Agency (PBL) is the national institute for strategic policy analysis in the field of environment, nature and spatial planning. We contribute to improving the quality of political and administrative decision-making by conducting outlook studies, analyses and evaluations in which an integrated approach is considered paramount. Policy relevance is the prime concern in all our studies. We conduct solicited and unsolicited research that is both independent and always scientifically sound.

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Rapport in het kort

Emissies van luchtverontreinigende stoffen in Nederland 1990-2007

Dit rapport over de Nederlandse inventarisatie van grootschalige luchtverontreinigende stoffen licht de 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 door Nederland gerapporteerde emissiecijfers zijn te vinden op de EMEP[2]-website: http://www.emep-emissions.at/ (EMEP data) en www.emissieregistratie.nl.

De IIR 2009 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. In de periode 1990 – 2007 vertonen de emissies van SO_2, NO_x, NMVOC, CO, NH_3, zware metalen en POPs een neerwaartse trend. De belangrijkste oorzaken van deze trend zijn emissiereductiemaatregelen in industriële sectoren, schonere brandstoffen en schonere auto's.

1 National Emissions Ceilings Directive.

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

Contents

Summary

This report, constituting the Netherlands Informative Inventory Report (IIR), contains information on the inventories in the Netherlands, from 1990 up to 2007 (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).

In the 1990 – 2007 period emissions of SO_2, NO_x, NMVOC, CO, NH_3, heavy metals and POPs 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 to 2007 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).

Introduction

1

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, 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) 2009 contains information on the Netherlands' inventories for the years 1990 to 2007, 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.

1.1 National inventory background

Emissions in the Netherlands are registered in the Pollutant Release and Transfer Register (PRTR), the national database for target group monitoring, set up to monitor pollutants within the framework of National Emission Ceilings (EU) and the Convention on Long-range Transboundary Air Pollution (CLRTAP). Since then the PRTR database has been 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). PRTR encompasses the process of data collection, data processing, registration and reporting on emission data for some 350 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.

1.2 Institutional arrangements for inventory preparation

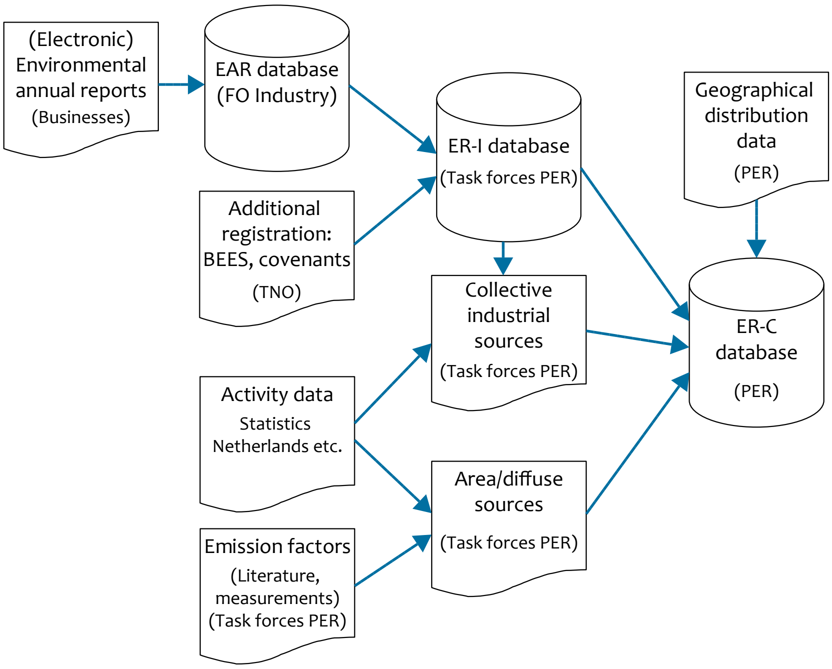
The Dutch Ministry of Housing, Spatial Planning and the Environment (VROM) has the overall responsibility for the emission inventory and submissions to CLRTAP. A Pollutant Release and Transfer Register (PRTR) system has been in operation in the Netherlands since 1974. Since April 2004 the Ministry of 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);
- Netherlands Organisation for Applied Scientific Research (TNO);
- Centre for Water Management
- Deltares
- Alterra
- 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 (see www.prtr.nl). The Informative Inventory Report (IIR) is prepared by PBL.

Data flow in the Netherlands Pollutant Release and Transfer Register (PRTR) **Figure 1.1**



The Netherlands Pollutant Emission Register

1.3 The process of inventory preparation

Data collection

For the collection and processing of data (according to pre-determined methods), the PRTR is organised in task forces. 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.

About 250 companies are legally obliged to submit an Annual Environmental Report (MJV). As from 1 January 2002, companies may submit their MJVs electronically (e-MJV). 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. Information from the Annual Environmental Reports is stored in a separate database.

Point-source emission data in the MJV database are checked for consistency 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 (Soest-Vercammen et al., 2002), while, for other substances, the Implied Emission Factors (IEFs) derived from the MJVs 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 1000), 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, by NFR category.

Key source categories for SOx, NOx, NH3 and NMVOC — Table 1.1a

Component	SO_x		NO_x		NH_3		NMVOC	
Key source categories (Sorted from high to low from top to bottom)	1B2a1	27.8%	1A3b3	22.4%	4B8	27.6%	3D	16.9%
	1A1b	22.6%	1A3b1	12.9%	4B1a	26.3%	3A	13.8%
	1A1a	14.5%	1A1a	10.8%	4B1b	14.9%	2G	11.0%
	1A2c	6.6%	1A2f	6.2%	4B9	10.8%	1A3b1	10.4%
	1A2b	6.5%	1A3d1	4.0%	4G	9.9%	1B2a1	6.9%
	1A2f	5.9%	1A3b2	6.0%	7	3.9%	1A4b1	5.2%
	1A2a	5.9%	1A4c2	5.9%	1A3b1	1.7%	1A3b4	5.1%
	1A4c2	2.4%	1A2c	4.8%			2B5	4.5%
	2A7	1.6%	1A4b1	4.5%			1B2b	3.8%
	1A3d2	1.2%	1A4a	4.2%			2D2	3.1%
	1A2e	1.1%	1A3d2	4.0%			1A3b5	2.4%
			1A4c3	4.0%			3B	2.3%
			1A4c1	3.8%			1A3d2	2.3%
Energy			1A2a	2.0%			1B2a4	1.8%
Transport			1A1b	1.8%			1A3b3	1.8%
Industry			1A1c	1.6%			1A4c2	1.3%
Solvent and product use							1A2f	1.1%
Agriculture							1A4c1	0.9%
Waste							1A3b2	0.9%
Other								
Total (%)		**96.0%**		**99.1%**		**95.2%**		**95.3%**

1.4 Methods and data sources

Methods used in the Netherlands are documented in several reports, protocols and in meta-data files, available on www.prtr.nl. However, some reports are only available in Dutch. For greenhouse gases (www.greenhousegases.nl), 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

For all components, more than 95% of national total emissions should be covered by the 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.

Key source categories for CO and particulate matter species

Table 1.1b

CO		TSP		PM_{10}		$PM_{2.5}$	
1A3b1	35.5%	4B9	12.0%	4B9	14.1%	1A3b1	11.5%
1A2a	15.9%	2C	10.3%	2D2	7.1%	1A3b2	8.7%
1A4b1	10.1%	1A4b1	7.7%	4B8	6.9%	1A4b1	8.5%
1A3b4	8.9%	2D2	7.2%	2G	6.2%	7	7.3%
2C	7.1%	4B8	5.8%	1A3b1	6.1%	1A3b3	7.1%
1A3d2	4.6%	2B5	5.5%	2C	5.7%	1A4c2	6.5%
1A2c	3.6%	2G	5.4%	1A4b1	5.0%	2C	6.5%
1A4c2	2.1%	1A3b1	5.2%	1A3b2	4.6%	4B9	5.3%
1A3b2	2.0%	1A3b2	4.0%	1A3b6	4.2%	2B5	4.4%
1A3b3	1.9%	1A3b6	3.6%	7	3.9%	1A2f	4.1%
1A2f	1.6%	7	3.3%	1A3b3	3.8%	2G	3.4%
1A1a	1.1%	1A3b3	3.2%	1A4c2	3.6%	1B2a1	3.3%
1B2a1	0.9%	1A4c2	3.1%	3D	3.6%	4B8	2.6%
		3D	3.0%	2A7	3.3%	2A7	2.5%
		1B2a1	2.8%	1A3b7	3.2%	1A3d2	2.4%
		2A7	2.8%	2B5	3.2%	3D	2.2%
		1A3b7	2.7%	1B2a1	2.9%	2D2	2.2%
		4B1	2.0%	4B1	2.3%	1A1b	1.7%
		1A2f	2.0%	1A2f	2.3%	1A1a	1.6%
		1A1a	1.4%	1A3d2	1.3%	1A3b6	1.4%
		1A3d2	1.1%	2D1	1.1%	1A4c3	1.3%
		1A1b	0.9%	4G	1.0%	1A3b7	0.9%
	95.4%		**95.2%**		**95.5%**		**95.5%**

Key source categories for Pb, Hg, Cd, DIOX and PAH

Table 1.1c

Pb		Hg		Cd		DIOX		PAH	
2C	58.2%	1A1a	48.4%	2B5	53.5%	3D	66.5%	3D	32.7%
1A3b6	16.4%	2C	30.5%	2C	37.1%	1A4b1	17.0%	2G	27.9%
2B5	6.5%	6C	12.1%	1A1a	3.7%	1A2a	7.7%	1A4b1	16.8%
1A4b1	6.4%	2B5	5.1%	1A4b1	3.1%	1A2b	1.7%	1A3b1	6.9%
1A3a2	6.2%					1A1a	1.3%	1A3b3	5.8%
2A7	4.6%					1A3b1	1.1%	1A3b2	1.8%
								1A4c2	1.7%
								1A3b4	1.5%
	98.4%		**96.0%**		**97.5%**		**95.2%**		**95.1%**

1.6 Reporting, QA/QC and archiving

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

QA/QC
PBL and therefore the PRTR have been ISO 9001:2000 certified for many years. However on 1 January 2009, PBL did not renew its certification, because of a merger with another institution. On 1 January 2009, the PRTR is expected to return to the National Institute for Public Health and the Environment (RIVM) and consequently renew its certification. QA/QC, documentation and archiving are 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 2009 inventory the PRTR task forces filled in a standard-format database with emission data for 1990 to 2007. 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 (facilities). 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.

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 uncertainty 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 diffuse 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.

1.7.1 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

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 to 2007 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 in all sector background tables:

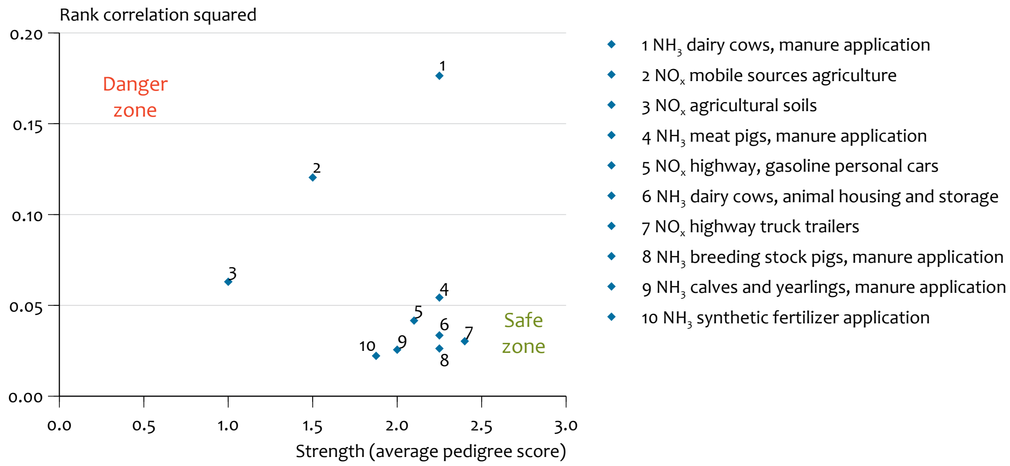
- *annual changes in emissions;*
- *annual changes in activity data;*
- *annual changes in implied emission factors and*
- *level values of implied emission factors.*

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.

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) **Table 1.2**

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%

Diagnostic diagram acidifying equivalents **Figure 1.2**



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

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.

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 2.1). 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).

1.8 Explanation on the use of notation keys

The Dutch emission inventory covers all relevant sources 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

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
1 A 4 c i	DIOX	Not in PRTR
2B	DIOX	Not in PRTR
All	HCB	Not yet in PRTR

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	

tables (NFR). These notation keys will be explained in tables 1.3 – 1.5.

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 specify 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 specified PAHs (Alkemade et al., 2005). These recommendations have been further elaborated on by TNO, but still have to be implemented in the PRTR. The Netherlands aims at including the specified substances in the submission for 2010.

Trends in emissions

2

2.1 Trends in national emissions

The emissions of all substances showed a downward trend in the 1990-2007 period (see Table 2.1). The major overall drivers for this trend are:

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

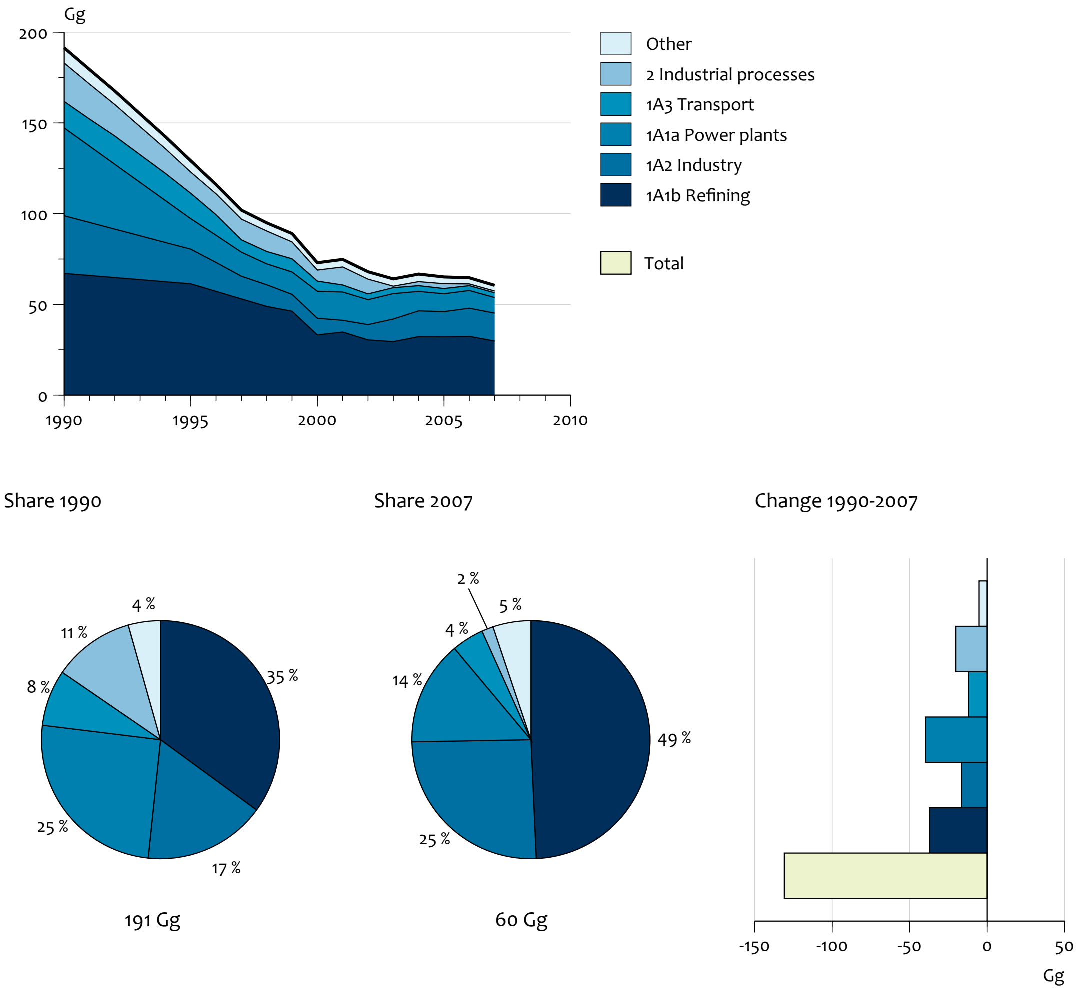
European regulations for road traffic emissions have caused a decrease in vehicle emissions of 79% since 1990 for NMVOC, 53% for particulate matter, 51% for NO_x and 95% for SO_2, despite a growth in traffic of 33%. For particulate matter and NO_x, standards have been set for installations by tightening 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 58% 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.

Total national emissions, 1990-2007 **Table 2.1**

	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	560	1077	459	191	250	96	75	46	338	2.1	3.5
1995	460	809	319	129	193	71	55	34	162	1.1	1.2
2000	398	655	224	73	152	51	45	26	36	1.0	0.9
2005	343	563	173	65	133	45	38	22	39	1.7	0.8
2006	327	553	167	65	130	44	38	21	39	1.9	0.8
2007	300	535	165	60	133	43	37	20	39	1.9	0.7
period 1990-2007, abs	-260	-542	-294	-131	-117	-53	-38	-26	-299	0	-3
period 1990-2007, %1990	-46%	-50%	-64%	-68%	-47%	-55%	-50%	-56%	-88%	-8%	-81%

	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	1551	34000	1.5	9.9	70.9	75.3	0.4	224.6
1995	66	788	29000	1.0	6.6	72.7	86.6	0.3	145.7
2000	31	454	24000	1.1	3.1	77.9	18.8	0.5	96.4
2005	36	393	20750	1.5	2.2	82.9	10.7	2.4	89.7
2006	26	398	20100	0.7	2.2	83.5	10.0	0.7	97.1
2007	25	388	19400	0.7	2.2	83.5	10.0	0.7	91.4
period 1990-2007, abs	-717	-1153	-13900	-0.7	-7.7	12.5	-65.3	0.4	-128
period 1990-2007, %1990	-97%	-74%	-41%	-50%	-78%	18%	-87%	91%	-57%

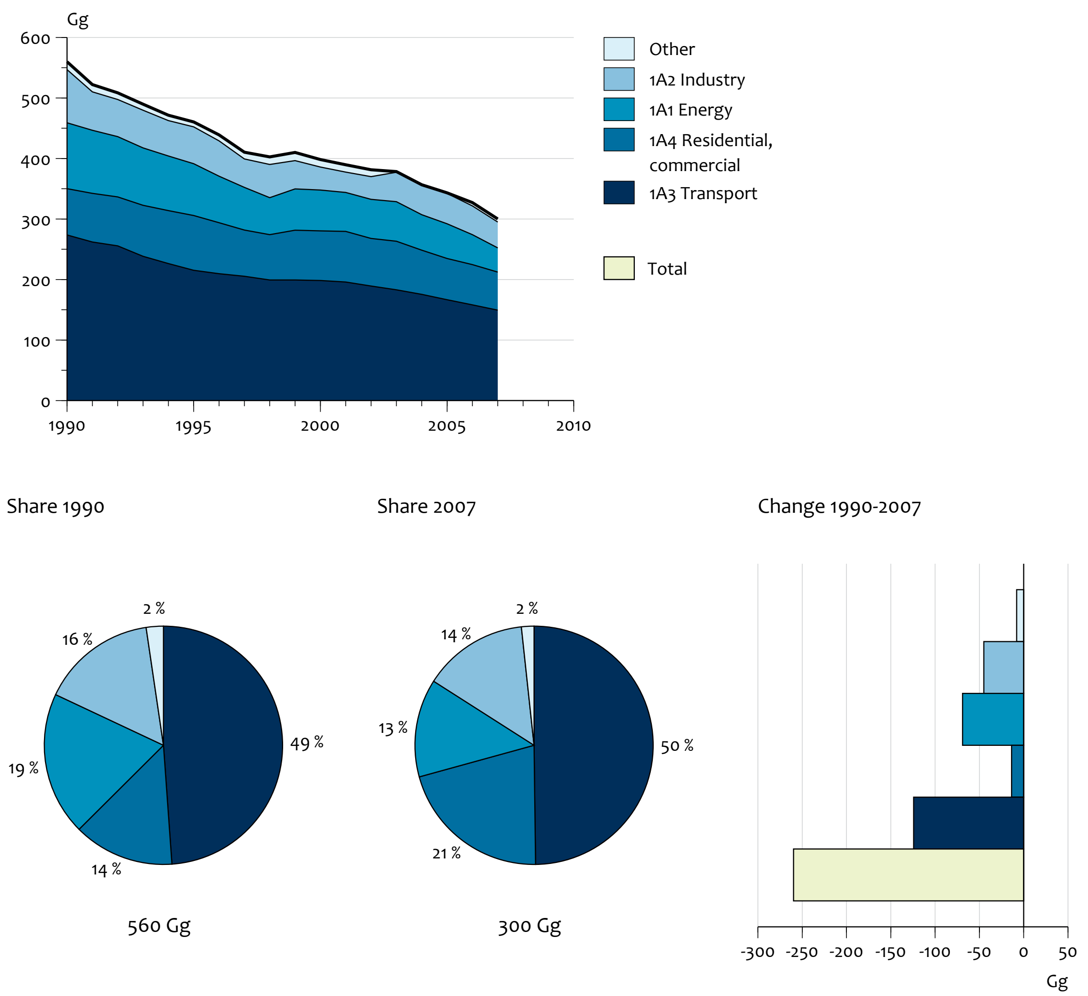
SO_2 emissions **Figure 2.1**



SO2, emission trend 1990-2007 and share by sector in 1990 and 2007

2.2 Trends for sulphur dioxide (SO_2)

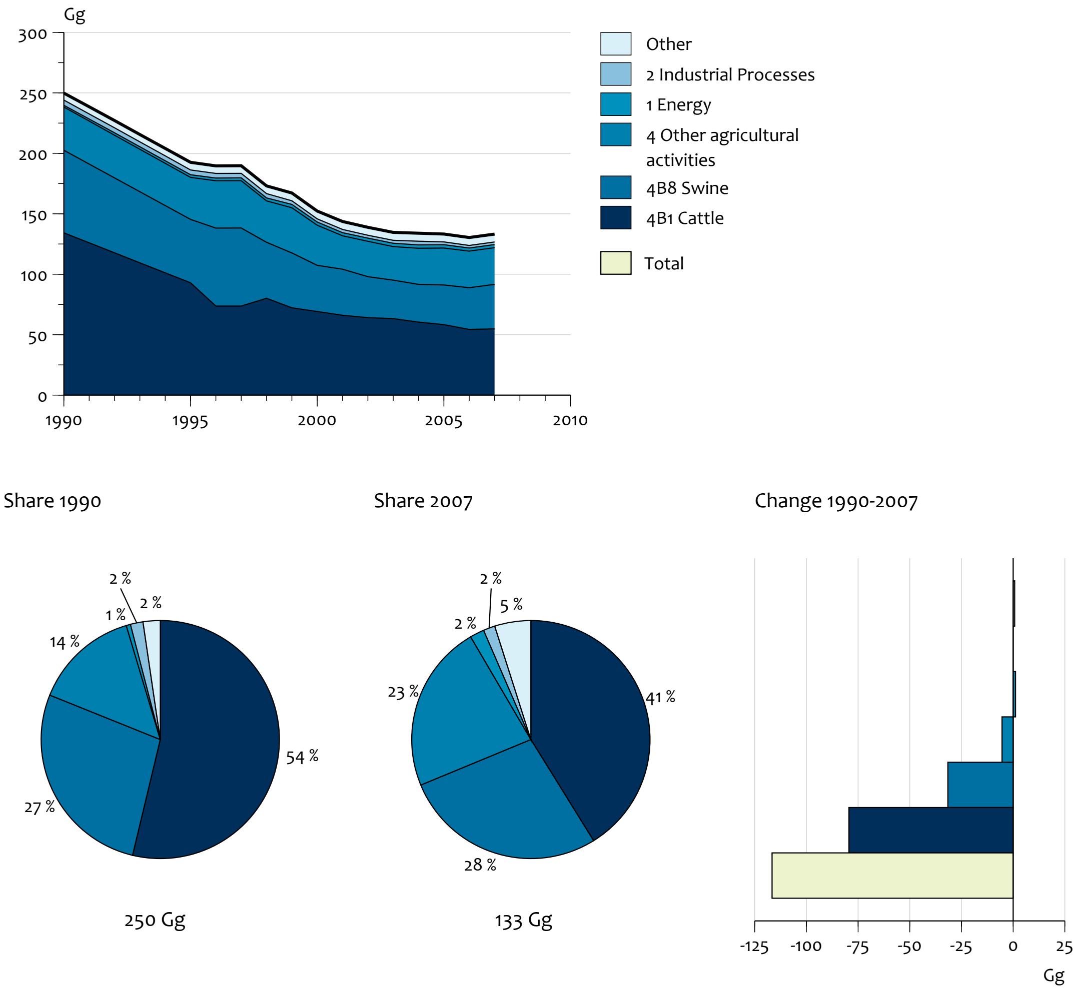
The Dutch SO_x emissions (reported as SO_2) decreased by 131 Gg, in the 1990-2007 period, corresponding to 68% of the national total in 1990 (Figure 2.1). Main contributions to this decrease came from the energy, industry and transport sectors. The use of coal declined and major coal-fired electricity producers installed flue-gas desulphurisation plants. The sulphur content in fuels for the (chemical) industry and traffic was also reduced. At present the industry, energy and refining sector (IER) is responsible for 90% of the national SO_2 emissions.



NOx, emission trend 1990-2007 and share by sector in 1990 and 200

2.3 Trends for nitrogen oxides (NO_x)

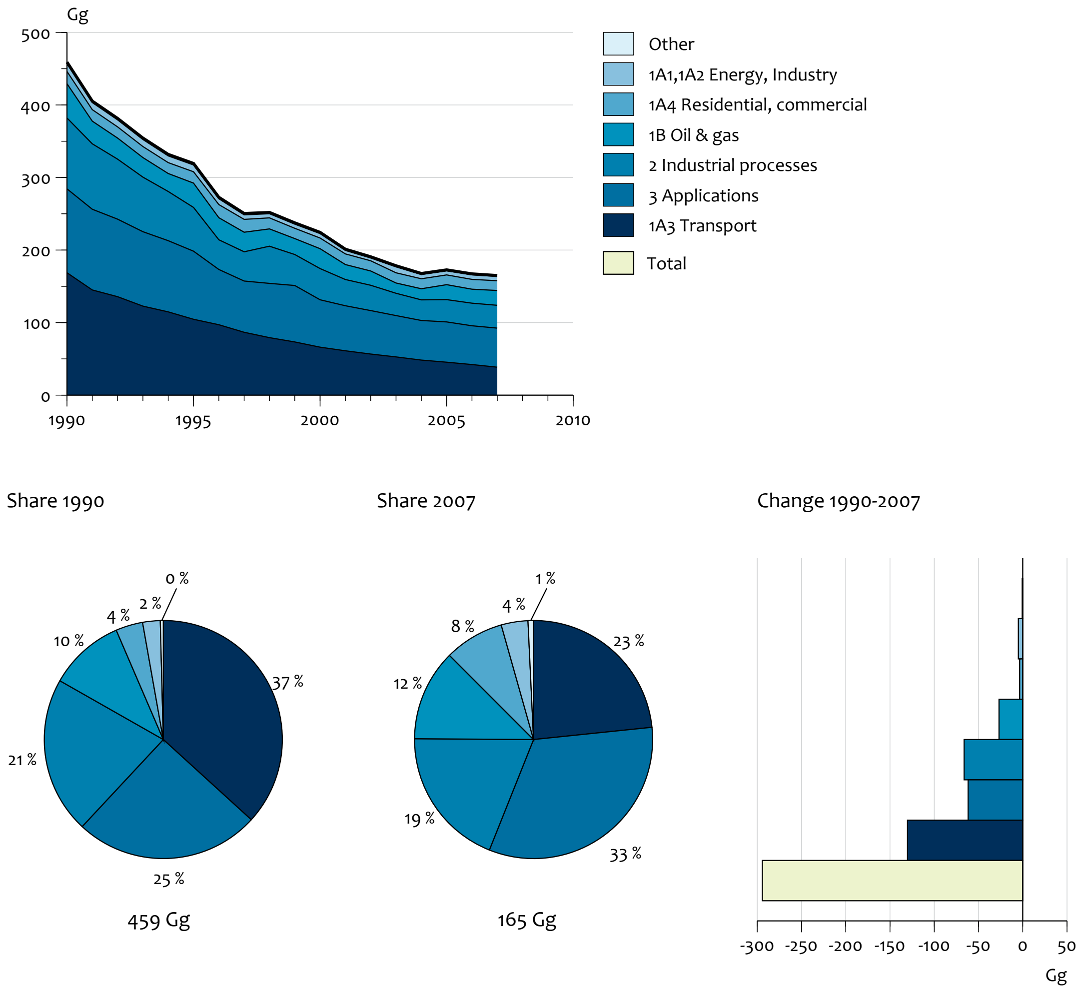
The Dutch NO_x emissions (NO and NO_2, expressed as NO_2) decreased by 260 Gg, in the 1990-2007 period, corresponding to 46% of the national total in 1990 (Figure 2.2). Main contributors to this decrease were the road-transport and energy sectors. The emissions per vehicle decreased significantly in 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.



NH3, emission trend 1990-2007 and share by sector in 1990 and 2007

2.4 Trends for ammonia (NH_3)

The Dutch NH_3 emissions decreased by 117 Gg, in the 1990-2007 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. At present over 90% of Dutch NH_3 emissions come from agricultural sources.

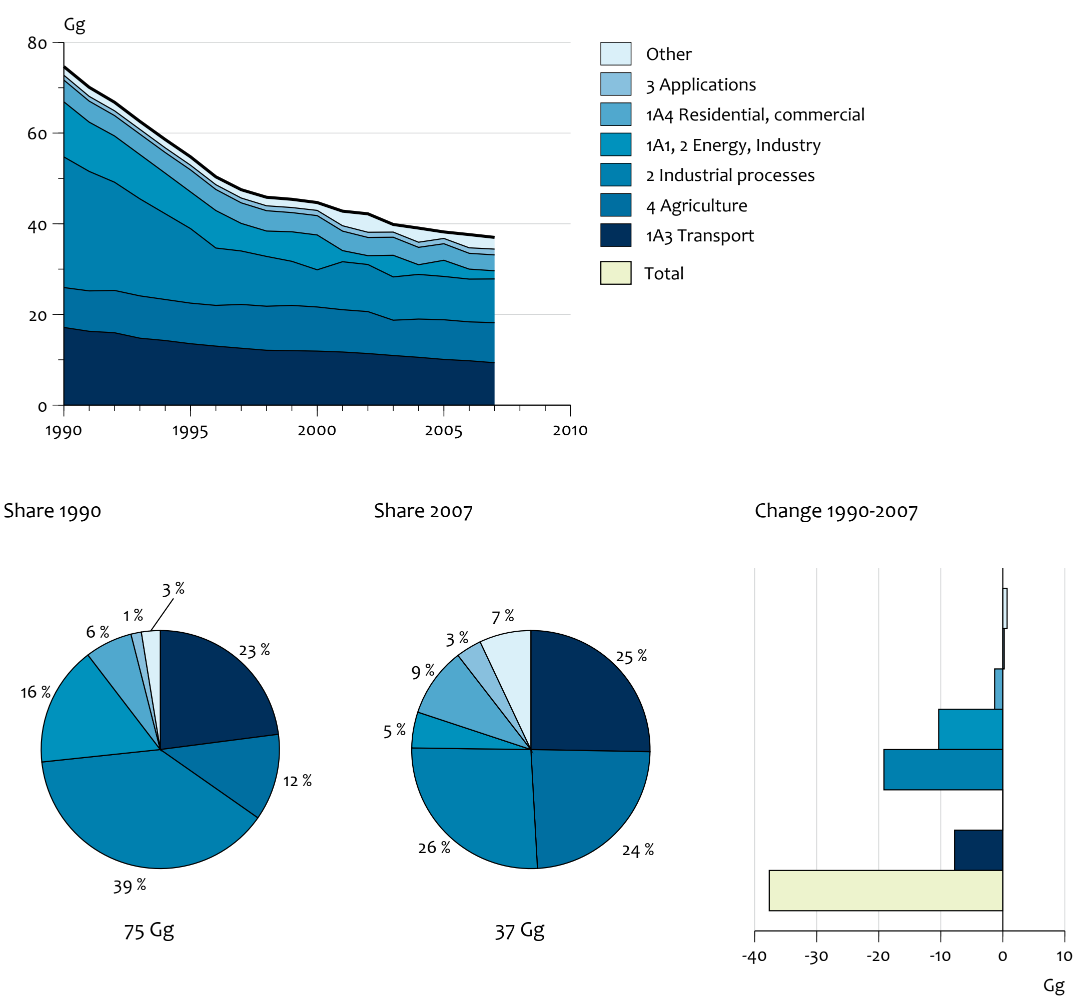


NMVOC, emission trend for 1990-2007 and share by sector in 1990 and 2007

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

The Dutch NMVOC emissions decreased by 294 Gg, in the 1990-2007 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).

PM10 emissions **Figure 2.5**



PM10, emission trend 1990-2007 and share by sector in 1990 and 200

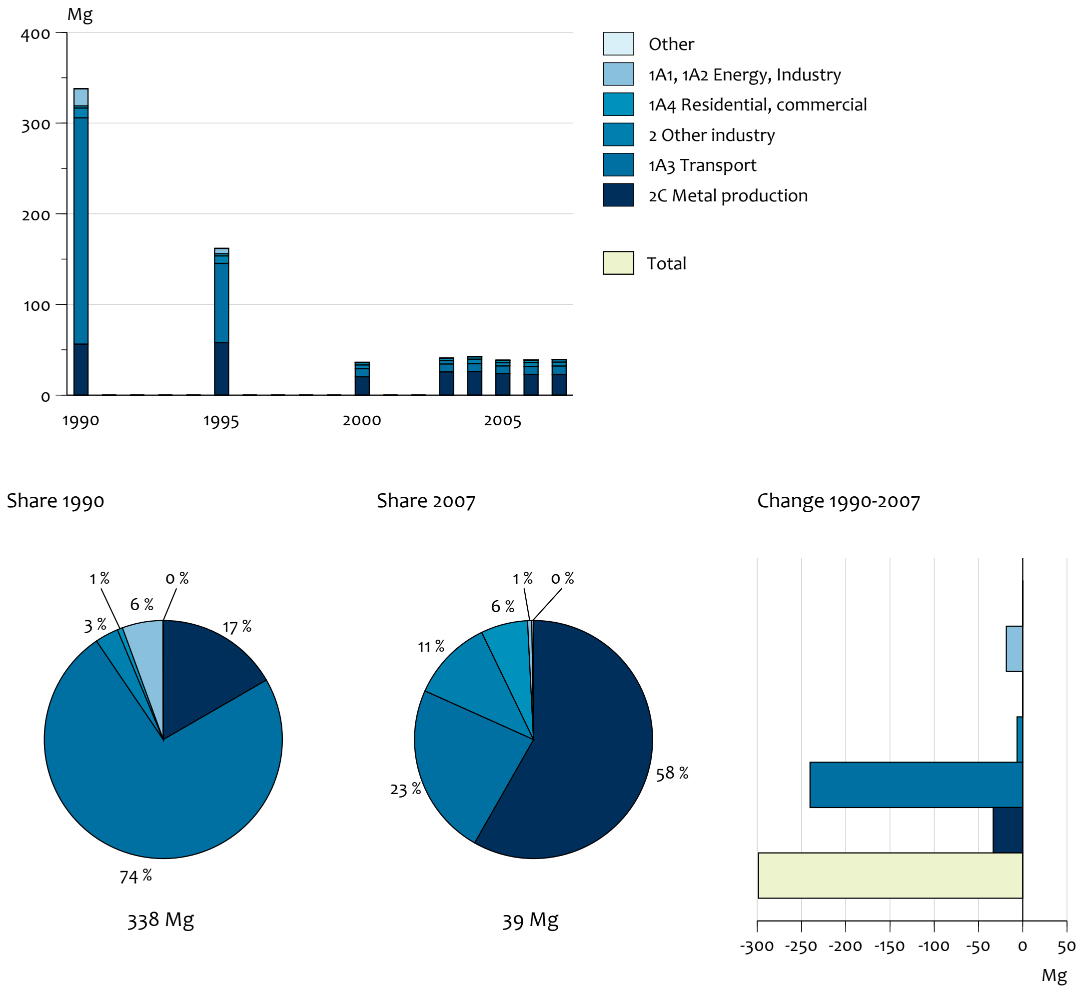
2.6 Trends for particulate matter (PM_{10})

Dutch PM_{10} emissions decreased by 38 Gg, in the 1990-2007 period, corresponding with 50% 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

The emissions from animal husbandry in agriculture did not change significantly; neither did the emissions from consumers (1A4b1). $PM_{2.5}$ emissions are also included in the 2009 submission to UNECE. These emissions are calculated as a specific fraction of PM_{10} by sector (based on Visschedijk *et al.*, 1998).

Pb emissions Figure 2.6



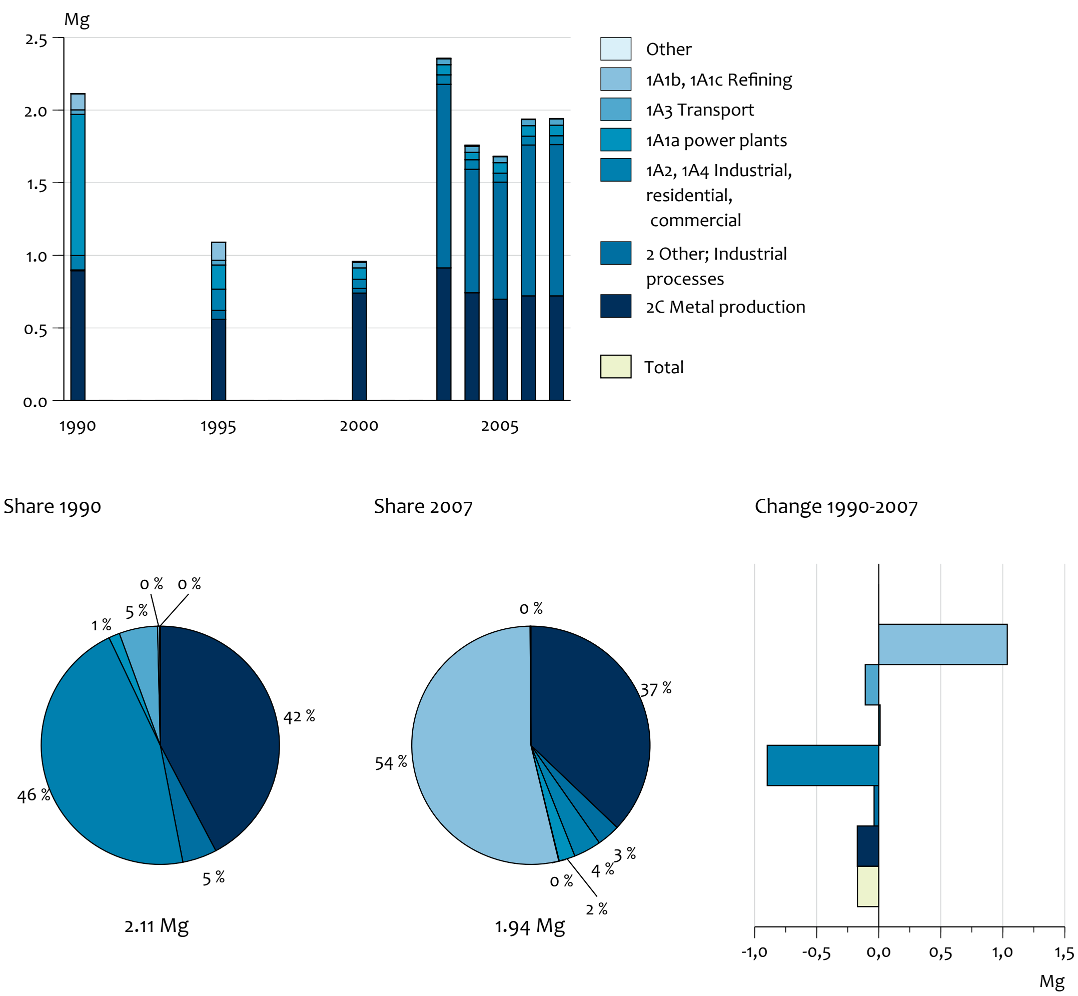
Lead (Pb), emission trend 1990-2007 and share by sector in 1990 and 2007

2.7 Trends for heavy metals (Pb and Cd)

The Dutch lead (Pb) emissions decreased by 299 Mg, in the 1990-2007 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 of Pb are the iron and steel industry, and other industry (combustion and process emissions).

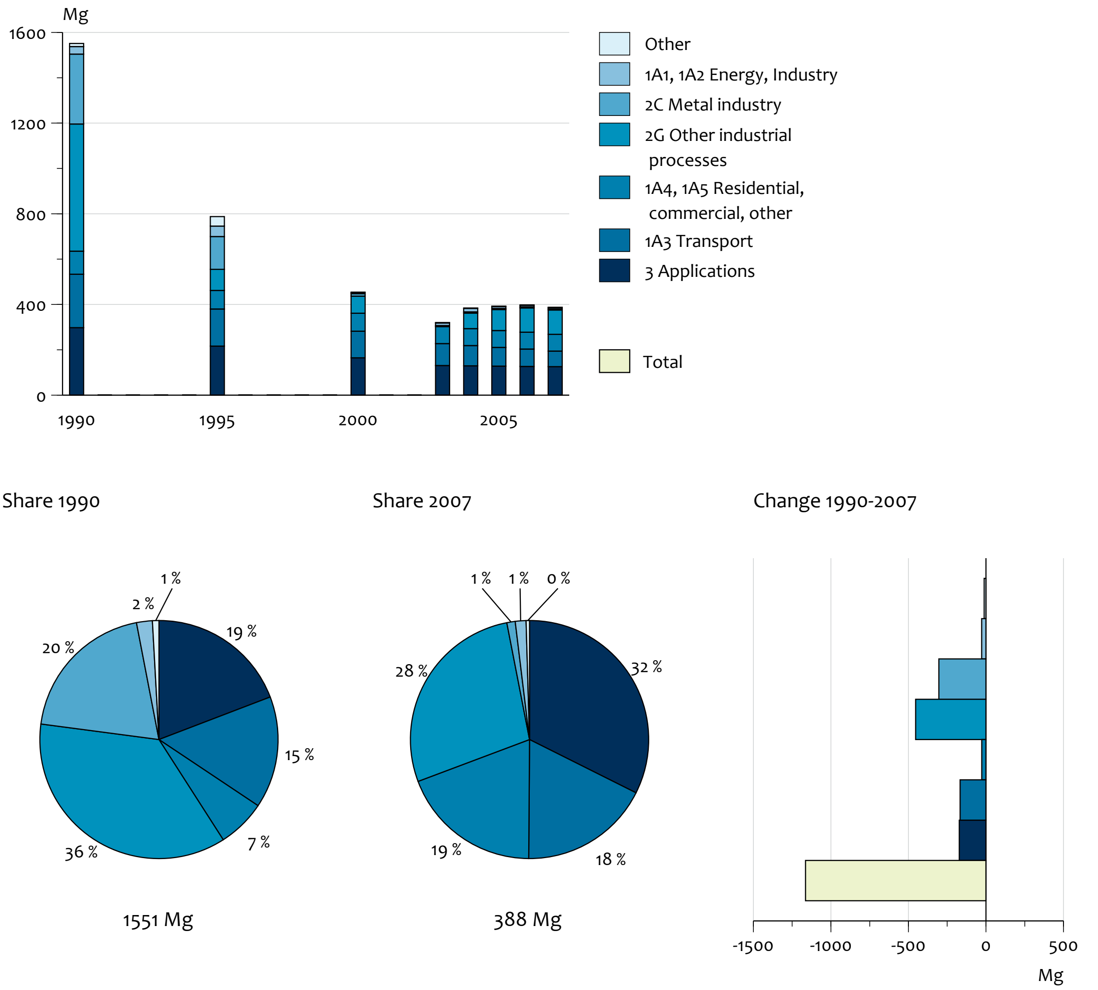
Dutch cadmium (Cd) emissions fluctuated and over the 1990 – 2007 period decreased by only 170 kg, corresponding to 8% of the national total in 1990 (Figure 2.7). In the 1990s, emissions decreased, whilst emissions rose again in 2003. The waste sector was responsible for the decrease where old incinerators 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. Major sources of Cd in the Netherlands are the chemical industry and the iron and steel industry. The higher emissions from the chemical industry, from 2001 onward, are caused by the Annual Environmental Report from one company, which started reporting in 2001.

Cd emissions **Figure 2.7**



Cadmium (Cd), emission trend 1990-2007 and share by sector in 1990 and 2007

Figure 2.8



PAH, emission trend 1990-2007 and share by sector in 1990 and 2007

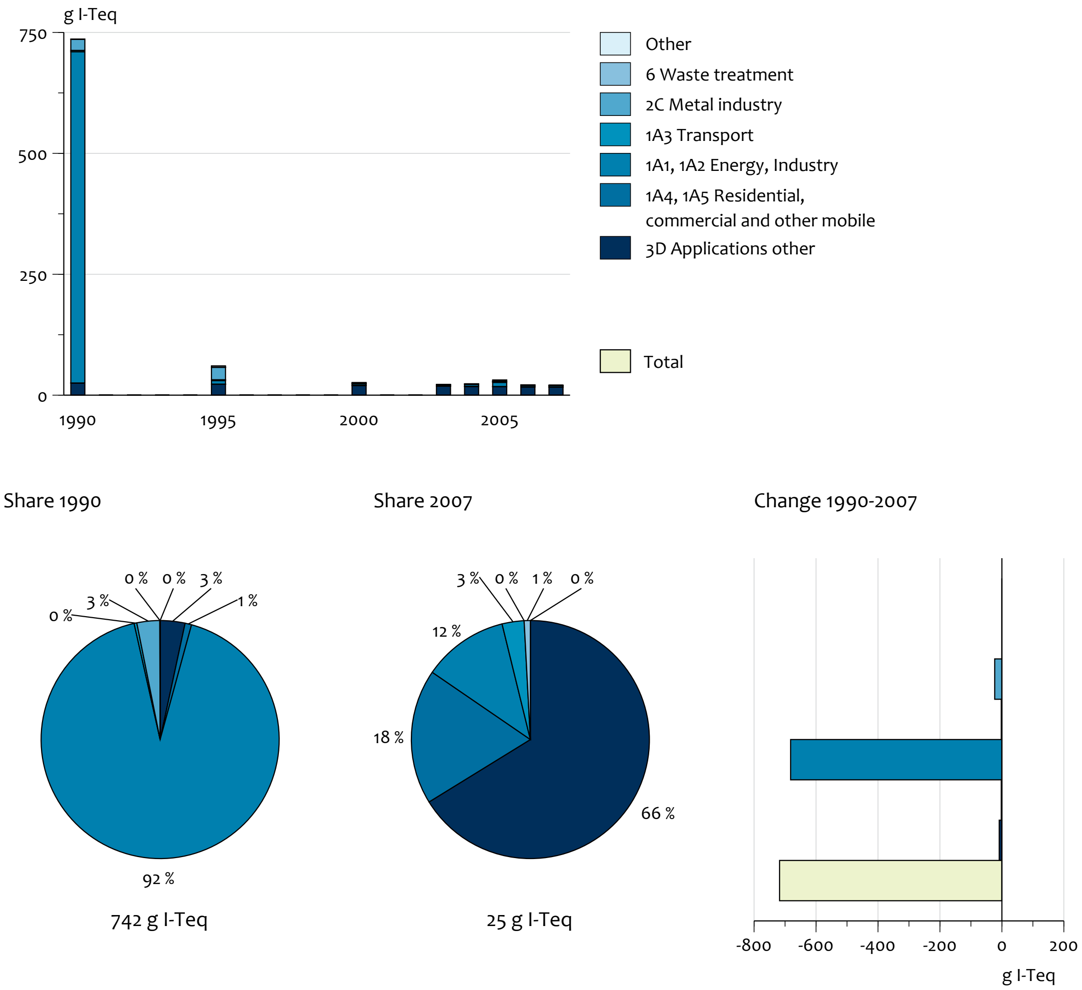
2.8 Trends for PAH and dioxins

The Dutch polycyclic aromatic hydrocarbons (PAH) emissions decreased by 1.2 Mg, in the 1990-2007 period, corresponding to 74% 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 – as in 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. 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 717 g I-Teq, in the 1990-2007 period, corresponding to 97% 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 of dioxin emission is the category product use (3).



Dioxins, emission trend in 1990-2007 and share by sector in 1990 and 2007

Energy, stationary fuel combustion (1A)

3

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 Annual Environmental Reports (MJVs) 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 MJVs 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.

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

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.

$$ER\text{-}I\_SBI\_emission_{\text{(SBI category, fuel type)}} = EF\ ER\text{-}I_{\text{(SBIcategory, fuel type)}} * Energy\ NEH_{\text{(SBI category, fuel type)}}$$

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)

3.1.1 Public electricity and heat production (1A1a)

Emission data are based on Annual Environmental 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 decribes a key source for the following components (% of national total in 2007):

SOx	(14.5%)
NOx	(10.8%)
CO	(1.1%)
TSP	(1.4%)
$PM_{2.5}$	(1.6%)
Hg	(48.4%)
Cd	(3.7%)
DIOX	(1.3%)

Petroleum refining (1A1b)

All emission data are based on Annual Environmental Reports and registered in the ER-I database.

Category 1A1b describes a key source for the following components (% of national total in 2007):

SO_x	(22.6%)
NO_x	(1.8%)
TSP	(0.9%)
$PM_{2.5}$	(1.7%)

Manufacture of solid fuels and other energy industries (1A1c)
Category 1A1c describes a key source for the following com ational total in 2007):

NO_x	(1.6%)

3.2 Manufacturing industries and construction (1A2)

Iron and steel (1A2a)
All emission data are based on Annual Environmental Reports and registered in the ER-I database.

Category 1A2a describes a key source for the following components (% of national total in 2007):

SO_x	(5.9%)
NO_x	(2.0%)
CO	(15.9%)
DIOX	(7.7%)

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

Category 1A2b describes a key source for the following components (% of national total in 2007):

SO_x	(6.5%)
DIOX	(1.7%)

Chemicals (1A2c)
Emission data are based on Annual Environmental 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 describes a key source for the following components (% of national total in 2007):

SO_x	(6.6%)
NO_x	(4.8%)
CO	(3.6%)

Pulp, paper and print (1A2d)
All emission data are based on Annual Environmental 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 Annual Environmental Reports and collectively estimated industrial sources.

Category 1A2e describes a key source for the following component (% of national total in 2007):

SO_2	(1.1%)

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 Annual Environmental Reports and collectively estimated industrial sources.

Category 1A2f describes a key source for the following components (% of national total in 2007):

SO_x	(5.9%)
NO_x	(6.2%)
NMVOC	(1.1%)
CO	(1.6%)
TSP	(2.0%)
PM_{10}	(2.3%)
$PM_{2.5}$	(4.1%)

3.3 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 3.1.).

Category 1A4a describes a key source for the following component (% of national total in 2007):

NO_x	(4.2%)

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).

Category 1A4b1 describes a key source for the following components (% of national total in 2007):

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

Table 3.1

	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)

Emission factors for combustion emissions from households (g/GJ)

Table 3.2

	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)

NO_x	(4.5%)
NMVOC	(5.2%)
CO	(10.1%)
TSP	(7.7%)
PM_{10}	(5.0%)
$PM_{2.5}$	(8.5%)
Pb	(6.4%)
Cd	(3.1%)
DIOX	(17.0%)
PAH	(16.8%)

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).

Category 1A4c1 describes a key source for the following components (% of national total in 2007):

NO_x	(3.8%)
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 describes a key source for the following components (% of national total in 2007):

SO_x	(2.4%)
NO_x	(5.9%)
NMVOC	(1.3%)
CO	(2.1%)
TSP	(3.1%)
PM_{10}	(3.6%)
$PM_{2.5}$	(6.5%)
PAH	(1.7%)
DIOX	(17.0%)
PAH	(16.8%)

Emission factors for stationary combustion emissions from agriculture (g/GJ) Table 3.3

	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 NOx emission factors in Soest-Vercammen et al. (2002)

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 describes a key source for the following components (% of national total in 2007):

NO_x	(4.0%)
$PM_{2.5}$	(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 by 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.

Road transportation, passenger cars
Category 13b1 describes a key source for the following components (% of national total in 2007):

Basis for estimating emissions from mobile sources — **Table 3.4**

NFR code	Description	Fuel sold	Fuel used
1A3a1(i)	International Aviation (LTO)		X
1A3a1(ii)	International Aviation (Cruise)		X
1A3a2(i)	1A3a2 Civil Aviation (Domestic, LTO)		X
1A3a2(ii)	1A3a2 Civil Aviation (Domestic, Cruise)		X
1A3b	Road transport ation		X
1A3c	Railways	X	
1A3d1(i)	International maritime Navigation		X
1A3d1(ii)	International inland waterways (Included in *NEC* totals only)		X
1A3d2	National Navigation		X
1A4c1	Agriculture	X	
1A4c2	Off-road Vehicles and Other Machinery	X	
1A4c3	National Fishing		X
1A5b	Other, Mobile (Including military)	X	

NO_x	(12.9%)
NH_3	(1.7%)
NMVOC	(10.4%)
CO	(35.5%)
TSP	(5.2%)
PM_{10}	(6.1%)
$PM_{2.5}$	(11.5%)
PAH	(6.9%)

1A3b2 Road transport, light duty vehicles

Category 1A3b2 describes a key source for the following components (% of national total in 2007):

NO_x	(6.0%)
NMVOC	(0.9%)
CO	(2.0%)
TSP	(4.0%)
PM_{10}	(4.6%)
$PM_{2.5}$	(8.7%)
PAH	(1.8%)

1A3b3 Road transport, heavy duty vehicles

Category 1A3b3 describes a key source for the following components (% of national total in 2007):

NO_x	(22.4%)
NMVOC	(1.8%)
CO	(1.9%)
TSP	(3.72)
PM_{10}	(3.8%)
$PM_{2.5}$	(7.1%)
PAH	(5.8%)

1A3b4 Road transport, mopeds and motorcycles

Category 1A3b4 describes a key source for the following components (% of national total in 2007):

NMVOC	(5.1%)
CO	(8.9%)
PAH	(1.5%)

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:

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

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 assigned 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 1995-1999 period 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)
Category 1A3a2 describes a key source for the following component (% of national total in 2007):

Pb	(6.2%)

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, NOx and PM10 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 describes a key source for the following components (% of national total in 2007):

SO_x	(1.2%)
NO_x	(4.0%)
NMVOC	(2.3%)
CO	(4.6%)
TSP	(1.1%)
PM_{10}	(1.3%)
$PM_{2.5}$	(2.4%)

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 3.5).

Category 1A3b5 describes a key source for the following component (% of national total in 2007):

NMVOC	(2.4%)

VOC profile for gasoline and gasoline evaporation (mass %) **Table 3.5**

	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

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 describes a key source for the following components (% of national total in 2007):

TSP	(3.6%)
PM_{10}	(4.2%)
$PM_{2.5}$	(1.4%)
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 describes a key source for the following components (% of national total in 2007):

TSP	(2.7%)
PM_{10}	(3.2%)
$PM_{2.5}$	(0.9%)

3.7 Energy, fugitive emissions from fuels (1B)

Category 1B2a1 describes a key source for the following components (% of national total in 2007):

SO_2	(27.8%)
NMVOC	(6.9%)
CO	(0.9%)
TSP	(2.8%)
PM_{10}	(2.9%)
$PM_{2.5}$	(3.3%)

Category 1B2a4 describes a key source for the following components (% of national total in 2007):

NMVOC	(1.8%)

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 describes a key source for the following components (% of national total in 2007):

NMVOC	(3.8%)

Industry (2)

4

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

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)

No key source reported for this sector.

Other mineral products, including non-fuel mining and construction (2A7)

Category 2A7 describes 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 m² 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 describes a key source for the following components (% of national total in 2007):

SO_x	(1.6%)	SBI 261 Glass production (1Gg) and SBI 264 production of roof tiles
TSP	(2.8%)	
PM_{10}	(3.3%)	
$PM_{2.5}$	(2.5%)	
Pb	(4.6%)	SBI 261 Glass production

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 describes a key source for the following components (% of national total in 2007):

NMVOC	(4.5%)
TSP	(5.5%)
PM_{10}	(3.2%)
$PM_{2.5}$	(4.4%)
Pb	(6.5%)
Hg	(5.1%)
Cd	(53.5%)

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.

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 describes a key source for the following components (% of national total in 2007):

CO	(7.1%)
TSP	(10.3%)
PM_{10}	(5.7%)
$PM_{2.5}$	(6.5%)
Pb	(58.2%)
Hg	(30.5%)
Cd	(37.1%)

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 describes a key source for the following component (% of national total in 2007):

PM_{10}	(1.1%)

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 describes a key source for the following components (% of national total in 2007):

NMVOC	(3.1%)
TSP	(7.2%)
PM_{10}	(7.1%)
$PM_{2.5}$	(2.2%)
Cd	(53.5%)

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 describes a key source for the following components (% of national total in 2007):

NMVOC	(11.0%)
TSP	(5.4%)
PM_{10}	(6.2%)
$PM_{2.5}$	(3.4%)
PAH	(27.9%)

Solvents and product use (3)

5

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 describes a key source for the following component (% of national total in 2007):

NMVOC	(13.8%)

5.2 Degreasing and dry cleaning (3B)

Category 3B describes a key source for the following component (% of national total in 2007):

NMVOC	(2.3%)

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 describes a key source for the following components (% of national total in 2007):

NMVOC	(16.9%)
TSP	(3.0%)
PM_{10}	(3.6%)
$PM_{2.5}$	(2.2%)
DIOX	(66.5%)
PAH	(32.7%)

Agriculture (4)

6

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 describes a key source for the following component (% of national total in 2007):

NH_3	(26.3%)

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 describes a key source for the following component (% of national total in 2007):

NH_3	(14.9%)

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 describes a key source for the following component (% of national total in 2007):

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 describes a key source for the following component (% of national total in 2007):

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 describes a key source for the following component (% of national total in 2007):

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 describes a key source for the following components (% of national total in 2007):

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 describes a key source for the following components (% of national total in 2007):

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

Recalculations and other changes

9

9.1 Recalculations of the 2008 submission

Compared to the 2008 submission no methodological improvements are implemented in the PRTR system. Some recalculations are made due to new insights in emission factors or the availability of more accurate statistical information. Compared to the 2008 submission, the following changes can be distinguished:

- For the subsector 1A3di(ii) 'International inland shipping' new information concerning the age distribution was derived from a recent survey of the ships engines. This resulted in a recalculation for NO_x emissions in this subsector. This recalculation resulted in a decrease of between 3 and 7 ktonnes in NO_x emissions for the 1990-2006 period;
- For the subsector 1A3dii 'National navigation', a new emission factor for PM_{10} was implemented, based on the results of a survey. This resulted in approximately 20% reduction of PM_{10} emissions (1 to 1,5 ktonnes) for the 1990-2006 period in this subsector on the Dutch continental shelf;
- For the subsector 1A3b 'Road transportation', the results of an update of the European model for calculating evaporation of NMVOC from traffic were implemented. This resulted in an increase in NMVOS emission of 6 ktonnes for this subsector in 1990, to 0.8 ktonnes in 2005
- New insights into import figures of paint led to recalculation of NMVOC for the (sub)sector 3A 'Paint application'.

The 2009 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 totalled for the sectors, the remaining policy efforts for all NEC substances had decreased, since 2000.

In January 2009, the Netherlands submitted a revised prognosis to NEC (Table 9.1)

- Compared to the prognosis submitted in 2008, reduction plans have been added and minor improvements were noted for other substances.

9.3 Improvements

Improvements included in 2009 submission and IIR 2009:

In the ER-database, the NH_3 emissions from manure applied in non-agricultural sectors are asigned to consumers.

2009 Submission of the Netherlands prognosis — **Table 9.1**

	UNIT	Current legislation projections			Current reduction plans		
Pollutant:		2010	2015	2020	2010	2015	2020
Sulphur oxides (SO_x as SO_2)	Gg	53	55	57	48	50	51
Nitrogen oxides (NO_x as NO_2)	Gg	261	233	218	261	228	205
Non-methane volatile organic compounds (NMVOC)	Gg	162	170	165	162	165	170
Ammonia (NH_3)	Gg	123	133	143	123	133	143

As before, for the Netherlands, the emissions from road transportation were calculated on the basis of 'fuel consumed'. More accurate activity data have become available, related to the amount of kilometres driven within the Netherlands; and related to the subdivision of kilometres driven on motorways, and regional and local roads;

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

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

Based on literature research, the calculation of $PM_{2,5}$ emissions improved.

NMVOC emissions from road transportation increased because of the application of an updated European methodology for calculating evaporative emissions from vehicles. Therefore, NMVOC emissions are, about 15 to 20% higher than those in the 2007 submission.

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

The submission of PM_{10} in category 4G contained a doubling. This was corrected.

Animal numbers and implied emission factors have been added to improve documentation on agricultural NH_3 emissions.

Other differences compared to former submissions stem from improved activity data.

Planned improvements to the inventory

Based on research in 2007 to 2009, the Netherlands will be able to report on the individual PAH emissions, instead of total PAH emissions.

Recalculations of agricultural NH_3 emissions from 1998 and before will become available in 2010.

For the subsector 'Commercial', 'Riding Horses' are recognised as a new emission source. A calculation for the complete reporting period will be added to the inventory.

The effects of the economic contraction are taken into account. The effects are expected to cause lower emissions projections. They will become available in the next submission in 2010.

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This investigation has been performed by order and for the account of the Directorate-General for Environmental Protection, Climate and Air Division, of the Netherlands Ministry of Spatial Plan-ning, Housing and the Environment, within the framework of project Emission Registration M/500080/IIR, 'Netherlands Pollutant Emission Register'.

Report prepared for submission in accordance with The UN Framework Convention on Long Range Transboundary Air Pollution including electronic Excel spreadsheet files containing No-menclature for Reporting (NFR) data for 1990 to 2007.

This report constituting the Netherlands Informative Inventory Report (IIR) contains information on the inventories in the Netherlands up to 2007 (see www.prtr.nl and EMEP 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 2009 submission includes emission data from the Netherlands for the years 1990 up to and including 2007. The emission data, with the exception of PM2.5 emissions, are extracted from the Dutch Emission Inventory system (PER). These data are calculated from the PM10 data and have not yet been incorporated in the PER.

In the 1990 – 2007 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 2003-2007 are recalculated annually in the Dutch inventory. Data for other years (1991-1994, 1996-1999, 2001 and 2002) have been based on interpolations..

Netherlands Environmental Assessment Agency, November 2009