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Emission Data reported to LRTAP Convention and NEC Directive. Initial review for HMs and POPs

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Inventory Review 2005

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EXECUTIVE SUMMARY

This report presents the first annual review of emissions data reported under the UNECE Convention on Long-Range Transboundary Air Pollution (LRTAP) and the National Emissions Ceilings Directive (NEC Directive) of the European Union. The review has been performed according to the recommendations from the TFEIP/EIONET meeting in 2003 (UNECE, 2004b) and 2004 (UNECE, 2005a) and the Draft methods and procedures for the technical review of air pollutant emission inventories under the Convention on Long-Range Transboundary Air Pollution (UNECE, 2005b).

The report has two main sections. The first section is an initial review of emission data for HMs and POPs reported under the LRTAP Convention, including a comparison of reported data with emissions data calculated for several pan-European emission inventories. The second section of the report comprises the second part of the Synthesis and Assessment Report. It presents an overview of the results from the 2005 review of inventory data quality. This annual review is a continuation of the trial inventory reviews that have been performed in 2003 and 2004 (e.g. Vestreng et al., 2004). In 2005, as in the two preceding trial reviews, the assessment of the inventory data has been performed on emissions data reported under both the LRTAP Convention and under the NEC Directive.

The review tests performed in 2005, and which are the focus of this report, correspond to the first two stages (initial check, and synthesis and assessment) of the proposed annual review process, as described in the draft UNECE paper on the methods and procedures for the technical review of air pollutant emission inventories under the Convention on Long-Range Transboundary Air Pollution (UNECE, 2005b). The TFEIP meeting in June 2005 proposed to initiate a further more detailed review stage on a trial and voluntary basis in 2006 to test models for the detailed reviewing of individual inventories. Further discussions are expected in the October 2005 meeting of the TFEIP in order to plan for a future detailed individual review to be included as part of the Inventory Improvement Programme under the TFEIP.

A main recommendation from this work is to continue progress towards a centralized review in order to get a step further towards the goal of increasing the accuracy of the emissions inventories. Work should be continued within the Expert Panel on Review (EPR) to define the scope of any potential Stage 3 centralized review. Such a review will necessarily depend heavily on the provision and availability of timely Informative Inventory Reports (IIR) from countries. The Expert Panel on Review should therefore continue to develop a process for an in-depth annual review. Resources in terms of both manpower and finance will need to be allocated if these aims are to be achieved.

The main messages generated from this year's review are summarised below. Further details on each issue are provided in the respective sections of the main body of the report. General recommendations arising from this year's review are summarised in the final section of the Executive Summary.

A) REVIEW OF HEAVY METALS AND PERSISTENT ORGANIC POLLUTANTS

Reliable emission data for HMs and POPs are essential to understand and control the large-scale distribution of these pollutants. On the basis of this initial assessment and review, it seems fair to conclude that current emission data for HMs and POPs are still rather uncertain and incomplete, although the official reporting of many of these components has been improved in recent years. From the inter-comparison of various emission inventories for 1990, it appears that emission data for the priority HMs may be considered more reliable than emission data for many POPs. As the current quantitative understanding of HM and POP emissions remains fragmented, there is a general concern if most of the true sources are truly captured in the current inventories.

There are significant gaps in officially reported emission data from various Parties to the CLRTAP, both in terms of spatial and temporal completeness. The reporting of official estimates is very limited before 1990, and maximum reporting is found to be from 1995 onwards for both priority POPs and HMs. Maximum reporting for POPs occurs for PAH in 1998 and is 61% of all Parties. Maximum reporting for HMs is somewhat higher, namely 67% for Pb. This reporting might consist only of a "national total" and no information on sector specific emissions. In such cases, no information for further development of emission reduction strategies is available.

We have undertaken a key source analysis of 1990 and 2003 emissions respectively. It is seen that the relative importance of emissions of PAHs and PCDD/Fs (as well as HMs) from residential plants is increasing compared with emissions from various other sources, such as metal production.

It should be recognised that relevant activities related to HM and POP emissions are being carried out within other international organisations, such as the European Union and efforts related to the UNEP Stockholm Convention on POPs. Closer co-operation with other international organisations on emissions of HMs and POPs could be beneficial, create useful synergies and avoid potential duplication of efforts.

B) BILATERAL COMMUNICATION AND TRANSPARENCY

Prior to the compilation of this report, all Parties received a country specific review document available from the web that contained country-specific questions covering various aspects of inventory quality. An example of a country specific report can by found in Appendix II. Eighteen Parties (37%) responded to the review. The responses were more extensive and useful in terms of detail than those received last year. In addition, the submission of Informative Inventory reports (IIR) also increased from 7 to 12, hence the increase in transparency was significant. Most questions related to the emission inventories could be explained by the additional information supplied from the Parties. The review team of experts would like to stress the importance (and usefulness in terms of increasing inventory transparency) of submitting an IIR. If possible, the IIR should be submitted around 1st April in due time before the country specific review is completed in order to be taken into account in that review process. The increased reporting of IIRs is most likely because a template for the IIR was provided this year.

C) RECALCULATIONS

The recalculation analysis has assessed the degree to which estimates made in the preceding reporting year (2004) have been revised in this year's reporting. The analysis of recalculations between 2005 and 2004 for twelve countries showed that the magnitude of all recalculations for all countries was below 15% of total emissions except for PAH and HCB. An example of recalculations for priority POPs is shown in Figure ES 1. POPs have generally larger recalculations than the HMs. The Dioxins are less recalculated, while HCB recalculations fluctuate a lot and are sometimes above 70%. The PAH recalculations are large (50%) and negative; the sizes of the recalculation for all selected compounds varied between 2% (SOx) to 55% (HCB). Recalculations for individual countries were in many cases larger than for the group of twelve countries. For the main pollutants covered by the Gothenburg Protocol (NOx, NMVOC, NH3 and SOx) eleven out of fourteen countries reporting recalculations reported recalculations greater than +/- 3% for any one year. In particular, Spain reported large negative recalculations for emissions of NMVOC (-44% to –33% of the previously reported emissions values for the years between 1990-2002). According to feedback received from the country during the review, the reduction is caused by suppression in the 2004 submission of biogenic NMVOC emitted by the foliar biomass of agricultural crops (as they are considered basically non-anthropogenic). Sweden reported large recalculations for both NOx and SOx (up to 14%). While the recalculations for NOx emissions were negative for all years, the recalculations were positive up to 1996 for SOx and negative thereafter. Sweden explained in their review feedback that emission factors for SOx and NOx had been revised. Denmark reported large positive recalculations of NMVOC (40-11% increase from 2004 to 2005 reporting between 1990 and 2002) and Latvia has increased NH_3 in the 2005 reporting for various years between 1990 and 2002 up to 35%. No explanation has yet been received from Denmark and Latvia.

Frequent recalculations can be interpreted as a sign of Parties currently improving their inventories. This means that it could be useful to target guidance (for example through the EMEP/CORINAIR Guidebook) to HCB, PAH, Pb, Cd and NMVOC, the pollutants for which the magnitude of recalculations was highest.

Parties are kindly requested to recalculate the whole time series when new information becomes available or when errors are corrected in previous submissions in line with the UNECE Guidelines for estimating and reporting emissions (UNECE 2003).

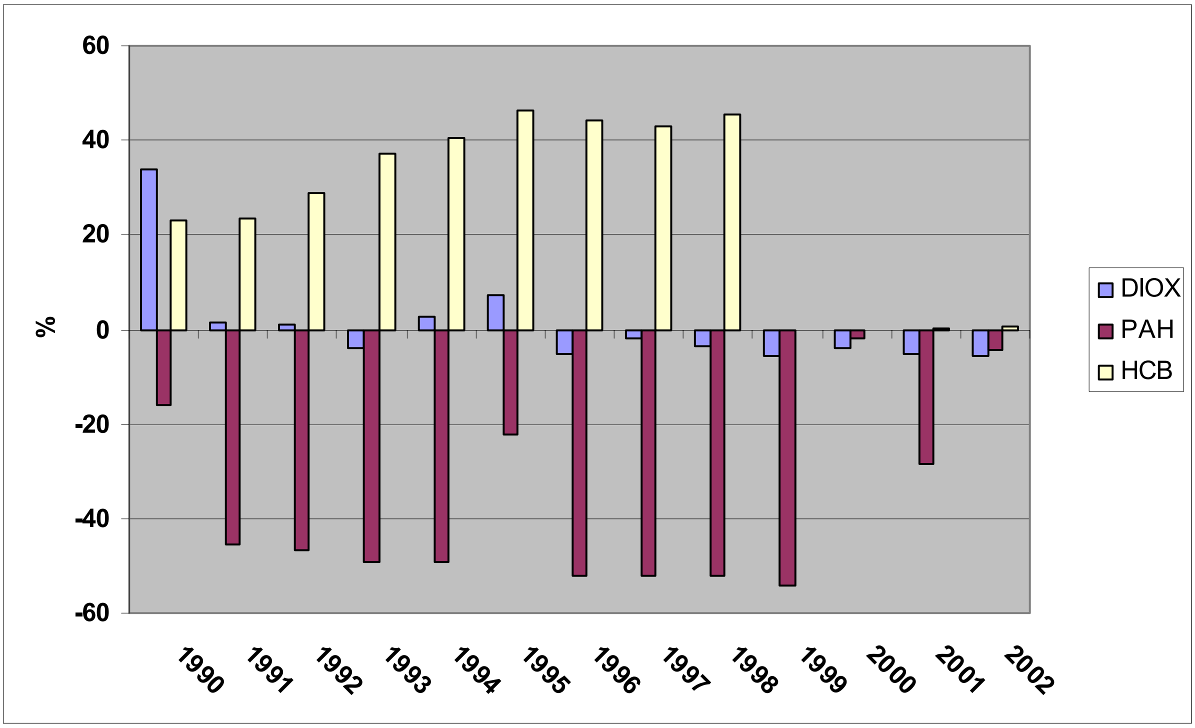

Figure ES 1. Change in LRTAP reported national totals for priority POPs between the 2005 and 2004 reporting rounds

D) LRTAP AND NEC INVENTORY COMPARABILITY

The difference (100*[($emis_{NEC}$ – $emis_{LRTAP}$)/$emis_{LRTAP}$]) between the NEC emission data reported in 2004/2005 with those of the LRTAP Convention (reported shortly afterwards in 2005) was analysed. Last year's trial review revealed that there were differences between the revised (UNECE, 2003) and the previous emission reporting guidelines (UNECE, 1997) and a note on this issue was prepared to the EMEP SB (UNECE, 2004c).

Five countries had differences larger than ±0.1 % in reporting of national totals to LRTAP and to NEC as shown in Table ES1. Differences larger than 3% were flagged. Differences in the Guidelines were the reason for the differences noted only for the Netherlands and Spain. An editorial error was found for Estonia, and hence the difference disappeared. For the remaining two countries the reasons for the differences are not known, but an explanation is requested. Differences larger then ±0.1 % could be expected for more countries due to differences in the Guidelines in with respect to Domestic Aviation Cruise, International Aviation LOT, International inland shipping and the size of the territory included in the emission calculations.

The analysis of inventory comparison and memo items reported revealed that countries are not yet sufficiently informed about the difference in the reporting requirements under the NEC Directive and under the LRTAP Convention.

A check to find out if Parties report transport emissions according to Fuel Consumed or Fuel Sold, showed that all but one of the thirteen Parties that provided this information (e.g. via an Informative Inventory Report - IIR) reported according to Fuel Consumed in at least one sector.

Table ES 1 Differences between NEC and LRTAP reporting for data reported in 2004/2005. Difference in Gg. Percent in parentheses

Compound	ISO	1990	1995	1996	1997	1999	2000	2001	2002	2003
NH3	Estonia									0.01 (0.1)
	Spain						-3.3 (-0.8)	-3.1 (-0.9)	-3.3 (-0.8)	-3.2 (-0.8)
	Slovenia									-0.8 (-4.4)
NMVOC	Belgium						-76.5 (-30.8)		-0.4 (-0.2)	-0.4 (-0.2)
	Estonia									0.2 (0.5)
	Spain						-48.7 (-4.2)	-48.8 (-4.4)	-50.1 (-4.3)	-46.4 (-4.1)
	Latvia				-0.1 (-0.1)				-0.1 (-0.1)	
	Netherlands								1.6 (0.7)	1.7 (0.7)
NOx	Belgium								1.7 (0.6)	1.5 (0.5)
	Estonia									6.5 (16.6)
	Spain						-103.7 (-7.2)	-106.1 (-7.4)	-111.4 (-6.8)	-107.7 (-7.3)
	Latvia	-0.1 (-0.2)	-0.1 (-0.3)		-0.3 (-0.6)	-0.2 (-0.6)	-0.2 (-0.7)	-0.2 (-0.6)	-0.2 (-0.5)	
	Netherlands								25.2 (6.8)	25.3 (7.0)
SOx	Belgium						-92.9 (-54.1)			-0.3 (-0.2)
	Estonia									4.2 (4.2)
	Spain						-29.5 (-2.0)	-29.7 (-2.1)	-32.5 (-1.9)	-29.8 (-2.4)
	Latvia			-0.2 (-0.4)		-0.7 (-2.5)	-0.5 (-3.2)	-0.3 (-3.0)	-0.2 (-2.6)	
	Netherlands								1.6 (2.4)	1.6 (2.4)

E) SUMMARY OF INDIVIDUAL COUNTRY REVIEWS

Timeliness of submissions

- CLRTAP: 49% of submissions from Parties were received by the reporting deadline (15 February 2005). This is an improvement in timeliness of 11% or six Parties
- NEC: Nine of the submissions from EU15 Member States were received on time (six in 2004). Only five of the new EU10 MS submitted, and of these, 3 submissions were received by the reporting deadline.

Format of submissions

- All LRTAP submissions, except the submission from Armenia, were received in NFR format. i.e. 97% reported in NFR formats. This is an improvement from 2004 of one Party. Eleven countries modified the reporting templates. This makes automatic loading of the data into the EMEP database more complicated.
- Of the Member States that had reported NEC emissions data by 1 June 2005, two countries (GR and IT) reported emissions in the old SNAP-based reporting format, although GR subsequently reported emissions data to LRTAP using the new NFR reporting format.
- Of the remaining Member States that did report, all used the required new NFR format for reporting.

Key source analysis

- The key source analysis lists emission sources that contributed to 95% of the total emissions reported. The key source analyses were performed for groups of Eastern and Western countries to reflect the inherent differences between regional circumstances etc. . SOx is the only pollutant where more than 50% from the emissions comes from one single source (1A1a). The number of sources required to reach 95% of the total emissions ranges from 10 (SOx) to 57 (NMVOC). The largest sectors are identical for East and West only for five compounds (CO, PM10, PM2.5, Hg and PAH). The result of the implementation of better control technology in power plants, less field burning of wastes and more cars with catalysts emissions in the West then in the East clearly shows up in the analysis of 2003 data.

Completeness

The completeness of LRTAP data increased for almost all countries and pollutants compared with submissions in previous years, both in terms of notation keys and unique values reported. The increase was seen both for 2003 emissions data and for the number of time series reported.

National totals:

- The completeness of national total emissions, i.e. the number of unique values reported for national totals, increased by approximately 5%. There was an increase of 10% in the level of reporting of both PM2.5 and PM10 for at least one year. There was no reporting of emissions values for Annex I POPs and DDT in 2005.

Sector data:

Figure ES 2 shows the completeness per country for the time series 1980-2003. The 100% completeness line signifies that there is a number or a notation key in every cell in the reporting template for the years 1980-2003 for the main pollutants, 1990-2003 for HMs and POPs, and 2000-2003 for PMs for all the 49 Parties to the Convention.

- 5 Parties (i.e. 10%) of the Parties met the minimum time series reporting requirements i.e. to report emissions of main pollutants 1980 to latest year, heavy metals and persistent organic pollutants 1990 to latest year and particulate matter 2000-latest year. This is the same number as last year.
- The percentage of reporting of unique values varies considerably among Parties (1-35%).
- The completeness of emission data (unique values) reported for main pollutants, priority HMs., Dioxins and PAH is about 10% (not shown here).

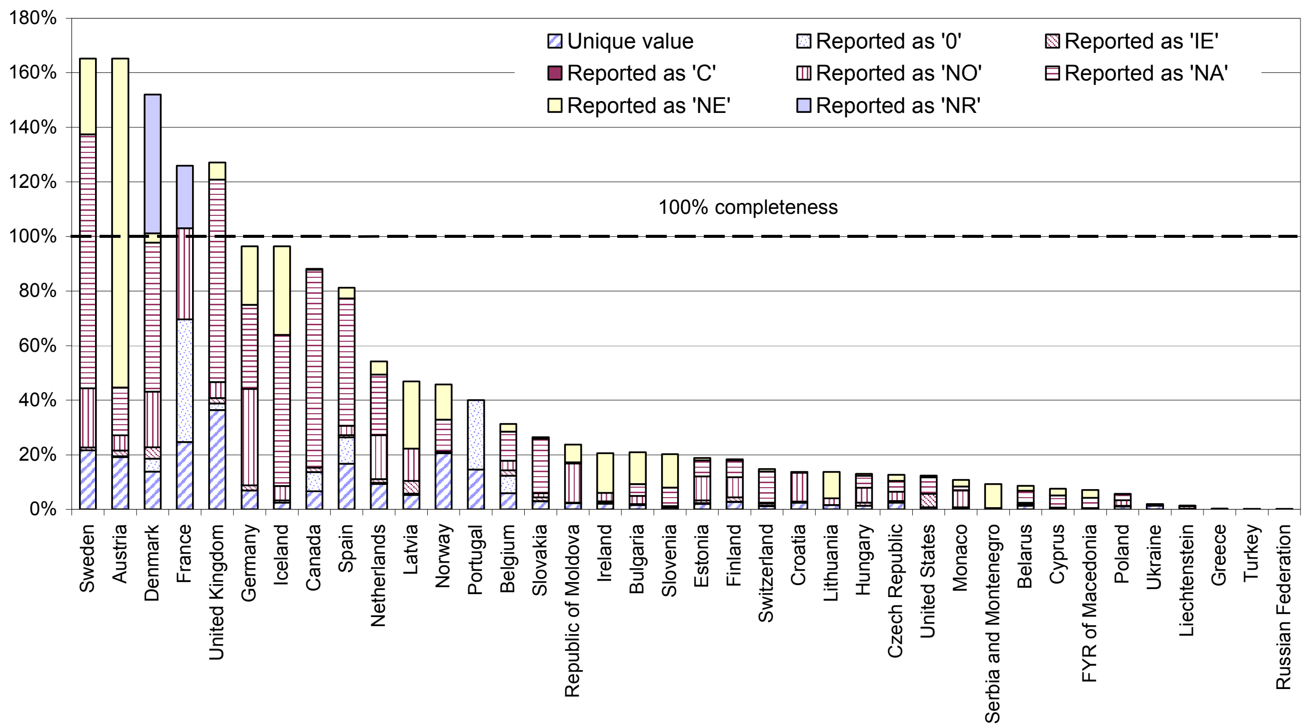

Figure ES 2 Completeness of LRTAP data for 1980-2003: by country

Notation keys

- The use of notation keys has been better harmonized between countries as a consequence of preshading in reporting templates and the focus on this issue in last year's review report. The harmonization is expected to increase again next year, when all Parties are requested to report in the newest version of the template.

Consistency

Internal consistency

- The internal consistency of LRTAP data appears reasonably good. For 75% of the Parties at least 80% of their reported data was found to be internally consistent, i.e. the sum of sub sectors did add up to sector or national totals. We revised this analysis this year based on feedback received from Parties during the previous year's review process, hence the result is not directly comparable to the last review result.

Consistency of timeseries

- CLRTAP: Approximately 3.0% of the reported number of time series were flagged as containing a possible inconsistency. NEC: Approximately 5.2% of the reported time series were flagged as containing a potential inconsistency.
- In percentage terms, the 'Manufacturing Industries and Construction' and 'Oil and Natural Gas' sectors had the highest numbers of flagged time series. For two thirds of the sectors evaluated, no potential inconsistencies were identified.
- Most potential inconsistencies were noted for the pollutant CO followed by NMVOC and HCH.

- Many Parties do not report sufficiently detailed or complete data to enable an analysis of time-series consistency therefore the level of inconsistencies might be larger than actually recorded.

Comparability

Analysis of the traffic sector

Pollutant ratios were calculated for officially reported emissions in the transport sector and compared to the TREMOVE and TRENDS model results. Ratios, which were more than a factor of two different from the model data, were flagged. The analysis showed that the data included were generally comparable. Based on feedback from the Parties this test should be modified to only analyse combustion sources.

Implied emission factors

- The aim of the implied emission factor (IEF) check is to identify significant differences between Parties in the implied emission factors derived from emissions data reported by Parties to the LRTAP Convention and corresponding sectoral activity data reported to UNFCCC. Comparison of IEFs allows country emissions to be put in context, can help identify potential inconsistencies within an inventory that should be subject to explanations and possible further review.
- IEF values were derived and subsequently compared for the main pollutants CO, NOx, NMVOC and SOx across 9 energy combustion sectors. 23% of the derived IEF were flagged as being significantly different from the average IEF, indicating the use of a range of IEFs used by Parties. Across all countries and sectors, the highest number of flags occurred for SO2 (37%) and the least for NOx (9%). The large variability in SOx IEFs probably reflects the intrinsic differences between countries in terms of technology & abatement options.

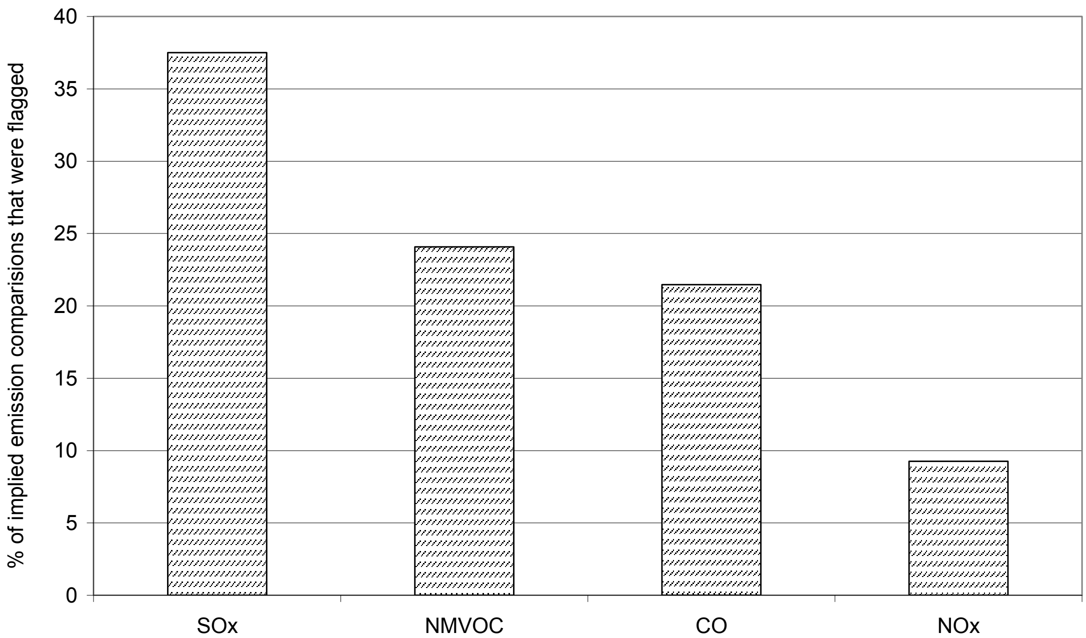

Figure ES 3. Number of IEF flagged values by pollutant expressed as a percentage of the number of IEF comparisons made.

Recommendations arising from the review

The recommendations and requests to the bodies arising from the 2005 review:

- Investigate further harmonization of the LRTAP and NEC Guidelines for reporting. There is significant support from Parties and Member States to investigate whether it is possible for the Commission to harmonize the NEC submission deadline with the LRTAP Convention deadline (and possibly also to UNFCCC greenhouse gas reporting). Harmonisation of the reporting procedures is recommended so that Parties reporting to both bodies might do so with one submission and at the same time;
- Define completeness and how this should be analysed for compliance purposes;
- Consider if the NEC data should be made publicly available through WEBDAB.

The recommendations and requests for the Expert Panel on Review from the 2005 review:

- Update the Guidebook with respect to POPs and HMs;
- Give more guidance on how to calculate and sector allocate the NMVOC emissions;
- Increase transparency in reporting of memo-items and additional reporting;
- Inspect the keysource analysis for individual countries to see if all major sources are included;
- Agree on a methodology and threshold for flagging of inconsistencies in time series, so that Parties can flag the potential inconsistencies themselves, and comment on these within their IIRs;
- Make steps to speed up the publication of the first part of the Synthesis and Assessment report, with the aim of publishing the reports by 1st May, with responses from Parties one month later;
- Develop a system to capture all the responses to the review and information in the IIRs;
- The IEF review needs to be linked to an improved EMEP/CORINAIR Guidebook and followed in the Stage 3 reviews.

Recommendations and requests to the countries from the 2005 review:

- Parties are kindly requested to report complete time series of emissions data in NFR format, and whenever recalculations are performed, in order for the inventory to be complete and consistent. The completeness concerns also reporting of all memo items in order to increase the transparency between the 1997 and 2002 Guidelines.
- Parties are encouraged to test their submissions for internal consistency prior to submission, and pay particular attention to situations where there are sub-sectors which are completed by notation keys while the aggregated level is not. The task can be facilitated by REPDAB (http://webdab.emep.int/repdab.html), which was been improved during 2004 (e.g. by performing checking calculations with all notation keys turned to zero).
- Recalculate the whole timeseries, and not only a few years, in order for the inventory to be consistent;
- Twinning projects between countries with large difference in inventory completeness to find gaps with respect to source categories included
- Encourage reporting of what is included in the “other” sectors
- Encourage submission of the IIR no later than 1st April in order for the information to be taken into account in the review

Contents

1 INTRODUCTION

At its twenty-first session, 21st January 2004, the Executive Body of the Convention on Long-range Transboundary Air Pollution (LRTAP) recognized the importance of high-quality emission data and strongly encouraged further work on its improvement and validation (UNECE, 2004a, paras. 56 and 60(n)). The Convention's Task Force on Emission Inventories and Projections (TFEIP), in collaboration with the European Environmental Agency (EEA) and the European Commission's Joint Research Centre (JRC), has subsequently initiated an Inventory Improvement Programme. This initiative has also been appreciated and supported by DG Environment, as it is also relevant to emission data submitted under Directive 2001/81/EC (EC, 2001) of the European Parliament and of the Council on national emission ceilings for certain atmospheric pollutants (the NEC Directive). As part of this programme, a trial review of inventory submissions was performed in 2003 and 2004.

The 2005 review is the first annual review of emissions data reported under the NEC Directive and the Convention on LRTAP. This annual review is a continuation of the trial inventory reviews that have been performed in 2003 and 2004 (e.g. Vestreng et al., 2004). In 2005, as in the two preceding trial reviews, the assessment of the inventory data has been performed on both emissions data reported under the LRTAP Convention and under the NEC.

The review has been performed according to the recommendations from the TFEIP/EIONET meeting in 2003 (UNECE, 2004b) and 2004 (UNECE, 2005a) and the Draft Methods and Procedures for the Technical Review of Air Pollutant Emission Inventories under the Convention on Long-Range Transboundary Air Pollution (UNECE, 2005b).

The main focus this year has been on Heavy Metals (HMs) and Persistent Organic Pollutants (POPs), since the HM and POP protocols entered into force in 2003. Moreover, both the NEC Directive and the Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (Gothenburg Protocol) are being reviewed in the near future. Focus has therefore also been on the recalculation of emissions and the comparability of NEC and LRTAP inventories.

The report has two main sections. The first section is an initial review of emission data for HMs and POPs reported under the LRTAP Convention. This assessment includes a comparison of reported data with emissions data calculated for several pan-European emission inventories. The second section of the report is the second part of the Synthesis and Assessment Report. It presents the results from the 2005 review of inventory data quality.

The first part of this Synthesis and Assessment report, was the country specific reports posted on a password protected site on the EMEP website (*http://www.emep.int/REVIEW/2005/index.html*). These Synthesis and Assessment reports (Part I) contained the same elements as this second part, but on a much more detailed (country) level.

As described above, this second part of the Synthesis and Assessment Report presents an overview of the findings from the annual review of inventory data submitted by countries under the requirements of the LRTAP Convention and the NEC Directive. The review has included all data that was received by the review team of experts by 10th March 2005 and documented in the UNECE report, Present State of Emissions data (UNECE, 2005c). The data was available from WEBDAB (http://webdab.emep.int/) (Vestreng and Klein, 2002) by mid April. In 2005, 10 review tests have been performed. Two of these tests can be regarded as being compliance-focussed i.e. assessments of the timeliness and format of the submitted data. In contrast, the remaining tests share the general aim of providing countries with information to allow them to optimise their own inventory quality and hence future reporting in subsequent submission rounds. Additionally, it is intended that the more general findings from the review can also be used to prioritise future activities of the Task Force on Emission Inventories and Projections (TFEIP) and the European Environment Information and Observation Network (EIONET).

The review tests performed in 2005 correspond to the first two stages (initial check and synthesis and assessment) of the proposed annual review process, as described in the draft UNECE paper (UNECE, 2005b). The TFEIP meeting in June 2005 proposed to initiate a more detailed review on a trial and voluntary basis in 2006 (UNECE, 2005a). Further discussions are expected in the October 2005 meeting of the TFEIP in order to plan for a future detailed individual review to be included as part of the Inventory Improvement Programme under the TFEIP.

The experiences with the 2005 review procedures will be discussed at the joint EIONET/TFEIP meeting in Rovaniemi, Finland 19-21 October 2005. The results of the 2005 inventory review contained in this report will be presented there, and the TFEIP and EIONET will have the opportunity to give feedback, taking account of comments from the EMEP Steering Body, with the aim of improving review procedures in future years.

2 AN INITIAL REVIEW OF EMISSION DATA FOR HEAVY METALS AND PERSISTENT ORGANIC POLLUTANTS

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2.1 INTRODUCTION

The Convention on LRTAP has been extended by the 1998 Aarhus protocols on Heavy Metals (HMs) and Persistent Organic Pollutants (POPs) that both entered into force by the end of 2003. The former protocol on HMs currently has 25 ratifications and the latter protocol on POPs has 23 ratifications (as of June 1, 2005).

The protocol on HMs targets Cd (cadmium), Pb (lead) and Hg (mercury). Each Party of the protocol on HMs is obliged to develop and maintain emission inventories for the priority metals Pb, Cd and Hg. No specific requirements for the emission inventories for other heavy metals are listed in the protocol. The protocol on POPs addresses 16 substances comprising eleven pesticides, two industrial chemicals and three by-products/contaminants. The POPs protocol further discriminates between various substances in annex I, II and III. Annex I refers to various pesticides for which production and use are banned upon the date of entry into force of the protocol. These pesticides are aldrin, chlordane, chlordecone, dieldrin, endrin, hexabromobiphenyl, mirex and toxaphene. Some additional substances listed in annex I, are scheduled for elimination at a later stage. These substances are DDT (*dichloro-diphenyl-trichloroethane*), heptachlor, HCB (*hexachlorobenzene*) and PCBs (*polychlorinated biphenyls*). Annex II list those substances for which use is severely restricted. The annex II group of substances are DDT, HCHs (*hexachlorocyclohexanes including lindane*) as well as the PCBs. Annex III additionally obliges Parties to reduce their emissions of PCDD/Fs (*polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans*), PAHs (*polycyclic aromatic hydrocarbons*) and HCB below their levels in 1990 (or an alternative year between 1985 and 1995). For the incineration of municipal, hazardous and medical waste, it lays down specific limit values. Each party of the protocol are requested to develop and maintain emission inventories for the substances listed in annex III, and shall collect available information relating to the production and sales of the substances listed in annexes I and II.

Following their entry into force, officially reported emission inventories by Parties are increasingly needed (a) to understand and predict source-receptor relationships for such contaminants, as well as (b) to develop sound emission reduction strategies. While strong efforts have been made to improve emission inventories needed for research on ozone depletion (CFCs), climate change (CO_2, CH_4, N_2O) and acid deposition (SO_2, NOx), inventories for HMs and POPs have for many years been considered unreliable and inaccurate (e.g. Graedel et al. 1993, Pacyna & Graedel, 1995). So far, only a limited number of Parties have previously reported emission data for HMs and POPs to EMEP, as compared to most of the classical air pollutants (Vestreng, 2003). For this reason, the EMEP database has significant gaps in spatial and temporal coverage for individual HMs and POPs.

The key objectives of this initial review have been:

1) To identify specific data needs and requirements regarding emission data for HMs and POPs by key users of such information.
2) To compare and contrast policy-driven (official emission data) and research-driven (so-called expert inventories) emission estimates and their availability.
3) To carry out an initial assessment of emission data for selected HMs and POPs submitted by Parties to EMEP under convention on LRTAP with emphasis on the following quality criteria; transparency, consistency, comparability, completeness and accuracy.
4) To evaluate if current officially submitted data are of sufficient quality for source-receptor relationships to be predicted and understood.
5) To identify bottlenecks in the emission reporting in order to propose short and long-term solutions that may improve the emission reporting for selected pollutants with regards to the quality criteria above (long-term goal).

We stress that some of these objectives are fairly ambitious for an initial review. Further in-depth reviews may thus be desirable to fully meet these objectives. We therefore emphasise that this report should be considered as a starting point for evaluation of further strategies that may improve emission data reporting and emission data quality for HMs and POPs. A special workshop devoted to emissions of HMs and POPs has been arranged for October 2005, back to back with the annual meeting of the Task Force on Emission Inventories and Projections in Rovaniemi, Finland. It is our hope that this initial assessment may serve to stimulate the discussion at the workshop and further work on emissions and HMs and POPs under the Convention on LRTAP.

2.2 DATA NEEDS AND REQUIREMENTS

As indicated, the specific data needs and requirements are motivated by the specific needs of the two key users of this information. These are (*i*) policy-makers aiming to reduce the environmental exposure to these substances, and (*ii*) scientists aiming to understand and predict source-receptor relationships for such contaminants. Specific key features emphasised by these two groups are discussed in turn. Common to both groups is the need for accurate emission information as close to the “true” level as possible. Guidelines have been issued by UNECE to facilitate emission data reporting by Parties with the aim to achieve an improved emission data quality through greater transparency, consistency, comparability, completeness and accuracy (UNECE, 2003). Secondly, information on emission data uncertainty is highly valuable to evaluate the uncertainty of predicted source-receptor relationships as well as the potential risk of choosing erroneous control strategies.

2.2.1 Features emphasised by policy-makers

Decision makers clearly need emission data for HMs and POPs to be reported on a source-category basis. Further, emission inventories are also needed as useful documentation between Parties that have agreed to reduce the emissions of these toxic compounds.

2.2.2 Features emphasised by scientists (modellers)

As mentioned, reliable emission data are essential as model input in order to understand and predict source-receptor relationships for HM and POPs. Within EMEP, these activities are being carried out at MSC-E (www.msceast.org). A number of studies have highlighted that emission data are frequently the most uncertain input that determines the overall uncertainty of model predictions for POPs (e.g. Vallack et al., 1998; Cohen et al., 2002; Malanichev et al., 2004) and HMs (e.g. Petersen et al., 1995). The selection of emission data set to drive a model is therefore a crucial choice made by the modeller. Specific features typically emphasised by this group of scientists are discussed in the following.

Spatial coverage

Emission data for HMs and POPs should be spatially complete across the model domain. In other words, the modeller needs to make sure that there are no gaps (e.g. countries or regions left out) in parts of the spatial domain of the model (if emissions occur in these regions). If significant inflow of chemical is likely from the outside world into the model domain, additional information on the spatial distribution outside the model domain may provide useful information for evaluation of boundary conditions. Modellers also need information on spatial distribution of national emissions. Surrogate information may be used to allocate national emission totals for certain contaminants, such as crop area distribution in the case of pesticides and population density for the emissions of PCBs.

Sophisticated models as the one being used at MSC-E also require additional information on the height of emission release, as this affects the chemical mobility and atmospheric behaviour of such substances. Spatially resolved transport models also need point source information of the emissions (co-ordinates, stack heights, exhaust gas velocities).

Temporal coverage

Many POPs and Hg have the potential for undergoing reversible atmospheric deposition. Atmospheric levels measured today, may thus be a legacy of emissions that occurred in the past. The data should therefore be temporally complete (if using a model with temporal resolution). That is to say that interannual emission trends are needed, reflecting the potential lifetime of the pollutant of concern, which in the case of certain POPs could be decades or even more (e.g. Sinkkonen and Paasivirta, 2000). Modellers may additionally need information on seasonal and diurnal variability of the emission data. In the case of HMs and POPs, this information is rarely available at all.

Speciation

Modellers also need information on the physical and/or chemical speciation of HMs and POPs. This issue may appear to be of particular interest to modellers, but it is argued here that it also has important implications for the development of sound control strategies. Speciation typically entails *(i)* if information on the speciation of individual substances is included for compounds that may exhibit distinctly different environmental behaviour dependent on physical-chemical state, and

(ii) if information on the emissions of individual species of a group of POPs is included in cases there are different environmental behaviour within this group.

A prime example of the former is mercury (Hg), which mainly occurs in the gas phase as two species. Elemental mercury (Hg^0) tends to dominate and is considered to have a very long atmospheric residence time and thus exhibits a potential for large-scale atmospheric distribution. The other important specie is reactive gaseous mercury (RGM) or Hg(II) which undergoes a much more rapid atmospheric deposition. Physical-chemical speciation of mercury emissions is thus critical because it influences how far mercury will travel in the atmosphere (e.g. Renner, 2004). A similar reasoning applies for certain groups of POPs (e.g. PAHs; HCHs; PCBs; PCDD/Fs), which contain numerous individual species with different physical-chemical properties (e.g. Mackay et al., 1999; Li et al., 2003), environmental half-lives (e.g. Sinkkonen and Paasivirta, 2000) and environmental behaviour (e.g. Wania and Su, 2004). Large variations in long-range transport behaviour within groups of similar substances are therefore suggested (Beyer et al., 2000; Wania and Dugani, 2003) and different control strategies may thus be required. For example Li et al. (2002a) have nicely illustrated how β-HCH, unlike α-HCH, exhibited limited propensity for transport into the Arctic in spite of similar emission histories. A lack of information on speciation may thus provide erroneous source-receptor relationships (and thus control strategies).

2.2.3 Policy-motivated and research-driven emission estimates

It seems natural to distinguish between so-called official emission data (i.e. mainly policy-motivated) and so-called expert emission estimates (i.e. mainly research-motivated). The justification of making such a simple (and sometimes artificial) distinction is that certain features of the inventory characteristics seem to be emphasised out of specific data needs and requirements of the key user(s) of data being targeted. Official emission data for POPs and HMs are commonly developed and maintained by national agencies of Parties to CLRTAP (Vestreng et al., 2004), whereas expert estimates are typically developed and targeted to the specific needs of various research projects or carried out as regional assessments of emission levels.

Complete and accurate official emission data are the preferred choice of emission information. This is because the national experts are expected to know the detailed characteristics in their respective countries concerning fuel use, industrial processes and abatement technologies, which are controlling the emission levels of various toxic compounds. Furthermore, official emission data is the only emission information that seems suitable as documentation in international negotiations between Parties that have agreed to reduce their emissions. Finally, official estimates also seem most suitable when evaluating further emission reduction at a national and international level. In summary, official emission data are primarily motivated and considered superior for the purpose of decision-making processes at national and international level. However, lack of information on spatial, temporal and speciation features may obstruct the applicability for use by modellers. For this reason, modellers often have to rely on research-driven estimates.

Research-driven estimates are typically targeted to meet the specific objectives of various individual research projects (see Breivik et al., 2004 for recent overview of regional and global emission inventories for POPs) Many such studies typically emphasise emission information for individual compounds, such as HCB (Bailey, 2001), α-HCH (Li et al 2000), β-HCH (Li et al 2002b), multiple HCHs (Breivik et al. 1999), Hg-speciation (e.g. Pacyna et al. 2001) and individual PCBs (Breivik et al., 2002a,b). The overall goal of several such studies may often be a desire to present the "big picture" of emissions of individual substances in quantitative terms (e.g. Bailey 2001; Breivik et al. 2002b). For this reason, many research-driven emission estimates may sometimes be of limited use for policy-oriented applications, but the preferred choice by modellers.

Other studies may include emphasis on a wider coverage of substances, with strengthened emphasis on the potential use by policy makers (i.e. to support regional assessments for the European Union). Examples are the European emission inventories for PCDD/Fs (Quaβ et al., 2000; 2004) selected POPs (Pacyna et al. 2003), as well as the comprehensive report by Berdowski et al. (1997), which covers both HMs and POPs. We will return later to further details about the latter two inventories.

In addition, several new emission inventories are just about to be completed. One study focuses on European emissions of HMs and POPs for the reference year 2000 (H.A.C. van der Gon, TNO, NL, pers. comm.). This study will additionally include estimates of the emissions for several "new" POPs. A study on dioxin emissions in Central Europe is also awaiting final approval (M.P.J. Pulles, TNO, NL, pers.comm.). This study, which additionally has been submitted to a scientific journal (Pulles et al. submitted), may be particularly valuable because of its effort to quantify uncertainties in the emission data being presented and discussed. Furthermore, the EU ESPREME project aims at the assessment of people's willingness to pay for the reduction of human exposure to heavy metals, including Pb, Cd and Hg. In order to meet this aim, emission inventories are compiled on the basis of reports from national emission experts and estimated by the ESPREME project experts. Two sets of emission data were therefore prepared within the project. While no differences between the emission values within these two were noted for Hg, the ESPREME estimates were more than 2 times higher for Cd and 1.5 times higher for Pb than the official data. These differences can be explained by: (*i*) incompleteness of official data with regard to emission categories, and (*ii*) differences in emission factors used in the two estimates.

2.3 RESULTS

2.3.1 Availability and intercomparison of emission data

Availability of official emission data

An overview of official emission data submitted to CLRTAP is given in Table 1 (POPs) and Table 2 (HMs) to highlight the spatial and temporal (interannual) availability of this information. Although different criteria of temporal and spatial completeness may be envisaged depending on the scope of the inventory, we here primarily have in mind the availability of:

(i) complete temporal trends in emission data on an annual basis, and
(ii) complete spatial coverage of the emission data from all Parties of the Convention.

Table 1 and Table 2 lists the number of Parties to the CLRTAP that have submitted official emission data to EMEP during 1980-2003 for POPs and HMs, respectively. It should be emphasised that the numbers in parentheses in Table 1 and Table 2, list the number of Parties that are actually reporting a numerical value greater than zero. The difference between the two numbers reveal Parties that are either reporting "Not Estimated", "Not Occurring", "Not Applicable" or zero in terms of national total emissions. Although "Not Occurring", "Not Applicable" or zero may be valid assumptions in the case of certain pesticides that may never have been produced or used by a party (Table 1), it seems less reasonable in case of:

(i) pollutants that are formed and emitted in trace amounts as unwanted by-products of common combustion processes (e.g. PCDD/Fs, PAHs and possibly also HCB) or,
(ii) industrial chemicals (e.g. PCBs) that have been subject to extensive usage world-wide for a multitude of applications (Breivik et al., 2002a,b), and
(iii) heavy metals that are emitted in trace amounts from various industrial and combustion processes.

It is evident from Table 1 and Table 2 that there are significant gaps in officially reported emission data from various Parties to the CLRTAP, both in terms of spatial and temporal completeness. The reporting of official estimates is very limited before 1990, and maximum reporting is found to be from 1995 onwards for both priority POPs and HMs. Maximum reporting for POPs occurs for PAH in 1998 and is 61% of all Parties. Maximum reporting for HMs is somewhat higher, namely 67% for Pb in 1990, 1995 and 1998. This reporting might consist only of a "national total" and no information on sector specific emissions. In such cases, no information for further development of emission reduction strategies is available. Gaps in the emission data also limits the applicability of such emission data as input for environmental models evaluating the regional transport and fate of such contaminants, although there is a slight improvement in the reporting over the last few years. Still, the detailed information on relative contribution of emissions from various source categories may provide valuable information for the development of control strategies for individual Parties.

Table 1. Number of Parties submitting official emission data for selected POPs to EMEP, 1980-2003. The numbers in parentheses are the number of Parties submitting a numerical value (greater than zero), if different from the former value. Data for 1980-1989 indicate the annual maximum reporting during the period.

Year	PCDD/Fs	PAHs	HCB	PCBs	HCHs	DDT	Pesticides (other)
1980-1989	5 (3)	5 (3)	5 (2)	4 (1)	3 (0)	3 (0)	4 (1)
1990	27 (26)	26	20 (14)	18 (11)	13 (7)	14 (0)	17 (9)
1991	17 (15)	19	14 (9)	12 (6)	9 (4)	11 (0)	10 (3)
1992	18 (16)	21	15 (10)	13 (7)	12 (5)	12 (0)	11 (4)
1993	17 (15)	21	15 (10)	13 (7)	11 (5)	11 (0)	10 (3)
1994	21 (20)	24	18 (12)	15 (10)	12 (5)	12 (0)	12 (4)
1995	23 (22)	26	19 (12)	18 (11)	12 (5)	14 (1)	15 (7)
1996	24 (22)	27	21 (13)	15 (9)	14 (7)	12 (0)	17 (7)
1997	26 (24)	29	20 (13)	16 (10)	14 (7)	12 (0)	15 (6)
1998	27 (26)	30	21 (13)	18 (11)	14 (6)	13 (0)	14 (6)
1999	27 (24)	29	21 (13)	19 (12)	12 (3)	14 (0)	14 (5)
2000	28 (26)	28 (27)	22 (13)	21 (12)	13 (4)	13 (0)	15 (6)
2001	28 (27)	28 (26)	26 (13)	23 (11)	20 (3)	21 (0)	19 (6)
2002	28 (26)	28 (25)	27 (14)	24 (13)	24 (4)	24 (1)	24 (6)
2003	27 (25)	27 (23)	26 (14)	24 (13)	25 (3)	24 (0)	22 (7)

Table 2. Number of Parties submitting official emission data for HMs to EMEP, 1980-2003. The numbers in parentheses are the number of Parties submitting a numerical value (greater than zero), if different from the former value. Data for 1980-1989 indicate the annual maximum reporting during the period.

Year	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
1980-1989	11 (7)	10 (6)	10 (6)	8 (4)	7 (3)	8 (4)	7 (3)	6 (2)	8 (4)
1990	35 (33)	34 (31)	35 (32)	27 (23)	28 (24)	28 (24)	27 (23)	21 (16)	26 (22)
1991	30 (28)	26 (23)	27 (24)	21 (17)	23 (19)	24 (20)	22 (18)	17 (11)	22 (18)
1992	31 (29)	27 (24)	28 (25)	23 (19)	24 (20)	25 (21)	23 (19)	19 (14)	23 (19)
1993	30 (28)	26 (23)	27 (24)	21 (17)	23 (19)	24 (20)	22 (18)	17 (12)	22 (18)
1994	32 (30)	29 (26)	30 (27)	23 (19)	24 (20)	25 (21)	23 (19)	19 (14)	24 (20)
1995	35 (33)	32 (29)	34 (31)	24 (20)	25 (21)	26 (22)	24 (20)	19 (14)	25 (21)
1996	36 (34)	34 (31)	35 (32)	26 (22)	27 (23)	26 (22)	26 (22)	21 (16)	27 (23)
1997	34 (32)	32 (29)	32 (29)	24 (20)	26 (22)	26 (22)	25 (21)	20 (15)	25 (21)
1998	36 (33)	34 (31)	34 (31)	25 (21)	27 (23)	27 (23)	26 (22)	21 (16)	28 (24)
1999	37 (34)	34 (31)	34 (31)	26 (22)	29 (25)	28 (23)	27 (23)	22 (17)	28 (23)
2000	36 (31)	34 (31)	34 (30)	27 (21)	29 (23)	29 (23)	28 (21)	24 (17)	28 (21)
2001	36 (31)	35 (30)	35 (30)	32 (23)	32 (24)	33 (25)	31 (23)	30 (19)	32 (24)
2002	38 (32)	37 (31)	37 (31)	32 (23)	33 (25)	33 (25)	32 (24)	31 (19)	33 (24)
2003	32 (27)	31 (26)	31 (26)	30 (21)	30 (22)	30 (22)	29 (21)	28 (17)	29 (21)

The base year of the protocols on HMs and POPs - 1990

The year 1990 is of specific interest as it is an important base year of the protocols on HMs and POPs. For this reason, we have chosen to compare and contrast official emission data provided by Parties under the Convention on LRTAP with additional emission data from the literature that are available on a European scale that includes information at SNAP Level 1 for this specific reference year. This includes emission data for selected POPs from Pacyna et al. (2003) [hereafter listed as NILU] as well as estimates presented by Berdowski et al. (1997) [hereafter listed as TNO]. Please observe that the EMEP data for Russia (RU) only includes the European Part of the Russian Federation. National total emissions from these three studies are listed in Table 3.

We recognise that there are other important and/or relevant studies available for the reference year 1990 that should be consulted by the interested reader (e.g. Quass et al. 2000/2004 for PCDD/Fs, Kakareka et al. 2004 for HMs in Newly Independent States). However, these studies are not considered in the following because they did not fulfil the selection criteria for this intercomparison (European-wide coverage with information on emissions at SNAP Level 1 for 1990). Furthermore, the data for PAHs presented by Pacyna et al. (2003) are not included, because it only addressed one single PAH compound (Benzo[a]pyrene).

Heavy Metals

Table 3 lists the estimated national total emissions in 1990 for the three priority heavy metals; Cadmium (Cd), Mercury (Hg) and Lead (Pb) as submitted by Parties to the convention (EMEP) up to March 2003 or estimated by TNO. For a few countries (AT, LU, NL, SE), the data referred to by TNO are reflecting a reference year other than 1990 (please see footnotes for further details). The database presented by TNO contains a mixture of official data submitted by countries prior to the publication of the TNO report (in black) and default emission estimates (in red) as calculated by the TNO project team. In principle, the official data reported by countries to TNO would be expected to be similar to the EMEP data (see CH, PL in Table 3). For some countries and HMs, differences in national totals may in extreme cases even exceed several orders of magnitude (CY, PT). In the case of Portugal, we suspect that this could be due to a unit error in the official emission data. In most cases there is only some disagreement between national reported totals for HMs, even though both reflect officially reported data. A likely explanation is the resubmission of updated and improved emission estimates for HMs by Parties to EMEP in recent years (following the release of the report by TNO). However, when comparing the sum of emissions for estimates of official origin, there is 10% or less difference between the TNO and EMEP estimates.

A similar comparison of default TNO estimates and official EMEP data for those countries that are reporting a numerical value greater than zero, shows larger discrepancies. In this case, the sum of emissions for estimates of official origin and TNO estimates deviates by 70% (Pb), and sometimes even more. Berdowski et al (1997) suggest that the uncertainty in estimated emissions of HMs can be large, ranging by a factor of 1.5 – 3.5. For the north-western European countries the range will vary between 1.2 – 1.5, while for central and eastern European countries the range will be 2.5 – 3.5 and for southern European countries a value in between.

Table 3. Intercomparison of estimated national totals in 1990 in tonnes/year (except PCDD/Fs in g I-TEQ/year; HCB and PCBs in kg/year).

	Cadmium		Mercury		Lead		PAHs		PCBs		HCB			PCDD/Fs		
	TNO	EMEP	TNO	EMEP	TNO	EMEP	TNO	EMEP	TNO	EMEP	TNO	NILU	EMEP	TNO	EMEP	NILU
AM	NE	X	NE	0.01	NE	11.0	NE	X	NE	X	NE	NE	X	NE	X	NE
AT [1]	5.11	1.51	4.27	2.16	2.2	2.1	243.4	17.5	1319	NE	1	81	93	85	161	142
BA	0.41	X	0.22	X	8.6	X	47.8	X	128	X	20	NE	X	9	X	NE
BE	9.91	7.80	8.86	6.66	716.3	565.9	818.0	199.4	5202	NE	213	73	18	616	624	520
BG	8.41	28.25	6.91	13.20	316.2	435.9	55.0	677.3	**317**	258	0	400	544	154	554	67
BY	6.59	15.19	0.09	0.96	735.7	1595.3	191.0	X	600	X	0	570	X	106	X	107
CA	NE	93.57	NE	35.18	NE	1214.5	NE	667.4	NE	X	NE	NE	88.9	NE	436	NE
CH	4.24	4.20	6.82	6.80	519.9	520.0	96.0	X	1644	X	4	59	0	242	242	242
CS	8.31	X	3.86	X	597.0	X	171.7	X	435	X	50	NE	X	112	X	NE
CY	0.20	0.20	0.30	0.30	0.9	81.0	0.2	X	44	X	0	NE	X	1	1 [6]	NE
CZ	12.04	4.34	9.34	7.52	338.2	269.4	259.2	751.6	1995	773	70	NE	X	224	1252	216
DE[2]	31.5	NE	113.37	NE	2347.6	1619.6	**419.8**	0.7	**42956**	43579	86	1700	86	1196	1196	1623
DK	2.11	1.14	6.92	3.34	179.4	122.4	76.7	7.0	988	NA	103	130	NA	71	0	77
EE	**3.87**	1.61	**2.02**	1.29	**171.0**	83.4	28.3	0.3	179	X	0	87	X	18	X	15
ES	36.64	14.58	20.19	21.47	4673.8	2810.9	520.6	176.5	8536	0	1176	1200	6647	134	182	300
FI	3.66	6.30	3.03	1.10	214.2	326.1	104.4	15.8	2620	X	0	130	X	53	30	188
FR	14.84	17.14	32.41	24.31	4413.7	4302.1	3478.7	43.6	**19520**	88	11	1300	1649	1636	1765	1229
GB	24.92	25.74	25.60	37.82	2703.6	2914.0	**1437.0**	224.1	3453	7138	1240	550	3515	**881**	1232	974
GR	4.47	X	7.12	X	505.4	X	152.7	X	251	X	0	200	X	25	X	155
HR	3.24	1.61	1.08	1.15	465.6	466.0	54.0	15.1	132	X	30	NE	0.3	13	179	NE
HU	4.61	5.52	4.19	6.28	638.5	680.5	192.4	132.0	129	135	4538	430	0.3	167	157	76
IE	1.58	X	1.63	X	134.0	X	73.7	X	62	X	0	47	X	44	X	17
IS	0.17	NE	0.05	NE	6.4	NE	6.4	0.1	47	X	0	7	NE	0.6	10	0.2
IT	59.81	9.95	11.80	10.79	1643.1	4371.1	693.6	91.9	5825	X	406	840	X	583	443	873
LT	2.85	3.80	<0.01	0.02	245.9	46.7	52.3	X	220	X	0	210	X	23	X	24
LU[3]	1.14	0.60	0.77	0.30	73.5	77.4	6.2	X	119	X	0	3	X	28	40	58
LV	3.23	1.83	0.34	0.70	217.5	10.3	38.4	X	162	X	0	160	X	14	X	13
MC	NE	0.06	NE	0.11	NE	3.9	NE	<0.1	NE	<1	NE	NA	X	NE	2.4	NE
MD	1.78	3.08	1.52	4.25	168.1	253.2	58.1	6.2	268	X	0	140	X	23	X	18
MK	9.13	X	1.49	X	210.2	X	21.7	X	82	X	0	NE	X	4.9	X	NE
NL[4]	2.17	2.11	2.63	3.42	266.4	334.6	183.6	1707	251	0	0	93	0	505	743	373
NO	2.42	1.64	2.34	1.49	225.8	187.2	140.2	14.5	384	X	1	45	X	39	130	45
PL	91.57	91.60	33.29	33.30	1372.0	1371.7	372.0	159.2	2372	2425	0	1300	62	359	529	425
PT	2.99	<0.01	5.48	<0.01	631.0	1.3	137.7	X	523	X	0	160	X	17	X	40
RO	21.58	X	7.50	X	584.3	X	723.3	X	516	X	53	970	X	1500	X	129
RU	159.36	79.40	86.17	15.60	10147.8	3591.0	3146.0	18.3	10202	X	1	12000	1.6	1412	991	1849
SE[5]	2.04	2.52	1.45	4.67	536.7	474.5	282.0	38.8	1935	NE	3	160	NE	84	53	282
SI	1.04	1.68	0.87	0.76	123.0	460.2	50.5	23.5	71	357	0	NE	0	6.0	8.6	NE
SK	9.67	9.49	12.46	12.53	166.1	151.6	310.0	41.9	**1334**	164	30	NE	X	43	189	75
UA	54.27	X	35.98	X	3877.5	X	1136.8	X	3736	X	0	2600	X	877	X	925
US	NE	180	NE	187	NE	2996	NE	15642	NE	102	NE	NE	1450	NE	234	NE
Total	612	616	462	444	40177	32351	15779	20672	118557	55019	8036	25645	14156	11306	11378	11077
Count	37	31	37	32	37	33	37	26	37	11	19	29	13	37	26	31

Footnotes to Table 3:

Abbreviations used:
X = No reporting
NA = Not Applicable
NE = Not Estimated

For the data presented by Berdowski et al. (1997), the following colour codes have been used:

Black: data submitted by the country

Red: data estimated by TNO, not approved by the country

Black: subdivision of country (sub)total based on TNO estimates, not approved by the country

Red: summation of country data and TNO data not approved by country

[1] Data for HMs by Berdowski et al. (1997) refer to 1992
[2] Data for PAHs and PCBs refer to data for 1985-1990 submitted by the country
[3] 1993 data submitted by the country
[4] 1993 data submitted by the country
[5] 1987/1991 data submitted by the country
[6] EB.AIR/GE.1/2003/6.corr

POPs

PAHs The atmospheric emissions of PAHs are mainly caused by incomplete combustion of fossil fuels. The amount and composition of PAHs emitted are to a large extent controlled by the fuel composition, the combustion temperature, oxygen availability and potential abatement technologies. The source categorisation and emission inventory methodologies that were originally developed for classical "stack-derived" air pollutants (EEA, 2004), should thus fit the PAHs. And indeed, PAHs and dioxins (PCDD/Fs) are the POPs that are most extensively reported by Parties to the convention (Table 1 and Table 3). For 23 Parties, there are both official data and TNO estimates available. In the case of PAHs, TNO includes the sum of the Borneff six {benzo[*a*]pyrene, benzo[*b*]fluoranthene, benzo[*g,h,i*]perylene, benzo[*k*]fluoranthene, fluoranthene and indeno[*1,2,3-c,d*]perylene}, while EMEP request the Parties to address four out of these six PAHs {benzo[*a*]pyrene or B[*a*]P, benzo[*b*]fluoranthene or B[*b*]F, benzo[*k*]fluoranthene or B[*k*]F, and indeno[*1,2,3-c,d*]perylene or IND}. This may help to explain why the total PAH emissions for the 23 Parties is suggested to be about three times higher by TNO (in comparison to the EMEP data). However, the estimates for individual Parties often deviate substantially, and in several cases even more than by an order of magnitude (AT, BG, DE, DK, EE, FR, IS, RU).

PCBs The primary atmospheric emissions of PCBs may either be a result of (*i*) past intentional production, use and disposal of intentionally produced PCBs, or (*ii*) the unwanted formation of PCBs as a result of de-novo synthesis in various combustion processes (Breivik et al. 2002b). Only 11 Parties of CLRTAP have submitted official emission data (greater than zero) for 1990. For the total emissions of PCBs from all 11 Parties, it can be seen that the EMEP estimates are about half of the TNO estimates. Again, difference in compounds included within the group of PCBs is an issue that may help to explain deviations between these two estimates. The TNO estimates address total PCBs (i.e. the sum of 209 different compounds) when dealing with leakage or evaporation or the sum of six frequently reported congeners (PCB-28, PCB-52, PCB-101, PCB-118, PCB-153 and PCB-180). For the official data, the actual composition of the PCB emissions referred to is not known.

HCB Hexachlorbenzene (HCB) has been used as a fungicide and is known as an impurity in other pesticides as well as a by-product from the production of chlorinated solvents. There may also be unintended formation and emissions of HCB from various industrial processes involving chlorine (e.g. Bailey, 2001). 13 Parties report their emissions of HCB in 1990 being greater than zero. The TNO estimate is a bit more than 50% of the sum of official data, whilst the NILU data is about 1.5 times the sum of official submissions. Again, there are substantial deviations between the official data and independent estimates by NILU and TNO. NILU suggests that the emissions in Russia were about three orders of magnitude higher than the data submitted to EMEP. NILU also suggests higher emissions than the other estimates for CH, DE, NL and PL, whilst TNO suggest higher emissions for HU as compared to the other inventories.

PCDD/Fs PCDD/Fs [polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs)] are unintentional by-products of various combustion processes where chlorine is present. As an unintentional by-product of combustion, emissions of PCDD/Fs are expected to take place in all countries. 26 Parties report higher emissions than zero. For the total of emissions from these Parties, the EMEP data shows the highest sum. Large discrepancies (more than 100%) between the official data and one or both independent estimates are evident for BG, CZ, DK, FI, HR, HU, IS, NO, SE, SK.

2.3.2 Key source analysis for 1990 and 2003

The determination of key sources is a fairly simple ranking technique, which is considered useful to identify which sources are important for the main conclusions about the inventory emission level and trend (e.g. Rypdal and Flugsrud, 2001; Rypdal, 2002; Vestreng et al. 2004). Inventory improvements may then be directed towards the key sources that have been identified. Table 4 lists the key sources that contribute up to 95% of the cumulative emissions of selected HMs and POPs in 1990 and 2003, respectively (See Appendix YY, Table XX for an overview of source categories). For simplicity, only the top ten source categories are listed for those pollutants that have more than ten source categories contributing to 95% of the total emissions. Please observe that the number of countries is limited as we only included Parties for which data in NFR format for both years are available. The years 1990 and 2003 were included to evaluate potential temporal changes in the key sources. Only official emission data submitted to EMEP were considered.

While the use of lead as an additive in gasoline put passenger cars (1A3b i – 68%) and light duty vehicles (1A3b ii – 7.3%) were the two key sources of atmospheric emissions in 1990, the most recent results now suggest that metal production (2C) other processes within manufacturing industries and construction (1A2f) and iron and steel manufacturing (1A2a) are the key sources of lead emissions in 2003 (see also von Storch et al. 2003). The results further suggest that lead emissions from waste incineration (6C), which used to be number four, now is not even included in the top ten list. The relative importance of waste incineration has also decreased dramatically for Cd, but only to a limited extent for Hg. It turns out that it is public electricity and heat production (1A1a) that is the key source of mercury emissions in both years, and that this source category is the second most significant source category with respect to cadmium emissions. Interestingly, residential plants (1A4b i) are newcomers on the top ten list for Pb (nr. 6) and Cd (nr. 7) in 2003 as compared to 1990.

Waste incineration (6C) has been, and still is, recognised as the most important source category for dioxin emissions (see also McKay, 2002). However, it should also be recognised that waste incineration may not necessarily be the key source for any country (see e.g. results for Belarus; Kakareka, 2002). The relative importance of dioxin emissions from residential plants (1A4b i) is also increasing in recent years (see Lee et al. 2005 for a recent study for the U.K.), in line with the findings for Pb and Cd in 2003. For PCDD/Fs, there is however a particular concern if all relevant sources have been included in the inventory (i.e. completeness). It is therefore worth emphasising that a key source analysis does not consider the risk for incomplete coverage of the true key sources. The dioxin emissions from the open burning of household waste have received considerable attention in recent years (Lemieux et al. 2000; Gullett et al. 2001; Lemieux et al. 2004; Wevers et al. 2004). However, reliable estimates of the relative importance of such emissions are considered difficult because of the lack of reliable activity and emission factors related to open burning.

For PAHs, various other processes in the chemical industries (2G – 21.5%) and metal production (2C – 18.7%) where the two key sources in 1990. At that time, other sources contributed 10%, or less. Nowadays, residential plants (1A4b i) are currently the key sources of PAHs. The result thus mirrors the findings for Pb, Cd and PCDD/Fs with respect to the relative increase in residential plant emissions from 1990 to 2003.

For PCBs, only five source categories are included. Other processes in the chemical industries (2G) are attributed as the key source in both years. According to the explanatory notes from United Kingdom (which is one out of three Parties reporting emissions of PCBs) this source category accounts for emissions from capacitors, fragmentisers and transformers. Additional sources considered in Table 4 are metal production (2G), waste incineration (6C), public electricity and heat production (1A1a) as well as iron and steel manufacturing (1A2a). As for the dioxins, there is a concern if all true sources of PCBs are captured in the inventories (see e.g. Breivik et al. 2002b; Lee et al. 2005).

Only a limited number of sources are considered for HCB. The key source is attributed to “Other” (4G). Additional sources considered are non-ferrous metal manufacturing (1A2b), other processes in chemical industries (2B5), waste incineration (6C) and metal production (2C). According to the notes from GB, 4G includes agrochemical and pesticide use, while 2B5 includes the production/use of various chemicals.

Table 4. Key Source Analysis for selected HMs and POPs in 1990 and 2003 in selected countries for which data for both 1990 and 2003 are available [A]. The numbers in parenthesis give the relative contribution to total emissions. Only the top ten source categories are listed.

Component		Year	Key source categories (Sorted from high to low from left to right)										Not listed [B]
Heavy Metals	Pb	1990	1A3b i (68.0)	1A3b ii (7.3)	2C (3.3)	6C (2.6)	1A2a (1.7)	1A1a (1.7)	1A2b (1.4)	1A3b iv (1.1)	1A2f (1.1)	2B5 (0.7)	40
		2003	2C (21.3)	1A2f (12.3)	1A2a (10.8)	1A2b (7.9)	1A1a (3.9)	1A4b i (3.7)	1A3b i (3.4)	2B5 (1.2)	1A3a ii (ii) (1.1)	1A3a ii (i) (0.7)	36
	Cd	1990	6C (12.7)	1A1a (8.3)	2 C (7.9)	1A2b (6.0)	1A2f (2.9)	1A2a (2.4)	1A1b (2.2)	1A3d ii (1.4)	1A4a (1.2)	1A3b vi (1.1)	38
		2003	2C (15.3)	1A1a (9.3)	1A2b (6.4)	1A1b (5.3)	1A2f (4.7)	1A3b vi (4.6)	1A4b i (2.1)	1B1b (2.1)	1A2a (2.0)	6C (1.1)	36
	Hg	1990	1A1a (25.1)	6C (13.6)	2B5 (11.3)	1A2f (9.0)	1A2a (4.2)	1A2b (3.9)	2C (3.1)	6A (1.7)	1A4b i (1.5)	1A1b (1.5)	37
		2003	1A1a (29.4)	1A2f (25.9)	6C (9.8)	2C (7.8)	2B5 (7.4)	1A1b (3.9)	1A4b i (2.0)	1A2a (1.9)	6A (1.8)	2A1 (0.8)	16
Persistent Organic Pollutants	PCDD/Fs	1990	6C (34.1)	1A1a (23.1)	2C (9.3)	6D (9.1)	1A2a (7.9)	1A4b i (2.9)	1A2b (2.1)	1A4a (1.9)	1A2f (1.5)	4F (1.3)	2
		2003	6C (22.6)	1A4b i (18.2)	1A1a (12.7)	2C (9.2)	1A2a (8.4)	1A2f (5.6)	1A2b (2.1)	3D (2.9)	7 (1.7)	6D (1.4)	17
	PAHs	1990	2G (21.5)	2C (18.7)	3D (10.0)	1A4b i (6.3)	1A3b i (4.6)	4F (3.3)	1A3b iii (2.5)	3A (1.3)	1A2b (2.1)	1B1b (1.2)	41
		2003	1A4b i (20.4)	3D (11.9)	2C (11.2)	2G (8.2)	1A3b i (2.7)	1A2b (2.1)	1A3b iii (1.8)	4F (1.4)	6C (1.3)	1A3b ii (1.1)	41
	PCBs	1990	2G (86.2)	2C (6.9)	6C (2.6)								0
		2003	2G (66.1)	6C (10.9)	2C (9.5)	1A1a (8.1)	1A2a (1.7)						0
	HCB	1990	4G (55.1)	1A2b (29.8)	2B5 (7.7)	6C (4.8)							0
		2003	4G (70.7)	1A2b (14.4)	6C (6.7)	2C (4.6)							0

[A] The following countries are included in the key source analysis:
Pb, Cd, Hg: AT, BE, CA, DK, FR, LV, NL, NO, ES, SE, GB. **PCDD/Fs and PAHs**: AT, BE, CA, DK, FR, IS, NL, NO, ES, SE, GB. **PCBs**: FR, SE, GB. **HCB**: AT, BE, CA, FR, ES, SE, GB.
[B] Sum of categories not included in the table.

2.4 DISCUSSION AND CONCLUSIONS

Reliable emissions data for HMs and POPs are essential to understand and control the large-scale distribution of these pollutants. On the basis of this initial assessment and review, it seems fair to conclude that current emission data for HMs and POPs are still rather uncertain and incomplete, although the official reporting of many of these components has been improved in recent years. From the intercomparison of various emission inventories for 1990, it appears that emission data for the priority HMs may be considered more reliable than emission data for many POPs. As the current quantitative understanding of HM and POP emissions remains fragmented, there is a general concern whether official inventories are complete i.e. whether most of the true sources are truly captured in the current inventories (as exemplified by the discussion around dioxin emissions from open burning).

There are probably several reasons why the reporting of HM and POP emissions are less complete in comparison to the so-called main pollutants. First and foremost, HMs and POPs have just recently been included in Protocols under the Convention on LRTAP. Therefore, HMs and POPs have so far generally received limited attention in comparison to the main pollutants. Secondly, the current quantitative understanding of HMs and POPs emissions is more limited as compared to the main pollutants, and further research on HM and POP emissions seems to have been less prioritised on the research agenda. To some extent, this also mitigates further development of the emission inventory guidebook (EEA, 2004) with respect to these pollutants. Furthermore, the national experts involved in the preparation of national emission inventories may have limited time and resources for addressing less prioritised pollutants.

Still, the key source analysis may assist TFEIP in making priorities for further improvements of the emission inventory guidebook (EEA, 2004). It may also help to identify sources for which further research and emission characterisation seem desirable. The key source analysis revealed that there have been changes in the relative importance of various source categories between 1990 and 2003 for Parties that have submitted data for both years. A prime example is the reduction in lead emissions, due to the removal of lead as an additive in gasoline. In addition, it is worth mentioning that the relative importance of emissions of PAHs and PCDD/Fs (as well as HMs) from residential plants is increasing at the expense of emissions from various other sources, such as metal production.

The analysis also revealed that many key source categories for some intentionally produced POPs are frequently classified as “other” within various sectors. Although explanations to the use of “other” are required from Parties through so-called Informative Inventory Reports, this information may not be readily accessible to the users of emission data. The frequent use of “other” also serves to illustrate that the reporting scheme originally developed for classical air pollutants may be considered less suitable for intentionally produced chemicals, which again affects the transparency of reported results. For intentionally-produced POPs (industrial chemicals, pesticides), a mass balance approach may be used as an alternative methodology to evaluate atmospheric emissions.

Parties should also be encouraged to undertake further efforts to evaluate the uncertainty of estimated emissions in quantitative terms. This is emphasised in the emission reporting guidelines issued by UNECE, whereby it is stated in Article 32; “*When reporting emissions, the level of uncertainty associated with these data and their underlying assumptions should also be reported to the extent practicable. The methodologies used for estimating* *uncertainties should be indicated in transparent manner. Parties are encouraged to report quantitative information on uncertainties, where this is available.*" At present, Denmark seems to be the only party that has made such uncertainty estimates. The uncertainty estimates of the annual Danish emissions inventory report to UNECE (Illerup et al., 2005) were based on the simple tier 1 approach in the EMEP/CorinAir Good Practice Guidance for CLRTAP Emission Inventories (Pulles and Aardenne, 2002). The uncertainty estimates are based on emission data for 2003 and on uncertainties for activity rates and emission factors for each of the main SNAP sectors. The estimated uncertainties, which include the sectors stationary combustion, transport, industry and agriculture, are shown in Table 5.

Table 5. Estimated uncertainty in Danish emissions, 2003 (Illerup et al. 2005).

Pollutant	Uncertainty Total emission [%]	Pollutant	Uncertainty Total emission [%]
SO_2	9	Cr	191
NO_x	32	Cu	739
NMVOC	38	Ni	171
CO	34	Se	111
NH_3	28	Zn	220
TSP	263	**B[*a*]P**	**970**
Pb	**261**	**B[*b*]F**	**947**
Cd	**263**	**B[*k*]F**	**913**
Hg	**229**	**IND**	**960**
As	124		

It is evident that some of the key objectives formulated for this initial review remain to be fully addressed. Further efforts in the form of in-depth reviews may thus be required. There could also be additional issues that need to be addressed to support relevant activities on HMs and POPs under the Convention on LRTAP. More comprehensive and detailed in-depth reviews carried out under CLRTAP may contribute to clarify the underlying causes for uncertainties in HM and POP emissions. Potential future reviews should preferably involve the national experts responsible for preparing national emission inventories for HMs and POPs, the Task Force on Emission Inventories and Projections (TFEIP) as well as scientists / experts with a detailed knowledge and experience on the compound(s) being targeted. Because of various peculiarities governing the emissions of individual HMs and POPs, it may prove to be beneficial to address one compound at a time if such in-depth reviews are to be carried out in the future. It seems likely that more thorough reviews would identify more clearly that several sources are poorly characterised and quantified. An important outcome of in-depth reviews could thus be to identify specific source categories for which the empirical basis needs to be improved.

Finally, it should be recognised that relevant activities related to HM and POP emissions are being carried out within other international organisations, such as the European Union and efforts related to the UNEP Stockholm Convention on POPs (e.g. UNEP, 2005). Closer co-operation with other international organisations on emissions of HMs and POPs could be beneficial, create useful synergies and avoid potential duplication of efforts.

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3 REVIEW PROCEDURE AND BILATERAL COMMUNICATIONS

The main review procedure and timings from the 2005 review process are given below:

- 31 December 2004/15 February 2005: Submission deadlines for inventory data to NEC/LRTAP;
- 15 February-10 March 2005: E-mail acknowledgement of receipt of submissions sent to designated country contacts from UNECE Secretariat (LRTAP submissions) and ETC-ACC (NEC submissions);
- 10th March 2005. Final date for inclusion of submission data for review tests;
- 10 Mar-27 May 2005: NEC and LRTAP data loaded into WEBDAB, programming of test routines and generation of results, compilation of the country-specific first part of the Synthesis and Assessment Report (S&A), website development;
- 30 May 2005: Launch of review web site: *http://www.emep.int/REVIEW/2005/index.html*. E-mail with passwords sent to designated Party emission experts (*http://www.emep.int/emis2005/20050531-Designatedexperts.pdf*) to allow access;
- 1st July 2005: 18 Parties had replied to the review team with comments (Appendix I, Table 1).

Several improvements to the reporting and review procedure were made by MSC-W in 2005 as a response to the Parties requests in the 2004 trial review. The main improvements were:

- The reporting templates were updated to include footnotes and extension to the sectors;
- The REPDAB was updated with respect to the completeness and consistency checks;
- A template was provided for the Informative Inventory Report (IIR);
- The first part of the Synthesis and Assessment report, the country specific feedback template, was redesigned;
- The deadline for reply to the review was extended to one month.

The response to this year's review was comparable to the response last year in terms of numbers of replies (37%), but the amount of information fed back to the review team of experts was more extensive this year. An example of a country specific review report can be found in Appendix II. During the TFEIP in Pallanza in 2004, Parties stated that they were generally satisfied with the trial reviews, and this view was also reflected in the responses this year. Nevertheless, there is still room for improvement in the review process, and recommendations received from Parties on further development of the review is covered under each of the tests described in Chapter 6 of this report.

From the expert team of review perspective, further consideration is needed with respect to the timings of the review process. There is currently too little time between the deadline for the review responses (1. July) and the deadline for the publication of this report (15 July). Next year, the Review team aims at having the first part of the S&A ready by the 1st of May with a response deadline one month later, namely the 1st of June.

This year is the first year that we have loaded also the NEC data to WEBDAB. The Commission has indicated that making the NEC data publicly available via WEBDAB is a potential option. Further consideration on this issue is needed.

4 RECALCULATIONS

Key messages – Recalculations

The recalculation analysis has assessed the degree to which estimates made in the preceding reporting year (2004) have been revised in this year's reporting.

- *The analysis of recalculations between the 2005 and 2004 inventory submissions for twelve European countries showed that the magnitude of all recalculations for all countries was below 15% of total emissions except for PAH and HCB.*
- *For the main pollutants covered by the Gothenburg Protocol (NOx, NMVOC, NH3 and SOx) eleven out of fourteen countries reporting recalculations reported recalculations greater than +/- 3% for any one year*
- *In particular, Spain reported large negative recalculations for emissions of NMVOC (-44% to –33% of the previously reported emissions values for the years between 1990-2002). Sweden reported large recalculations for both NOx and SOx (up to 14%). While the recalculations for NOx emissions were negative for all years, the recalculations were positive up to 1996 for SOx and negative thereafter. Sweden explained in their review feedback that emission factors for SOx and NOx had been revised. Denmark reported large positive recalculations of NMVOC (40-11% increase from 2004 to 2005 reporting between 1990 and 2002) and Latvia has increased NH_3 in the 2005 reporting for various years between 1990 and 2002 up to 35%. No explanation has yet been received from Denmark and Latvia.*

Differences between the national totals reported by Parties to the LRTAP convention in different inventory submission years have been analysed in this chapter. Recalculations have been defined as $(100*[(emis_{2005} – emis_{2004})/ emis_{2004}])$ for years 1990-2002.

An assessment of recalculations in data submitted by MS under the NEC Directive has not been performed due to the small number of countries for which a time series of emissions data is available (in 2004 only 4 MS reported time series data by the 2004 review deadline which could potentially have been included in a comparison with this year's data). In addition we acknowledge that under the NEC reporting requirements, Member States are in any case not obliged to report a complete time series of data, but only provisional data for inventory year X-2 and final data for year X-3. Nevertheless we hope to perform a meaningful assessment of recalculations of NEC data in the future.

A check of recalculations is important as it provides an indication of the extent to which changes in emission estimation methodology used by Parties, and/or the availability of improved activity data/emission factors have changed the levels of the previously reported emissions. The amount and size of the recalculations might be looked at as an indicator of uncertainty in that large fluctuations from year to year point towards less confidence in the methodology and or input data to the emission calculations. Recalculations might also be important to trace in connection with compliance to Protocols under the LRTAP and the NEC. In part one of the S&A report, we provided each Party with a table of its recalculations in percent and differences larger than 10% were flagged. Due to an error in the calculation algorithm we actually estimated the recalculations relative to the 2005 emissions and not relative to the 2004 emissions as intended in the Part One S&A report. As a consequence of Parties' responses, this has been changed in this report. We have analysed the variability of the year to year recalculations for the Main Pollutants (Figure 1), the PMs (Figure 2), the priority HMs (Figure 3) and the priority POPs (Figure 4). We did the calculation for the whole timeseries 1980-2002, but there were too few countries (maximum of six) which provided recalculations in the 1980s. The number of countries recalculating their data in fact increased by a factor 4 from 1980 to 1990. We therefore decided to look only at the 1990-2002 period.

Fourteen countries recalculated their data reported in NFR between the 2004 and the 2005 submissions (Austria, Belgium, Canada, Denmark, France, Germany, Latvia, Netherlands, Norway, Slovakia, Spain, Sweden, United Kingdom and the United States) The graphs that follow show the extent to which the reported national total estimates have been revised in the 2005 reporting round compared with the estimates provided by LRTAP Parties in 2004 i.e. they show how much the emission estimates have changed since originally reported. Canada and the United States have been excluded from these figures. The results show that the size of the recalculation this year was larger for HCB and smallest for SOx. The size of the recalculations was distributed per pollutants as shown below:

SOx<NOx<NH3<PM10<PM2.5<TSP<Hg<DIOX<NMVOC<Cd<Pb<PAH<HCB.

This list may provide some information of where the future priorities for improving the EMEP/CORINAIR Guidebook (EMEP/CORINAIR, 2003) should be. Many Parties did respond to the country specific review, so that the reasons for many of the recalculations are known. The review team also encourages Parties to provide such information in an Informative Inventory Report (IIR), which if possible should be submitted in time for it to be reviewed together with the data. No clear trend in the year to year variability is apparent.

Figure 1 displays the recalculation between the 2005 and the 2005 reporting for the Main pollutants. Recalculations for all pollutants are small and less than ±7%. All pollutants but ammonia have negative percentage differences i.e. there was a reduction of the emissions in 2005 reporting relative to the value reported in 2004. The NMVOC has the largest recalculation. Recalculations of the other pollutants are generally below 1%. The recalculations of NMVOC are heavily influenced by the huge reduction in NMVOC reported from Spain this year. The reason for the recalculation is explained by Spain in the response to the review. They said that the reduction is caused by suppression in the 2004 submission of biogenic NMVOC emitted by the foliar biomass of agricultural crops (as they are considered basically non-anthropogenic). Sweden reported large recalculations for both NOx and SOx (up to 14%). While the recalculations for NOx emissions were negative for all years, the recalculations were positive up to 1996 for SOx and negative thereafter. Sweden explained in their review feedback that emission factors for SOx and NOx had been revised. Denmark reported large positive recalculations of NMVOC (40-11% increase from 2004 to 2005 reporting between 1990 and 2002) and Latvia has increased NH_3 in the 2005 reporting for various years between 1990 and 2002 up to 35%. No explanation has yet been received from Denmark and Latvia.

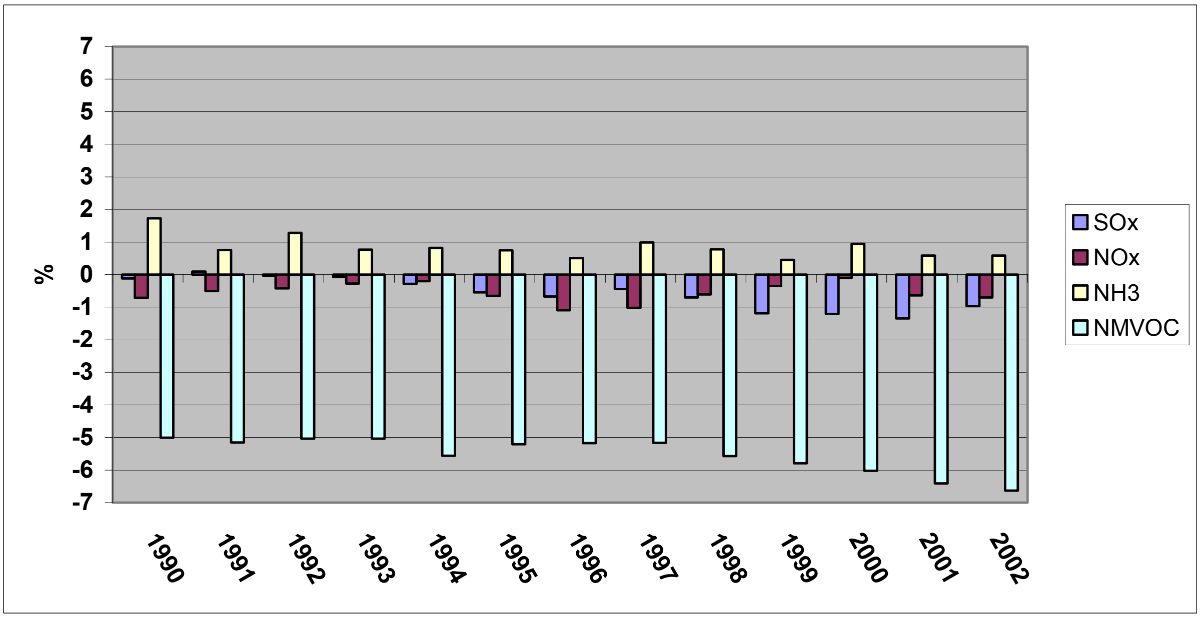


Figure 1 Change in LRTAP reported national totals for Main Pollutants between the 2005 and 2004 reporting rounds

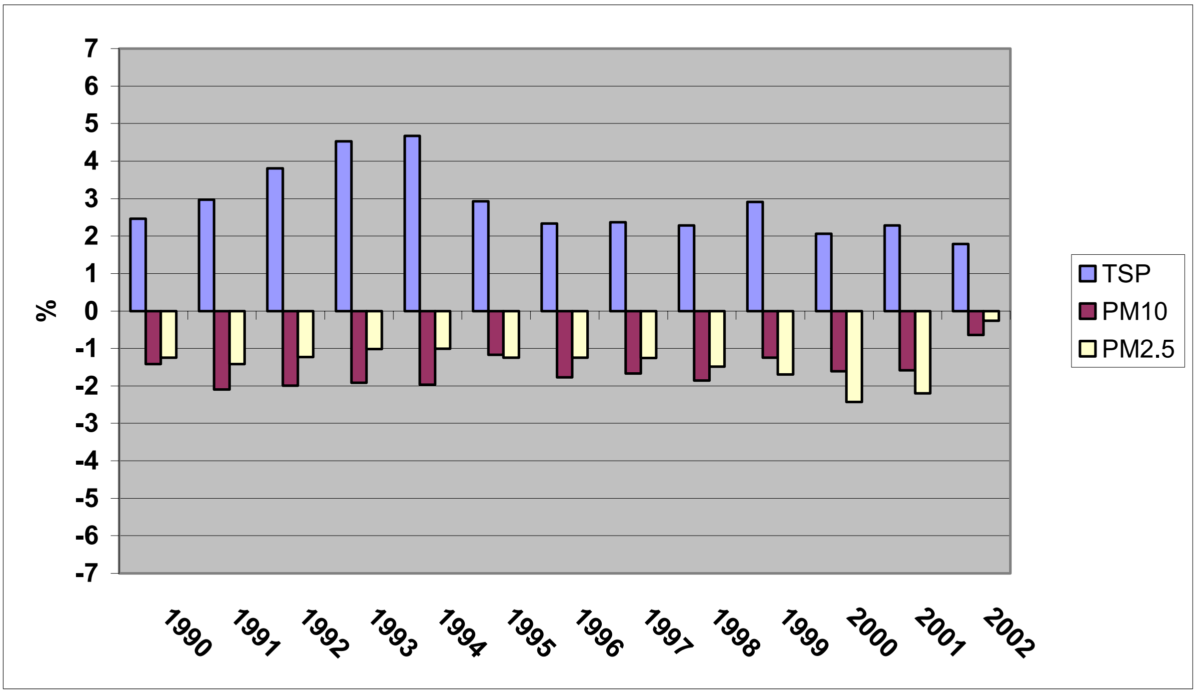


Figure 2 Change in LRTAP reported national totals for PMs between the 2005 and 2004 reporting rounds

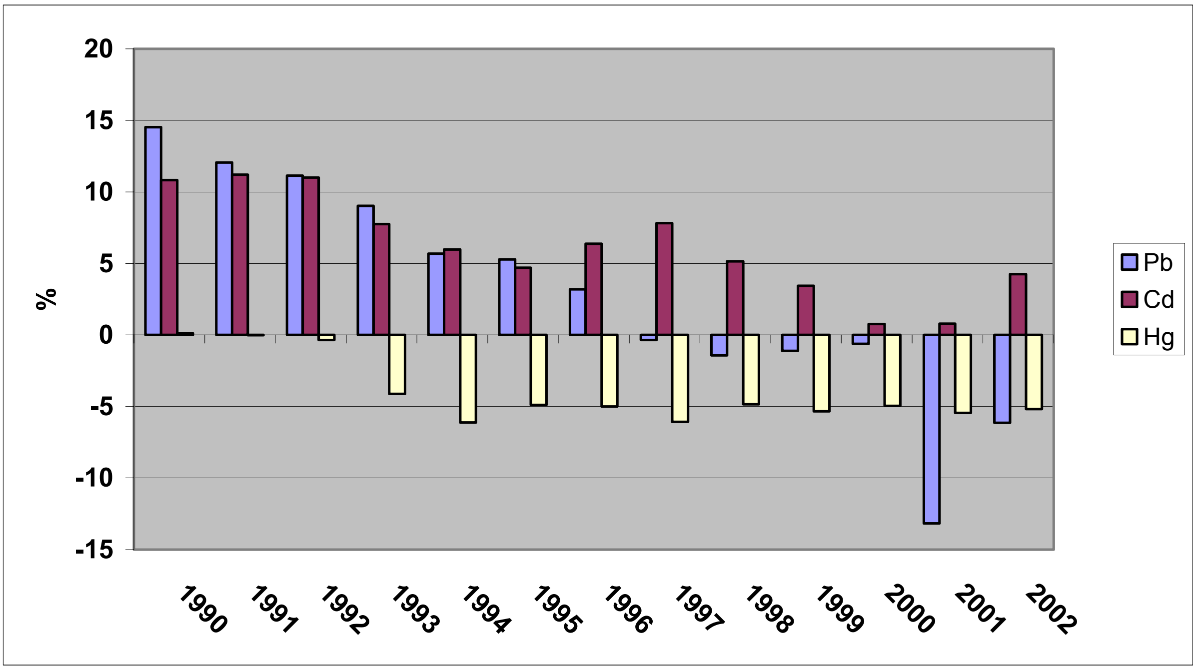


Figure 3 Change in LRTAP reported national totals for priority HMs between the 2005 and 2004 reporting rounds

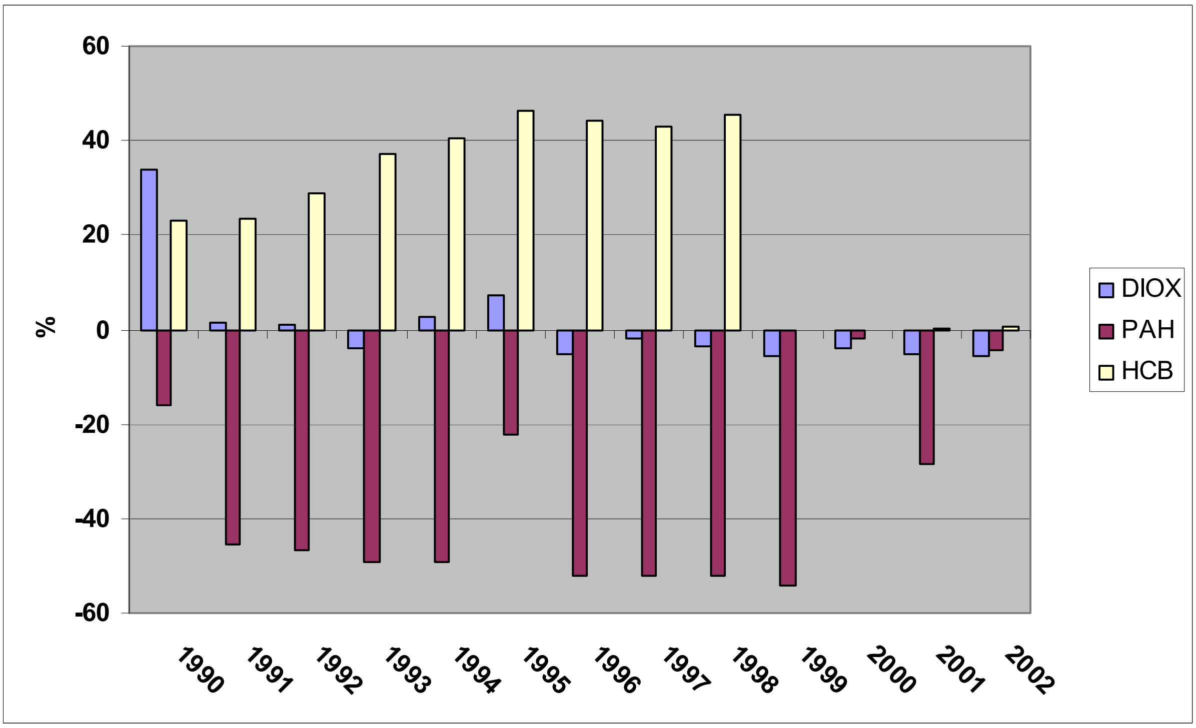


Figure 4 Change in LRTAP reported national totals for priority POPs between the 2005 and 2004 reporting rounds

Figure 2 shows the recalculation for the PMs. The recalculation for PM2.5 and PM10 are generally below ±2%. The recalculation of PM10 was larger than the recalculation of PM2.5 up to 1999, both being negative (i.e. a reduction). The TSP is recalculated more, in the early 1990s up to 4.5%, and is increasing. The somewhat larger TSP recalculations do reflect the German TSP recalculation. Germany explained that the large recalculation of their TSP emission values was due to new information in sector 1A3bvi (tyre and break wear), inclusion of heavy duty vehicles (HDV), editorial errors in the 2004 submission and recalculation of activity rates for sector 2D (Other Production).

Figure 3 shows that the magnitude of the recalculations for the priority HMs have been much larger than for the Main pollutants and the PMs. While the mercury (Hg) recalculations are negative and below 5%, the recalculation for cadmium (Cd) are positive and generally below 10% throughout the timeseries. The recalculation for lead (Pb) is highest, close to ±15% in 1990 and 2001, but fluctuates more (being positive in the first part of the period (higher 2005 emissions) and negative in the last part).

Finally, Figure 4 displays the priority POPs, which have generally larger recalculations than the HMs. The Dioxins are less recalculated, and are at the same level as Mercury, while HCB recalculations fluctuates a lot and are sometimes above 70%. The PAH recalculations are large (50%) and negative, and reflects the recalculations from Spain and France. Spain replied to the review that they had a new emission factor based on measurements to replace the old one for Sinter plants (with the old factor being 3 orders of magnitude too high due to an error). In addition, open burning of additional agricultural wastes was added to the forestry wastes previously included in the inventory. France has also revised emission factors, and in addition and very importantly, reduced the number of PAHs from Borneff to the 4 UNECE PAHs. The pattern in the PAH recalculation is mainly due to the fact that some countries, like the Netherlands, only recalculate emissions for 1990, 1995, 200-2002. In this case the recalculations from the Netherlands led to lower emissions in the 2005 reporting than in the 2004 reporting, hence the PAH is lower in 1990 and in 1995. The HCB fluctuations basically show the recalculation from the UK between 1990 and 1998 where UK replaced old emission factors with new factors from literature studies.

Interpreting the information on these graphs requires caution, due to the uncertainties inherent in the reported national total estimates. The general magnitude of change between reported national totals in the different reporting years is below 10% for all pollutants excepting PAH and HCB. This percentage variation in the reported national totals is considered to be small and well below the expected uncertainty margins of the emission totals which is considered to be in the order of +/- 20% or greater (EEA, 2003).

Although comparison of emission data submitted in 2004 and in 2005 for a group of twelve countries show that differences are generally below 15%, the magnitude of changes may be substantially larger for individual countries. Particularly in those cases, it is necessary for the Parties to report the reason for their recalculations in their IIRs. Parties are kindly requested to recalculate the whole timeseries when new information becomes available or errors are corrected in previous submissions.

5 LRTAP AND NEC INVENTORY COMPARABILITY

Key messages – LRTAP and NEC Inventory Comparability

- *Five countries had differences of larger than ±0.1 % in reporting of national totals to LRTAP and to NEC*
- *The analysis of inventory comparison and memo items reported revealed that countries are not yet sufficiently informed about the difference in the reporting requirements under the NEC Directive and under the LRTAP Convention.*
- *A check to find out if Parties report transport emissions according to Fuel Consumed or Fuel Sold, showed that all but one of the thirteen Parties that provided this information (e.g. via their IIRs) reported according to Fuel Consumed in at least one sector.*

In this chapter the difference between the NEC emission data reported in 2004/2005 with those of the LRTAP submissions reported shortly afterwards in 2005 has been analysed. The formula used in the analysis is: $(100*[(emis_{NEC} – emis_{LRTAP})/ emis_{LRTAP}])$.

Last year's trial review revealed that there were differences between the revised (GL2002) (UNECE, 2003)) and the previous emission reporting guidelines (GL1997), (UNECE, 1997) and a note on this issue was prepared to the EMEP SB (UNECE, 2004c). The differences in Guidelines have implications for the reporting under the NEC and the LRTAP, as LRTAP data is requested according to GL2002 and NEC data according to GL1997. The note points out the following differences between the Guidelines;

1. **Air traffic:** The LRTAP national totals are requested for: Domestic air traffic LTO emissions (below 1000 m) and Cruise emission (above 1000m). The NEC data is requested for both domestic and international LTO cycles, but not Cruise emissions
2. **Road and maritime transport:** The NEC Directive includes international inland shipping, while international inland shipping is not mentioned in the GL2002. The GL2002 encourages Parties to report transport emission also on the basis of fuel sold if they have reported on the basis of fuel consumed for compliance purposes. The GL1997 indicate that emissions should be reported on the basis of fuel consumed. The method chosen might have implication for the national totals reported.
3. **National territory:** In the GL2002 it is stated that for compliance purposes each Party should report national totals according to the Protocol, which is the total territory. The NEC Directive requires reporting from territories within EMEP.

In order to be able trace the differences in reporting Guidelines, there have been editorial changes made to the GL2002. A new memo item on international inland shipping was included, likewise a national total concerning emissions within the EMEP grid (GRID total), and a national total according to GL1997 (SNAP total). A footnote sheet was also included, allowing the Party to indicate whether it had reported according to fuel sold (FS) or fuel consumed (FC). In the following sections we analyse the differences seen between the emission data reported to the NEC and the LRTAP in light of memo items and footnote reporting, in order to see if the transparency and traceability is clear.

5.1 OVERVIEW BY COUNTRY

Twelve countries (Austria, Belgium, Estonia, France, Ireland, Lithuania, Latvia, Netherlands, Slovenia Spain, Sweden and United Kingdom) reported data to both LRTAP and NEC in time to be included in the inventory comparability test. Austria, France, Ireland, Lithuania, Sweden and United Kingdom had no differences in the reporting. In fact France sent the same submission to both NEC and LRTAP. Table 6 shows the differences larger than ±0.1% per component and year found in for the remaining countries. Differences larger than ±3 % are flagged.

Most of the differences have been explained either through the review process, or by going through the submissions in great detail. The reasons for differences are found to be differences in the Guidelines, errors and possibly updates of activity data between the two submissions.

Table 6. Differences between NEC and LRTAP reporting for 2004/2005. Difference in Gg. Percent in parentheses

Compound	ISO	1990	1995	1996	1997	1999	2000	2001	2002	2003
NH3	Estonia									0.01 (0.1)
	Spain						-3.3 (-0.8)	-3.1 (-0.9)	-3.3 (-0.8)	-3.2 (-0.8)
	Slovenia									-0.8 (-4.4)
NMVOC	Belgium						-76.5 (-30.8)		-0.4 (-0.2)	-0.4 (-0.2)
	Estonia									0.2 (0.5)
	Spain						-48.7 (-4.2)	-48.8 (-4.4)	-50.1 (-4.3)	-46.4 (-4.1)
	Latvia				-0.1 (-0.1)				-0.1 (-0.1)	
	Netherlands								1.6 (0.7)	1.7 (0.7)
NOx	Belgium								1.7 (0.6)	1.5 (0.5)
	Estonia									6.5 (16.6)
	Spain						-103.7 (-7.2)	-106.1 (-7.4)	-111.4 (-6.8)	-107.7 (-7.3)
	Latvia	-0.1 (-0.2)	-0.1 (-0.3)		-0.3 (-0.6)	-0.2 (-0.6)	-0.2 (-0.7)	-0.2 (-0.6)	-0.2 (-0.5)	
	Netherlands								25.2 (6.8)	25.3 (7.0)
SOx	Belgium						-92.9 (-54.1)			-0.3 (-0.2)
	Estonia									4.2 (4.2)
	Spain						-29.5 (-2.0)	-29.7 (-2.1)	-32.5 (-1.9)	-29.8 (-2.4)
	Latvia			-0.2 (-0.4)		-0.7 (-2.5)	-0.5 (-3.2)	-0.3 (-3.0)	-0.2 (-2.6)	
	Netherlands								1.6 (2.4)	1.6 (2.4)

Unlike last year's results (in which there were only a small number of significant differences noted), the results from this year's analysis show a greater nu,mber of more significant differences between the NEC and the LRTAP submissions. 48 values were flagged to have differences between the national totals reported to NEC and LRTAP by more than ±0.1%. Moreover 16 values were larger than ±3%. The largest difference in terms of gigagrams of emission was for Spanish NOx emissions in 2002 (111.4 Gg). Last year there were only ten occurrences of differences larger than ±0.1%, and only the Netherlands had differences larger than ±3%. The reason for the increase in differences this year may be due to the focus made on this issue in last year's trial review.

Five countries were flagged to have differences between their reporting to NEC and LRTAP. The Netherlands reported all memo items, so the differences were traceable from the reporting. Spain explained the reasons for differences in their review response. For the Netherlands, the differences seen are explained by the memo item, 1A3di (ii), International inland waterways and 1 A 3 a i (i) International Aviation (LTO). The LRTAP National total for Spain includes Canary Islands and national air cruise (1 A 3 a ii Civil Aviation (Domestic, Cruise), 15.448 Gg NOx) emissions that are not included in the NEC. In turn, NEC includes international LTO emissions that are not in LRTAP (but this is a comparatively minor contribution). This makes Spanish LRTAP consistently higher than the NEC emissions. If Spain had used the newest reporting template where there is a possibility to report national totals within the EMEP domain only, these differences would have been fully traceable since Spain is reporting other memo items. In conclusion, if Parties are reporting all memo items, there is possible to trace why the LRTAP and NEC totals are different.

For Belgium several of the sector emissions are different. Belgium did use different versions of the reporting templates when reporting to NEC (version 2002-1) than to LRTAP (version 2004-1), and error might have been introduced when the tables were filled. Another possible explanation is that updated activity data became available for the LRTAP submissions. We have requested a response from Belgium on this issue. Latvia reported higher lower emissions in 1A1a1 Public Electricity and Heat Production to NEC than to LRTAP, while Slovenia reported “NA” in NEC and 0.84 Gg NH3 to LRTAP from Road Transport. The reasons for these differences are not immediately clear from the IIRs. However, the differences seen for Latvia and Slovenia might be because, for example, updated activity data became available for the LRTAP reporting. Estonia made an error when calculating the NEC totals. The sum of the sector data are actually equal to LRTAP. The UK does not show up in the table above, but they have reported to LRTAP a difference larger than ±0.1% between NOx emissions in the NFR national total GL2002 and the SNAP national total GL1997. The total reported to NEC is however very close to the LRTAP national total, there is only a small difference in sector 5 B (forest and grassland conversion).

Looking through the submissions in detail reveals several peculiarities. For example a number of countries report different notation keys to LRTAP and to NEC. One prime example for one country is reporting NA to NEC and IE to LRTAP in sector 1A5A Other, Stationary (including Military).

Few Parties do report deliberately different national total to the LRTAP and the NEC. Further Guidance to Parties on how to report under the different obligations under LRTAP and NEC seems needed. Moreover, the Guidelines should be harmonized as soon as possible in order not to increase the reporting burden on Parties and Member States.

5.2 FUEL SOLD VS FUEL USED

Thirteen Parties (Austria, Belarus, Belgium, Bulgaria, Cyprus, Czech Republic, Estonia, Finland, Germany, Norway, Republic of Moldova, Sweden and Slovakia) reported if the emission calculation was made according to Fuel Sold (FS) or Fuel Consumed (FC). The information was given either in the reporting template or in the Informative Inventory report (IIR). An overview of the basis for the transport calculation is shown in Table 7.

Table 7. Overview of emission estimation according to Fuel Sold (FS) an Fuel Consumed (FC)

COUNTRY	FUEL SOLD / FUEL USED
Austria	FC (IIR)
Belarus	FC
Belgium	FC (IIR)
Bulgaria	FS, FC: Agriculture (1a4ci)
Cyprus	FC (IIR)
Czech Republic	FS, FC (IIR)
Estonia	FC (sold not available)
Finland	FC
Germany	FS
Norway	FS: 1a3b, 1a3diiI, 1a4ciii, 1a5b
	FC: 1A3aii (i), 1A3aii (ii), 1A3ci, 1A4cii
Moldova	FC
Sweden	FC (IIR)
Slovakia	FC
Total	FS: 1, FC: 9, FS&FC:3

Germany was the only country reporting to calculate emissions based only on FS, while Bulgaria and Norway used both methods depending on source category.

5.3 REPORTING OF MEMO ITEMS

Reporting of memo items concerning the international air traffic and navigation was investigated, since this has consequences for the traceability of differences in national total reported to different bodies. 17 Parties (Belarus, Belgium, Bulgaria, Canada, Cyprus, Czech Republic, Estonia, Finland, Germany, Hungary, Iceland, Netherlands, Slovakia, Slovenia, Switzerland, TFYR of Macedonia and United Kingdom) reported in the most updated template which includes the memo item for the international waterway emissions included in NEC the footnote sheet and the extension sheet with possibility to report more details in certain sectors.

Table 8 shows the amount and size of memo items reported for 2003 NOx emissions. Because of the difference in NEC and LRTAP Guidelines we are most concerned about column two, International Aviation (LOT) and five, International inland waterways since these emission are included in NEC and not in LRTAP. Only the Netherlands used the opportunity to report emissions in sector 1 A 3 d i (ii), International inland waterways (22.85 Gg NOx). Eighteen countries reported emissions in sectors 1 A 3 a i (i), International Aviation (LTO) . However, emissions from the International Aviation (LTO) alone did not lead to differences between the emission totals reported this year to LRTAP and NEC of ±0.1 % or more (see section 5.1). This can be expected in future submissions taken the size of the emissions for some of the countries (e.g. Germany) into account. However, the domestic cruise emissions included in LRTAP and not in NEC should reduce the difference in the national total.

Ten Parties reported all the three national totals (National total GL2002, National total GL1997 and Grid total) included in the most updated the template (Belarus, Bulgaria, Czech Republic, Estonia, Finland, Germany, Netherlands, Slovakia, Slovenia and United Kingdom)**.**

Only UK and the Netherlands reported to LRTAP differences between the totals following the different Guidelines. Moreover, UK did not report the GL1997 total, but the GL2002 total to NEC.

The reasons for differences between the NEC and LRTAP submissions should be easily traceable if Parties report correctly. It appears as though the differences need to be further clarified to the Parties.

Table 8. Reporting of memo items for 2003 NOx emissions

Memo items	International Aviation (LTO)	International Aviation (Cruise)	International maritime Navigation	International inland Waterways
	1 a 3 a i (i)	1 a 3 a i (ii)	1 A 3 d i (i)	1 A 3 d i (ii)
	Gg NO2	Gg NO2	Gg NO2	Gg NO2
Austria	0.71	3.93	NO	
Belarus	NE	NE	NO	NO
Belgium	1.50	1.45	NE	
Bulgaria	NE	NE	NE	NE
Cyprus	0.97	NE	NE	NE
Czech Republic	0.89	8.19	NO	NO
Denmark	0.93	8.35	85.76	
Estonia	0.24	0.22	6.50	NE
Finland	2.97	IE	47.17	NO
France	4.39	30.64	159.02	
Germany	76.22	IE	195.26	IE
Hungary	0.26	NO	NA	NA
Iceland	NE	NE	NE	NE
Ireland	3.08	2.05	9.47	
Latvia	0.45	IE	10.70	
Lithuania	IE	0.40	8.09	
Monaco	NO	NO	NO	
Netherlands	2.47	NE	126.70	22.85
Republic of Moldova	0.10	0.02	NO	
Serbia and Montenegro	NE	NE	NE	
Slovakia	NA	NA	NA	NA
Slovenia	NE	NO	NO	NO
Spain	4.11	41.11	504.92	
Sweden	0.55	6.50	115.44	
Switzerland	IE	18.06	NO	NO
TFYR of Macedonia	NE	NE	NE	NE
Ukraine	0.78	2.75		
United Kingdom	10.04	123.79	91.22	NO

6 Summary of individual country reviews

6.1 TIMELINESS

Key messages – Timeliness of reporting

- *CLRTAP: 49% of submissions from Parties were received by the reporting deadline (15 February 2005). This is an improvement in timeliness of 11% or six Parties*
- *NEC: Nine of the submissions from EU15 Member States were received on time (six in 2004). Only five of the new EU10 MS submitted, and of these, 3 submissions were received by the reporting deadline.*

Timeliness is crucial both with respect to inventory improvement (and to allow participation in the review) and in order for emission data to be included in the various assessments that are subsequently performed under the Convention on LRTAP and the European Commission.

LRTAP

During the 2005 reporting round, 33 Parties out of a total of 49 (i.e. 67%) reported emissions data to the UNECE. This is one Party more than in 2004. Twenty-four Parties of the total (49%) reported by the submission deadline (15th February 2004). This compares to 38% of Parties that reported by the required date in 2004, i.e. an increase in timeliness of 11% or six Parties. Figure 5 shows the Parties that reported emission data in 2005 in time to be included in the UNECE database, WEBDAB, and in the review process (10th March 2005). The Parties reporting within deadline are displayed to the left, the others to the right. The fifth version of WEBDAB was made publicly available by MSC-W by mid April.

In addition to the 33 Parties reporting emission data in time to be included in WEBDAB and the review, Italy and Greece also submitted 2003 data, while Poland submitted only 2002 data. These emission data together with revisions from other Parties received after 10th March will be taken into account during the next reporting round and the next update of WEBDAB. A summary table of the data submitted to the LRTAP before 4th of July this year is included in Appendix III, Table 2.

Portugal and Italy reported data to the Commission (see below) but not to the Convention. On the other hand, Cyprus, Hungary and Slovakia reported to the Convention but not to the Commission. Parties and Member States are requested to report both to LRTAP and to NEC.

NEC

Details of the timeliness of the 2004/05 submissions received by the European Commission and/or the EEA under the requirements of the NEC Directive are shown in Figure 6. An overview of the NEC submissions are shown in Appendix III, Table 3.

Of the twenty five Member States at the time of the reporting deadline (31 December 2004), only 12 (AT, BE, DK, EE, FI, FR, IE, IT, LV, NL, SE and SI) submitted inventory data on time to the Commission.

As of 25 April 2005, a further eight Member States had submitted inventory data, but after the reporting deadline. Five Member States (CY, HU, MT, PL and SK) had still not reported emissions data to the Commission by this date.

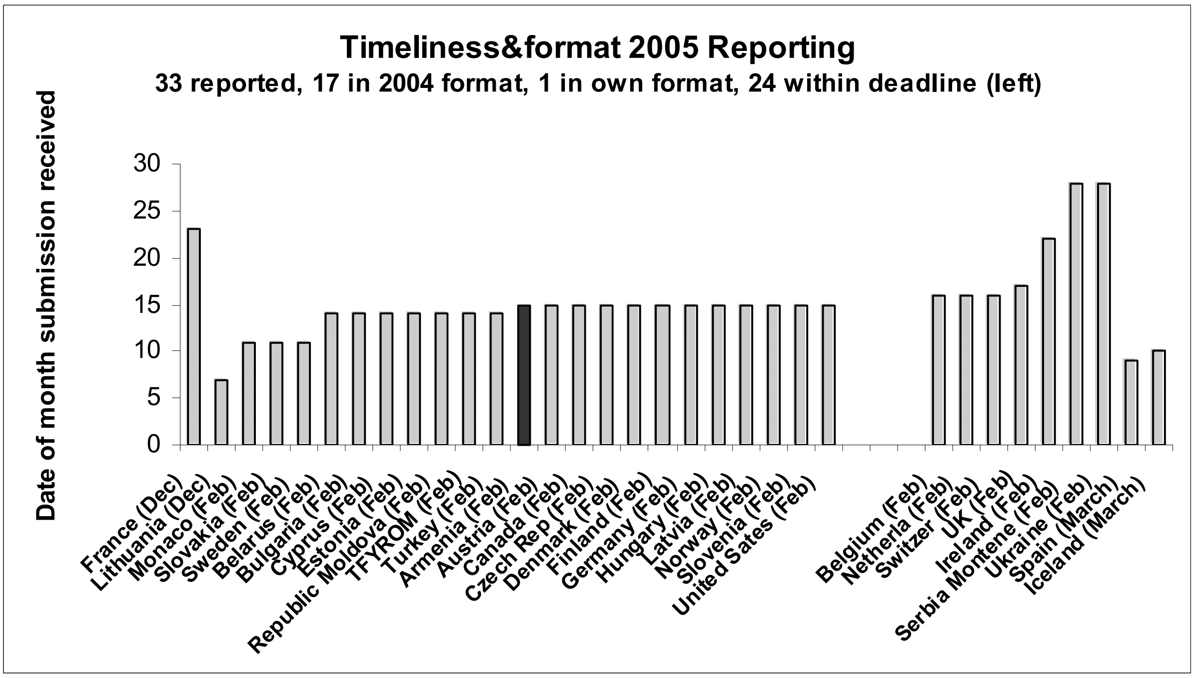


Figure 5. Date of submission to the UNECE for Parties to the CLRTAP. Parties submitting data within the deadline (15th February 2005) are displayed to the left. Parties displayed to the right submitted data before 10th March, and could be included in the review. Parties submitting data after March 10th are not included

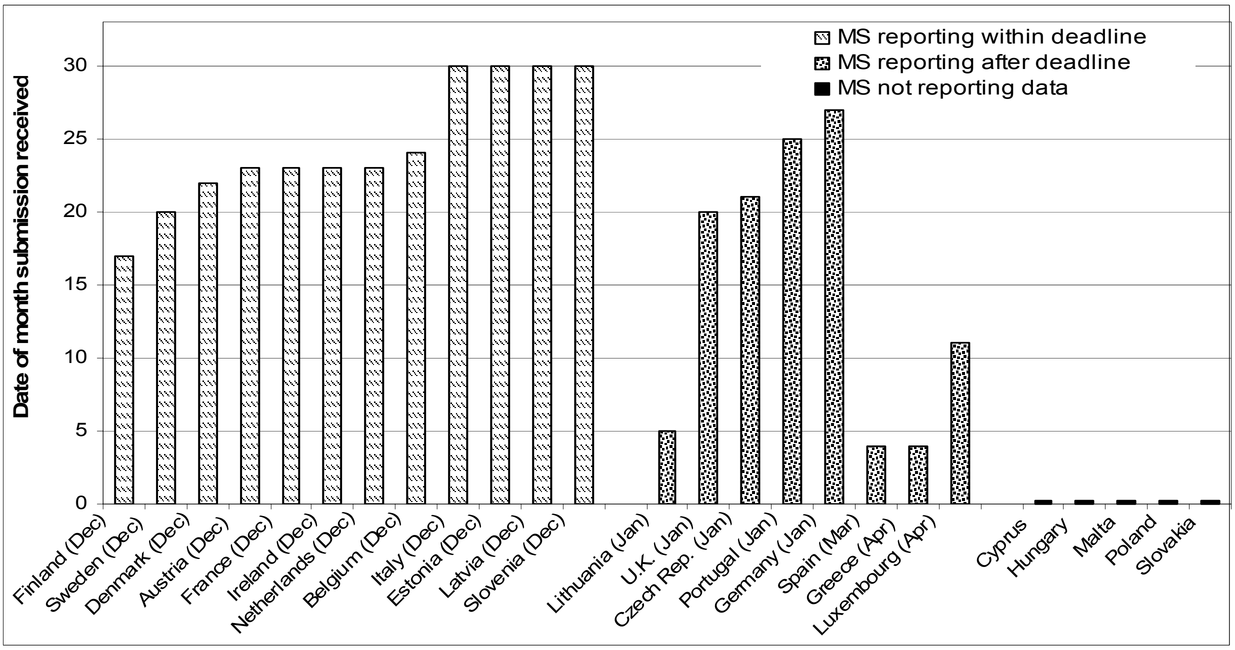


Figure 6. Date of first receipt of Member State NEC submissions received by the Commission or the EEA by 25 April 2005. Member States submitting data within deadline are displayed to the left, the others to the right.

6.2 FORMAT OF SUBMISSIONS

Key messages – Format of submissions

- *All LRTAP submissions, except the submission from Armenia, were received in NFR format. i.e. 97% reported in NFR formats. This is an improvement from 2004 of one Party.*
- *Eleven LRTAP countries reported in NFR but modified the reporting templates. This makes automatic loading of the data into the EMEP database more complicated.*
- *Of the Member States that had reported NEC emissions data by 1 June 2005, two countries (GR and IT) reported emissions in the old SNAP-based reporting format, although GR subsequently reported emissions data to LRTAP using the new NFR reporting format.*
- *Of the remaining Member States that did report, all used the required new NFR format for reporting.*

The format in which submissions are reported is important for reasons of transparency, consistency and comparability of data hold in the UNECE database, WEBDAB (i.e. all countries should report the same information in the same manner). This facilitates the subsequent use of the inventory data in policy analysis and modelling activities. Reporting data in the specified format also means that the automatic loading of data into a database is possible, therefore minimising any potential errors that might occur if manual reformatting of data is required.

LRTAP

97% of received submissions were in the NFR format. Only Armenia reported in the old format. This means that most of the reporting countries could benefit from the automatic consistency and completeness tests from REPDAB. Impressively, 55% of the reporting Parties used the updated version of the template. Still 11 of the Parties (France, Denmark, Latvia, Switzerland, Slovakia, Ukraine, FYR of Macedonia, Slovenia, Finland, Iceland and Spain) modified the reporting templates which means data cannot be automatically loaded into WEBDAB. Hopefully the detailed feedback each Party has got through the Synthesis and Assessment Report Part available on the password protected web site http://www.emep.int/REVIEW/2005, will improve the future reporting in this area.

NEC

Of the Member States that had reported emissions data by 1 June 2005, two countries (GR and IT) reported emissions in the old SNAP-based reporting format. Interestingly, shortly after their submissions to NEC, GR subsequently reported emissions data to LRTAP using the new NFR reporting format. It is not known why they did not also use this format for reporting under the NEC Directive. The remaining Member States that did report, all used the required new NFR format for reporting.

6.3 KEY SOURCE ANALYSIS

Key messages – Key source analysis

- *The key source analysis lists emission sources that contributed to 95% of the total emissions reported. The key source analyses were performed for groups of Eastern and Western countries.*
- *SOx is the only pollutant for which more than 50% from the emissions come from one single source (1A1a).*
- *The number of sources required to reach 95% of the total emissions ranges from 10 (SOx) to 57 (NMVOC). The largest sectors are identical for East and West only for five compounds (CO, PM10, PM2.5, Hg and PAH).*
- *The result of the implementation of better control technology in power plants, less field burning of wastes and more cars with catalysts emissions in the West clearly shows up in the analysis of 2003 emissions.*

A comparison of key sources between countries and between compounds has been carried out for 2003 emissions. The analysis may reveal missing sources in one country relative to a neighbouring country. The key source analysis was carried out on officially reported 2003 emission data of all LRTAP pollutants. Each Party received a country specific key source analysis in the S&A Part I (Appendix II).

In this analysis countries were grouped in Western European and Eastern European categories in order to pinpoint similarities and differences between the groups of countries. We did not find it plausible to make a more refined grouping (e.g. EU-15, EU-25 etc.) at this stage, since the reporting is still incomplete. In this analysis there are approximately the same number of countries included in the two groups, 15 countries from Western Europe and 13 for Eastern Europe.

An overview of the results is given in Table 9 and Table 10 below. The Pollutants are listed in the first column of Table 8 and Table 9, and the ten largest sectors are listed from left (largest) to right (smallest). A description of the sectors can be found in Appendix VI, Table 4. The analysis is carried out for the least aggregated sectors if they are reported, if not, the aggregated level is used. All sectors contributing to 95% of the total were calculated, but the table only displays the ten largest sectors for each pollutant. In the cells both the name of the sector and the percentage contribution to the total from this sector are listed. The two last columns list the percentage covered by the ten largest sectors and the number of sectors not included in the table.

Starting with the last column, we immediately see that the number of sectors included varies significantly between components (from 1 to 57). The variation in numbers of sectors is much higher in Eastern European than in Western European countries i.e. in Western European countries the sources seem more confined to a limited set of sectors per pollutant. In these countries, the highest variation of sectors is found for PAH and CO. The corresponding pollutants are NMVOC and TSP for the Eastern European countries. Other pollutants seem well defined to a small, fixed set of sectors in both country groups (e.g. HCB). There are large differences between East and West in the number of sectors included for each of the pollutants. For SOx, emissions come from 25 sectors in West, while there is only one sector included in the East. Likewise for NH3, the number of sectors in the West is 12 while the number is 46 in the East**.**

Looking in more detail at the results per pollutant, we can see the effect of policies that have been implemented and are now effective in the West, but still lacking in the East. On the other hand, we see that for the main pollutants, the first sectors listed in both groups appear in the list of ten sectors in the contrasting group, even though the sequence can be different. SOx is an exception as this pollutant is the only one with more than 50% of emissions coming from one single source (1A1a) in both East and West, and in fact the only source reported in the East. SOx is together with CO, PM10, PM2.5, Hg and PAH the compounds where the largest sector is identical in East and West. In West, passenger cars are the number one NOx source, while power plants are still the largest source in East. Passenger cars are not listed as a source for NH3 in the East, while contributing 2% in the West. CO from field burning of agricultural wastes (4F) is number three on the list in the East, while it does not appear in the West. These observations might be viewed as a result of more extensive implementation of control technology in power plants in West than in the East, stricter regulation on field burning of waste and lower share of passenger cars with catalysts in the East. As reported last year, countries seem to have difficulties finding the right sectors to report NMVOC from, as the category “Other Solvent and Product use” (3D) is the largest sector in the West. We tried to give some more guidance on this in the reporting template this year, by adding a sheet. “Additional info”, with more detailed information of where emissions are expected to occur. So far it does not seem to have helped a lot, but only 17 Parties reported in the updated template so far, so the effect might be seen first next year when reporting in this template becomes obligatory.

TSP seems to be another pollutant where it is difficult to decide where to report emissions, since here also “Other, Mineral Products” (2A7) is listed as the number one sector in the West. In the East, residential plants (1A4bi) are listed as the main sector. The differences between East and West are large for TSP. The two first sectors listed in the West do not even appear on the top ten list in the East. There are reported emissions from a multitude of sectors both in the West and in the East, and this might be due to a larger uncertainty attached to the emission reporting for TSP than for many other compounds.

The Heavy Metals and POPs have been analysed in detail in Chapter Two of this report, here we should only report that HMs emissions seem have the same sources in both East and West, except for reporting of Pb and Hg in West in the category “Other, Manufacturing Industries and Construction” (1A2f) and the emissions of Hg from cement production in the East.

The pollutant with emissions from fewer sectors in the POPs group is the HCB. In fact, in the West, more than 70% of HCB is reported to come from “Other, Agriculture” (4G). In East the largest sector is “Other, waste” (4G, 44%). While the main PAH source is residential plants in both East and West, the main sector for Dioxins in the East is power plants (1A1a).

Caution should be taken to draw too firm conclusions, but this picture may indicate that Eastern and Western emissions inventories are not really comparable and that the reporting is less harmonized in the East than in the West.
Finally it should be mentioned that this type of analysis does not make sense if Parties are reporting inconsistent data (e.g. the sum of sectors does not add up to the national total) (see section 6.5). This is yet another reason that Parties are encouraged to check the submissions carefully with REPDAB before submitting data to the Convention.

Table 9. Key Source Analysis for 2003 in selected Western European countries[1] . The numbers in parenthesis give the relative contribution to total emissions. Only the top ten source categories are listed.

Component		Key source categories (Sorted from high to low from left to right)										Total (%)	Not listed[2]
Main Pollutants	SOx	1 A 1 a (53.2%)	1 A 2 f (8.3%)	1 A 1 b (8.2%)	1 A 4 b i (4.9%)	1 A 4 a (2.3%)	1 B 2 a iv (1.9%)	1 A 3 d ii (1.9%)	1 A 2 a (1.7%)	2 C (1.6%)	1 A 2 c (1.5%)	85.5	15
	NOx	1 A 3 b iii (18.9%)	1 A 3 b i (16.9%)	1 A 1 a (16.5%)	1 A 2 f (7.7%)	1 A 4 c ii (5.4%)	1 A 4 b i (4.6%)	1 A 3 b ii (4.4%)	1 A 3 d ii (3.2%)	4 D 1 (2.2%)	1 A 1 c (2.0%)	81.8	17
	NH3	4 D 1 (24.0%)	4 B 1 b (19.5%)	4 B 1 a (18.5%)	4 B 8 (15.7%)	4 B 9 (9.7%)	1 A 3 b i (2.0%)	4 B 13 (1.3%)	4 B 3 (1.2%)	6 D (1.0%)	2 B 5 (1.0%)	93.9	2
	NMVOC	3 D (18.0%)	3 A (14.7%)	1 A 3 b i (8.4%)	1 A 4 b i (7.5%)	1 B 2 a i (5.4%)	1 A 3 b v (4.4%)	3 C (3.4%)	2 B 5 (3.4%)	2 D 2 (2.8%)	2 A 6 (2.6%)	70.6	19
	CO	1 A 3 b i (32.7%)	1 A 4 b i (21.2%)	2 C (9.3%)	1 A 2 a (7.5%)	1 A 3 b iv (3.6%)	1 A 2 f (2.9%)	1 A 3 b ii (2.7%)	1 A 4 b ii (2.0%)	1 A 3 b iii (1.6%)	6 C (1.6%)	85.1	29
PMs	TSP	2 A 7 (22.5%)	4 D 1 (17.7%)	1 A 4 b i (9.6%)	1 A 3 b vi (7.3%)	1 A 5 b (6.9%)	2 C (4.3%)	1 A 4 c ii (2.7%)	1 A 1 a (2.7%)	1 A 2 f (2.4%)	1 A 3 b i (2.1%)	78.2	18
	PM10	1 A 4 b i (20.6%)	2 A 7 (11.1%)	4 D 1 (8.6%)	1 A 3 b vi (5.5%)	1 A 2 f (5.3%)	1 A 4 c ii (4.7%)	1 A 3 b i (4.6%)	1 A 1 a (4.4%)	2 C (3.6%)	1 A 3 b ii (3.4%)	71.8	22
	PM2.5	1 A 4 b i (30.7%)	1 A 3 b i (7.8%)	1 A 4 c ii (6.5%)	1 A 3 b iii (6.2%)	1 A 2 f (5.6%)	1 A 3 b ii (5.3%)	2 A 7 (4.7%)	1 A 1 a (3.9%)	2 C (3.9%)	4 D 1 (3.0%)	77.6	19
HMs	Pb	2 C (28.5%)	1 A 2 f (15.7%)	1 A 2 a (13.5%)	1 A 2 b (9.9%)	1 A 4 b i (5.8%)	1 A 1 a (5.4%)	1 A 3 b i (5.1%)	2 B 5 (1.5%)	1 A 3 a ii (ii) (1.4%)	6 C (1.4%)	91.8	9
	Hg	1 A 1 a (28.3%)	1 A 2 f (28.1%)	2 C (9.1%)	2 B 5 (8.2%)	6 C (7.4%)	1 A 1 b (4.3%)	1 A 4 b i (2.5%)	1 A 2 a (2.0%)	6 A (0.9%)	1 A 2 d (0.8%)	91.6	6
	Cd	2 C (25.1%)	1 A 1 a (14.8%)	1 A 2 b (10.9%)	1 A 1 b (9.4%)	1 A 2 f (8.2%)	1 A 3 b vi (7.8%)	1 A 4 b i (4.3%)	1 B 1 b (3.5%)	1 A 2 a (3.4%)	6 C (2.6%)	90	4
POPs	DIOX	1 A 4 b i (21.7%)	6 C (17.4%)	1 A 1 a (14.0%)	1 A 2 a (9.1%)	2 C (8.9%)	1 A 2 f (6.1%)	1 A 2 b (4.7%)	6 D (3.1%)	3 D (3.1%)	7 (1.7%)	89.8	5
	PAH	1 A 4 b i (31.7%)	3 D (17.5%)	2 G (12.1%)	2 C (9.1%)	1 A 3 b i (4.0%)	1 A 2 b (3.1%)	1 A 3 b iii (2.7%)	4 F (2.1%)	6 C (1.9%)	1 A 3 b ii (1.7%)	85.9	41
	HCB	4 G (70.9%)	1 A 2 b (14.4%)	6 C (6.7%)	2 C (4.6%)							96.6	0

[1] The following countries are included: FR,MC,SE,AT,DK,FI,DE,NO,BE,NL,CH,GB,IE,ES,IS

[2] Sum of categories not included in the table.

Table 10. Key Source Analysis for 2003 in selected Eastern European countries[3] . The numbers in parenthesis give the relative contribution to total emissions. Only the top ten source categories are listed.

Component		Key source categories (Sorted from high to low from left to right)										Total (%)	Not listed[4]
Main Pollutants	SOx	1 A 1 a (99.5%)										99.5	0
	NOx	1 A 1 a (39.9%)	1 A 3 b i (15.3%)	1 A 3 b iii (7.3%)	1 A 4 b i (3.6%)	1 A 4 c ii (3.3%)	1 A 2 a (2.3%)	1 A 3 b ii (2.2%)	1 A 3 e ii (2.0%)	1 A 2 f (1.7%)	1 A 3 c (1.7%)	79.3	34
	NH3	4 B 8 (16.8%)	4 B 1 a (15.1%)	4 D 1 (11.3%)	4 B 9 (10.0%)	4 B 1 b (9.6%)	4 B 13 (4.4%)	6 D (2.2%)	4 B 3 (2.2%)	6 B (1.8%)	4 B 6 (1.5%)	74.9	36
	NMVOC	3 A (15.3%)	1 A 3 b i (12.3%)	1 A 4 b i (10.2%)	3 D (6.4%)	3 C (3.2%)	3 B (3.0%)	1 A 1 a (2.2%)	2 D 2 (2.2%)	1 B 2 a iv (2.0%)	4 D 1 (1.6%)	58.4	47
	CO	1 A 3 b i (20.6%)	1 A 4 b i (19.6%)	4 F (11.2%)	1 A 2 a (4.2%)	2 C (3.3%)	1 A 3 b iii (2.8%)	1 A 4 a (2.5%)	1 A 1 a (2.1%)	1 A 3 b ii (1.3%)	1 A 4 b ii (1.2%)	68.8	36
PMs	TSP	1 A 4 b i (24.1%)	1 A 1 a (11.9%)	1 A 3 b iii (5.1%)	1 A 4 a (4.9%)	1 A 2 a (3.5%)	1 A 2 b (3.2%)	2 C (2.7%)	2 D 1 (2.3%)	2 G (2.2%)	2 A 5 (2.2%)	62.1	43
	PM10	1 A 4 b i (42.6%)	1 A 1 a (14.5%)	1 A 3 b iii (9.5%)	1 A 2 a (3.8%)	1 A 2 f (3.8%)	1 A 4 a (3.5%)	1 A 4 c ii (2.3%)	2 C (1.8%)	1 A 1 c (1.5%)	1 A 4 c i (1.5%)	84.8	42
	PM2.5	1 A 4 b i (46.2%)	1 A 1 a (10.4%)	1 A 3 b iii (9.7%)	1 A 2 f (4.5%)	1 A 4 c ii (3.3%)	1 A 4 a (3.0%)	1 A 2 a (3.0%)	2 C (1.6%)	1 A 1 c (1.3%)	1 A 4 c i (1.2%)	84.2	40
HMs	Pb	1 A 2 b (20.7%)	1 A 2 a (14.2%)	2 C (13.4%)	1 A 1 a (9.7%)	1 A 2 f (4.9%)	1 A 3 b i (4.2%)	6 C (2.8%)	1 A 4 b i (1.8%)	1 A 1 c (1.2%)	1 A 3 b iii (0.9%)	73.8	20
	Hg	1 A 1 a (28.2%)	1 A 2 b (14.2%)	1 A 2 a (10.3%)	2 A 1 (9.1%)	1 A 4 b i (8.8%)	6 C (6.8%)	1 A 1 c (4.0%)	2 B 5 (2.1%)	2 C (2.1%)	6 D (2.1%)	87.7	11
	Cd	1 A 2 b (40.1%)	1 A 2 f (15.1%)	1 A 1 a (10.7%)	2 C (8.9%)	1 A 2 a (4.8%)	1 A 3 b iii (3.5%)	6 C (2.7%)	1 A 4 b i (2.3%)	1 A 1 b (1.7%)	1 A 1 c (1.5%)	91.3	12
POPs	DIOX	1 A 1 a (17.2%)	7 (16.8%)	1 A 4 b i (14.5%)	6 C (6.1%)	1 A 2 a (3.8%)	2 C (3.7%)	1 A 3 b i (1.3%)	1 A 1 b (1.0%)	6 D (1.0%)	1 A 2 b (0.8%)	83.4	26
	PAH	1 A 4 b i (36.9%)	1 A 3 b i (13.8%)	2 C (13.7%)	1 A 1 a (5.0%)	1 A 1 b (3.9%)	1 A 2 a (3.3%)	1 A 1 c (2.1%)	1 A 4 a (1.9%)	1 A 2 b (1.5%)	1 A 3 b ii (1.3%)	83.4	24
	HCB	6 D (43.8%)	2 C (40.7%)	1 A 2 a (4.2%)	1 A 4 a (4.0%)	1 A 2 b (2.4%)	1 A 1 a (2.3%)					97.4	0

[3] The following countries are included: LT,SK,BY,BG,CY,EE,MD,MK,TR,CZ,HU,LV,SI

[4] Sum of categories not included in the table.

6.4 COMPLETENESS

Key messages – Completeness

- *The completeness of LRTAP data increased for almost all countries and pollutants compared with submissions in previous years, both in terms of notation keys and unique values reported. The increase was seen both for 2003 emissions data and for the number of time series reported.*
- *The completeness of national total emissions, i.e. the number of unique values reported for national totals, increased by approximately 5%. There was an increase of 10% in the level of reporting of both PM2.5 and PM10. There was no reporting of emissions values for Annex I POPs and DDT in 2005.*
- *5 Parties (i.e. 10%) of the Parties met the minimum time series reporting requirements i.e. to report emissions of main pollutants 1980 to latest year, heavy metals and persistent organic pollutants 1990 to latest year and particulate matter 2000-latest year. This is the same number as last year.*
- *The percentage of reporting of unique values varies considerably among Parties (1-35%).*
- *The use of notation keys has been better harmonized between countries as a consequence of preshading in reporting templates and the focus on this issue in last year's review report.*

Completeness of reported data is important both with respect to the comparability, their accuracy (i.e. all sources included) and with respect to the analysis of trends in the emission data (all sources included for all years). If incomplete inventories are reported then any subsequent analysis performed using the data for purposes of, for example, policy analysis or air quality modelling, may lead to wrong conclusions.

In this year's review, as in the previous trial reviews, we have defined a submission to be complete if all cells in the template have been filled with either a number or a notation key. A time series is complete if the above criterion applies for all years 1980-latest year for Main Pollutants, 1990-latest year for HMs and POPs and 2000-latest year for PMs. We would like to stress that this definition of completeness cannot be used to assess compliance. The Guidelines' §9 reads that each Party must report the base year, and every year starting with the entry into force of the Protocol. Each Party and each pollutant might have different base years, and obligations in accordance with the various Protocols under the Convention, and hence needs to be treated separately. This is not accounted for in our assessments below.

Another issue with respect to the definition of completeness arises from the use of notation keys. If a Party reports national totals for the years required by the Protocols and fills in the rest of the table with notation keys, should we then consider this report as complete even though we do not know whether or not all key sources have been included in the totals?

Based on experiences from the trial reviews, we made several editorial changes to the reporting template and in the reporting tool, REPDAB, in order to facilitate the reporting of complete submissions. We "preshaded" cells with NA (Not Applicable) and we introduced the notation key NR (Not Relevant). Last year we noted that the use of notation keys varied a lot between countries, and we developed a footnote sheet where Parties could explain how they used the notation keys. The footnote sheet also facilitated the reporting of where emissions are included if IE (Included Elsewhere) is used, and a quick way of listing which sources are covered in the “other” sectors.

In this section we will look at the different aspects of completeness mentioned above, and try to assess if the improvements we made to the reporting templates had a positive effect on the reporting. We have analysed the completeness of emissions reported in NFR by first looking at the completeness of national totals, thereafter the sector data and finally the use of notation keys. The completeness has been analysed by pollutant, by year, by NFR sectors and by most recent year available (2003).

National totals Figure 7 shows completeness of 2003 national totals in terms of the percentage of the number of Parties to the Convention on LRTAP. The figure shows that the reporting of main pollutants (yellow) is better, followed by the priority metals (purple), the PMs (blue) and the priority POPs (dark green). The completeness varies between 6% (HCH) to 63% (SOx and NOx). The figure might be viewed as a recommendation on where/for which pollutants the EMEP/CORINAIR Guidebook (EMEP, 2003) needs to be strengthened. The PMs have a low score, only about 45% of the Parties have reported the priority POPs. However, there is a remarked increase of about 5% in completeness of national totals emission (unique values) for the most recent year compared to last year’s result (Vestreng et al., 2004, Figure 7). The increase was most pronounced for PAH (8%). The completeness increased about 5% for the Main pollutants, the dioxins, HCB and the additional HMs.

The completeness of priority HM were relatively constant, while reporting of PMs increased slightly (see also below). The completeness of Main Pollutants and PMs timeseries of national totals per country used for modelling at the MSC-W together with the European trends are shown in Appendix V Table 5-10. The grey shaded cells shows where there is a lack of official reporting of national totals for Main pollutants and for PMs. Emission figures in bold indicates that there has been recalculations since last year’s reporting. The trends for the time period 1980-2003, 2010, 2020 for the individual Parties and the whole EMEP area are also depicted. We see that the completeness is generally better in later years than in the 1980s and that the completeness is best for SO_2 and NO_2 and worst for NH_3. Further, only 12 Parties (24%) reported both $PM_{2.5}$ and PM_{10} from year 2000 to 2003 as shown in Table 6. However 20 Parties reported at least one year of consistent PM data (both PM10 and PM2.5), an increase of 5 Parties. This is very encouraging, and we appreciate that more of the expert estimates can be substituted by consistent PM data reported.

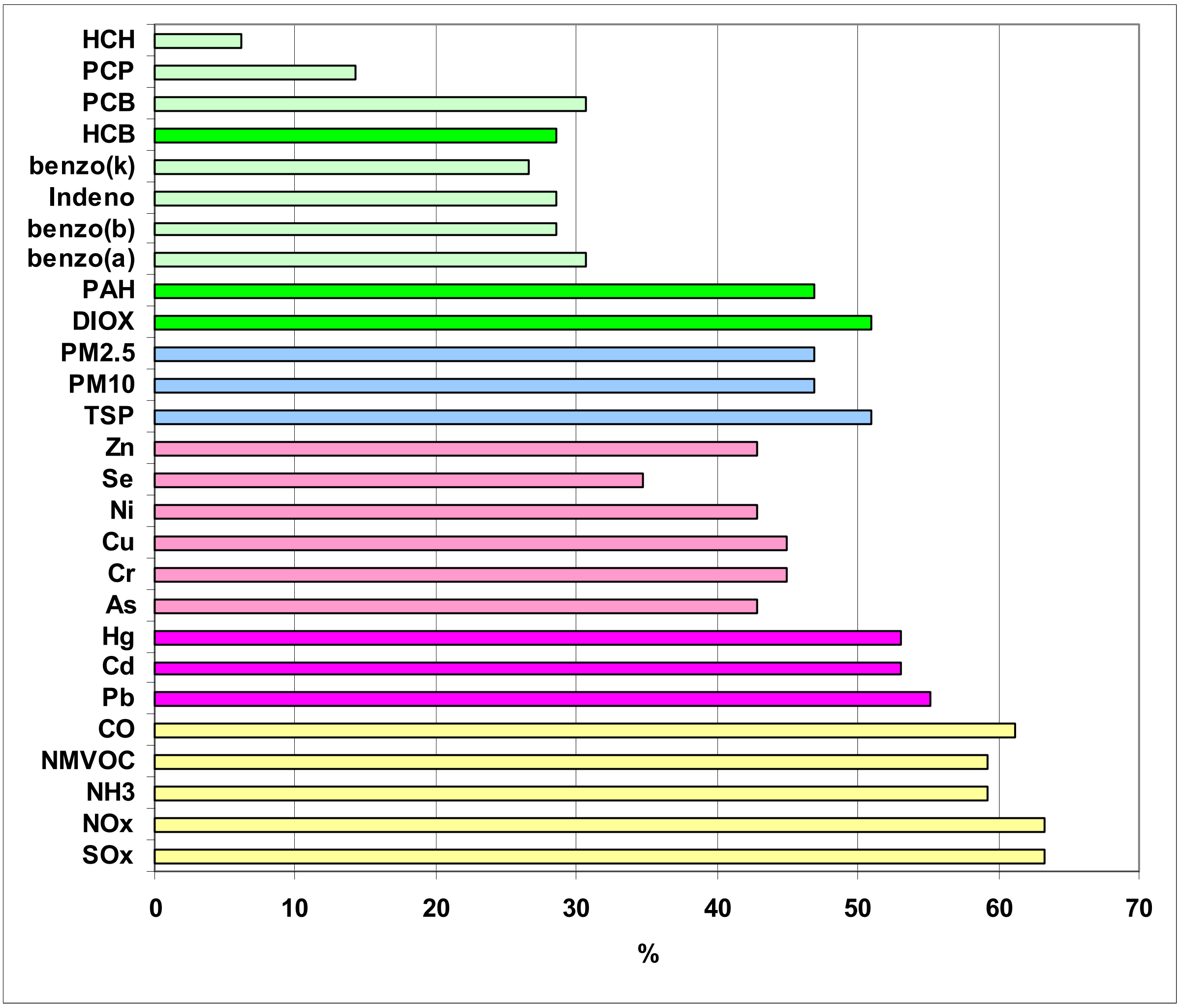


Figure 7. Completeness of national total 2003 emissions reported to CLRTAP before 10th March 2005 (%)

Sector data. Figure 8 shows the analysis of completeness by country for 2003 emissions. The countries reporting 2003 data are displayed on the X-axis, excluding Armenia since they did not report in NFR. The percentage completeness is plotted on the Y-axis. The completeness bars are made up of reporting of unique values (bottom), zeros, and then the notation keys: Included Elsewhere (IE), Not Occurring (NO), Not Applicable (NA), Not Estimated (NE) and Not relevant (NR). The 100% completeness line is the level of reporting when all cells in the reporting template is filled in either with a value or a notation key.

The number of countries reporting data in NFR in time for the review has increased from 30 last year to 32 this year. Ten countries (32%) submitted 100% complete submission for 2003. 72% of countries submitted over 80% of the required data (i.e. at least 80% of cells in the reporting template were completed with either a unique value, 0, or a notation key). Completeness, both the reporting of unique values and notation keys, has increased in 2005 compared to the 2004 reporting levels.

The increase in completeness is partly attributable to the use of pre-filled NA notation keys, although it is noted that some of these were removed by 11 of 17 Parties (generally replaced by other notation keys (mostly NO) or blanks). Two Parties used the new notation key, NR.

Another reason may be that Parties have picked up on the main messages from the previous reviews and presentation at TFEIP/EIONET meetings that they should enter a value or notation key in every cell of the reporting template in order to meet the reporting requirements.

Finally, we note that there is a large difference between countries in the level of unique values reported. United Kingdom report most values, about 25%, followed by France, Spain, Norway, Sweden and the Netherlands with approximately 20% values. For the other countries the percentage completeness of actual emission data varies, but more than half of the countries have reported 10% or more emission data. Evidently, some countries do not report all pollutants, but the completeness of sources included in the reporting must also differ (e.g. between the UK and Germany). It is not easy to depict what the correct level of source categories should be in each country, but Parties might like to consider informal twinning projects to find out if there are sources included in e.g. the UK, which are overseen in their own country. The reporting of notation keys do also vary a lot, and this is discussed below.

Figure 9 shows the_completeness of timeseries 1980-2003 by pollutant. It shows the number of unique values reported by countries during this period, together with the relative numbers of zeros and notation keys. The 100% completeness line signifies that there is a number or a notation key in every cell in the reporting template for the years 1980-2003 for main pollutants, 1990-2003 for HMs and POPs, and 2000-2003 for PMs for all the 49 Parties to the Convention. The fact that PM reporting exceeds 100% is that some Parties report timeseries from 1980 also for PMs. The completeness of Main Pollutants, HMs and POPs has increased compared to last year (Vestreng et al, 2004, Figure 10). The completeness of Main pollutants exceeds 20%, the PMs are around 130%, the Priority HMs about 40%, while the POPs are around 30%. The figures last year were 18%, 130%, 30% and 20%. This means that the completeness of HMs and POPs timeseries from 1990-2003 has increased by remarkably 10% in one year. The reporting of Main Pollutants increased slightly while the PMs remained approximately the same level. The huge increase seen for HMs and POPs is most likely because of the much stronger focus, and probably more resources allocated to these substances since their Protocols entered into force.

Figure 10 shows the completeness of timeseries reported 1980-2003 reported to the LTRAP Convention. As mentioned above, the 100% completeness line signifies that there is a number or a notation key in every cell in the reporting template for the years 1980-2003 for main pollutants, 1990-2003 for HMs and POPs, and 2000-2003 for PMs for all the 49 Parties to the Convention. The completeness varies between 160% (Sweden and Austria) to close to zero percent (Greece, Turkey, Russian Federation). Most countries increased their completeness this year compared to last year (Vestreng et al., 2004, Figure 8). The increase is mostly due to increased reporting of notation keys, but there is also an increase in the reporting of unique values e.g. from UK and Belgium. The increase in completeness of unique values are generally quite small, 1-2%. The sequence of the six countries with highest completeness (Sweden, Austria, Denmark, France, United Kingdom and Germany) is the same as last year.

There are however newcomers to the list of countries included in this analysis. Iceland has only ratified the POPs and HMs Protocols which entered into force in 2003, and as a consequence has submitted data to the Convention for the first time in many years. Other countries like Switzerland, Canada and Bulgaria are newcomers to this list because they report for the first time in NFR format. The number of unique values varies considerably between countries. If we look only at the five countries meeting the minimum level of reporting required, Sweden, Austria, Denmark, France and United Kingdom, we see that the percentage of unique values vary between close to 40% (United Kingdom, 25% (France), about 20% (Sweden and Austria), 15% (Denmark) and 5% (Germany). Again, it is difficult to establish what is the correct percentage of emission reporting for each timeseries and country, and it is difficult to understand why there is such a big difference in the reporting of emissions between e.g. United Kingdom and Germany. Based on our findings, we hope that countries start to talk bilaterally to find out if the others do estimate emissions in sectors where they don't.

Notation Keys From Figure 8Figure 9 and Figure 10 we note that the use of notation keys varies between countries (Figure 8 and Figure 10) and between pollutants (Figure 9). Figure 8 shows as a consequence of the pre-filling of templates with NA, the level of reported NA's is fairly well harmonized between countries reporting in the most updated version of the template. (Belarus, Belgium, Canada, Cyprus, Czech Republic**,** Estonia, Finland, Hungary, Iceland, Netherlands, Slovakia, Slovenia, Switzerland, TFYR of Macedonia and United Kingdom). Bulgaria and Germany modified the pre-filling by insertion of NE (Bulgaria) and NO (Germany). The variation in notation keys are larger among those countries reporting in the older version of the template (e,g, Austria and France). Progress is underway in France to substitute the reporting of zeros with notation keys. Figure 10 shows that only two countries, Denmark and France used the newly introduced notation key NR (Not Relevant).

Figure 9 shows that the Annex I POPs and DDT have no unique values reported, which means that of the 38 pollutants currently included in the Convention only 28 pollutants are reported to have emissions. Reporting of unique values for HCH, PCP and SCCP is also scarce. This is as expected, since the Annex I POPs have been faced out, and the other POPs are for restricted use only. It is not obligatory to report PCP and SCCP as these are defined as additional reporting. Because of the difference in reporting years between pollutants in Figure 9, the exact sequence of pollutants with highest reporting of values and or notation keys cannot be read from the figure. What we can see is that the use of notation keys and the level of unique values are fairly constant between pollutants of the same group (Main, PMs, Priority HMs and propriety POPs), except for HCB which has a higher reporting of NA's compared to Dioxins and PAHs. In conclusion, the notation keys varies quite a lot between countries (Figure 10), but are fairly constant within each pollutant group (Figure 9).

We emphasised the importance of the use of notation keys last year, and we included their definition in the updated reporting template and in the IIR. Still there are uncertainty among Parties of whether to report NA ,NE, NO or zero.

We have noted that emission reporting increases, but a final observation from the 2003 submissions is that sixteen Parties (33%) failed to report 2003 national sulphur emissions. We know that some Parties had trouble reporting on time, and that more 2003 emissions will be included next year. Still there are many Parties which do not submit data to the Convention. We have not received any specific feedback from Parties as to why they do not manage to report on time, but this may be an area in which the TFEIP could seek further information to help improve the current situation. For other pollutants than Main Pollutants we know that the lack of emissions factors in the Guidebook (EMEP/CORINAIR, 2003) might hamper the emission calculation. The TFEIP emphasises that resources are needed in order to update the Guidebook. Parties are welcomed to flag their requirements in order to report emission data to the TFEIP secretariat (torgrim.asphjell@sft.no).

The Capacity Building workshop to be held back to back with the TFEIP meeting in October 2005 will hopefully help clarify what improvements/resources are needed in order that Parties can further improve their reporting in future years.

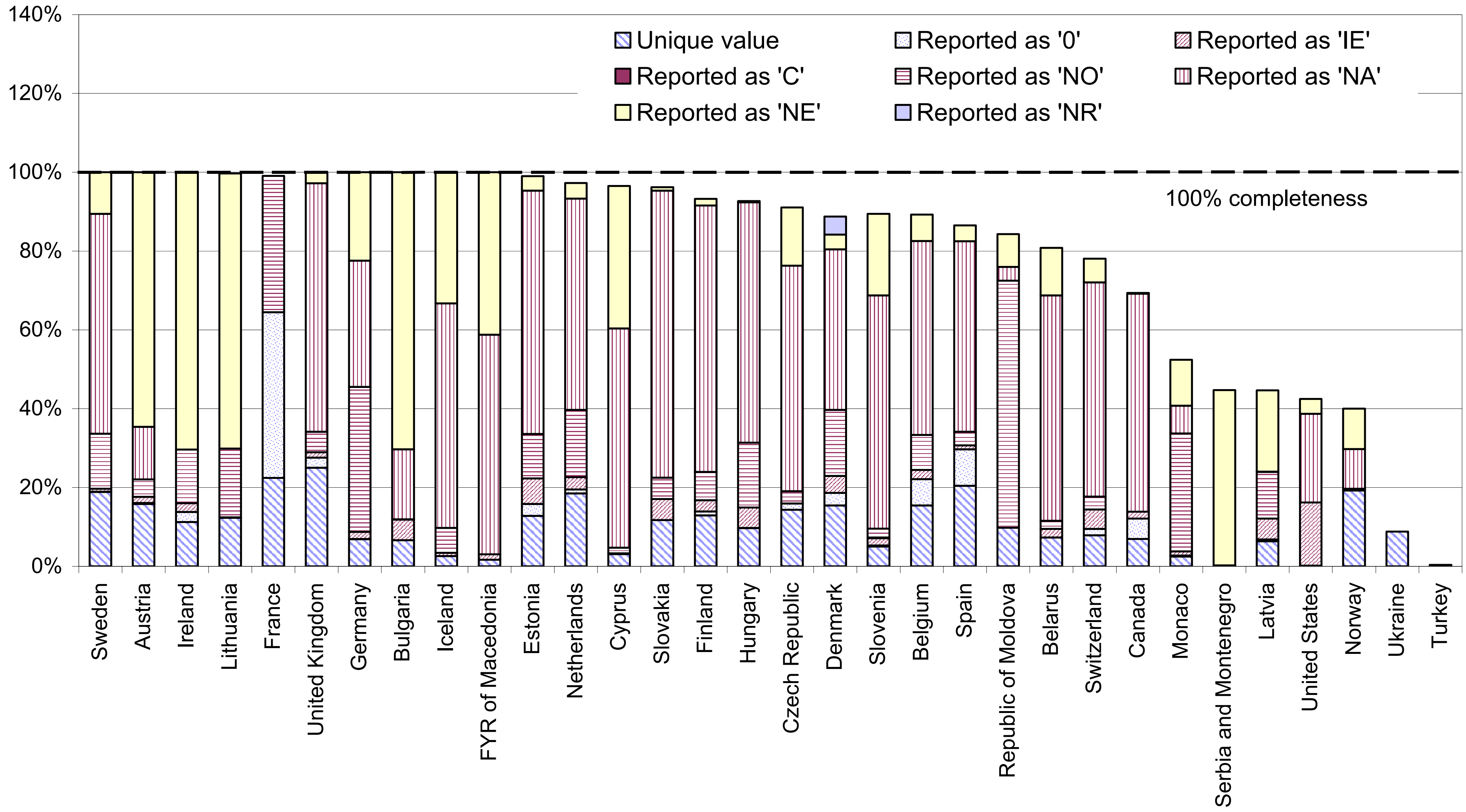


Figure 8 Completeness of LRTAP data for 2003: by country (All pollutants included)

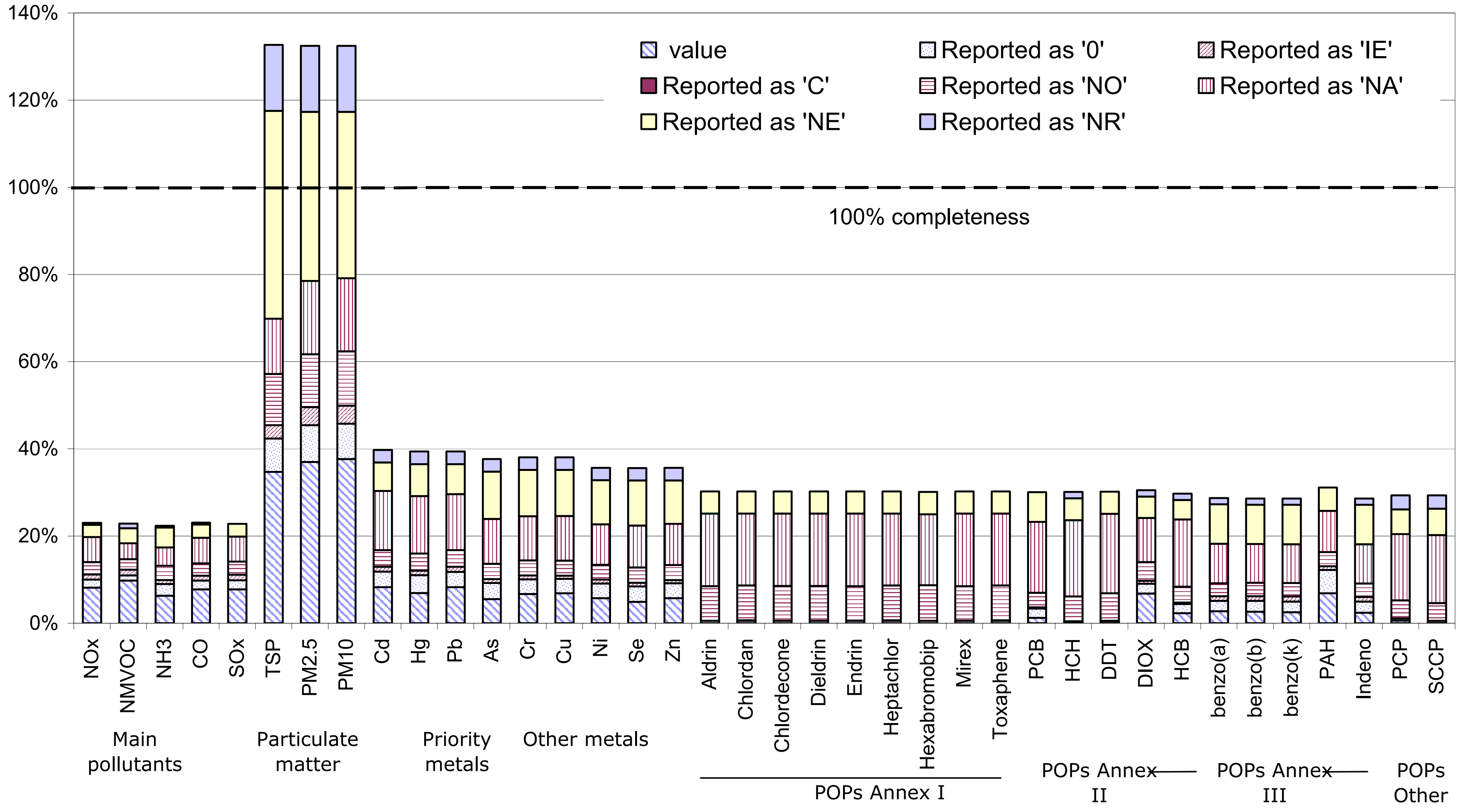


Figure 9 Completeness of LRTAP data for 1980-2003: by pollutant

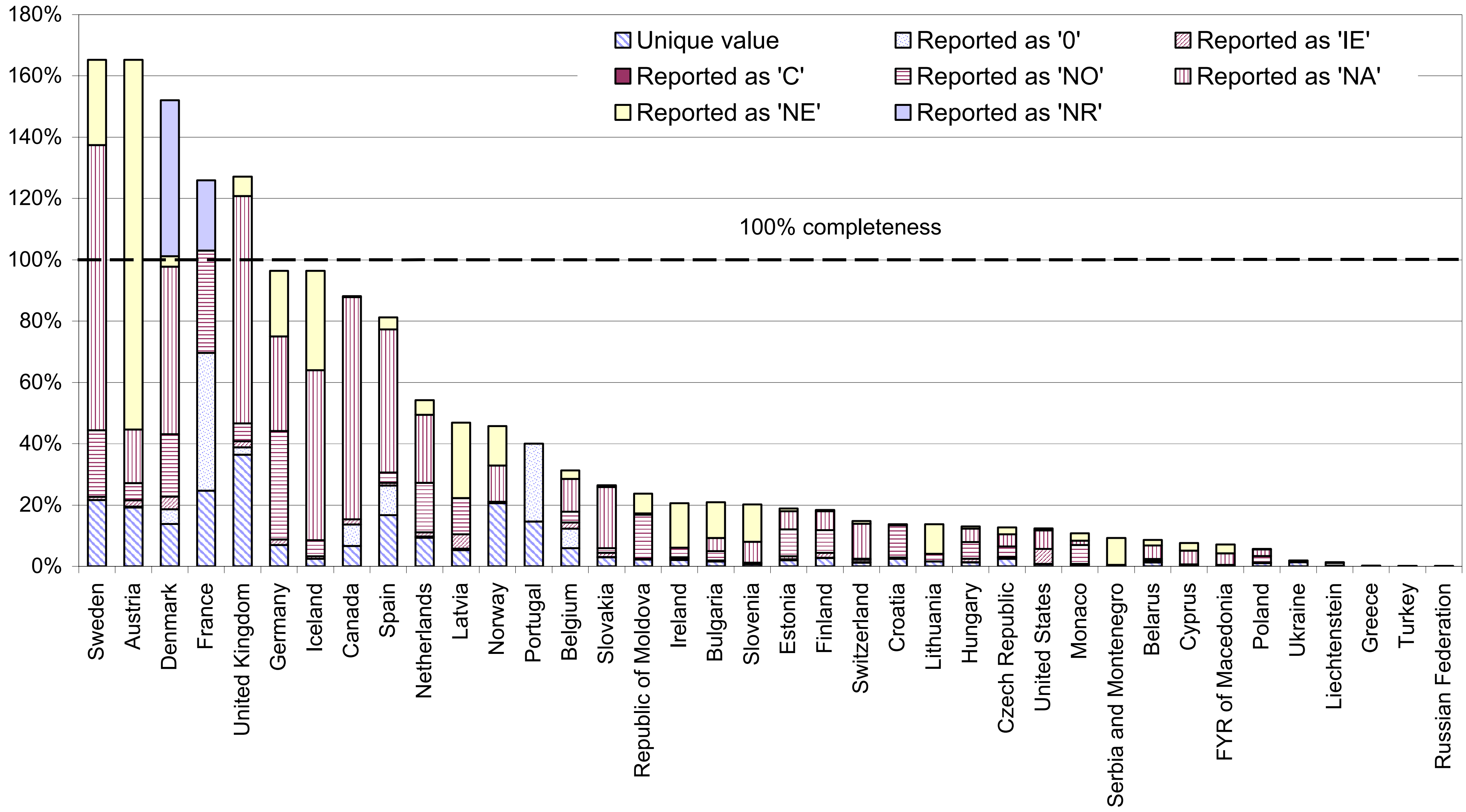


Figure 10 Completeness of LRTAP data for 1980-2003: by country

6.5 CONSISTENCY

Key messages – Consistency

- *The consistency of LRTAP data is generally good. 75% of Parties reported at least 80% of their data in an internally consistent way. Efforts should be made to reach 100% consistency.*
- *The aim of time series checks is to identify instances of dips, jumps and sudden trends in time series data reported by countries. This can provide indications of possible inconsistencies in activity data, EFs, calculations etc. It is important to recognise that many of the discontinuities identified will represent real fluctuations in emissions e.g. changes in power plant and refinery activities, and not errors or inconsistencies (although a number of confirmed errors in the reported data have been identified).The test only reviewed data reported in NFR format and for which a complete time series of values has been reported for 1990-2003. In practice this meant that of the LRTAP Convention Parties, data from only 11 countries was reviewed; from the NEC Directive data from 6 Member States was reviewed. Countries should be encouraged to report a full time series of NFR data to improve the comparability of emissions between countries. CLRTAP: Approximately 3.0% of the total number of time series reported were flagged as containing a potential inconsistency. NEC: Approximately 5.2% of the reported time series were flagged as containing a potential inconsistency In percentage terms, the 'Manufacturing Industries and Construction' and 'Oil and Natural Gas' sectors had the highest numbers of flagged time series. For two thirds of the sectors evaluated, no potential inconsistencies were identified.*
- *Most dips/jumps occurred for the pollutant CO followed by NMVOC and HCH.*

Consistency of reported data is important when emissions are used both for scientific purposes and for policy making. Inconsistent data might lead to completely different results when model assessment are performed and when e.g. analysing key sources.

6.5.1 Internal consistency

The consistency testing of submitted data performed by the review team of experts improved form 2004 to 2005. Consistency of the 2003 data was carries out by translating all types of notation keys to zero, and adding sub-sectors together and compare to aggregated sectors by the formula 100*(Aggregated sector-Σsub-sectors)/Aggregated). Each party has got the result per pollutant in the S&A Part I (Annex II). The result of the overall consistency per country is shown in Figure 11. The overall consistency represents the fraction of internally consistent data reported compared to the total number of aggregation checks able to be made.

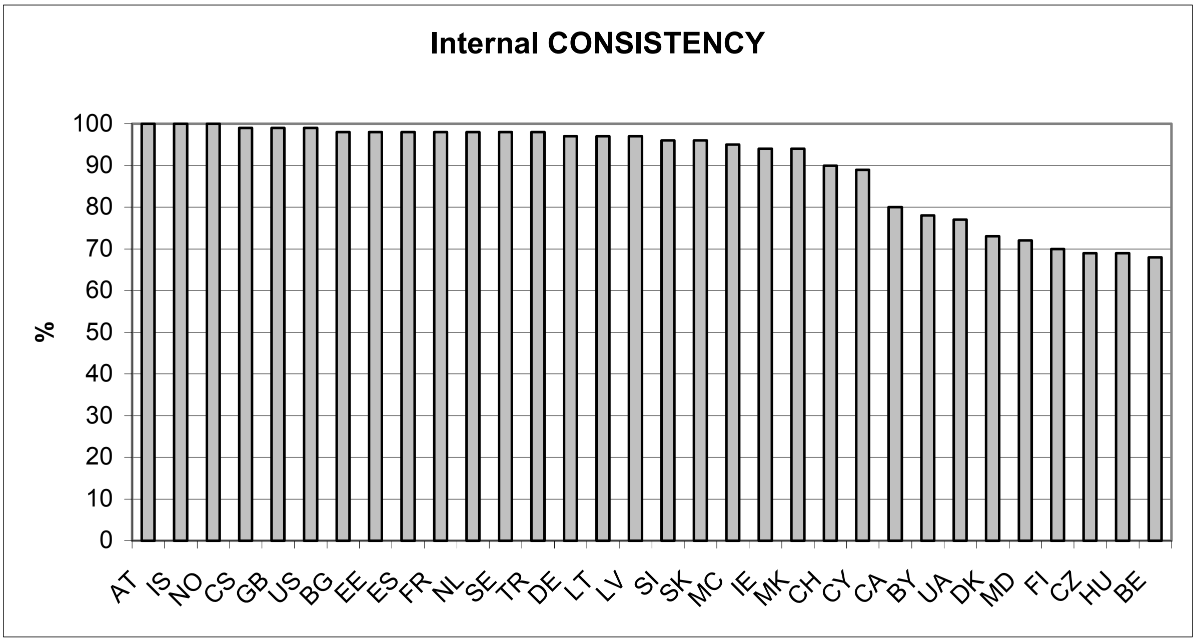


Figure 11 Internal consistency in percent of possible aggregations

The consistency of LRTAP data is generally good. 75% of Parties reported at least 80% of their data in an internally consistent way. The reason why the consistency is less than 100% is in most cases due to the use of notation keys in all or some sub-sectors, while the aggregated sectors are larger than zero. All the notation keys translate into zero in the checking calculations, which make the sums of the sub-sectors zero or at least smaller than the aggregated sectors. There has been an improvement of the way we calculate the consistency, hence it is not comparable with the results of last years analysis.

6.5.2 Consistency of timeseries

Tests were performed on the data provided by countries under the requirements of the LRTAP Convention and the NEC Directive submission to identify potential inconsistencies in the time series reported. These were flagged as dips or jumps in the data. Only data in the NFR reporting format and for which a complete time series of values 1990-2003 was available from countries was assessed. The initial test results were manually reviewed by members of the Expert Review Team to remove instances where reasons for the change in trend were known.

It is noted by the review team that the Emission Reporting Guidelines request data be reported by NFR allowable categories only from year 2000 and Parties are encouraged, (not required), to also report data going back to 1990 in a similar format. Several countries have subsequently reported back to the review team that while they have yet had sufficient resources to allow them provide a complete time series in NFR for years 1990-present, it is their intention to do so in the future.

It is very important to note that values flagged as dips or jumps may not all represent potential inconsistencies in the time series data but rather may be logically explained as variations occurring in activity data used by Parties to derive emission estimates (e.g. removal of lead from leaded petrol, greater fuel use during a cold winter). The aim of this test is therefore not focussed on compliance issues, but is rather aimed at providing Parties and Member States with information that can allow them to improve the quality of their future data submissions.

LRTAP time series test results

A total of 7710 time series were reviewed. Of these 235 time series (or 4.6%) were flagged. The actual number of flags generated by the data checking tool is a subjective measure, as the threshold at which a discontinuity is flagged is a manually set parameter. Based on feedback received during last year's review process (where it was felt too many flags were generated by the test), the sensitivity of the test was decreased in 2005. This helped ensure that only those time series in which large discontinuities occurred were flagged.

Figure 12 provides an analysis for all LRTAP countries, showing the number of flagged time series as a percentage of the total number of complete time series reported (1990-2003).

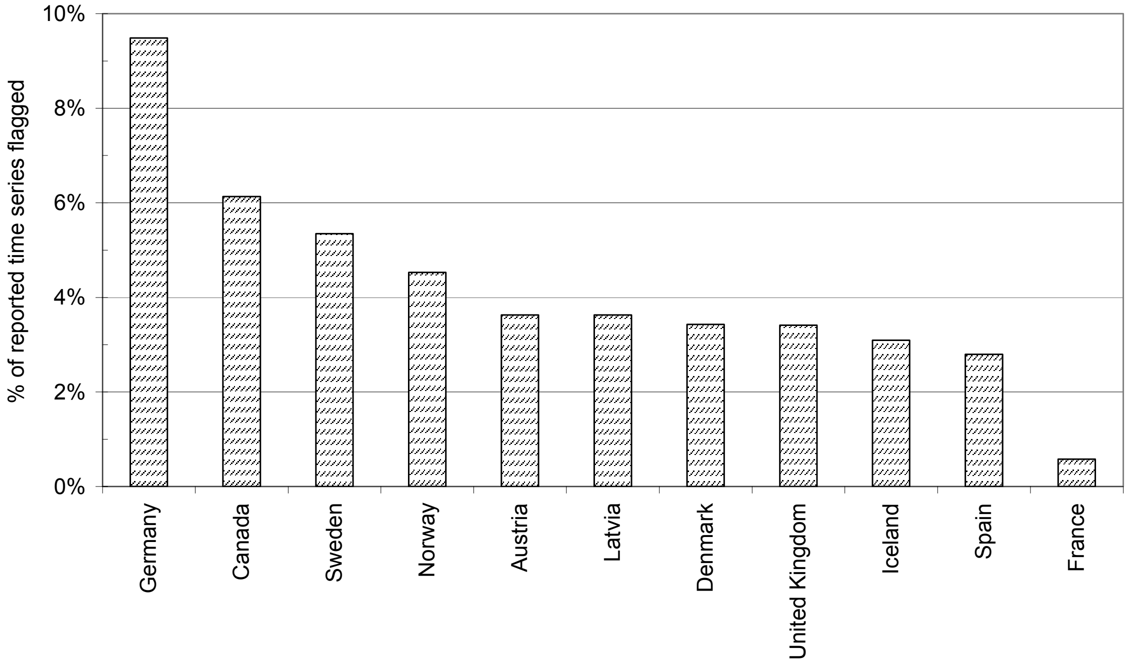


Figure 12. Number of flagged dips and jumps as a percentage of the number of time series reported by country: 1990-2003.

Potential inconsistencies were identified in the reported data from all the 11 countries in which time series data was evaluated (Figure 12). Of the countries analysed, the level of potential inconsistencies in the time-series that were determined ranged from 9.5% (Germany) to less than 1% (Belgium), when the number of flagged time series is expressed as a percentage of the number of time series reported. Most countries in which dips and jumps were identified had levels of flagged time series between 3% and 5% of the total number of time series reported.

Based on the responses received from Parties at time of writing, it is clear that the majority of potential inconsistencies do reflect actual changes in the underlying activity data as previously described. Where such explanations have been supplied, these will be kept on record by the review team to ensure that the same question is not asked of countries in next year's review. However, several countries have confirmed that the flagged time series do correspond to actual errors in the submitted inventory data. Reasons provided for these errors include mistakes made in calculations prior to submission, through to incorrect emission factors being used to generate the emission values.

Test results are also shown below in Figure 13 by pollutant. This figure enables the levels of consistency (based on the number of dips and jumps) to be identified for specific pollutants.

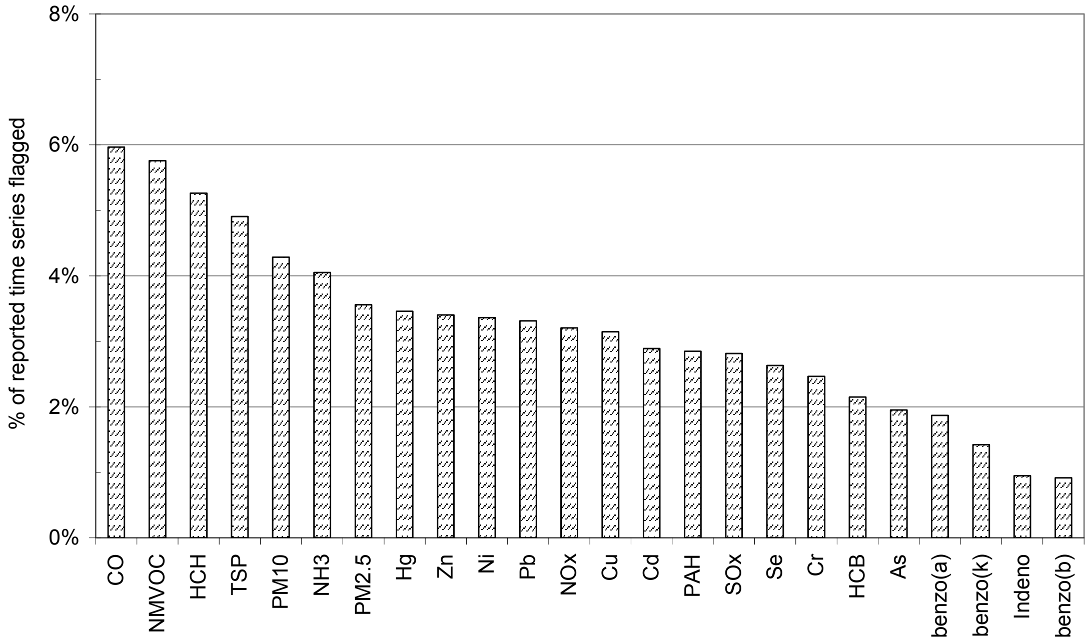


Figure 13. Number of flagged dips and jumps as a percentage of the number of time series reported by pollutant: 1990-2003. Only pollutants for which at least one flagged time series was determined are shown.

On a percentage basis, the pollutants CO, NMVOC, HCH and TSP had highest number of flagged time series (>5% of the number of total reported series for these pollutants). The ranking of flagged time series by pollutant is somewhat different to that observed in the test results from last year's review (Vestreng et al., 2004). Although HCH again had relatively high levels of potentially inconsistent time series (in 2004 it was the pollutant with the highest number of flags), in 2004 the benzene derivatives and heavy metals generally had the highest number of flagged values. In contrast, the analysis from this years review shows that the time series for several of the main air pollutants (CO, NMVOC, PM_{10}, and NH_3) had the largest number of flags. It is noted however, that the number of times series reported for these pollutants is generally higher than for the POPs and heavy metal pollutants.

In the same way that reported data by pollutants has been assessed in the above graphs, data has also been assessed on a sectoral basis. A sector overview is shown in Figure 14. Such analysis may be able to identify sectors where reporting of data is not as consistent (based on number of dips and jumps) relevant to other sectors.

There is clearly a wide variation in the number of emission estimates reported for each sector. Three sectors had a significantly larger number of flagged time series than others (1A3ei – 'Pipeline compressors'; 1A2b – 'Non-ferrous metals' and 1B2c – Venting and flaring (Oil and gas)'). In general, many of the sectors having the highest number of flagged values fall into the broad categories of 'Manufacturing Industries and Construction' and 'Oil and Natural Gas' sectors. This somewhat contrasts to the 2004 review results, in which a number of agricultural sectors were flagged as having relatively high levels of potential time series inconsistencies.

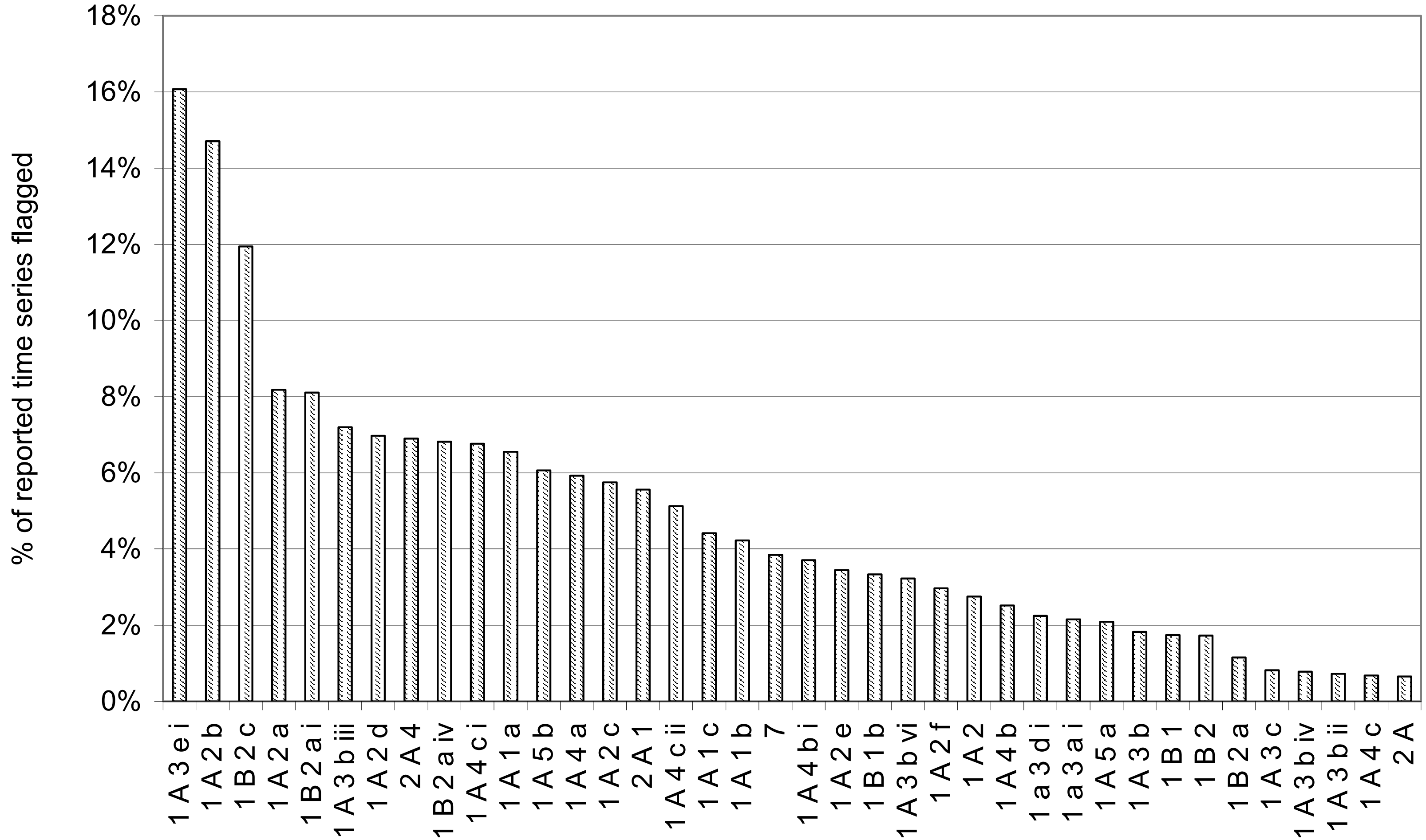


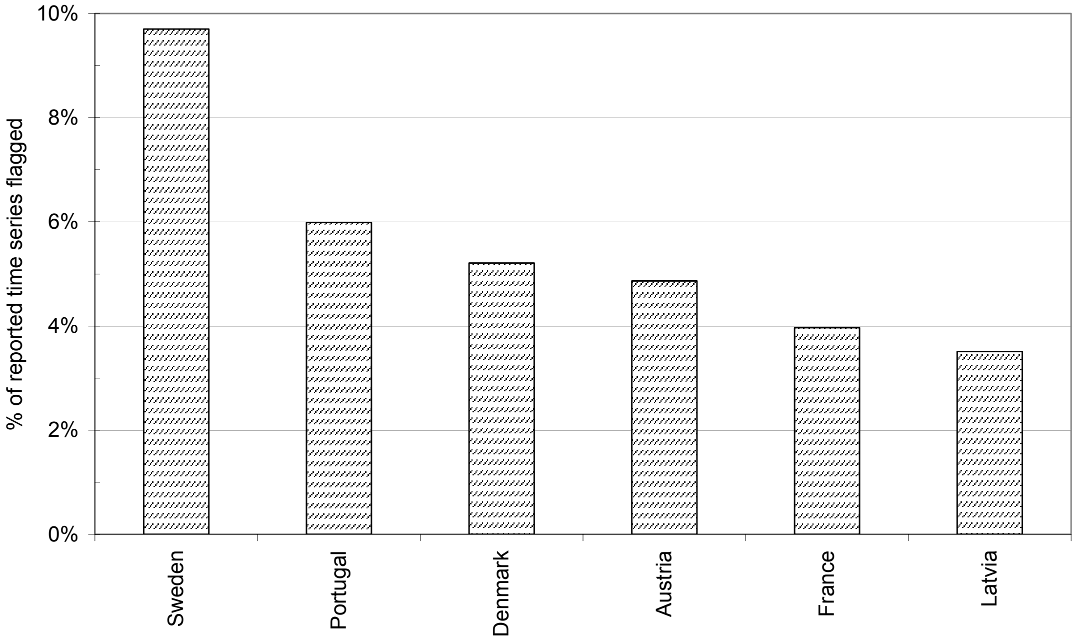
Figure 14. Number of flagged dips and jumps as a percentage of the number of time series reported by sector: 1990-2003. Only sectors in which at least one time series was flagged are shown.

NEC time series test results

As for the LRTAP data described above, the time series checks were also performed using the 2005 NEC Directive submissions to identify instances of dips, jumps, and sudden trends in time series data reported by Member States. As for the LRTAP data, the initial test results were manually reviewed by members of the Expert Review Team to remove instances where reasons for the changes in trend were known.

As noted previously, only a limited amount of NEC data was received by ETC-ACC in time to be included in the review. Only countries that reported a complete time series of NFR data 1990-2003 were reviewed. Data from only six countries could be reviewed. (It is of course noted that under the reporting requirements of the NEC Directive, Member States are not obliged to report a complete time series from 1990 but only data for reporting year X-3 and provisional data for year X-2). Of the Member States for which data was available, a total of 765 complete time series were reviewed for potential inconsistencies. Of these, 40 time series were flagged as indicating a potential inconsistency (i.e. 5.2%). A summary of the results from the time-series checks by country is given below in Figure 15.

Figure 15. Number of flagged dips and jumps as a percentage of the number of



time series reported by country: 2005 reported data, 1990-2003.

Of the Member States for which data was available, Sweden had the highest percentage of flagged time series (9.7%), with Latvia having the least (3.5%). Interestingly, the number of flagged time series for Sweden was higher for the 4 NEC pollutants than the average number of flags across all pollutants that Sweden reported under the LRTAP Convention (5.4%).

Figure 16 illustrates the number of flagged time series for the four NEC pollutants. There was a similar number of flagged time series for NH_3, NO_x and SO_2 (approximately 4%) ; the number of flagged time series for NMVOCs was higher (9%), somewhat higher than the average number of flagged time series for this pollutant reported by all countries to the

LRTAP Convention (5.7%). The reasons why a relatively larger number of NMVOC time series were flagged as containing potential inconsistencies is not clear, but may reflect greater variability in the underlying activity data from the NMVOC sources.

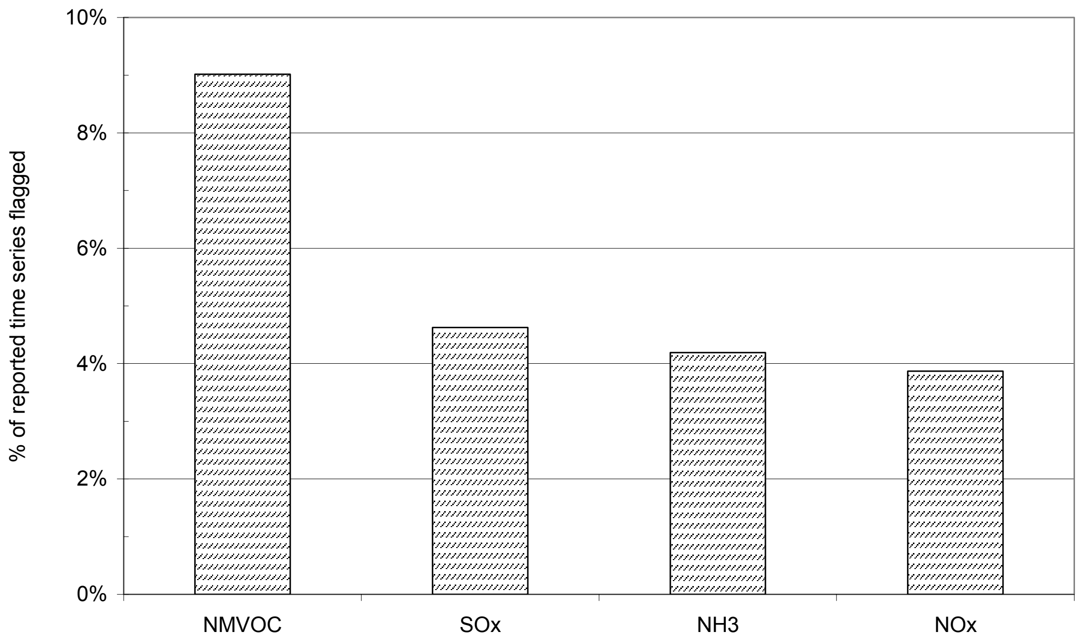


Figure 16. Number of flagged dips and jumps as a percentage of the number of time series reported by pollutant: 2005 reported data, 1990-2003.

As complete time series data from only a relatively small number of Member States (6) was available, an assessment by sector has not been completed for the NEC dataset as only a small number of flags in any given sector would skew any analysis.

6.6 COMPARABILITY

Key messages - comparability

- *Only two Parties failed the cross-pollutant test. The test should be further evaluated and possibly extended to other sectors than road transport.*
- *The aim of the implied emission factor (IEF) check is to identify significant differences in the implied emission factors derived from emissions data reported by Parties to the LRTAP Convention and corresponding sectoral activity data reported to UNFCCC. Comparison of IEFs allows country emissions to be put in context, can help identify potential inconsistencies within an inventory, and hence can also be an important driver for inventory improvements.*
- *IEF values were derived and subsequently compared for the main pollutants CO, NO_x, NMVOC and SO_x across 9 energy combustion sectors. 23% of the derived IEF were flagged as being significantly different from the average IEF, indicating the use of a range of IEFs used by Parties. Across all countries and sectors, the highest number of flags occurred for SO_2 (37%) and the least for NO_x (9%). The large variability in SO_X IEFs probably reflects the intrinsic differences between countries in terms of technology & abatement options.*

Conclusions and Recommendations

- *It is recognised that flagged IEF values are not necessarily themselves indicative of any underlying inconsistency in an inventory, but rather may simply reflect the differences between different countries e.g. the use of different types of emission abatement equipment, different implementation/penetration rates of abatement technologies, different fuel splits etc.*
- *The IEF review needs to be linked to the improvement of the EMEP/CORINAIR Guidebook*
- *The IEF checks will be expanded to other sectors (e.g. agriculture), and a focus will be made to improve the clustering of countries, to ensure IEFS are more comparable within country groups*

6.6.1 Special analysis of the traffic sector

The cross pollutant tests were performed for the sector 1A3b Road Transport, since for this sector there where expert emissions to compare with. The results of the cross-pollutant test are shown in Table 11. The ratios to the left are calculated from officially reported data, the data to the right with green background is calculated with the TRENDS and TREMOVE models. In dark yellow is flagged rations that differ by a factor 3 or more from the **TRENDS** (TRENDS, 2003) and **TREMOVE** (De Ceuster, 2004) data. In light yellow is flagged ratios that differ by a factor 2 or more from the model data. In pink are ratios flagged because they are outside an average range (average ± 2*average). We see that only the Netherlands failed the "factor 3 criteria". Low reported CO emissions seem to be a possible explanation, but an answer was requested from the Netherlands. They found it difficult to comment because they did not know the underlying assumptions in the TRENDS and TREMOVE calculations. Austria is the only country which fails the "factor 2 criteria". A possible explanation put forward was high NOx reported, and Austia replied that the emission factor used for HDVs is based on more accurate measurement, and is comparatively higher than what is used in TRENDS and TREMOVE.

Two other messages came out from this test; Germany has a problem with the PM reporting as they report PM2.5 to be larger then the PM10, and not all Parties are reporting the aggregated sectors. The PM problem has been communicated to Germany, and the lack of completeness in reporting has been communicated to the Parties not reporting all sectors.

Germany and Sweden commented that the test would be more useful if only combustion sources were included, i.e. road abrasion and tyre and break ware should be excluded from the PMs. We will certainly look into this, and modify the test if Parties think it is worth continuing with cross-pollutant testing. If or when adequate data to compare to is found, the cross-pollutant test could be performed for other sectors, e.g. the residential combustion.

Table 11: Emissions ratios for the sector 1A3b, Road Transport.

	REPORTED EMISSIONS			TRENDS			TREMOVE		
Country	NOx/NMVOC	NOx/CO	NOx/PM2.5	NOx/NMVOC	NOx/CO	NOx/PM2.5	NOx/NMVOC	NOx/CO	NOx/PM2.5
Austria	5.82	0.73	23.12	2.581	0.322	12.385	2.007	0.261	12.303
Belarus	0.49	0.13							
Bulgaria	2.28	0.39							
Canada	2.30	0.15	50.20						
Cyprus	1.14	0.13							
Czech Republic	2.09	0.41	17.20						
Estonia	1.86	0.24	19.73						
Finland	not reported 1A3b			2.322	0.249	16.200	2.258	0.256	10.681
France	1.76	0.29	12.17	2.392	0.350	11.409	2.989	0.415	11.889
Germany	3.30	0.35	27.85	1.840	0.173	13.638	2.337	0.257	14.061
Ireland	1.79	0.25	14.61						
Latvia	1.69	0.24							
Lithuania	1.92	0.32							
Netherlands	2.06	0.49	15.03	1.917	0.158	13.063	1.834	0.166	15.422
Norway	1.25	0.18	15.98						
Republic of Moldova	1.08	0.15	44.67						
Slovakia	1.36	0.30	13.22						
Slovenia	2.35	0.66	16.48						
Spain	2.46	0.48	15.87	1.756	0.220	10.667	1.749	0.378	14.078
Sweden	1.49	0.27	21.83	1.558	0.158	18.063	1.989	0.214	19.713
Switzerland	1.79	0.19	23.15						
TFYR of Macedonia		0.29							
Turkey	1.29	0.25							
Ukraine	0.61	0.09							
United Kingdom	3.96	0.47	20.67	1.415	0.126	16.203	2.349	0.251	16.208

6.6.2 Implied emission factors

The objective of the implied emission factors (IEF) check was to identify significant differences in the IEFs derived for individual countries, when compared to the average IEF for the country region to which an individual country was assigned. This test therefore helps inform upon whether emissions from countries appear to have been compiled using a similar basis in terms of emission factors.

Implied emission factors were calculated for 9 selected sectors that include combustion activity (1A1a, 1A1b, 1A1c, 1A2, 1A3b, 1A3c, 1A3e, 1A4b and 1B1b) for the year 2002 and for the main air pollutants CO, NMVOC, NO_x and SO_2. IEF values were derived from a) emissions data reported by Parties to the LRTAP Convention and b) sectoral activity reported to UNFCCC obtained from the Locator tool (2004 data submission – the most recent year for which data was available at the time of analysis). An average IEF per pollutant/sector was subsequently calculated for each country region (Western and Eastern Europe country groupings) and individual country IEF values flagged if they exceeded the average IEF for the respective country region by more than a factor of 5 or by less than a factor of 0.2. The review test was only performed for those Parties reporting in the NFR format and where IEFs were available for 5 countries or more in a region.

Due to the limited number of Member States that reported detailed emissions data (in the NFR format) under the NEC Directive in time to be included in the review tests, a comparison of IEFs obtained from NEC data reported in 2005 was not performed.

An important point to emphasise is that activity data being used in this analysis (from the UNFCCC Locator database) may be significantly different from the activity data actually used in the calculation of the emission estimate for the different Parties. The use of different types of activity data, and data from different sources, could lead to significant differences between implied emission factors, as tested by their deviation from the average.

It should also be clearly recognised that flagged IEF values are not necessarily themselves indicative of any underlying inconsistency in an inventory, but rather may simply reflect the differences in sectors across different countries e.g. the use of different types of emission abatement equipment, different implementation/penetration rates of abatement technologies, different fuel splits etc.

Figure 17 shows a generic example of the analysis performed to determine which points were significantly different from the average IEF and which subsequently were flagged for expert review for the 1A4b - residential combustion sector. In this instance, reasons for the flagged values are known. For example, the IEF for Sweden differs from the average due to the higher use of bio fuels in this sector, Belgium and the Netherlands due to higher electricity use and low fuel use in the residential sector, and Germany due to the use of district heating.

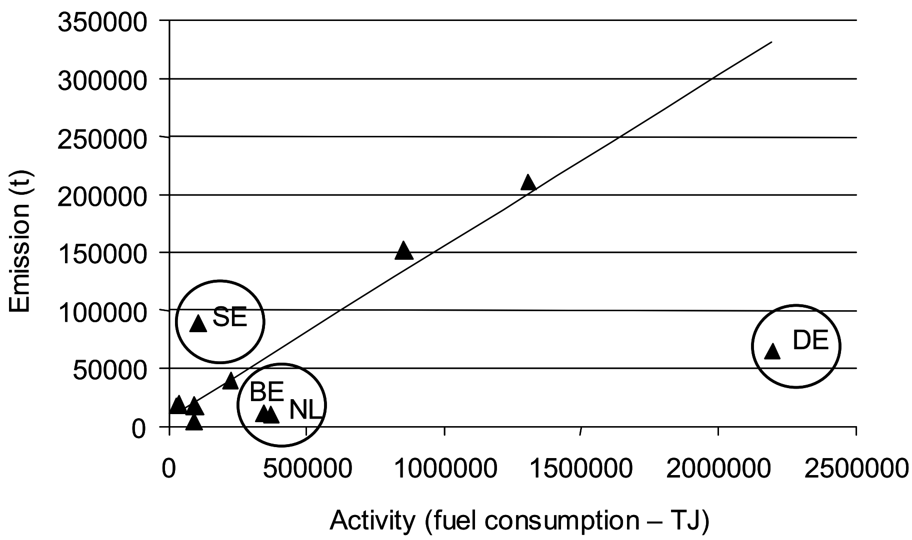


Figure 17. Example of implied emission factor analysis showing data points that would be flagged as being significantly different than the average IEF (NMVOC, sector 1A4b – Residential combustion)

Figure 18 shows the number of flagged values by pollutant expressed as a percentage of the number of IEF comparisons made. On a percentage basis, the highest number of flags occurred for SO_x (37%) followed by NMVOC (24%) and CO (21%). The lowest number occurred for NO_x (9%). It is expected that SO_x IEFs will show a high level of variability which reflects the intrinsic differences between abatement options and technologies (and rates of implementation) in different countries.

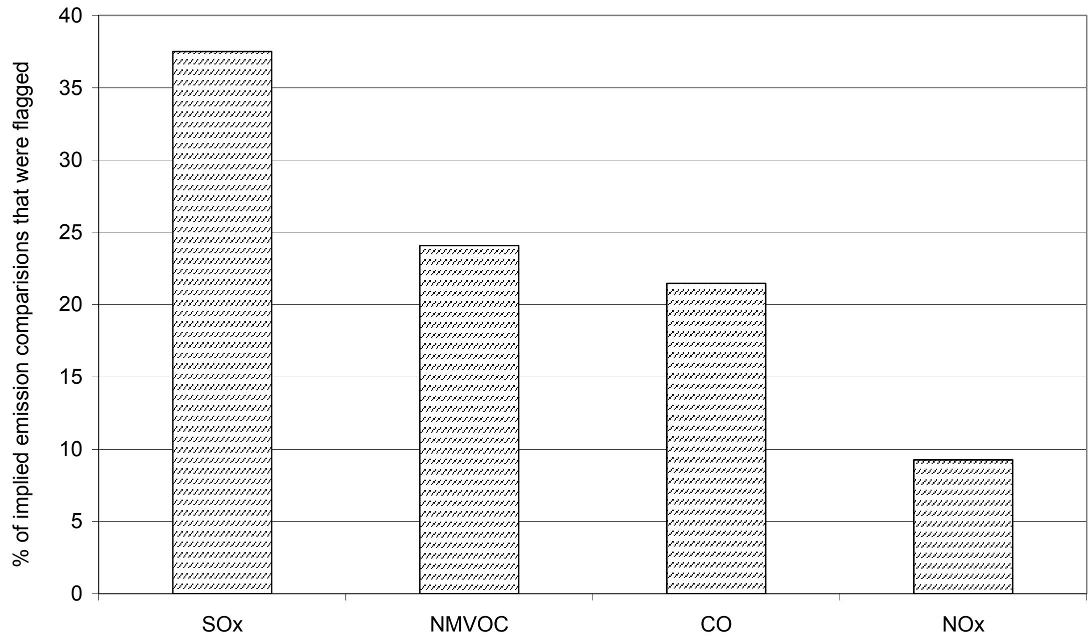


Figure 18. Number of IEF flagged values by pollutant expressed as a percentage of the number of IEF comparisons made.

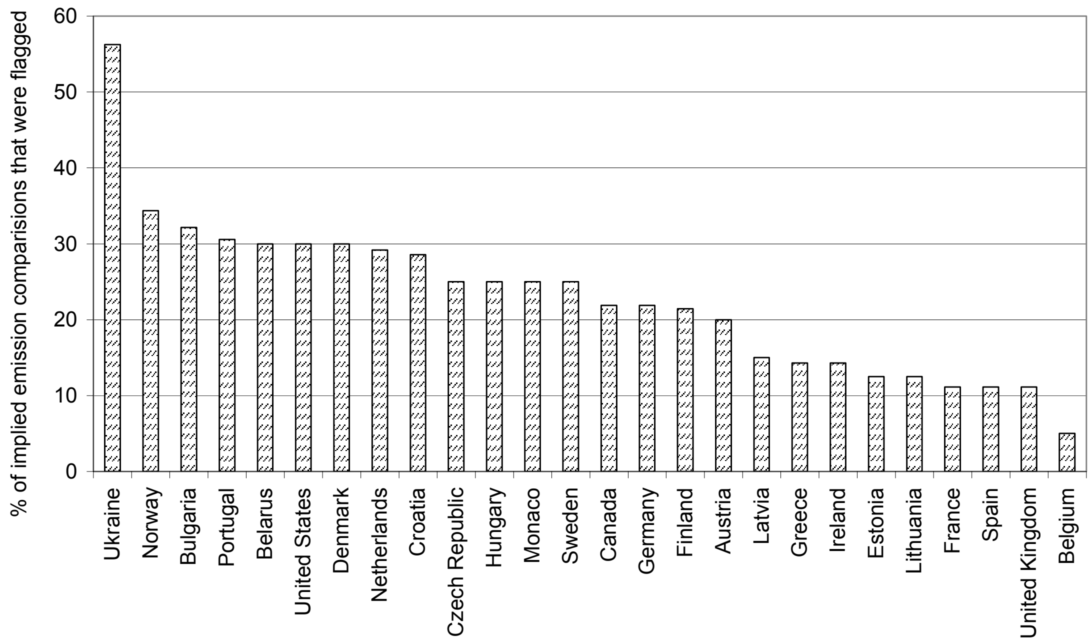


Figure 19. Number of IEF flagged values by country expressed as a percentage of the number of IEF comparisons made. Comparisons could not be made for a number of countries due to lack of emissions and/or activity data; these are not shown in the chart above.

Figure 19 illustrates the number of flagged values by countries expressed as a percentage of the number of IEF comparisons made. For most of the countries for which IEF values could be calculated, the number of flagged IEFs fell between 10 and 30% of the total number of IEF values derived. Ukraine had a significantly higher number of flagged IEFs (56%) than other countries, with the lowest number occurring for the Belgian dataset.

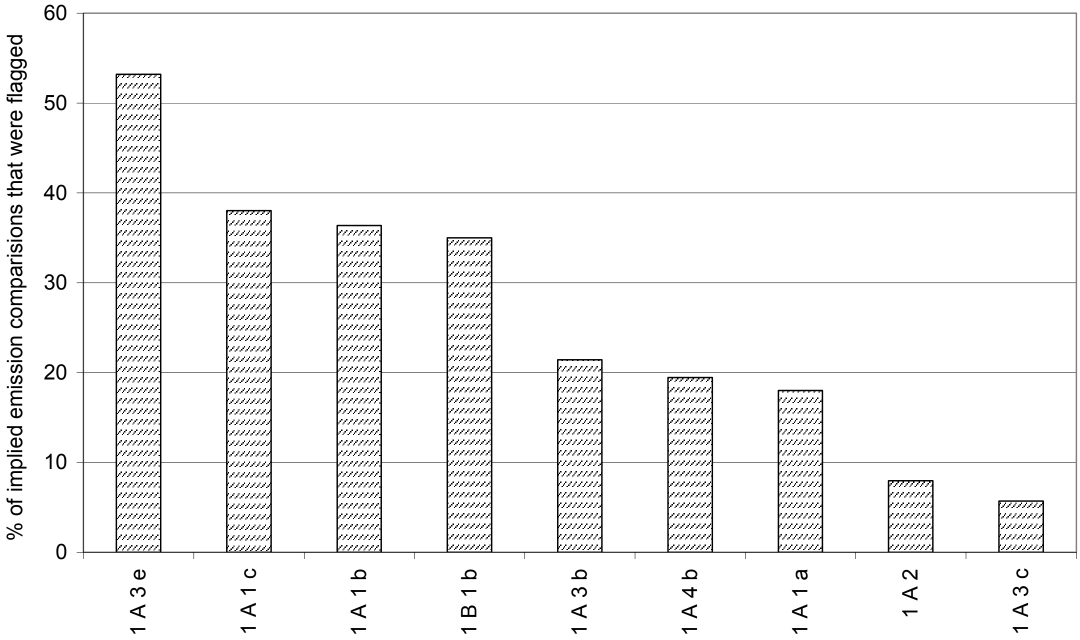


Figure 20. Number of IEF flagged values by sector expressed as a percentage of the number of IEF comparisons made.

There was a range of IEF values flagged across the different sectors (Figure 20). The sector with the most flagged IEF values was 1A3e (‘Other, Transport below 1000’) which probably reflects the diverse nature of the sources that different countries may have reported in this sector. The three subsequent sectors of the most significance (1A1c – ‘Manufacture of solid fuels and other energy industries’, 1A1b – ‘Petroleum refining’, and 1B1b – ‘Solid fuel transformation’) had similar levels of flagged values (approximately 35%).

7 CONCLUSIONS AND RECOMMENDATIONS FROM THE 2005 REVIEW

The aim of the review process is to increase the transparency, completeness, consistency, comparability and accuracy of emission inventories reported by Parties to the LRTAP Convention and by Member States under the NEC Directive.

With respect to the above, there are a number of **positive conclusions** from this year's review:

- The review responses were extensive both in terms of numbers (37%) and in terms of content. The review processes is seen to increase the transparency of the emission inventories considerably, in that many of the findings from the review were explained by the Parties. The transparency is also enhanced by the increase in the submissions of Informative Inventory Reports (IIR) from 7 to 12 submissions. The reason for the more extensive responses to the review, and increased transparency this year is probably because the review document was more user friendly, because the time allowed for response was extended from two weeks to one month, and because we provided a template for the IIR.

- The timeliness of the LRTAP submissions was 49%, an increase by 11% (6 Parties) relative to last year. All but one Party reported in NFR format. Moreover the number of submissions included in the review increased by one.

- The completeness of LRTAP data increased for almost all countries and pollutants both in terms of notation keys and unique values. The increase was seen both for 2003 emission data and for timeseries. The completeness of national total emissions increased by approximately 5%. There was an increase of 10% in the reporting of both PM2.5 and PM10 for at least one year.

- The use of notation keys has been more harmonized between countries as a consequence of shading in reporting templates and the focus on this issue in last year's review report. The harmonization is expected to increase next year, when all Parties are requested to report in the newest version of the template.

- The internal consistency of LRTAP data is quite good. 75% of the Parties report at least 80% of their data to be internal consistent.

- The consistency analysis performed for the transport sector showed high comparability between pollutants.

There is also a set of more **general conclusions**, some of which have led to the main recommendations listed at the end.

- The analysis of recalculations between 2005 and 2004 for twelve countries showed that all recalculations were below 15% except for PAH and HCB. The sizes of the recalculation varied between 2% (SOx) to 55% (HCB). Recalculations for individual countries were in many cases larger than for the group of twelve countries. There was no general trend seen in the recalculations.

- The analysis of inventory comparison and memo items reported revealed that countries are not yet sufficiently informed about the difference in the reporting requirements under the NEC Directive and under the LRTAP Convention. Five countries had differences in reporting of national totals to LRTAP and to NEC. Differences in the Guidelines was the reason for two countries, an editorial error was found for one Party, while the differences for the remaining two countries are not known.

- Based on IIRs and the footnote sheet in the reporting template, it became clear that most countries report their transport emissions in terms of fuel consumed. This is somewhat surprising, as the reason why the Guidelines was altered from fuel consumed to fuel sold was to harmonize to the UNFCCC reporting.

- The keysource analysis performed for groups of Eastern and Western countries showed that the comparability between the two groups might not be the best, and further that the reporting seem less harmonized for the Eastern countries. SOx is the only pollutant where more than 50% from the emissions comes from one single source. The number of sources included to reach 95% of the total emissions ranges from 1 (SOx) to 57 (NMVOC). The largest sectors are identical for East and West only for five compounds (CO, PM10, PM2.5, Hg and PAH). The result of the implementation of better control technology in power plants, less field burning of wastes and more cars with catalysts emissions in the West clearly shows up in the analysis.

- The inconsistency of timeseries was in average 3% for LRTAP data and 5.2% for NEC data. The reasons why the 4 pollutants reported under NEC have a slightly higher rate of ‘potential inconsistencies’ is not clear. The threshold for flagging was made less sensitive this year based on experience from last year’s review, so the results for 2004 and 2005 are not comparable. Most dips and jumps were found for CO followed by NMVOC and HCH. Three sectors had a significantly larger number of flagged time series than others (1A3ei – ‘Pipeline compressors’; 1A2b – ‘Non-ferrous metals’ and 1B2c – Venting and flaring (Oil and gas)’)

- In the comparability analysis Implied Emission Factor (IEF) for the LRTAP data, SOx emissions were flagged most, followed by NMVOC, CO and NOx. The test was only performed for these pollutants. The sector with the most flagged IEF values was 1A3e (‘Other, Transport below 1000’) which probably reflects the diverse nature of the sources that different countries may have reported in this sector. IEF tests will be extended in future years to address other sectors (e.g. agriculture) and analysis for individual countries will be performed using improved country-clustering.

- The national experts involved in the preparation of national emission inventories may have limited time and resources for addressing what have been regarded as less prioritised pollutants e.g. POPs and HMs.

- Only a few tests could be performed for the NEC data due to limited data availability and the different reporting requirements i.e. it is not obligatory to report a complete time series of inventory data.

The overall recommendation from the review process is that work is undertaken to move further towards a centralized review in order to get a step towards the goal of increasing the accuracy of the emissions inventories. Resources need to be allocated both in terms of manpower and in terms of finance.

The recommendations and requests to the bodies from the 2005 review:

- Harmonization of the LRTAP and NEC Guidelines for reporting;
- Define completeness and how this should be analysed for compliance purposes;
- Consider if the NEC data should be made publicly available through WEBDAB.

The recommendations and requests for the Expert Panel on Review from the 2005 review:

- Update the Guidebook with respect to POPs and HMs;
- Give more guidance on how to calculate and sector allocate the NMVCO emissions;
- Clarify why Parties do not report transport emissions according to fuel sold as recommended by the reporting Guidelines;
- Give recommendations on what the level of completeness of unique values should be and inspect the key source analysis for individual countries to see if all major sources are included;
- Agree on a methodology and threshold for flagging of inconsistencies in timeseries, so that Parties can flag the potential inconsistencies themselves, and comment on them their IIR;
- Make steps to speed up the publication of the first part of the Synthesis and Assessment report, with the aim of publishing the reports by 1st May, with responses from Parties one month later;
- Develop a system to capture all the responses to the review and information in the IIRs.
- The IEF review needs to be linked to an improved EMEP/CORINAIR Guidebook and followed in the Stage 3 reviews.

Recommendations and requests to the countries from the 2005 review:

- Recalculate the whole timeseries, and not only a few years, in order for the inventory to be consistent;
- Report complete timeseries. The completeness concerns also reporting of all memo items in order to increase the transparency between the 1997 and 2002 Guidelines.
- Twinning projects to find out if the inventory is complete with respect to source categories included;
- Report what is included in the “other” sectors;
- Submit the IIR no later than 1st April in order for the information to be taken into account in the review.

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All UNECE/EMEP documents are available from: http://www.unece.org/env/emep/

Other UNECE/CLRTAP documents are available from: http://www.unece.org/env/lrtap/

This report and other EMEP reports are available from the EMEP home page:
http://www.emep.int/

APPENDICES

Appendix I: Review responses 2005 review

Table 1 Overview of responses from Parties

Party/Response	Logged in[5]	Review doc.
Armenia	X	
Austria	X	X
Azerbaijan		
Belarus	X	
Belgium	X	X
Bosnia and Herzegovina		
Bulgaria	X	
Canada	X	
Croatia		
Cyprus	X	
Czech Republic	X	X
Denmark	X	
Estonia	X	X
Finland	X	X
France	X	X
Georgia		
Germany	X	X
Greece	X	
Hungary	X	X
Iceland		
Ireland	X	X
Italy		
Kazakhstan		
Kyrgyzstan	X	
Latvia	X	
Liechtenstein		
Lithuania	X	
Luxembourg	X	
Malta		
Monaco	X	X
Netherlands	X	X
Norway	X	X
Poland	X	
Portugal		
Republic of Moldova	X	
Romania		
Russian Federation	X	
Serbia and Montenegro	X	X
Slovakia	X	X
Slovenia		
Spain	X	X
Sweden	X	X
Switzerland	X	
TFYR of Macedonia	X	
Turkey		
Ukraine		
United Kingdom	X	X
United States	X	X
European Community		
TOTAL	34	18

[5] Logged into the country specific web page at: *http://www.emep.int/REVIEW/2005/* by 8th July 2005

Appendix II: First part of S&A - country spesific review report – an example

Review report 2005 for XXX

Data included in review: Emissions reported to LRTAP and NEC in NFR format by: March 10^{th} 2005

Questions prepared and made available to countries by the Expert Review Team on: May 26^{th} 2005.

Response from XXX sent:

Date of your response: **29.6.2005**

Introduction

This review has been performed in accordance with the proposals for approaches and procedures fore technical review of air pollutant emission inventories agreed at the joint TFEIP/EIONET meeting in October 2004 for consideration of the EMEP Steering Body. In addition, efforts have been made to meet the requirements from the Parties highlighted during the 2003 and 2004 trial reviews. The 2005 review presents the results of different types of review tests and lists specific questions about your emissions inventory submitted to LRTAP and NEC. We wish to make the review process as easy as possible for you, and we will appreciate any additional feedback on the review process itself.

The review process is aiming at inventory improvements. As part of the Inventory Improvement Programme under the Task Force on Emission Inventories and Projections (TFEIP) Parties are expected to gradually improve the reporting. However, it may not be practical to implement all improvements in the next reporting. We do appreciate ideas for better solutions that may be implemented at a national or international level to improve the reporting and quality over a longer timescale.

The draft review findings will be discussed at the meeting of the TFEIP/Expert Panel on review at its meeting in Copenhagen 6-7 June 2005.

The emission data included in the 2005 review is data reported to the UNECE under the LRTAP Convention or to the European Commission under the NEC Directive, and received before 10^{th} March 2005. The LRTAP data is available through WEBDAB.

We hope that you will take the time to complete the response boxes included in this document and return it to by e-mail to **vigdis.vestreng@met.no by July 1^{st} 2005.**

Review tests performed in 2005

The review looks at several aspects of the national inventories. The intention of the review is to understand the common problems faced by countries with estimating and reporting emissions inventories.

- Part 1: An overview of key sources in order to understand the important source sectors for each country and prioritise review questions and improvement suggestions.
- Part 2: Compliance tests where the submissions are evaluated against the reporting guidelines and checks the timeliness, formats, completeness and that internal summations are consistent.
- Part 3: A review of consistency between Parties' inventories on the basis of sector-implied emission factors, key sector pollutant ratios, and sector and national totals in other reported inventories (e.g. NEC and UNFCCC) and within the time series presented. Checks are preformed against previously reported inventories for recalculations and changes in reported estimates to determine whether these have been applied consistently across the latest available time series.

We would like to know who is responding to our questions, so please enter your own contact details:

Your name:
Your organisation: **XXX**
Your e-mail address:

Thank you for your assistance with the 2005 Inventory Review!

1 KEY SOURCE ANALYSIS

Key source analysis is increasingly important in order to prioritise emission sources and identify where implementation of improvements is most effective. We have assessed the most important sources (e.g. the sources making up 95% of the national total) for your country based on your latest submission. The table below ranks the sources in order of importance for each pollutant.

M ain sectors (sorted by largest contribution to total):

	(Largest)																(smallest)
Component	**Key sectors (Least aggregated sectors contributing to 95% of reported national total)**																
Cd	1 A 4 b i	2 C	1 A 1 b	1 A 3 b vi	1 A 1 a	1 A 2 d	1 A 2 f	1 A 4 c i	1 A 4 a	1 A 2 c							
CO	1 A 4 b i	1 A 3 b i	1 A 2 a	1 A 4 c ii	1 A 4 c i	1 A 4 b ii	1 A 3 b iii	1 A 2 f	2 B 5	1 A 3 b iv	1 A 4 a	2 A 5					
DIOX	1 A 4 b i	2 C	1 A 4 c i	1 A 2 b	1 A 4 a	1 A 2 f	1 A 1 a	1 A 3 b iii	1 A 2 c								
HCB	1 A 4 b i	2 C	1 A 4 c i	1 A 4 a													
Hg	2 C	1 A 1 a	1 A 4 b i	1 A 2 f	1 A 2 d	1 A 2 c	1 A 4 c i										
NH3	4 B 1 b	4 B 8	4 B 1 a	4 D 1	4 B 9	1 A 3 b i	4 B 3	4 B 6									
NMVOC	3 D	1 A 4 b i	3 A	2 B 5	3 C	1 A 3 b i	3 B	1 A 4 c ii	1 A 3 b iii	1 A 3 b v	1 A 4 b ii	1 A 4 c i	1 A 2 f	2 D 2	1 A 3 b iv	4 D 1	1 A 4 a
NOx	1 A 3 b iii	1 A 3 b i	1 A 2 f	1 A 4 c ii	1 A 4 b i	1 A 1 a	4 D 1	1 A 2 a	1 A 3 b ii	1 A 2 d	1 A 1 b	1 A 2 c	1 A 4 a				
PAH	1 A 4 b i	1 A 3 b iii	1 A 3 b i	1 A 4 c i	4 F	2 C	1 A 2 f	1 A 4 c ii									
Pb	2 C	1 A 4 b i	1 A 1 a	1 A 2 b	1 A 2 f	1 A 2 d	1 A 2 c	1 A 1 b									
PM10	2 A 7	1 A 4 b i	4 D 1	1 A 3 b vi	1 A 4 c ii	1 A 3 b iii	2 C	1 A 3 b i	1 A 2 f	1 A 2 d	1 A 1 a	1 A 2 c	1 A 3 b ii	1 A 3 c	1 A 4 c i		
PM2.5	1 A 4 b i	2 A 7	1 A 4 c ii	1 A 3 b iii	1 A 3 b i	1 A 2 f	1 A 2 d	2 C	1 A 1 a	1 A 3 b vi	4 D 1	1 A 3 b ii	1 A 2 c	1 A 4 c i	1 A 4 a		
SOx	1 A 4 b i	1 A 2 a	1 A 1 a	1 A 1 b	1 A 2 f	1 A 2 c	1 A 2 d	1 A 3 b iii	1 A 4 a	1 A 3 b i	2 B 5	1 A 4 c i	2 C				
TSP	2 A 7	4 D 1	1 A 3 b vi	1 A 4 b i	2 C	1 A 4 c ii	1 A 3 b iii	1 A 3 b i	1 A 2 f	1 A 1 a	1 A 2 d	1 A 3 c	1 A 2 c	1 A 3 b ii	2 A 3		

Review Team Comment:

Please indicate if the sources (in the table above) are the key sources for your country or whether there are additional sources that are important but not reported. For your information, an overview of key sources for other countries can be found in Vestreng *et. al* 2004.

Your comments: The key source analysis is in line with XXX's analysis.

2 COMPLIANCE TESTS

2. a) Timeliness

Date of submission NEC: 23 Dec 2004

Review Team Comment: Submission was received within deadline 31st Dec. 2004

Date of submission Convention of LRTAP: 15.02.2005

Review Team Comment: Submission was received within deadline 15 Feb. 2005

Informative Inventory Report: Received

You may want to provide additional response to the comments above in the box below.

Your comments: The findings are correct.

2.b) Format of submission:

This section indicates whether the data submitted was in the correct Nomenclature For Reporting (NFR) and the files were formatted as requested in the Guidelines for Estimating and Reporting Emission data to the LRTAP and NEC.

NEC Submitted Format: NFR

LRTAP Submitted Format: NFR

LRTAP According to Reporting Template? YES

Review Team Comment to reporting format:

Please indicate any additional response to the review comments in the box below.

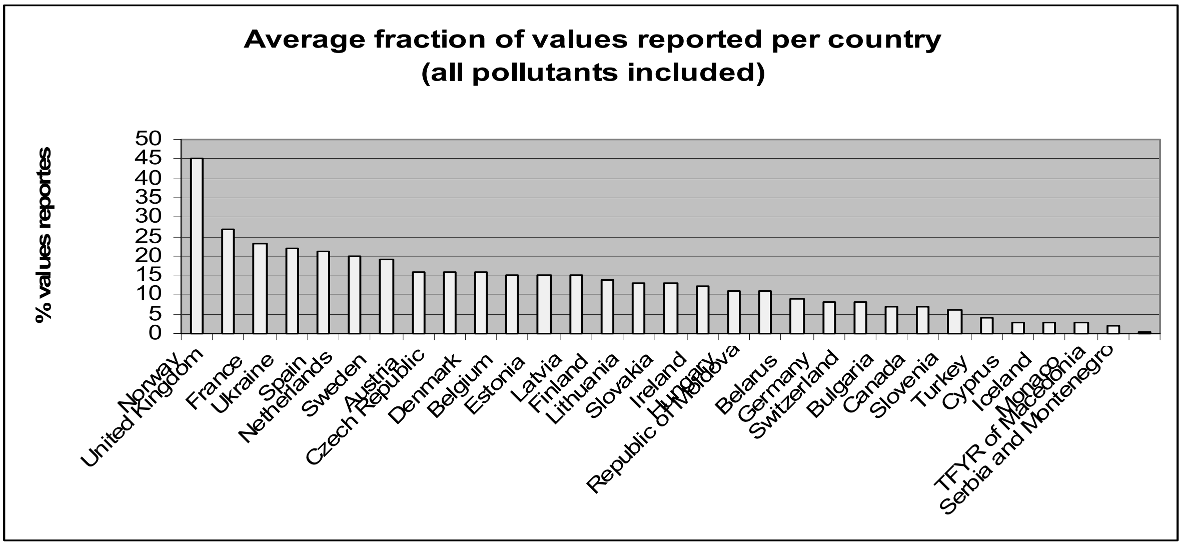
Your comments: The findings are correct.

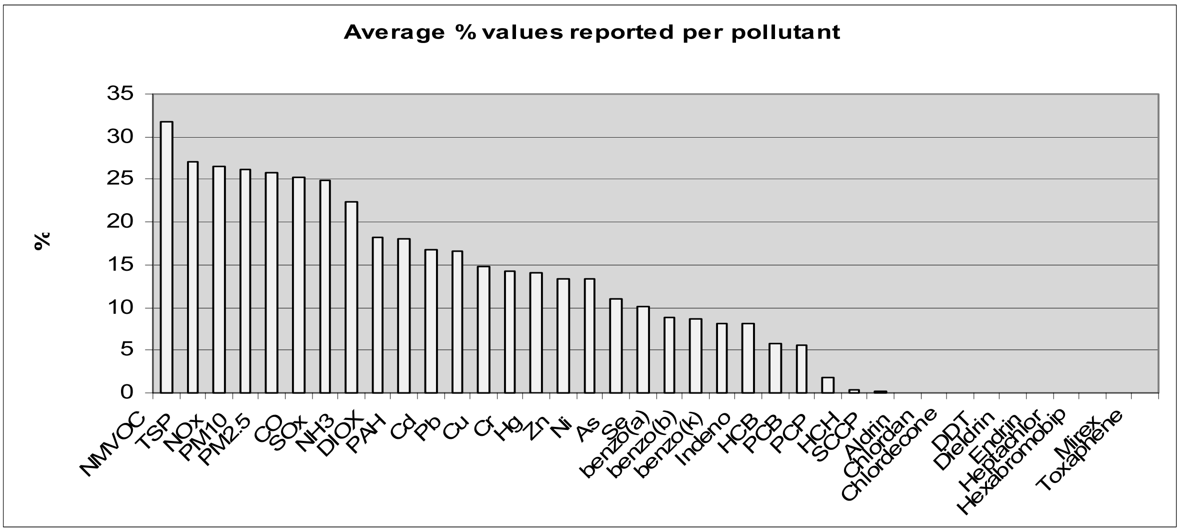
2.c) Completeness per pollutant (Year 2003 emissions)

The completeness of your submission has been evaluated and is summarised below. All numbers are in percent of the total number of cells per component (A maximum of 102 cells as in the NFR 2004 Reporting Template). Flagging occur when the total number of cells containing a value or notation key is less than 80%, if there are more than 10% zeroes reported in cells and if percent values reported is less than the average for all reporting Parties (12%).

Country	Component	% Total	0 %	% NO	% NE	% NA	% IE	% C	% NR	% Value
AT	Aldrin	98	0	0	98	0	0	0	0	0
AT	As	98	0	0	98	0	0	0	0	0
AT	CO	98	0	12	2	38	4	0	0	42
AT	Cd	98	0	12	2	43	4	0	0	37
AT	Chlordan	98	0	0	98	0	0	0	0	0
AT	Chlordecone	98	0	0	98	0	0	0	0	0
AT	Cr	98	0	0	98	0	0	0	0	0
AT	Cu	98	0	0	98	0	0	0	0	0
AT	DDT	98	0	0	98	0	0	0	0	0
AT	DIOX	98	1	12	10	41	4	0	0	30
AT	Dieldrin	98	0	0	98	0	0	0	0	0
AT	Endrin	98	0	0	98	0	0	0	0	0
AT	HCB	98	1	12	8	40	4	0	0	33
AT	HCH	98	0	0	98	0	0	0	0	0
AT	Heptachlor	98	0	0	98	0	0	0	0	0
AT	Hexabromobip	98	0	0	98	0	0	0	0	0
AT	Hg	98	0	12	2	45	4	0	0	35
AT	Indeno	98	0	0	98	0	0	0	0	0
AT	Mirex	98	0	0	98	0	0	0	0	0
AT	NH3	98	0	12	2	27	5	0	0	52
AT	NMVOC	98	0	12	3	23	8	0	0	53
AT	Nox	98	0	12	2	37	4	0	0	43
AT	Ni	98	0	0	98	0	0	0	0	0
AT	PAH	98	3	12	8	41	4	0	0	30
AT	PCB	98	0	0	98	0	0	0	0	0
AT	PCP	98	0	0	98	0	0	0	0	0
AT	PM10	98	1	12	4	24	4	0	0	54
AT	PM2.5	98	1	12	4	24	4	0	0	54
AT	Pb	98	0	12	2	44	4	0	0	36
AT	SCCP	98	0	0	98	0	0	0	0	0
AT	Sox	98	0	12	2	45	3	0	0	36
AT	Se	98	0	0	98	0	0	0	0	0
AT	TSP	98	1	12	4	24	4	0	0	54
AT	Toxaphene	98	0	0	98	0	0	0	0	0
AT	Zn	98	0	0	98	0	0	0	0	0
AT	benzo(a)	98	0	0	98	0	0	0	0	0

Country	Component	% Total	0 %	% NO	% NE	% NA	% IE	% C	% NR	% Value
AT	benzo(b)	98	0	0	98	0	0	0	0	0
AT	benzo(k)	98	0	0	98	0	0	0	0	0





Review Team Comment:

The completeness is very good! You have not reported values for component under additional reporting, together with Annex I, and in the case of DDT Annex II substances, and this seems fair enough, but could you please explain why you do not estimate PCB?

Please comment on your review results in the context of the figures provided for the average of all reporting Parties.

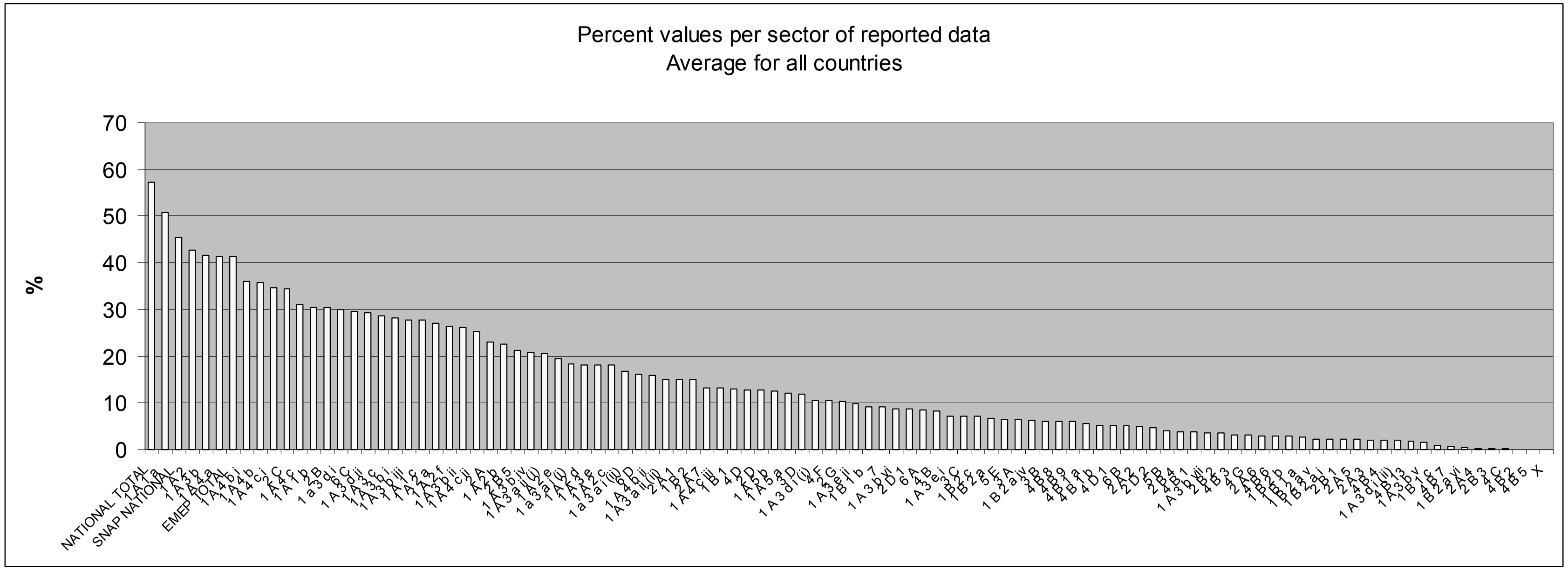
Please provide response to the specific request for clarification and any other additional related comments in the box below.

Your comments: PCB hasn't been is not estimated yet due to lack of resources but. will be considered for the next reporting round.

2.d) Completeness per sector (Year 2003 emissions)

The percentage of the 2003 reported emission data (all pollutants included) that consists of notation keys or zeroes are shown in the table below. The sectors with more than 80% notation keys are displayed in the table below.

Sector	% notation keys	Sector	% notation keys	Sector	% notation keys	Sector	% notation keys
1 A 3 b v	97	**1 B 2 b**	95	**2 D 1**	92	**4 B 5**	100
1 A 3 b vi	89	**1 B 2 c**	100	**2 D 2**	89	**4 B 6**	89
1 A 3 b vii	100	**1 a 3 d i**	100	**2 G**	97	**4 B 7**	100
1 A 3 e ii	100	**2 A**	82	**3 A**	97	**4 B 8**	89
1 A 4 c iii	100	**2 A 1**	92	**3 B**	95	**4 B 9**	89
1 A 5 a	100	**2 A 2**	92	**3 C**	92	**4 C**	100
1 B 1	100	**2 A 3**	92	**3 D**	97	**4 D**	84
1 B 1 a	100	**2 A 4**	100	**4 B**	89	**4 D 1**	84
1 B 1 b	100	**2 A 5**	97	**4 B 1**	89	**4 G**	100
1 B 1 c	100	**2 A 6**	100	**4 B 1 a**	89	**5 B**	100
1 B 2	95	**2 A 7**	84	**4 B 1 b**	89	**5 E**	95
1 B 2 a	97	**2 B 1**	92	**4 B 13**	89	**6 B**	100
1 B 2 a i	97	**2 B 2**	95	**4 B 2**	100	**6 D**	97
1 B 2 a iv	97	**2 B 3**	100	**4 B 3**	89	**7**	100
1 B 2 a v	97	**2 B 4**	100	**4 B 4**	89	**X**	100
1 B 2 a vi	100	**2 D**	84				



Review Team Comment:

Could you please compare your result in the table above with the average result for all reporting Parties in the accompanying figure? Please explain why you report only notation keys and or zeroes in several sectors where other Parties have estimated emissions.
What can be done in the framework of the TFEIP in order for you to estimate emissions in (some of) the sectors. Please provide response to the specific request for clarification and any other additional related comments in the box below.

Your comments:
According to the guidelines most of the sectors listed in the table above are emission sources of single pollutants or pollutant groups. This implies the frequent usage of "NA" notation keys and leads to a high proportion of notation keys for specific sectors. It is proposed that for this comparison only cells are considered for which values are expected (similar to the non-"grey-shaded" cells in the IPCC Common Reporting Format). For most of the "other"-sectors no specific guidance is given in the guidelines which is reflected in the usage of "NO" notation keys. It is proposed that thiese sectors are not considered in the checks above

in order to put the focus on the “real” reporting gaps. It is expected that thise proposals would give a better clearer picture of completeness.

However, tThe reason for the high share in usage of notation keys in XXX’s submission is the lack of reported POP substances and heavy metals which have to be reported “additionally”. Please note It is to mention that the production and usage of most of the non-mandatory POPs not reported is prohibited in XXX. For prohibited these substances historical information is not included in XXXs national inventory system and therefore not reported within the NFR.

2.e) Consistency (Internal)

The aim of this test is to confirm the internal data consistency of submissions. It checks that values reported within sub-sectors add up to the reported sector total, and that the values reported for sectors add up to the reported National Total. All notation keys are converted to zero in the calculation.

Key:
Value: % disagreement between aggregated value and the sum of sub-sectors
Value= [100*(Aggregated sector-Σsub-sectors)/Aggregated)]
100: Sub-sector sum is zero while aggregated sector is different from zero. 100% disagreement.
X: The Aggregated sector is not reported or zero. I.e. it is not possible to calculate the difference.

The overall reporting rate represents the fraction of internally consistent data reported compared to the total number of aggregation checks able to be made.

Review Team Comment:

Your submission was 100% consistent!

Please provide clarification in the box below.

Your comments: The findings are correct.

3 COMPARABILITY TESTS

These tests review the year to year comparability per country for **pollutant ratios**, **recalculation, emission time series**, **country specific and average implied emission factors and the differences between the LRTAP and NEC submissions**.

3.a) Cross pollutant

A cross pollutant ratio test has been implemented this year. The results for this test are presently only presented for the transport sector. The aim of this test is to check the consistency between reported pollutants and the comparability of pollutant ratios between countries and with expert estimates. Pollutant ratios have been calculated for the transport (NFR1A3b) sector, and the ratios that are higher or lower by a **factor two** compared to **TREMOVE** (G. De Ceuster, B. Van Herbruggen, S. Logghe and Stef Proost, TREMOVE 2.0 model description, Report to the European Commission DG ENV, March 2004) and or **TRENDS** (TRENDS, 2003. Calculation of Indicators of Environmental Pressure caused by Transport - Main report. European Commission, Office for Official Publications, Luxembourg.) are flagged

Pollutant ratio	Sector	Ratio calculated from reported data	Ratio calculated from TRENDS model	Ratio calculated from TREMOVE model
NOx/NMVOC	1A3b	5.82	2.58	2.01
NOx/CO	1A3b	0.73	0.32	0.26
NOx/PM2.5	1A3b	23.12	12.39	12.30

Review Team Comment:

Your NOx/NMVOC ration is flagged based on our criteria. It is possible that XXX has reported higher NOx emissions based on the latest findings from ARTEMIS suggesting an underestimation of the NOx emission factors especially for the HDVs) by current emission factor databases. Please comment below.

Your comments:
Your finding isThe suppositions of the RT are correct.
The high NOX emissions of *1 A 3 b Road Transportation* are a result of the usage of the comparatively high emission factors for HDVs which are based on more accurate measurements.

3.b) Recalculation

The aim of this test is to identify differences between national totals reported by Parties between the 2005 and 2004 reporting years ($100*[(X_{2005} – X_{2004})/ X_{2005}]$). Differences larger than 10% are flagged.

Key:
Blank cell: Data for one of the reporting years are missing.
Zero: Data (value or notation key) for the two years are equal.
NP (Not Possible): Different notation keys are reported for the two years or reporting 2005 is zero or notation key while reporting year 2004 has a value or reporting 2005 has a value while reporting year 2004 has zero or notation key.
Value: Percentage difference between 2005 and 2004 reporting.

year	CO	Cd	DIOX	HCB	Hg	NH3	NMVOC	NOx	PAH	PM10	PM2.5	Pb	SOx	TSP
1980	0.0	0.0	0.0	0.0	0.0	0.0	-1.2	0.0	0.0	0.0	0.0	0.0	-3.9	0.0
1981	-0.1	0.0	0.0	0.0	0.0	-0.2	-1.2	-0.1	0.0	0.0	0.0	0.0	-4.8	0.0
1982	0.1	0.0	0.0	0.0	0.0	0.1	-1.0	0.1	0.0	0.0	0.0	0.0	-4.5	0.0
1983	0.1	0.0	0.0	0.0	0.0	0.0	-1.1	0.0	0.0	0.0	0.0	0.0	-6.0	0.0
1984	0.2	0.0	0.0	0.0	0.0	0.1	-1.2	0.0	0.0	0.0	0.0	0.0	-5.3	0.0
1985	0.3	-4.3	-0.6	-0.1	-0.2	0.2	-1.1	0.0	-5.2	0.0	0.0	0.0	-4.4	0.0
1986	0.1	-4.8	-0.7	0.0	-0.3	-0.1	-0.9	0.1	-5.3	0.0	0.0	0.0	-4.6	0.0
1987	0.2	-6.2	-0.6	0.0	-0.3	-0.9	-1.1	-0.1	-5.3	0.0	0.0	0.0	-5.3	0.0
1988	0.5	-4.8	-0.6	0.4	-0.3	1.9	-1.2	0.7	-5.5	0.0	0.0	-0.1	-2.7	0.0
1989	0.4	-6.4	-0.8	0.1	-0.3	-0.2	-1.3	-0.1	-5.7	0.0	0.0	-0.1	-7.0	0.0
1990	-0.4	-1.9	0.2	0.5	-0.2	-0.5	-4.2	-0.5	-1.2	17.1	4.6	1.5	-5.0	23.1
1991	0.2	-1.9	0.1	0.3	-0.2	0.1	-4.8	1.8	-1.3	0.0	0.0	2.0	-8.3	0.0
1992	-0.3	-1.5	0.2	0.3	0.0	3.1	-5.0	1.4	-1.8	0.0	0.0	2.3	-7.6	0.0
1993	-0.5	0.4	-0.1	0.1	0.1	0.3	-4.8	1.8	-2.6	0.0	0.0	2.3	-6.7	0.0
1994	-1.1	0.3	-0.2	0.2	0.1	-0.3	-5.1	0.5	-2.8	0.0	0.0	1.3	-8.9	0.0
1995	-1.3	0.2	0.0	0.3	0.1	2.0	-5.0	1.4	-2.6	15.6	2.2	0.1	-7.8	21.4
1996	-0.6	-0.1	1.1	1.1	0.2	1.5	-4.3	8.6	-2.0	0.0	0.0	0.3	-6.6	0.0
1997	-1.6	0.2	0.1	0.3	-0.4	0.2	-4.6	4.5	-2.7	0.0	0.0	-0.6	-7.9	0.0
1998	-1.6	-1.0	0.6	0.1	-0.4	1.8	-5.3	8.1	-2.9	0.0	0.0	-0.2	-8.8	0.0
1999	-1.7	2.4	2.8	2.2	1.5	1.1	-5.3	4.8	-2.2	14.9	2.0	1.2	-6.7	19.8
2000	-2.8	0.2	1.5	0.8	0.7	1.4	-5.1	6.9	-3.0	13.3	0.1	0.6	-7.0	18.0

year	CO	Cd	DIOX	HCB	Hg	NH3	NMVOC	NOx	PAH	PM10	PM2.5	Pb	SOx	TSP
2001	-4.1	-4.1	-1.8	-2.3	1.1	1.0	-5.5	8.1	-3.8	11.4	-1.6	-3.7	-9.9	15.9
2002	-4.7	-4.0	-29.4	-2.3	0.4	1.5	-6.0	6.9	-5.3	10.0	-3.0	-2.4	-8.9	14.0

Review Team Comment:

Can you please explain the recalculations flagged?

Your comments:
No significant methodological changes were performed for TSP, PM10 and PM2.5.
The recalculations for TSP, PM10 and PM2.5 are based on an error in XXX'a initial submission 2004 were emissions fom agricultural soils were omitted. This error was corrected in a resubmission in June 2004. It is assumed that resubmitted data were not included into the EMEP database and thus the comparison gives this high difference for all reporting years 1990, 1995 and 1999-2002. The differences regarding to the resubmission in June 2004 are for TSP: 1990 +1.1% 2002 -5.4% for PM10: 1990 + 1.3% 2002 -4.6% and for PM2.5: 1990 1.9% 2002 -5.3%.
Recalculation of Dioxin emissions 2002 are based on recent more actual information from iron and steel plants, reported under category *2 C Metal Production*. The reduction is achieved on new abatement technologies.
A general comment: It is proposed that calculation of differences are performed in relation to the previous submission which would be in line with the formula used by the UNFCCC: $100*[(X_{2005} – X_{2004})/ X_{2004.}$

3.c) Inventory comparison

The aim of this test is to compare national totals reported to NEC and LRTAP in the 2005 reporting year. Flagged values indicate difference of greater than 0.1% between the respective national totals (LRTAP-NEC).

Review Team Comment:

There where no differences found between the data reported the LTRAP and the data submitted to NEC

Your comments: The findings are correct.

3.d) Time series checks

The aim of this test is to identify instances of dips, jumps, and sudden trends in time series data reported by countries. Only data in new NFR reporting format were analysed, and data for which a complete time series was reported 1990-2003. The table below shows data that was flagged where outliers in time series data were identified based on time series trend checks.

Colour Key	
(dark grey)	indicates a dip in the Time Series Data
(light grey)	indicates a jump in the Time Series Data

Source	component	sectorcode	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
CLRTAP	CO	1 A 1 b	4650.00	800.00	449.24	456.45	521.13	551.00	435.00	742.00	354.00	461.00	579.00	491.00	723.00	723.00
CLRTAP	CO	1 A 2 c	868.87	995.18	1244.74	919.02	901.32	921.73	1039.17	1087.87	966.06	1400.98	1088.36	894.67	1164.25	2553.87
CLRTAP	CO	1 A 2 d	4828.74	5056.80	5020.49	5312.65	5523.14	5791.48	5562.31	5929.02	5893.22	5855.33	5882.54	5563.62	5766.99	4611.44
CLRTAP	CO	1 A 3 b iii	7263.35	8773.30	8985.73	9797.51	9254.77	10085.33	14661.21	11165.67	13644.23	11833.03	13316.17	14680.88	15899.73	17372.92
CLRTAP	NH3	1 A 2	221.72	237.86	217.58	248.57	263.53	253.70	246.46	308.25	258.72	271.89	247.17	259.09	251.11	279.92
CLRTAP	NH3	1 A 3 b iii	34.51	40.18	40.18	42.59	40.59	43.93	61.47	46.63	55.51	47.65	52.43	56.65	60.42	64.69
CLRTAP	NH3	4 B 13	94.85	94.85	94.85	94.85	96.47	103.09	106.16	143.79	128.76	99.93	98.36	98.36	98.36	105.31
CLRTAP	NMVOC	1 A 2 c	119.58	137.13	169.73	120.49	123.43	132.41	144.88	135.55	120.90	187.43	144.64	110.24	158.14	422.49
CLRTAP	NMVOC	1 A 2 d	881.02	918.18	892.44	921.11	959.12	1008.47	975.83	1012.81	1033.00	1028.38	1039.44	992.93	998.16	770.52
CLRTAP	NMVOC	1 A 3 b iii	2624.24	3047.74	3055.13	3255.35	3085.35	3352.35	4730.74	3578.36	4272.06	3655.64	4039.90	4374.40	4652.58	4996.32
CLRTAP	NMVOC	1 B 2 a i	1093.00	1093.00	1093.00	1076.00	1035.00	1002.00	983.00	984.00	963.00	953.00	948.00	948.00	943.00	1015.00
CLRTAP	NOx	1 A 3 b iii	28636.63	36353.14	38039.22	42511.02	40028.09	43935.19	68119.11	53343.56	68984.46	61972.89	72740.38	79806.79	85242.70	91400.61
CLRTAP	PAH	1 A 2 e	0.001	0.002	0.002	0.002	0.002	0.001	0.001	0.001	0.001	0.006	0.002	0.002	0.002	0.001
CLRTAP	PAH	1 A 3 b iii	0.168	0.214	0.227	0.256	0.249	0.281	0.441	0.352	0.460	0.419	0.495	0.562	0.624	0.695
CLRTAP	Pb	1 A 2 e	0.004	0.005	0.005	0.005	0.005	0.003	0.001	0.002	0.002	0.033	0.007	0.006	0.005	0.004
CLRTAP	SOx	1 A 2 f	4349.351	4496.407	3897.133	3993.601	3404.725	3172.054	4063.606	6025.899	4367.289	3181.495	2957.107	2981.727	2650.383	2778.985

Review Team Comment: The table above highlights instances where large variations were found in the reported timeseries. While the respective jumps/dips may all have logical explanation (e.g. reduced fuel use in a given year) the identified instances may also reflect inconsistencies in underlying activity data/emission factors for that year. Any comments you are able to make concerning the identified jumps and dips are welcomed. (Timeseries from your NEC data submission that also contained identical flagged years as for CLRTAP NH_3, NMVOC, NO_x and SO_x have been removed from the above table).

Your comments: 1 A 1 b: CO emissions from refinery are reported by plant operators. The strong decrease from 1991 on is caused by the reconstruction of a FCC facility. 1 A 2 c, 1 A 2 d: The sectoral split in 2003 between pulp and paper industry and chemical industry is not consistent with the timeseries 1990 to 2002. However, the aggregated emissions of sector 1 A 2 c and 1 A 2 d do not show significant variations in timeseries. 1 A 3 b iii: Total fuel consumption used for estimate emissions from road and off road transport is consistent with national fuel sales for the whole timeseries. It is known that, dependent on fuel prices in neighbour countries, fuel sales statistics are not consistent with bottom up estimates of in-country fuel consumption. In recent years, an increasing share in fuel sales is consumed by international road transport which leads to over-estimates of in-country emissions from heavy duty vehicles for specific years. It is planned to avoid this over/under estimates. 1 A 2: Statistical outliers are caused by inconsistencies and variations of the sectoral split of fuel consumption. The energy statistics has been revised from a national economic nomenclature to NACE nomenclature. This implies variations of allocation of plants to their economic sector over time series. 1 A 2 e: PAH and Pb emission estimates of 1999 are high due to a peak of biomass consumption reported by energy statistics. It is known that consumption of non-traded biomass fuels for final energy use in industry might be underestimated for specific historical years. This implies peaks in timeseries for certain pollutants.
Your comments: 1 A 1 b: CO emissions from refinery are reported by plant operators. The strong decrease from 1991 on is caused by the reconstruction of a FCC facility.

1 A 2 c, 1 A 2 d: The sectoral split in 2003 between pulp and paper industry and chemical industry is not consistent with the timeseries 1990 to 2002 [Why?]. However, the aggregated emissions of sector 1 A 2 c and 1 A 2 d do not show significant variations in timeseries.

1 A 3 b iii: Total fuel consumption used for estimate emissions from road and off road transport is consistent with national fuel sales for the whole timeseries. It is known that, dependent on fuel prices in neighbour countries, fuel sales statistics are not consistent with bottom up estimates of in -country fuel consumption. In the recent years, an increasing share in fuel sales is consumed by international road transport which leads to over -estimates of in -country emissions from heavy duty vehicles for specific years. It is planned to avoid this over/under estimates. [how?]

1 A 2: Statistical outliers are caused by inconsistencies and variations of the sectoral split of fuel consumption. The energy statistics has been revised from a national economic nomenclature to NACE nomenclature. This implies variations of allocation of plants to their economic sector over time series.

1 A 2 e: PAH and Pb emission estimates of 1999 are high due to a peak of biomass consumption reported by energy statistics. It is known that consumption of non -traded biomass fuels for final energy use in industry might be underestimated for specific historical years. This implies peaks in timeseries for certain pollutants.

3.e) Implied emission factors

The aim of this test was to identify significant differences in Implied Emission Factors between Parties. Activity data for 2002 was obtained from the UNFCC locator tool (2004 data submission - most recent year for which data is available) and used in conjunction with reported LRTAP emissions data to calculate implied emission factors for year 2002. Assessment has concentrated on sectors involving energy combustion sectors for the main pollutants CO, NO_x, NMVOC, and SO_x. An average IEF per pollutant and sector was calculated for each country region, and individual country emission factors have been flagged if they were **more than 5 times greater or less than 0.2 of the average IEF for the respective country region.** The review test was only performed for those Parties reporting in the NFR format, and where IEFs were available for 5 or more countries in a region.

	Colour Key
	indicates IEF 5 x greater than the average IEF
	indicates IEF 5 x lower than the average IEF

		1 A 1 a	1 A 1 b	1 A 1 c	1 A 2	1 A 3 b	1 A 3 c	1 A 3 e	1 A 4 b	1 B 1 b
CO	country IEF	0.0163	0.0198	0.0030	0.7549	0.7005	0.2124	0.0140	1.5143	no_em_data
	average IEF	0.0386	0.0384	0.0738	0.3153	1.2866	0.2866	0.7731	1.1739	353.8190
NMVOC	country IEF	0.0049	no_em_data	0.0002	0.0183	0.0885	0.1002	0.0007	0.1726	no_em_data
	average IEF	0.0052	0.0035	0.0348	0.0239	0.2207	0.1147	0.1104	0.2061	113.8624
NO_x	country IEF	0.0491	0.0942	0.0451	0.1663	0.4617	0.7508	0.2100	0.0681	no_em_data
	average IEF	0.1443	0.1127	0.2054	0.1755	0.3883	1.0865	0.4650	0.0608	65.2330
SO_x	country IEF	0.0234	0.1010	0.0000	0.0542	0.0079	0.0438	no_em_data	0.0389	no_em_data
	average IEF	0.2723	0.2837	0.1548	0.1445	0.0071	0.0751	0.0099	0.0449	227.2144

Note: ‘no_em_data’ indicates emissions data was not available for this sector
‘no_act_data’ indicates activity data was not available for this sector

Review Team Comment:

Your comments:
1 A 1 c includes emissions from combustion of mainly natural gas in oil/gas extraction and gasworks with comparatively low CO and NMVOC emissions. Emissions from solid fuel transformation are included in category *1 A 2 a Iron and Steel*.
1 A 3 e includes emissions from natural gas combustion in pipeline compressors only which implies comparatively low CO and NMVOC emissions.

1 A 1 a: SO_2 emissions for coal and residual fuel oil fired plants are reported by plant operators and comparatively low because most of this plants are equipped with abatement technologies. Another reason for the low IEF might be the high share of natural gas, biomass and MSW which is 57% of fuel consumption in 2003.

4 YOUR COMMENTS ON THE REVIEW

We would greatly appreciate your feedback (positive or negative) on the present review contents and any suggestions on how to improve the presentation of the review questions and responses.

Thank you for completing the 2005 review questionnaire and sending it to *vigdis.vestreng@met.no*, before July 1st 2005.

Your comments: Many thanks to the review team for their efforts, the report is helpful for us to improve the quality of our inventory and the new "single document" is now much more easier to handle.

Contact Details For clarification of the questions please contact: Vigdis Vestreng **Address:** Mail: P.O. Box 43, Blindern, N-0313 Oslo Visit: Gaustadalleen 30D, 0373 OSLO NORWAY **Fax:** +47 22 96 30 50 **Work:** +47 22 96 33 25 **E-Mail:** Vigdis.vestreng@met.no

Appendix III: Overview of the 2005 reporting under the LRTAP Convention and NEC Directive

Table 2 LRTAP submissions received by the UNECE Secretariat as of 4th July 2005

PARTY	Date Rec'd & Format	Resub-mission	Main: SO2, NOx, VOCs, CO, NH3	HM: PB, Cd, Hg, priority PB, Cd, Hg, priority	POP: DIOX/ PAH/ HCB	PM: 2.5, 10, TSP= all, (s) = sectors	LPS: Tab 3C	Infor invenv RepT (IIR)	Activity Data	Projection 2010 2015 2020	grid data	REPDAB RUN?
Armenia	15/02/04 OLD		2003	2003 pri + add	No.	No.	No.		No.	No.		No excel
Austria	15/02/05 2002-1		1980-2003	1980-2003	1980-03 all	1980-2003(S) all	No.	Yes.	No.	No.		Passed all tests!
Azerbaijan	27/05/05											
Belarus	14/02/05 2004-1		2003	2003 pri + add	2003 all	2003 TSP(S)	No.	26/05/05	No.	No.		Tab 1 inconsist, NFR codes
Belgium	16/02/05 2004-1		2003	2003	2003 all	2003(S) all	No.	19/05/05	No.	No.		Tab 1 inconsist
Bosnia Herzegovina												
Bulgaria	14/02/05 2004-1	24/02/05	2003	2003 pri	2003: all	No.	No.	Yes. (Hard copy)	No.	No.		Tab 1 ok HCB
Canada	15/02/05 2004-1		1985-2003	1985-2003 pri	85-03:all	1985-2003 all (S)	No.	SOMA 1980-2020	No.	2010,2015 2020		Tab 1 inconsist Tab 2a ok
Croatia	01/12/04 2002-1		2001-2002 only	2001-2 pri+add	01-2 DIOX PAH	2001-2 all	No.		No.	No.		Tables incorrect format
Cyprus	14/02/05 2004-1	25/02/05 POPs: 1/07/05	2003	2003 pri + add	2003: DIOX only	2003 all (S)	2003	19/05/05	Yes.	CRP: 2010/2015/ 2020; CLP:2010		Tab 1 and 2c revised.
Czech Rep	15/02/05 2004-1	20/02/05	2003	2003 pri+add	2003: all	All (S)	No.	13/05/05	No.	No.		OK now.

PARTY	Date Rec'd & Format	Resub-mission	Main: SO2, NOx, VOCs, CO, NH3	HM: PB, Cd, Hg, priority PB, Cd, Hg, priority	POP: DIOX/ PAH/ HCB	PM: 2.5, 10, TSP= all, (s) = sectors	LPS: Tab 3C	Infor invenv RepT (IIR)	Activity Data	Projection 2010 2015 2020	grid data	REPDAB RUN?
Denmark	15/02/05 2002-1	18/03/05; POP 30/06/05	1980-2003	90-03 pri, 00-03 add	90-03: DIOX PAH	00-03 all (S)	No.		90 95 00 2b-e 2010 2015 2020 2e 2010	2010-2020		Tab 1a inconsistTa b 1b: format error (POPs)
Estonia	14/02/05 2004-1		2003	2003 pri + add	03: all	2003 all (S)				2010 2015 2020 SOx, NOx, VOC, NH3		Tab 1 inconsistTa b 2 incompl
Finland	15/02/05 2004-1	01/03/05	2003	2003 pri + add	03: all	2003 all (S)	No.		Yes.	2010,2020	3B	Probs: Tab. 1, 2a,2c,2e OK now
France	23/12/04 2002-1	01/03/05 GRID	1980-2003	1990-2003 pri + add	90-03: all	1990-03 all (S)		2004	Yes.	2010	Yes.	Tabs 1a, 1b 2003: ok
Georgia												
Germany	15/02/05 2004-1	Explain ed notation key 23/02/05	1990-2003	NE/NO	90-03:PAH	1990-2003 TSP only (S)	No.		2b 90 95 2d, 2e	No.		Tab2d-e ok Tab 1 inconsist OK now
Greece	13/05/05	29/06/05	1990-2003	NE	NE	NE	No.		IPCC energy tables	2010, SOx, NOx, VOCs, NH3		
Hungary	22/12/04; 15/02/05 2002-1;2004-1		2002; 2003	2002; 2003	02, 03: all	2002; 2003 all (S)	No.		No.	No.		Tab 1 passed all tests!
Iceland	10/03/05		No.	No.	90-03	No.	No.		Yes.	No.		Undefined: NR
Ireland	22/02/05 2002-1		2003	2003 pri + add	2003 all	2003 all (No sectors!)	No.		No.	No.		Passed all tests!
Italy	22/06/05		1990-03	1990-03	90-03PA	PM10 (S)	No.		No.	No.		

PARTY	Date Rec'd & Format	Resub-mission	Main: SO2, NOx, VOCs, CO, NH3	HM: PB, Cd, Hg, priority PB, Cd, Hg, priority	POP: DIOX/ PAH/ HCB	PM: 2.5, 10, TSP= all, (s) = sectors	LPS: Tab 3C	Infor invenv RepT (IIR)	Activity Data	Projection 2010 2015 2020	grid data	REPDAB RUN?
				pri+add	H,dio							
Kazakhstan												
Kyrgyzstan												
Latvia	15/02/05 2002-1		1990-2003	1990-2003 pri + add	2002	1990-2003 (S) all	Yes		90,95,00,10,15,20	05/10/20		1a not corr,1b incon 2abc incompl2de ok
Liechtenstein												
Lithuania	07/02/05 2002-1		2003	2003 pri + add	2003 all	2003 (TSP only) (S)	2003		2003	2010 CLP SO2 NOx VOC NH3		2ac incompl
Luxembourg					POPS: 1990/2003							
Malta												
Monaco	11/02/05 2002-1		2003	2003 pri + add	2003 PCB, DIOX	2003 (TSP) (S)						1ab, 2ac incompl
Netherlands	16/02/05 2004-1	03/03/05	1990-2003	1990-2003 pri + add	1990-2003 all	1990-2003 all (S)			Yes.	Forth-coming		OK.
Norway	15/02/05 2002-1	HCBs 24/6/05	1980-2003	1980-2003 pri + add	1990-2003 DIOX,PAH	1980-2003 all (S)			2B-2E, 2D coming	2010 2015 2020 CLP SOx NOx VOC NH3		posted EIONET web site
Poland	22/03/05		2002 only									
Portugal												Submis-sion to NEC not LRTAP
Republic Moldova	14/02/05 2002-1	03/03/05	2003	2003 pri + add	2003: all	2003 all (S)	No.	17/05/05	No.	No.		1a 1b OK now Passed all tests
Romania												
Russian Federation												

PARTY	Date Rec'd & Format	Resub-mission	Main: SO2, NOx, VOCs, CO, NH3	HM: PB, Cd, Hg, priority PB, Cd, Hg, priority	POP: DIOX/ PAH/ HCB	PM: 2.5, 10, TSP= all, (s) = sectors	LPS: Tab 3C	Infor invenv RepT (IIR)	Activity Data	Projection 2010 2015 2020	grid data	REPDAB RUN?
Serbia & Montenegro	28/02/05 2002-1		2003 SOX, NOx only	No.	No.	No.	No.		No.	No.	SOx NOx only	Passed all tests.
Slovakia	11/02/05 2004-1	POPs: 7/7/05	2000-2003	2000-2003 pri + add	2000-2003:all	2000-2003 all (S)	No.	Yes.	No.	2010 2015 2020 CLP SOx NOx VOC NH3	90-95-00	Tab 1 2a inconsistTa b 3a unread
Slovenia	15/02/05 2004-1	028/02/05	2003	2003 pri	2003 all	2003 all PMs (S)	2003		No.	No.		OK
Spain	09/03/05		1990-2003	1990-2003 all	1990-2003 all	1990-2003 all (S)	Yes.	2004	Yes.	No.	Yes.	Probs: 1A2B2C3 A3B
Sweden	11/02/05 2002-1	23/02/05	1980-1989; 1990-2003	1990-2003 pri + add	1980-2003 Diox + PAHs	1990-2003 all (S)	No.	Yes.	No. But annex on thermal values and fuel types	2010 2015 2020 CLP SOx NOx VOC NH3		OK
Switzer	16/02/05 2004-1	24/02/05	2003 NH3 90,00, 03	90,00,03 pri	90,00,03 DIOX only	2000 2003 PM2.5, 10 (S)	No.		No.	2010 2015 2020		OK.
TFYROM	14/02/05 2004-1; 2002-1		2003 NOx CO, SOx	No.	2003 DIOX only	2003 TSP only (S)	Yes.		Yes.	No.		1 incon 2c ncom 3c unread-able
Turkey	14/02/05 2002-1		2003 (No totals)	No.	No.	No.	No.		No.	2010 2015 2020 CLP NOx,VOC		Main, no totals.
Ukraine	28/02/05 2002-1		2003	2003 pri+add	No.	TSP only (S)	No.		No.	No.		

PARTY	Date Rec'd & Format	Resub-mission	Main: SO2, NOx, VOCs, CO, NH3	HM: PB, Cd, Hg, priority PB, Cd, Hg, priority	POP: DIOX/ PAH/ HCB	PM: 2.5, 10, TSP= all, (s) = sectors	LPS: Tab 3C	Infor invenv RepT (IIR)	Activity Data	Projection 2010 2015 2020	grid data	REPDAB RUN?
UK	17/02/05 2004-1	24/02/05 (Re-sub PM/HM 10/03)	1980-2003	1990-2003 pri + add	1990-2003: all	1990-2003 PM2.5 10 (S)	No.		Yes.	Yes.		Tab 1in-consist2d incom 2e ok now
USA	15/02/05 2002-1		2002-2003	1999 (no updates)	1999 (no up-dates)	2002-3 PM2.5 10	No.		No.	No updates.		Tab1 ok
EC	24/06/05		90-03	90-03	No.	90-03	Yes.		Yes.	Yes.	No.	

Table 3. Date of first receipt of NEC submissions by the European Commission and/or the EEA, years covered and NFR Tables available from Member States by 25 Apr 2005[6].

EU15 MS	Submission date	Latest data available	Years covered	Gases covered	Format
Austria	23 Dec 2004	2003	1990-2003	NOx, CO, NMVOC, SOx, NH3	New NFR
Belgium	24 Dec 2004	2003	2000, 2002-2003	NOx, NMVOC, SOx, NH3	New NFR
Denmark	22 Dec 2004	2003	1980-2003	NOx, NMVOC, SOx, NH3	New NFR
Finland	17 Dec 2004	2003	2000-2003	NOx, NMVOC, SOx, NH3	00-02 New NFR (aggregated), 03 Totals
France	23 Dec 2004	2003	1980-2003	NOx, CO, NMVOC, SOx, NH3, PM, HM, POPs	New NFR
Germany	27 Jan 2005	2003	2000-2003	NOx, NMVOC, SOx, NH3	Totals
Greece	4 April 2005				
Ireland	23 Dec 2004	2003	2002-2003	NOx, CO, NMVOC, SOx, NH3	New NFR
Italy	30 Dec 2004	2003	2001-2003	NOx, NMVOC, SOx, NH3	Totals
Luxembourg	11 April 2005				
Netherlands	23 Dec 2004	2003	2002-2003	NOx, NMVOC, SOx, NH3	New NFR
Portugal	25 Jan 2005	2003	1990-2003	NOx, CO, NMVOC, SOx, NH3, PM, HM	New NFR
Spain	4 Mar 2005	2003	2000-2003	NOx, NMVOC, SOx, NH3	New NFR
	18 Mar 2005	2003	2000-2003	NOx, NMVOC, SOx, NH3	New NFR
Sweden	20 Dec 2004	2003	1988-2003	NOx, NMVOC, SOx, NH3	New NFR
United Kingdom	20 Jan 2005	2003	2001-2003	NOx, NMVOC, SOx, NH3	New NFR

New EU10 MS	Submission date	Latest data available	Years covered	Gases covered	Format
Czech Republic	21 Jan 2005	2003	1990-2003	NOx, NMVOC, SOx, NH3	Totals
Estonia	30 Dec 2004	2003	2003	NOx, NMVOC, SOx, NH3	New NFR
Latvia	30 Dec 2004	2003	1990-2003	NOx, NMVOC, SOx, NH3	New NFR
Lithuania	5 Jan 2005	2003	2002-2003	NOx, NMVOC, SOx, NH3	New NFR
Slovenia	30 Dec 2004	2002	2002	NOx, CO, NMVOC, SOx, NH3, PM, HM, POPs	New NFR
	31 Dec 2004	2003	2003	NOx, CO, NMVOC, SOx, NH3, PM, HM, POPs	New NFR

[6] Source: Annual European Community CLRTAP emission inventory 1990-2002. Submission to the Executive Body of the UNECE Convention on Long-range Transboundary Air Pollution. Final draft 8 July, 2004. European Environment Agency Technical Report No. /2004.

NEC national programmes and NEC reports available from Member States by 15 Mar 2005

EU15 MS	National programmes (due 31 December 2003)	Projections (due 31 December 2004)	Background data projections
AT	Yes	Totals (2010)	
BE		Sectoral (2010)	
DK	Yes (01/2004)	Totals (2010)	Energy consumption
FI	Yes	Totals (2010)	Primary energy
FR		Totals (2010)	Table 2b, 2c, 2d, 2e
DE	Yes		
IE	Discussion paper	Sectoral (2010)	
IT	Yes	Totals (2010)	
NL		Totals (2010)	
GB		Sectoral (2010)	

New EU10 MS	National programmes (due 31 December 2003)	Projections (due 31 December 2004)	Background data projections
CZ	Yes	Totals (2010)	
EE		Totals (2010)	
LV		Sectoral (2010)	
LT		Totals (2010)	

Note: The table shows the first submission date of each Member State to the European Commission or EEA.

Appendix IV: Explanation of NFR sectors

Table 3 Explanation of NFR sectors

1 A 1 a Public Electricity and Heat Production
1 A 1 b Petroleum refining
1 A 1 c Manufacture of Solid fuels and Other Energy Industries
1 A 2 Manufacturing Industries and Construction
1 A 2 a Iron and Steel
1 A 2 b Non-ferrous Metals
1 A 2 c Chemicals
1 A 2 d Pulp, Paper and Print
1 A 2 e Food Processing, Beverages and Tobacco
1 A 2 f Other, Manufacturing Industries and Construction
1 A 3 a ii (i) Civil Aviation (Domestic, Cruise)
1 A 3 a ii (ii) Civil Aviation (Domestic, LTO)
1 A 3 b Road Transport
1 A 3 b i Road Transport, Passenger cars
1 A 3 b ii Road Transport, Light duty vehicles
1 A 3 b iii Road Transport, Heavy duty vehicles
1 A 3 b iv Road Transport, Mopeds & Motorcycles
1 A 3 b v Road Transport, Gasoline evaporation
1 A 3 b vi Road Transport, Automobile tyre and brake wear
1 A 3 b vii Road Transport, Automobile road abrasion
1 A 3 c Railways
1 A 3 d ii National Navigation
1 A 3 e Other, Transport below 1000 (please specify)
1 A 3 e i Pipeline compressors
1 A 3 e ii Other mobile sources and machinery
1 A 4 a Commercial / Institutional
1 A 4 b Residential
1 A 4 b i Residential plants
1 A 4 b ii Household and gardening (mobile)
1 A 4 c Agriculture / Forestry / Fishing
1 A 4 c i Stationary (A,F,F)
1 A 4 c ii Off-road Vehicles and Other Machinery (A,F,F)
1 A 4 c iii National Fishing
1 A 5 a Other, Stationary (including Military)
1 A 5 b Other, Mobile (including military)
1 B 1 a Coal Mining and Handling
1 B 1 b Solid fuel transformation
1 B 1 c Other, Fugitive Emissions from Solid Fuels
1 B 1 Fugitive Emissions from Solid Fuels
1 B 2 a Oil
1 B 2 a i Exploration, Production, Transport (Oil)
1 B 2 a iv Refining, Storage (Oil)
1 B 2 a v Distribution of oil products
1 B 2 a vi Other, Oil
1 B 2 b Natural Gas
1 B 2 c Venting and flaring (Oil and Gas)
1 B 2 Oil and natural gas

2 A Mineral Products
2 A 1 Cement Production
2 A 2 Lime Production
2 A 3 Limestone and Dolomite Use
2 A 4 Soda Ash Production and Use
2 A 5 Asphalt Roofing
2 A 6 Road Paving with Asphalt
2 A 7 Other, Mineral Products (including Non Fuel Mining & Construction)
2 B Chemical Industry
2 B 1 Ammonia Production
2 B 2 Nitric Acid Production
2 B 3 Adipic Acid Production
2 B 4 Carbide Production
2 B 5 Other, Chemical Industry
2 C Metal Production
2 D Other Production
2 D 1 Pulp and Paper Production
2 D 2 Food and Drink Production
2 G Other Industrial Processes
3 A Paint Application
3 B Degreasing and Dry Cleaning
3 C Chemical Products, Manufacture and Processing
3 D Other, Solvent and other Product Use (including products containing Hms and POPs)
4 B Manure Management
4 B 1 a Dairy
4 B 1 b Non-Dairy
4 B 1 Cattle
4 B 13 Other, Manure Management
4 B 2 Buffalo
4 B 3 Sheep
4 B 4 Goats
4 B 5 Camels and Llamas
4 B 6 Horses
4 B 7 Mules and Asses
4 B 8 Swine
4 B 9 Poultry
4 C Rice Cultivation
4 D Agricultural Soils
4 D 1 Direct Soil Emission
4 F Field Burning of Agricultural Wastes
4 G Other, Agriculture
5 B Forest and Grassland Conversion
5 E Other (not included in National Total)
6 A Solid Waste Disposal
6 B Waste-Water Handling
6 C Waste Incineration
6 D Other, Waste
7 Other (included in National Total)
1 A 3 a i (i) International Aviation (LTO)
1 A 3 a i (ii) International Aviation (Cruise)

1 A 3 d i (i)	International maritime Navigation
1 A 3 d i (ii)	International inland waterways (Included in NEC totals only)
SNAP NATIONAL	National Total for the entire territory (1997 Guidelines)
GRID TOTAL	National Total for the EMEP grid domain
X (11 08 Volcanoes)	

Appendix V: Completeness and Trends in national totals of Main Pollutants and PMs

Table 5: National total emission trends
Emissions of sulphur (1980-1992) used for modelling at the MSC-W (Gg of SO_2 per year)[a]

Area/Year	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Albania	72	72	72	72	72	72	72	72	72	72	72	68	64
Armenia	141	111	101	110	97	100	111	111	104	63	72	60	44
Austria	346	304	289	214	196	180	161	139	105	95	76	71	57
Azerbaijan	15	15	15	15	15	15	15	15	15	15	15	15	15
Belarus	740	730	710	710	690	690	690	761	720	668	637	652	458
Belgium	828	712	694	560	500	400	377	367	354	325	354	330	315
Bosnia and Herzegovina	482	482	482	482	482	482	482	482	482	482	482	457	433
Bulgaria	2050	2103	2156	2209	2261	2314	2367	2420	2228	2180	2008	1665	1115
Croatia	150	153	156	159	162	165	168	171	174	177	180	108	107
Cyprus	28	28	33	30	33	35	38	39	42	42	46	33	39
Czech Republic	2257	2341	2387	2338	2305	2277	2177	2164	2066	1998	1881	1780	1543
Denmark [b]	451	369	378	322	305	334	279	249	244	191	177	236	182
Estonia	287	280	274	267	261	254	256	255	254	254	252	246	187
Finland	584	534	484	372	368	382	331	328	302	244	260	194	141
France [b]	3213	2529	2426	2000	1785	1496	1363	1349	1245	1408	1330	1451	1264
Georgia	230	242	250	267	267	273	255	258	255	249	248	194	135
Germany	7514	7441	7440	7346	7633	7732	7641	7397	6487	6165	5326	3996	3307
Greece	400	420	440	460	480	500	499	497	496	494	493	532	546
Hungary	1633	1580	1545	1480	1440	1404	1362	1285	1218	1102	1010	913	827
Iceland	18	18	18	18	19	18	18	16	18	17	24	23	24
Ireland	222	192	158	142	142	140	162	174	152	162	186	180	172
Italy	3441	3172	2925	2518	2221	2017	2032	2136	2073	1972	1773	1656	1557
Kazakhstan [b]	289	289	289	289	289	289	289	289	289	289	289	324	324
Latvia	96	96	96	96	96	96	96	96	96	96	99	81	67
Lithuania	311	312	304	310	303	304	316	316	300	298	222	234	139
Luxembourg	24	21	17	14	15	16	16	16	15	15	15	15	15
Malta	26	26	26	26	26	26	26	26	26	26	26	26	26
Netherlands	490	464	404	323	299	258	264	263	250	204	189	173	172
Norway	136	128	111	104	96	98	91	73	68	58	52	44	36
Poland	4100	4140	4180	4220	4260	4300	4200	4200	4180	3910	3210	2995	2820
Portugal [b]	*253*	265	278	*291*	239	*188*	*222*	*207*	*194*	250	*307*	*298*	*356*
Republic of Moldova	308	305	287	284	270	282	297	317	273	238	265	260	168
Romania	1055	1095	1104	1229	1223	1255	1293	1305	1469	1517	1311	1041	951
Russian Federation [b]	7323	7110	7252	7095	6663	6350	5880	5806	5333	4875	4671	4603	4033
Serbia and Montenegro	406	408	409	440	456	478	470	484	502	506	508	446	396
Slovakia	780	747	713	680	646	613	604	614	589	573	542	445	380
Slovenia	234	254	256	274	250	241	247	222	210	211	196	180	186
Spain [b]	*2913*	*2848*	*2811*	*2828*	*2583*	*2448*	*2323*	*2193*	*1845*	*2178*	*2089*	*2096*	*2068*
Sweden	491	431	371	305	296	266	272	228	224	160	112	111	106
Switzerland	116	108	100	92	84	76	68	62	56	49	42	41	38
TFYR of Macedonia	107	107	107	107	107	107	107	107	107	107	107	105	105
Turkey	1030	1043	1062	1125	1186	1345	1500	1432	1269	1566	1590	1666	1647
Ukraine	3849	3492	3427	3498	3470	3463	3393	3264	3211	3073	2783	2538	2376
United Kingdom	4841	4393	4178	3839	3692	3713	3868	3856	3790	3667	3711	3521	3443
North Africa	577	599	620	642	664	686	707	729	751	772	794	816	837
Remaining Asiatic areas	822	857	892	927	962	997	1032	1067	1102	1137	1172	1207	1242
Baltic Sea	139	143	146	150	154	157	161	165	169	174	178	183	187
Black Sea	35	36	37	37	38	39	40	41	42	43	45	46	47
Mediterranean Sea	725	743	762	781	801	820	841	862	883	906	929	952	976
North Sea	277	284	291	298	306	313	321	329	337	346	355	363	373
Remaining N-E Atlantic Ocean	550	563	577	592	607	622	637	653	669	686	704	721	739
Natural marine emissions	743	743	743	743	743	743	743	743	743	743	743	743	743
Volcanic emissions	2144	2144	2144	2144	2144	2144	2144	2181	2114	2493	2607	1645	2235
TOTAL	60292	58022	57428	55873	54702	54013	53324	52830	50210	49541	46766	42778	39761

[a] All years except 2010 and 2020: Reported values with white background, expert estimates in grey. Values in bold differ from last year's reporting. Values in italic are reported values modified for modelling purposes by MSC-W.
[b] The part within the EMEP domain

Table 5 Cont.: National total emission trends
Emissions of sulphur (1993-2003, 2010, 2020) used for modelling at the MSC-W (Gg of SO_2 per year)

Area/Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2010[c]	2020[c]
Albania	59	55	51	52	54	55	57	58	58	58	58	30	31
Armenia	5,5	4,2	2,5	1,5	0,4	3,3	0,84	8,4	4,4	7,5	10	4	4
Austria	55	49	48	46	42	37	36	33	34	33	34	30	28
Azerbaijan	15	15	15	15	15	15	15	15	15	15	15	15	15
Belarus	382	324	275	246	209	190	164	143	151	143	131	349	295
Belgium	294	252	256	240	219	212	181	172	160	158	153	99	91
Bosnia and Herzegovina	408	383	359	371	383	395	407	419	419	419	419	411	380
Bulgaria	1426	1480	1476	1420	1365	1251	943	982	940	965	968	979	828
Croatia	114	89	70	66	80	90	91	58	63	67	67	69	65
Cyprus	43	42	41	45	47	49	50	50	48	51	46	17	10
Czech Republic	1424	1275	1089	944	697	438	268	264	251	237	232	121	64
Denmark	147	145	136	171	99	76	55	28	26	25	31	18	14
Estonia	154	149	119	125	119	110	103	95	92	88	101	44	11
Finland	123	114	96	105	99	90	87	74	85	82	99	61	60
France	1105	1041	974	950	800	815	701	605	544	500	492	414	363
Georgia	71	47	20	30	33	20	9	6	6	6	6	9	9
Germany	2945	2473	1937	1339	1039	836	735	636	643	611	616	450	426
Greece	545	517	541	525	521	528	540	483	485	509	509	168	113
Hungary	757	741	705	673	659	592	590	486	400	359	347	266	96
Iceland	25	24	24	24	25	27	27	27	27	27	27	29	29
Ireland	161	175	161	147	166	176	157	131	126	96	76	33	19
Italy	1454	1359	1287	1228	1151	1016	922	771	736	665	665	376	308
Kazakhstan	321	273	271	201	234	240	220	237	237	237	237	237	237
Latvia	67	77	48	54	40	36	29	15	11	9	8	11	9
Lithuania	125	117	94	93	77	94	70	43	49	43	43	33	25
Luxembourg	15	13	9	8	6	4	4	3	3	3	3	3	2
Malta	26	26	26	26	26	26	26	26	26	26	26	12	3
Netherlands	164	146	128	135	118	108	103	73	73	66	65	60	63
Norway	35	35	33	33	30	30	28	27	25	22	23	21	20
Poland	2725	2605	2376	2368	2181	1897	1719	1511	1564	1455	1455	1046	723
Portugal	*305*	*284*	*318*	*260*	*279*	*325*	*326*	*296*	*280*	*280*	*205*	103	87
Republic of Moldova	156	109	64	67	36	32	12	13	12	15	21	117	102
Romania	928	912	887	862	836	811	689	728	833	833	833	668	405
Russian Federation	3637	3131	2969	2774	2524	2275	2062	1997	2031	2130	2130	2464	2014
Serbia and Montenegro	401	424	462	434	522	521	355	387	394	382	396	277	167
Slovakia	325	238	239	227	202	179	171	127	131	103	106	54	38
Slovenia	183	177	125	112	118	123	104	99	68	71	66	22	19
Spain	*1937*	*1888*	*1744*	*1530*	*1720*	*1569*	*1576*	*1457*	*1414*	*1518*	*1317*	*416*	*350*
Sweden	92	91	78	75	69	66	52	49	49	50	52	59	60
Switzerland	34	31	34	30	26	28	26	18	21	19	18	16	14
TFYR of Macedonia	105	105	105	105	105	105	105	105	137	166	150	82	72
Turkey	1593	1817	1772	1929	1990	2118	2104	2112	2112	2112	2112	1708	1275
Ukraine	2194	1715	1639	1293	1132	1028	1029	1129	1230	1329	1252	1145	842
United Kingdom	3098	2663	2354	2014	1653	1598	1219	1194	1118	1002	979	366	225
North Africa	859	881	903	924	946	968	989	1011	1033	1054	413	413	413
Remaining Asiatic areas[d]	1277	1312	1347	1382	1417	1452	1487	1522	1557	1592	854	805	805
Baltic Sea	192	197	202	207	212	217	223	228	234	240	246	174	225
Black Sea	48	49	50	52	53	54	56	57	58	60	61	107	138
Mediterranean Sea	1000	1025	1051	1077	1105	1132	1160	1189	1219	1250	1281	1602	2082
North Sea	382	391	401	411	422	432	443	454	465	477	489	329	424
Remaining N-E Atlantic Ocean	758	777	796	816	837	858	879	901	924	947	970	510	657
Natural marine emissions	743	743	743	743	743	743	743	743	743	743	743	743	743
Volcanic emissions[e]	2027	1918	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
TOTAL	37465	34924	32949	31006	29481	28092	26149	25296	25363	25356	23656	19595	17498

[c] Projections (Base Line Scenario) provide by IIASA (December 2004) in grey boxes. Reported values in white.
[d] "Remaining Asian areas" refers to Syria, Lebanon, Israel and parts of Uzbekistan, Turkmenistan, Iran, Iraq and Jordan.
[e] Natural emissions reported by Italy.

Table 6: National total emission trends
Emissions of nitrogen oxides (1980-1992) used for modelling at the MSC-W (Gg of NO_2 per year)[a]

Area/Year	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Albania	24	24	24	24	24	24	24	24	24	24	24	24	24
Armenia	15	15	17	17	16	45	53	52	56	51	46	40	22
Austria	246	232	228	230	230	234	**228**	225	**220**	214	**211**	**221**	**210**
Azerbaijan	**43**	**43**	**43**	**43**	**43**	**43**	**43**	**43**	**43**	**43**	**43**	**43**	**43**
Belarus	234	235	235	237	240	238	358	263	262	263	285	281	224
Belgium	442	419	395	372	348	325	317	338	345	357	**368**	326	334
Bosnia and Herzegovina	79	79	79	79	79	79	79	79	79	79	**79**	74	69
Bulgaria	416	416	416	416	416	416	416	416	415	411	361	256	230
Croatia	60	63	66	68	71	74	77	79	82	85	88	65	56
Cyprus	13	13	14	14	14	14	15	16	17	17	18	16	19
Czech Republic	937	819	818	830	844	831	826	816	858	920	544	521	496
Denmark [b]	**307**	**307**	**307**	**307**	**307**	307	**327**	318	307	288	283	332	290
Estonia	70	70	70	70	70	70	70	70	70	69	68	63	39
Finland	295	276	271	261	257	275	277	288	293	301	300	290	284
France [b]	**1989**	**1895**	**1862**	**1843**	**1841**	**1800**	**1762**	**1795**	**1798**	**1859**	**1830**	**1892**	**1856**
Georgia	121	126	130	138	137	140	134	134	135	131	130	113	48
Germany	3334	3259	3219	3258	3305	3276	3286	3350	3230	3011	**2846**	**2611**	**2418**
Greece	306	306	306	306	306	306	296	285	304	297	290	298	297
Hungary	273	270	268	266	264	263	264	265	258	247	238	203	183
Iceland	21	21	21	22	22	21	22	24	25	25	26	27	28
Ireland	73	86	86	85	84	91	100	115	122	127	118	120	130
Italy	**1585**	**1558**	**1557**	**1537**	**1552**	**1641**	**1710**	**1827**	**1850**	**1909**	**1927**	**1982**	**2001**
Kazakhstan [b]	89	89	89	89	89	89	89	89	89	89	89	100	94
Latvia	**70**	**70**	**70**	**70**	**70**	**70**	**70**	**70**	**70**	**70**	**70**	**58**	**47**
Lithuania	152	154	156	158	162	166	169	171	172	173	158	166	98
Luxembourg	23	22	22	21	21	21	20	20	21	22	23	24	24
Malta	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**
Netherlands	583	575	562	555	573	589	587	599	602	584	**559**	568	556
Norway	191	178	182	187	201	213	228	230	224	225	224	214	212
Poland	1229	1283	1337	1392	1446	1500	1510	1530	1550	1480	1280	1205	1130
Portugal [b]	*158*	166	174	*182*	137	*91*	*105*	*110*	*116*	184	**252**	**265**	**284**
Republic of Moldova	115	114	107	99	101	123	129	128	131	127	100	97	67
Romania	523	528	516	542	546	542	559	580	590	579	546	464	357
Russian Federation [b]	3634	3815	3902	3876	3779	3803	3771	3411	3287	3335	3600	3435	3123
Serbia and Montenegro	192	195	195	198	203	203	203	205	208	207	211	200	189
Slovakia	197	197	197	197	197	197	197	197	212	227	216	193	181
Slovenia	51	52	52	51	52	53	58	57	59	58	63	58	58
Spain [b]	*1068*	*982*	*972*	*994*	*1007*	*979*	*1001*	*1059*	*1092*	*1185*	***1185***	***1227***	***1258***
Sweden	404	417	412	401	411	426	432	437	432	418	**315**	**305**	**299**
Switzerland	170	172	174	175	177	179	176	174	172	169	154	146	138
TFYR of Macedonia	39	39	39	39	39	39	39	39	39	39	**39**	37	36
Turkey	364	377	408	433	459	483	528	570	571	609	644	649	667
Ukraine	1145	1145	1153	1153	1102	1059	1112	1094	1090	1065	1097	989	830
United Kingdom	**2652**	**2563**	**2550**	**2557**	**2514**	**2601**	**2686**	**2797**	**2845**	**2831**	**2828**	**2704**	**2622**
North Africa	**441**	**460**	**479**	**499**	**518**	**537**	**556**	**575**	**595**	**614**	**633**	**652**	**671**
Remaining Asiatic areas	**632**	**650**	**668**	**686**	**704**	**722**	**739**	**757**	**775**	**793**	**811**	**829**	**847**
Baltic Sea	**215**	**220**	**226**	**231**	**237**	**243**	**249**	**255**	**262**	**268**	**275**	**282**	**289**
Black Sea	**52**	**54**	**55**	**56**	**58**	**59**	**61**	**62**	**64**	**66**	**67**	**69**	**71**
Mediterranean Sea	**1000**	**1025**	**1050**	**1077**	**1104**	**1131**	**1159**	**1188**	**1218**	**1248**	**1280**	**1312**	**1345**
North Sea	**395**	**405**	**415**	**426**	**436**	**447**	**458**	**470**	**481**	**494**	**506**	**519**	**532**
Remaining N-E Atlantic Ocean	**772**	**792**	**811**	**832**	**852**	**874**	**895**	**918**	**941**	**964**	**989**	**1013**	**1039**
Natural marine emissions	0	0	0	0	0	0	0	0	0	0	0	0	0
Volcanic emissions	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL 2005	27448	27280	27414	27608	27674	27961	28478	28624	28709	28861	28346	27587	26374

[a] All years except 2010 and 2020: Reported values with white background, expert estimates in grey. Values in bold differ from last year's reporting. Values in italic are reported values modified for modelling purposes by MSC-W.
[b] The part within the EMEP domain

Table 6 Cont.: National total emission trends
Emissions of nitrogen oxides (1993-2003, 2010, 2020) used for modelling at the MSC-W (Gg of NO_2 per year)

Area/Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2010[c]	2020[c]
Albania	24	24	24	25	26	27	28	29	29	29	29	28	36
Armenia	12	12	15	11	15	11	11	10	13	13	15	13	13
Austria	203	195	192	212	199	211	199	204	214	220	229	160	127
Azerbaijan	43	43	43	43	43	43	43	43	43	43	43	43	43
Belarus	207	203	195	173	189	164	142	135	135	137	140	271	291
Belgium	330	333	362	315	306	312	289	329	292	300	297	232	202
Bosnia and Herzegovina	64	59	54	54	54	55	55	55	55	55	55	54	58
Bulgaria	242	230	266	259	225	223	202	184	188	197	209	147	111
Croatia	59	66	66	69	73	76	77	77	70	69	69	94	104
Cyprus	20	20	19	21	21	22	22	23	18	22	22	21	20
Czech Republic	454	375	368	366	349	321	313	321	332	318	324	187	126
Denmark	290	291	273	311	265	243	225	208	203	201	209	147	105
Estonia	38	41	42	44	45	46	40	41	38	40	39	28	16
Finland	282	282	258	268	260	252	247	236	222	208	219	151	112
France	1742	1697	1646	1619	1554	1534	1462	1390	1335	1275	1220	1089	847
Georgia	33	21	27	50	55	42	30	42	44	44	44	30	30
Germany	2299	2130	2000	1918	1823	1766	1717	1634	1560	1493	1428	1182	909
Greece	292	299	296	306	310	334	326	321	331	318	318	266	215
Hungary	184	187	190	196	200	203	201	185	185	180	180	135	91
Iceland	29	29	28	30	29	28	28	28	28	28	28	30	30
Ireland	119	115	115	120	119	122	119	125	132	125	120	99	65
Italy	1903	1822	1789	1729	1652	1550	1451	1373	1358	1267	1267	1006	692
Kazakhstan	93	74	71	63	53	57	51	50	50	50	50	50	50
Latvia	47	44	42	44	43	40	38	35	38	37	37	29	17
Lithuania	78	77	65	65	57	60	54	48	55	51	53	41	29
Luxembourg	25	23	21	22	18	17	16	17	17	17	17	28	18
Malta	9	9	9	9	9	9	9	9	9	9	9	6	4
Netherlands	535	510	473	501	453	428	429	393	382	371	364	315	245
Norway	222	220	221	230	233	235	238	224	221	211	220	193	167
Poland	1120	1105	1120	1154	1114	991	951	838	805	796	796	616	390
Portugal	276	276	285	274	277	288	289	287	282	286	265	214	165
Republic of Moldova	53	46	38	38	37	22	17	27	23	25	30	64	63
Romania	318	319	322	325	328	331	251	289	349	349	349	283	208
Russian Federation	3054	2667	2570	2467	2379	2488	2494	2357	2462	2566	2566	2758	3040
Serbia and Montenegro	177	166	155	155	156	156	157	158	158	158	158	168	173
Slovakia	174	164	174	132	125	130	118	109	109	105	98	72	58
Slovenia	63	66	67	70	71	64	58	58	59	60	56	39	28
Spain	*1235*	*1246*	*1268*	*1230*	*1285*	*1293*	*1347*	*1378*	*1356*	*1420*	*1411*	*970*	*697*
Sweden	284	286	274	262	250	243	232	219	214	208	206	200	161
Switzerland	129	124	120	113	107	104	99	97	98	94	89	71	56
TFYR of Macedonia	34	32	30	30	30	30	30	30	32	37	50	41	43
Turkey	748	731	800	873	879	863	952	951	951	951	951	852	754
Ukraine	700	568	531	467	455	558	543	561	583	588	523	1184	1250
United Kingdom	2450	2377	2241	2165	2004	1935	1822	1737	1660	1578	1570	1085	829
North Africa	691	710	729	748	767	787	806	825	844	863	96	96	96
Remaining Asiatic areas[d]	865	883	901	918	936	954	972	990	1008	1026	169	79	79
Baltic Sea	296	303	311	319	327	335	344	352	361	370	379	458	592
Black Sea	72	74	76	78	80	82	84	86	88	90	93	155	199
Mediterranean Sea	1378	1413	1449	1485	1523	1560	1600	1639	1680	1723	1765	2383	3095
North Sea	545	559	573	587	602	617	632	648	664	681	698	862	1111
Remaining N-E Atlantic Ocean	1065	1091	1119	1147	1176	1205	1236	1266	1298	1331	1363	740	954
Natural marine emissions	0	0	0	0	0	0	0	0	0	0	0	0	0
Volcanic emissions[e]	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL 2005	25604	24636	24323	24112	23587	23467	23097	22672	22680	22631	20936	19465	18814

[c] Projections (Base Line Scenario) provide by IIASA (December 2004) in grey boxes. Reported values in white.
[d] "Remaining Asian areas" refers to Syria, Lebanon, Israel and parts of Uzbekistan, Turkmenistan, Iran, Iraq and Jordan.
[e] Natural emissions reported by Italy.

Table 7: National total emission trends
Emissions of ammonia (1980-1992) used for modelling at the MSC-W (Gg of NH3 per year)[a]

Area/Year	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Albania	32	32	32	32	32	32	32	32	32	32	32	31	30
Armenia	25	25	25	25	25	25	25	25	25	25	25	24	23
Austria	52	52	53	54	54	54	53	54	**52**	**52**	57	59	**57**
Azerbaijan	25	25	25	25	25	25	25	25	25	25	25	25	25
Belarus	142	142	142	142	142	142	142	142	142	142	142	142	142
Belgium	89	89	89	89	89	89	93	97	101	105	**109**	93	93
Bosnia and Herzegovina	31	31	31	31	31	31	31	31	31	31	31	29	27
Bulgaria	144	144	144	144	144	144	144	144	144	144	144	124	111
Croatia	**52**	**52**	**52**	**52**	**52**	**52**	**52**	**52**	**52**	**52**	**52**	**52**	**52**
Cyprus	9	9	9	9	9	9	9	9	9	9	9	9	9
Czech Republic	156	156	156	156	156	156	156	156	156	156	156	134	115
Denmark [b]	**138**	**138**	**138**	**138**	**138**	138	139	136	132	133	133	129	127
Estonia	24	24	24	24	24	24	24	24	24	24	24	22	18
Finland	39	40	41	41	42	43	41	45	43	40	38	40	41
France [b]	**810**	**819**	**823**	**827**	**815**	**807**	**815**	**820**	**796**	**791**	**787**	**772**	**777**
Georgia	97	97	97	97	97	97	97	97	97	97	97	97	97
Germany	835	821	817	841	853	857	846	845	835	823	**736**	654	**637**
Greece	79	79	79	79	79	79	79	79	79	79	79	78	75
Hungary	157	156	154	153	151	150	170	150	160	170	124	93	84
Iceland	3	3	3	3	3	3	3	3	3	3	3	3	3
Ireland	112	112	112	112	112	112	112	112	112	112	112	115	117
Italy	**441**	**438**	**427**	**464**	**443**	**448**	**456**	**457**	**459**	**443**	**428**	**435**	**428**
Kazakhstan [b]	18	18	18	18	18	18	18	18	18	18	18	18	18
Latvia	**52**	**52**	**52**	**52**	**52**	**52**	**52**	**52**	**52**	**52**	**52**	**48**	**35**
Lithuania	85	86	86	87	88	89	89	90	89	86	84	85	81
Luxembourg	7	7	7	7	7	7	7	7	7	7	7	7	7
Malta	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**
Netherlands	234	240	244	244	246	248	258	258	237	232	**249**	228	180
Norway	20	23	23	23	23	23	23	21	21	21	20	21	22
Poland	550	550	550	550	550	550	550	550	550	550	508	450	447
Portugal [b]	*96*	*96*	*96*	*96*	*96*	*96*	*96*	*96*	*96*	*96*	*96*	*95*	*91*
Republic of Moldova	53	54	55	56	57	58	56	54	53	51	49	49	44
Romania	340	332	327	311	359	343	350	329	339	341	300	267	255
Russian Federation [b]	1189	1192	1214	1245	1247	1239	1286	1277	1269	1258	1191	1161	1084
Serbia and Montenegro	90	90	90	90	90	90	90	90	90	90	90	88	85
Slovakia	63	63	63	63	63	63	63	63	63	63	63	56	47
Slovenia	24	24	24	24	24	24	24	24	24	24	24	23	24
Spain [b]	*285*	*276*	*292*	*295*	*299*	*296*	*304*	*330*	*331*	*339*	***326***	***316***	***314***
Sweden	54	54	54	54	54	54	54	54	54	54	**55**	55	55
Switzerland	77	73	69	64	60	74	73	73	72	72	**65**	71	71
TFYR of Macedonia	17	17	17	17	17	17	17	17	17	17	17	17	17
Turkey	321	321	321	321	321	321	321	321	321	321	321	321	321
Ukraine	729	729	729	729	729	729	729	729	729	729	729	734	691
United Kingdom	**370**	**370**	**370**	**370**	**370**	**370**	**370**	**370**	**370**	**370**	**370**	**372**	**357**
North Africa	**211**	**219**	**227**	**235**	**243**	**251**	**258**	**266**	**274**	**282**	**290**	**298**	**306**
Remaining Asiatic areas	**230**	**239**	**248**	**257**	**266**	**276**	**285**	**294**	**303**	**312**	**321**	**330**	**339**
Baltic Sea	0	0	0	0	0	0	0	0	0	0	0	0	0
Black Sea	0	0	0	0	0	0	0	0	0	0	0	0	0
Mediterranean Sea	0	0	0	0	0	0	0	0	0	0	0	0	0
North Sea	0	0	0	0	0	0	0	0	0	0	0	0	0
Remaining N-E Atlantic Ocean	0	0	0	0	0	0	0	0	0	0	0	0	0
Natural marine emissions	0	0	0	0	0	0	0	0	0	0	0	0	0
Volcanic emissions	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	8612	8615	8654	8752	8801	8811	8923	8924	8895	8879	8594	8275	7984

[a] All years except 2010 and 2020: Reported values with white background, expert estimates in grey. Values in bold differ from last year's reporting. Values in italic are reported values modified for modelling purposes by MSC-W.
[b] The part within the EMEP domain

Table 7 Cont.: National total emission trends
Emissions of ammonia (1993-2003, 2010, 2020) used for modelling at the MSC-W (Gg of NH3 per year)

Area/Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2010[c]	2020[c]
Albania	29	28	28	29	30	31	32	32	32	32	32	26	26
Armenia	22	21	20	19	18	17	16	15	14	12	15	25	25
Austria	57	59	59	58	58	58	57	55	55	54	54	56	54
Azerbaijan	25	25	25	25	25	25	25	25	25	25	25	25	25
Belarus	142	142	142	142	142	142	142	142	137	128	120	147	147
Belgium	97	96	100	99	99	102	100	83	85	79	77	79	76
Bosnia and Herzegovina	25	24	23	23	23	23	23	23	23	23	23	17	17
Bulgaria	109	101	99	83	77	66	60	56	56	56	52	124	124
Croatia	52	52	52	52	52	52	52	52	52	51	51	33	33
Cyprus	9	9	9	9	9	9	9	9	9	7	6	6	6
Czech Republic	99	91	86	81	81	80	75	74	77	72	82	68	66
Denmark	125	121	114	110	110	111	106	105	105	102	98	81	78
Estonia	13	13	11	10	10	10	9	9	9	9	8	11	12
Finland	39	37	35	35	38	38	35	33	33	33	33	34	33
France	757	766	771	774	788	786	779	788	774	777	753	733	702
Georgia	97	97	97	97	97	97	97	97	97	97	97	97	97
Germany	634	602	611	615	609	613	612	607	616	606	601	624	606
Greece	75	73	85	73	71	74	73	73	73	73	73	54	52
Hungary	77	76	77	78	76	74	71	71	66	65	67	83	85
Iceland	3	3	3	3	3	3	3	3	3	3	3	3	3
Ireland	117	119	120	122	123	127	127	122	123	119	116	129	121
Italy	429	425	426	419	434	435	436	433	446	447	447	421	402
Kazakhstan	18	18	18	18	18	18	18	18	18	18	18	18	18
Latvia	21	18	16	15	15	14	13	13	15	14	15	14	16
Lithuania	80	80	38	36	35	35	29	25	50	51	34	55	57
Luxembourg	7	7	7	7	7	7	7,3	7,2	7	7	7	6	6
Malta	5	5	5	5	5	5	5	5	5	5	5	1	1
Netherlands	191	166	193	146	188	170	166	152	142	136	128	144	140
Norway	22	22	23	24	23	23	23	23	23	23	23	23	23
Poland	382	384	380	364	350	371	341	322	328	325	325	328	335
Portugal	*90*	*90*	*91*	*91*	*90*	*92*	*94*	*93*	*93*	*94*	*94*	69	67
Republic of Moldova	37	35	33	31	25	25	25	25	26	27	28	45	44
Romania	223	221	215	209	202	196	210	206	164	164	164	285	285
Russian Federation	903	772	824	749	730	675	657	650	625	600	600	835	834
Serbia and Montenegro	83	80	78	78	78	78	79	79	79	79	79	69	69
Slovakia	42	39	40	38	36	32	30	30	31	31	30	32	33
Slovenia	23	22	22	22	19	20	20	19	19	19	19	20	20
Spain	*295*	*315*	*304*	*337*	*336*	*355*	*367*	*385*	*381*	*382*	*396*	382	370
Sweden	62	62	64	61	61	61	58	58	56	56	56	51	49
Switzerland	71	70	69	69	69	68	68	53	68	67	52	63	61
TFYR of Macedonia	16	16	16	16	16	16	16	16	16	16	16	15	15
Turkey	321	321	321	321	321	321	321	321	321	321	321	241	260
Ukraine	620	585	540	518	483	410	364	358	378	270	242	619	619
United Kingdom	355	357	347	350	354	348	346	326	321	311	300	323	311
North Africa	314	322	330	337	345	353	361	369	377	385	235	235	235
Remaining Asiatic areas[d]	348	357	367	376	385	394	403	412	421	430	278	278	278
Baltic Sea	0	0	0	0	0	0	0	0	0	0	0	0	0
Black Sea	0	0	0	0	0	0	0	0	0	0	0	0	0
Mediterranean Sea	0	0	0	0	0	0	0	0	0	0	0	0	0
North Sea	0	0	0	0	0	0	0	0	0	0	0	0	0
Remaining N-E Atlantic Ocean	0	0	0	0	0	0	0	0	0	0	0	0	0
Natural marine emissions	0	0	0	0	0	0	0	0	0	0	0	0	0
Volcanic emissions[e]	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	7561	7344	7333	7174	7165	7060	6959	6871	6873	6701	6297	7027	6936

[c] Projections (Base Line Scenario) provide by IIASA (December 2004) in grey boxes. Reported values in white.
[d] "Remaining Asian areas" refers to Syria, Lebanon, Israel and parts of Uzbekistan, Turkmenistan, Iran, Iraq and Jordan.
[e] Natural emissions reported by Italy.

Table 8: National total emission trends
Emissions of non-methane volatile organic compounds (1980-1992) used for modelling at the MSC-W (Gg of NMVOC per year)[a]

Area/Year	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Albania	31	31	31	31	31	31	31	31	31	31	31	30	30
Armenia	26	26	24	24	22	93	98	104	93	90	81	70	31
Austria	**432**	**408**	**403**	**402**	**402**	**396**	**389**	**386**	**374**	**341**	**286**	**273**	**245**
Azerbaijan	9	9	9	9	9	9	9	9	9	9	9	9	9
Belarus	549	546	543	543	540	516	506	509	535	511	533	546	412
Belgium	**399**	**399**	**399**	**399**	**399**	**399**	**399**	**399**	**399**	**399**	**399**	267	266
Bosnia and Herzegovina	51	51	51	51	51	51	51	51	51	51	51	49	46
Bulgaria	309	309	309	309	309	309	309	309	309	263	217	178	179
Croatia	105	105	105	105	105	105	105	105	105	105	105	87	64
Cyprus	14	14	14	14	14	14	14	14	14	14	14	14	14
Czech Republic	275	275	275	275	275	275	308	341	375	408	441	394	366
Denmark [b]	**261**	**261**	**261**	**261**	**261**	**261**	**258**	**255**	**249**	**249**	**229**	**228**	**223**
Estonia	81	81	81	81	81	81	83	83	84	87	88	82	45
Finland	210	210	210	210	210	210	210	210	225	227	224	210	204
France [b]	**2660**	**2660**	**2660**	**2660**	**2660**	**2660**	**2660**	**2660**	**2660**	**2627**	**2416**	**2395**	**2346**
Georgia	46	47	48	50	49	49	48	48	48	46	46	8,2	3,9
Germany	3224	3152	3134	3152	3191	3190	3218	3274	3256	3202	**3534**	**3082**	**2807**
Greece	255	255	255	255	255	255	255	255	255	255	255	253	261
Hungary	215	218	222	225	229	232	263	228	215	205	205	150	142
Iceland	7,7	7,7	7,7	7,6	7,7	8	8,4	12	13	13	13	14	14
Ireland	111	111	111	111	111	111	111	111	111	111	111	111	114
Italy	**2034**	**1984**	**1937**	**1915**	**1881**	**1851**	**1859**	**1936**	**1966**	**2057**	2040	**2100**	**2148**
Kazakhstan [b]	89	89	89	89	89	89	89	89	89	89	89	100	94
Latvia	**121**	**121**	**121**	**121**	**121**	**121**	**121**	**121**	**121**	**121**	**121**	**95**	**76**
Lithuania	100	102	104	105	106	112	108	108	109	109	108	111	66
Luxembourg	15	15	15	15	15	15	16	16	17	18	19	19	18
Malta	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
Netherlands	579	555	543	526	513	502	489	485	538	468	**486**	462	438
Norway	173	182	189	201	212	231	249	**252**	249	**273**	**295**	294	**323**
Poland	1036	912	889	954	985	1011	1029	1014	1026	1016	831	833	805
Portugal [b]	189	189	189	189	189	*189*	***203***	***217***	***231***	***245***	***259***	***267***	***281***
Republic of Moldova	105	105	105	105	105	105	101	102	102	96	157	151	99
Romania	829	810	772	796	812	787	830	884	846	812	772	678	627
Russian Federation [b]	3410	3410	3410	3410	3410	3410	3410	3410	3396	3444	3668	3361	3297
Serbia and Montenegro	142	142	142	142	142	142	142	142	142	142	142	137	132
Slovakia	**252**	**252**	**252**	**252**	**252**	**252**	**252**	**252**	**252**	**252**	**252**	**217**	**182**
Slovenia	39	39	39	39	39	39	39	39	39	42	44	41	40
Spain [b]	*1392*	*1372*	*1350*	*1377*	*1371*	*1393*	*1420*	*1475*	*1510*	*1544*	***1097***	***1139***	***1151***
Sweden	**528**	**528**	**528**	**528**	**528**	**528**	**528**	**528**	528	**525**	**517**	**496**	**482**
Switzerland	323	323	323	324	324	324	318	311	305	298	279	261	242
TFYR of Macedonia	19	19	19	19	19	19	19	19	19	19	19	18	17
Turkey	359	361	379	387	384	379	403	430	450	453	463	457	479
Ukraine	1626	1626	1626	1626	1626	1626	1660	1687	1604	1512	1369	1302	1171
United Kingdom	**2099**	2090	**2127**	**2162**	**2211**	**2227**	2292	**2368**	**2440**	**2475**	**2421**	**2338**	**2259**
North Africa	**1753**	**1788**	**1823**	**1859**	**1894**	**1929**	**1964**	**1999**	**2035**	**2070**	**2105**	**2140**	**2175**
Remaining Asiatic areas	**1370**	**1408**	**1446**	**1484**	**1522**	**1561**	**1599**	**1637**	**1675**	**1713**	**1751**	**1789**	**1827**
Baltic Sea	**5**	**5**	**5**	**5**	**5**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**7**
Black Sea	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**2**	**2**	**2**
Mediterranean Sea	**21**	**21**	**22**	**22**	**23**	**23**	**24**	**25**	**25**	**26**	**27**	**27**	**28**
North Sea	**9**	**9**	**10**	**10**	**10**	**10**	**11**	**11**	**11**	**11**	**12**	**12**	**12**
Remaining N-E Atlantic Ocean	**15**	**16**	**16**	**16**	**17**	**17**	**18**	**18**	**19**	**19**	**20**	**20**	**21**
Natural marine emissions	0	0	0	0	0	0	0	0	0	0	0	0	0
Volcanic emissions	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL 2005	27904	27650	27626	27854	28019	28154	28535	28979	29162	29102	28660	27325	26324

[a] All years except 2010 and 2020: Reported values with white background, expert estimates in grey. Values in bold differ from last year's reporting. Values in italic are reported values modified for modelling purposes by MSC-W.
[b] The part within the EMEP domain

Table 8 Cont.: National total emission trends
Emissions of non-methane volatile organic compounds (1993-2003, 2010, 2020) used for modelling at the MSC-W (Gg of NMVOC per year)

Area/Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2010[c]	2020[c]
Albania	29	29	28	29	30	32	33	34	34	34	34	36	41
Armenia	20	17	23	18	18	17	17	16	28	14	28	28	28
Austria	239	221	221	216	204	191	180	181	185	182	182	152	138
Azerbaijan	9	9	9	9	9	9	9	9	9	9	9	9	9
Belarus	372	366	347	328	345	294	240	225	215	229	308	262	267
Belgium	265	258	352	242	249	269	248	248	276	230	226	150	148
Bosnia and Herzegovina	44	41	39	40	40	41	41	42	42	42	42	46	52
Bulgaria	208	175	173	147	120	132	118	120	123	123	119	114	80
Croatia	69	75	74	82	80	79	77	80	80	88	88	105	107
Cyprus	14	14	14	14	14	14	14	14	14	16	16	6	6
Czech Republic	346	310	292	293	277	242	234	227	220	203	203	157	133
Denmark	219	214	201	208	200	173	169	172	140	145	158	73	58
Estonia	42	45	48	50	54	54	42	34	33	38	40	30	24
Finland	196	194	188	182	175	171	166	161	157	151	145	124	95
France	2242	2118	2033	1946	1874	1819	1740	1661	1586	1475	1400	1012	921
Georgia	2,2	1,7	1,5	2,4	2,8	11	19	28	29	29	29	19	19
Germany	2581	2404	2248	2110	2042	1966	1842	1697	1592	1492	1460	1057	783
Greece	270	274	273	284	285	290	291	305	268	268	268	168	146
Hungary	149	142	150	150	145	141	170	173	166	155	155	95	77
Iceland	14	14	12	12	9,8	10	10	10	10	10	10	7	7
Ireland	109	107	105	112	116	118	98	90	87	81	78	55	46
Italy	2104	2047	2023	1976	1910	1805	1712	1544	1444	1343	1343	995	739
Kazakhstan	93	74	71	63	53	57	51	50	50	50	50	50	50
Latvia	61	66	71	74	79	79	79	70	73	77	79	24	15
Lithuania	52	52	77	82	81	79	68	61	71	72	74	49	39
Luxembourg	18	18	16	16	15	13	15	15	15	15	15	9	9
Malta	2	2	2	2	2	2	2	2	2	2	2	2	2
Netherlands	405	389	357	362	317	301	291	260	242	230	225	213	203
Norway	340	353	367	370	367	362	370	381	391	345	300	122	99
Poland	756	819	769	766	774	730	731	599	576	576	576	418	324
Portugal	*275*	*282*	*284*	*286*	*290*	*291*	*283*	*277*	*275*	*278*	278	177	165
Republic of Moldova	75	66	62	64	69	43	22	21	25	28	29	43	43
Romania	634	638	613	588	562	537	502	518	474	474	474	348	242
Russian Federation	3062	2924	2857	2622	2386	2376	2451	2450	2614	2777	2777	2760	3012
Serbia and Montenegro	128	123	118	120	122	124	126	129	129	129	129	154	158
Slovakia	148	145	154	158	133	128	124	80	83	82	82	67	64
Slovenia	42	44	44	49	48	42	40	40	49	49	46	30	21
Spain	*1081*	*1104*	*1056*	*1069*	*1082*	*1139*	*1130*	*1112*	*1096*	*1090*	*1098*	790	697
Sweden	449	429	420	406	376	353	331	320	311	303	303	220	182
Switzerland	226	213	199	191	182	173	165	125	145	143	111	99	89
TFYR of Macedonia	16	15	14	15	15	16	16	17	17	17	17	32	38
Turkey	527	516	677	755	784	803	785	726	726	726	726	656	509
Ukraine	972	1024	811	718	665	254	272	271	269	282	318	738	837
United Kingdom	2146	2110	1967	1870	1798	1647	1471	1335	1241	1166	1089	935	870
North Africa	2211	2246	2281	2316	2351	2387	2422	2457	2492	2527	2563	96	96
Remaining Asiatic areas[d]	1865	1903	1942	1980	2018	2056	2094	2132	2170	2208	2246	186	186
Baltic Sea	7	7	7	7	7	8	8	8	8	8	9	17	22
Black Sea	2	2	2	2	2	2	2	2	2	2	2	6	7
Mediterranean Sea	29	29	30	31	32	32	33	34	35	36	37	88	114
North Sea	13	13	13	14	14	14	15	15	15	16	16	32	41
Remaining N-E Atlantic Ocean	21	22	22	23	23	24	24	25	26	26	27	27	35
Natural marine emissions	0	0	0	0	0	0	0	0	0	0	0	0	0
Volcanic emissions[e]	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL 2005	25198	24704	24158	23470	22848	21948	21394	20604	20362	20092	20038	13088	12093

[c] Projections (Base Line Scenario) provide by IIASA (December 2004) in grey boxes. Reported values in white.

[d] "Remaining Asian areas" refers to Syria, Lebanon, Israel and parts of Uzbekistan, Turkmenistan, Iran, Iraq and Jordan.

[e] Natural emissions reported by Italy.

Table 9: National total emission trends
Emissions of carbon monoxide (1980-1992) used for modelling at the MSC-W (Gg of CO per year)[a]

Area/Year	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**
Albania	84	84	84	84	84	84	84	84	84	84	84	84	84
Armenia	405	405	405	405	405	405	405	417	417	399	304	377	195
Austria	**1786**	**1740**	**1719**	**1695**	**1743**	**1719**	**1651**	**1582**	**1503**	**1443**	**1244**	**1255**	**1205**
Azerbaijan	293	293	293	293	293	293	293	293	293	293	293	293	293
Belarus	1654	1654	1654	1654	1654	1654	1605	1601	1590	1615	1722	1717	1381
Belgium	**1529**	**1529**	**1529**	**1529**	**1529**	**1529**	**1529**	**1529**	**1529**	**1529**	**1529**	1103	1123
Bosnia and Herzegovina	277	277	277	277	277	277	277	277	277	277	277	259	242
Bulgaria	997	997	997	997	997	997	997	997	995	985	891	608	768
Croatia	655	655	655	655	655	655	655	655	655	655	655	565	417
Cyprus	46	46	49	49	49	49	53	56	60	60	63	56	67
Czech Republic	894	900	906	901	895	899	740	738	737	884	1257	1179	1170
Denmark [b]	**1097**	**1097**	**1097**	**1097**	**1097**	**1097**	**1074**	**1088**	**1000**	**1053**	**772**	**814**	**805**
Estonia	400	400	400	400	400	400	417	423	419	448	434	399	208
Finland	660	650	640	630	620	610	600	589	579	569	559	552	478
France [b]	**15689**	**14914**	**14457**	**14023**	**14080**	**13937**	**13532**	**13294**	**12863**	**12308**	**10817**	**10706**	**10244**
Georgia	648	617	632	648	651	637	643	639	648	597	526	441	130
Germany	14046	13027	12438	11980	12176	12134	12135	12438	12081	11430	11212	9528	8351
Greece	1298	1298	1298	1298	1298	1298	1298	1298	1298	1298	1298	1290	1320
Hungary	1019	1001	984	996	949	931	942	952	963	980	997	913	836
Iceland	44	44	44	43	44	46	48	54	57	57	58	59	61
Ireland	401	401	401	401	401	401	401	401	401	401	401	394	395
Italy	**7070**	**7010**	**7094**	**7029**	**7192**	**7229**	**7178**	**7256**	**7126**	**7266**	**7049**	**7395**	**7587**
Kazakhstan [b]	*410*	*410*	*410*	*410*	*410*	*410*	*410*	*410*	*410*	*410*	*410*	*494*	*490*
Latvia	**528**	**528**	**528**	**528**	**528**	**528**	**528**	**528**	**528**	**528**	**528**	**624**	**613**
Lithuania	541	548	543	550	550	545	554	564	578	568	519	577	350
Luxembourg	193	193	193	193	193	193	189	186	182	179	175	190	204
Malta	**21**	**21**	**21**	**21**	**21**	**21**	**21**	**21**	**21**	**21**	**21**	**21**	**21**
Netherlands	1530	1418	1374	1354	1357	1381	1252	1192	1179	1131	**1126**	1025	983
Norway	**877**	815	824	816	842	844	872	**887**	869	869	867	800	**779**
Poland	7406	7406	7406	7406	7406	7406	7406	7406	7406	7406	7406	7245	7083
Portugal [b]	***794***	***794***	***794***	***794***	***794***	***794***	***794***	***794***	***794***	***794***	***794***	***804***	***832***
Republic of Moldova	394	392	395	388	387	483	478	474	496	476	453	468	279
Romania	3245	3217	3152	3030	3463	3307	3378	3196	3317	3314	3186	2695	2506
Russian Federation [b]	13520	15005	13617	13696	13672	14122	13142	13270	13144	12210	13329	13000	11703
Serbia and Montenegro	672	683	683	693	711	711	711	718	728	725	739	699	660
Slovakia	491	491	491	491	491	491	491	491	491	491	**493**	**438**	**384**
Slovenia	68	66	63	61	64	68	78	79	75	75	81	78	78
Spain [b]	*3494*	*3372*	*3343*	*3370*	*3344*	*3305*	*3347*	*3437*	*3620*	*3807*	***3441***	***3506***	***3561***
Sweden	**1189**	**1189**	**1189**	**1189**	**1189**	**1189**	**1189**	**1189**	**1189**	**1189**	**1189**	**1166**	**1146**
Switzerland	1280	1222	1164	1106	1048	990	933	877	820	764	673	629	581
TFYR of Macedonia	77	77	77	77	77	77	77	77	77	77	77	77	77
Turkey	2934	2961	3110	3141	3141	3121	3305	3477	3610	3505	3585	3579	3662
Ukraine	9832	9832	9832	9832	9832	9832	9722	9269	9085	8794	8141	7406	5496
United Kingdom	**9350**	**9200**	**9299**	**9018**	**8850**	**8996**	**8960**	**8813**	**8648**	**8787**	**8318**	**8152**	**7732**
North Africa	**336**	**336**	**336**	**336**	**336**	**336**	**336**	**336**	**336**	**336**	**336**	**336**	**336**
Remaining Asiatic areas	**449**	**449**	**449**	**449**	**449**	**449**	**449**	**449**	**449**	**449**	**449**	**449**	**449**
Baltic Sea	**18**	**18**	**19**	**19**	**20**	**20**	**21**	**21**	**22**	**22**	**23**	**23**	**24**
Black Sea	**5**	**5**	**5**	**5**	**5**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**7**
Mediterranean Sea	**85**	**87**	**89**	**91**	**94**	**96**	**98**	**101**	**103**	**106**	**109**	**111**	**114**
North Sea	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**
Remaining N-E Atlantic Ocean	**68**	**69**	**71**	**73**	**75**	**77**	**79**	**80**	**82**	**85**	**87**	**89**	**91**
Natural marine emissions	0	0	0	0	0	0	0	0	0	0	0	0	0
Volcanic emissions	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL 2005	110833	109878	107567	106258	106877	107118	105423	105050	103883	101799	99047	94721	87647

[a] All years except 2010 and 2020: Reported values with white background, expert estimates in grey. Values in bold differ from last year's reporting. Values in italic are reported values modified for modelling purposes by MSC-W.
[b] The part within the EMEP domain

Table 9 Cont.: National total emission trends
Emissions of carbon monoxide (1993-2003, 2010, 2020) used for modelling at the MSC-W (Gg of CO per year)

Area/Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2010[c]	2020[c]
Albania	84	84	84	88	91	95	98	102	102	102	102	160	196
Armenia	145	128	174	126	224	124	124	110	104	106	120	104	104
Austria	1165	1106	1018	1032	962	923	876	810	804	775	802	727	695
Azerbaijan	293	293	293	293	293	293	293	293	293	293	293	293	293
Belarus	1201	1241	1253	1242	1223	1034	786	718	711	712	733	837	951
Belgium	1088	1044	1219	1000	938	1114	1017	977	1006	915	888	306	286
Bosnia and Herzegovina	224	207	189	189	189	193	193	193	193	193	193	160	203
Bulgaria	820	855	846	613	515	650	617	667	619	700	716	568	393
Croatia	375	369	374	428	431	409	399	402	326	309	309	480	514
Cyprus	70	70	67	74	74	77	77	81	85	83	85	83	83
Czech Republic	1103	1125	999	1012	944	765	716	648	649	546	579	475	438
Denmark	812	781	772	771	718	655	626	615	618	590	591	358	309
Estonia	210	241	242	268	283	281	215	202	177	178	183	126	105
Finland	457	444	436	461	474	452	547	526	605	600	564	644	602
France	9712	9038	8881	8322	7889	7748	7262	6695	6406	6105	5897	4795	4576
Georgia	143	149	250	390	429	353	223	216	218	218	218	223	223
Germany	7701	7080	6580	6166	5993	5554	5200	4913	4561	4300	4155	4245	4000
Greece	1285	1264	1254	1354	1356	1489	1386	1531	1366	1169	1169	1237	1120
Hungary	796	774	761	727	733	737	722	633	592	620	600	492	487
Iceland	60	60	49	50	39	40	40	40	40	40	40	19	19
Ireland	350	329	304	307	312	318	285	280	270	254	239	204	192
Italy	7504	7320	7097	6801	6645	6118	5850	5150	5067	4476	4476	3651	3085
Kazakhstan	*450*	*356*	*355*	*363*	*345*	*336*	*297*	*279*	*279*	*279*	279	*279*	*279*
Latvia	318	327	404	409	386	384	374	333	310	290	295	185	133
Lithuania	292	303	286	312	358	358	320	282	229	224	225	228	156
Luxembourg	219	145	107	103	80	51	50	49	49	49	49	42	37
Malta	21	21	21	21	21	21	21	21	21	21	21	21	21
Netherlands	960	907	849	903	749	739	702	707	659	626	609	623	678
Norway	781	766	734	707	670	631	600	595	565	553	541	1552	1542
Poland	8655	5115	4547	4837	4700	4301	4363	3463	3528	3528	3528	2863	3068
Portugal	*822*	*809*	*806*	*794*	*772*	*772*	*757*	*752*	*708*	*692*	644	1794	1810
Republic of Moldova	218	171	192	170	210	153	100	84	88	107	139	192	199
Romania	2434	2325	2090	1856	1621	1386	1143	1238	1194	1194	1194	1034	845
Russian Federation	11320	10603	9945	9401	10332	10383	10804	10811	11164	11517	11517	9806	7924
Serbia and Montenegro	621	582	543	543	546	546	550	553	553	553	553	573	639
Slovakia	412	385	380	348	350	327	322	313	315	312	308	240	231
Slovenia	87	93	91	95	93	77	70	68	93	89	81	199	203
Spain	*3350*	*3317*	*3019*	*3083*	*2922*	*2902*	*2634*	*2489*	*2432*	*2320*	*2285*	3362	3176
Sweden	1097	1073	1058	1021	938	902	850	794	758	724	697	624	598
Switzerland	544	516	491	467	443	422	399	418	374	383	368	346	331
TFYR of Macedonia	77	77	77	77	77	77	77	77	76	81	139	214	248
Turkey	3936	3769	3987	4135	4179	4156	4047	3778	3778	3778	3778	3778	3778
Ukraine	4218	3375	2906	2567	2516	2810	2672	2708	2744	2780	2766	3055	3824
United Kingdom	7300	6889	6341	6188	5727	5288	4972	4117	3820	3336	2768	1924	1810
North Africa	336	336	336	336	336	336	336	336	336	336	336	336	336
Remaining Asiatic areas[d]	449	449	449	449	449	449	449	449	449	449	449	131	131
Baltic Sea	24	25	26	26	27	28	28	29	30	30	31	43	56
Black Sea	7	7	7	7	7	8	8	8	8	8	9	15	19
Mediterranean Sea	117	120	123	126	129	132	136	139	142	146	150	225	292
North Sea	50	51	52	53	55	56	58	59	60	62	64	81	105
Remaining N-E Atlantic Ocean	93	96	98	101	103	106	108	111	114	117	120	70	90
Natural marine emissions	0	0	0	0	0	0	0	0	0	0	0	0	0
Volcanic emissions[e]	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL 2005	84805	77011	73463	71210	69895	67559	64798	60859	59687	57867	56891	54022	51433

[c] Projections (Base Line Scenario) provide by IIASA (December 2004) in grey boxes. Reported values in white.

[d] "Remaining Asian areas" refers to Syria, Lebanon, Israel and parts of Uzbekistan, Turkmenistan, Iran, Iraq and Jordan.

[e] Natural emissions reported by Italy.

Table 10: National total emission trends
Emissions of particulate matter (2000-2003, 2010 & 2020) used for modelling at the MSC-W (Gg of $PM_{2.5}$ & PM_{10} per year)[a]

	2000 IIASA		2001		2002		2003		2010[b] IIASA		2020[b] IIASA	
Area/Year	PM10	PM2.5	PM10	PM2.5	PM10	PM2.5	PM10	PM2.5	PM10	PM2.5	PM10	PM2.5
Albania	9	7	9	7	9	7	9	7	7	5	8	6
Armenia	7	5	7	5	7	5	7	5	7	5	7	5
Austria	44	25	45	26	45	26	46	26	43	31	39	27
Azerbaijan	30	19	30	19	30	19	30	19	30	19	30	19
Belarus	56	37	56	37	56	37	56	37	49	34	41	29
Belgium	65	36	66	37	64	34	65	34	48	28	45	25
Bosnia and Herzegovina	48	20	48	20	48	20	48	20	37	17	34	16
Bulgaria	92	56	92	56	92	56	92	56	80	46	70	39
Croatia	7	6	7	6	7	6	7	6	20	14	21	15
Cyprus	5	3	5	3	5	3	5	3	3	2	3	2
Czech Republic	109	71	90	60	70	49	51	38	52	34	40	25
Denmark [c]	31	23	32	23	30	22	30	22	26	16	22	13
Estonia	42	22	39	24	35	25	30	21	18	13	9	7
Finland	48	38	54	38	55	39	55	38	37	31	33	26
France [c]	521	281	516	277	496	261	505	267	281	202	260	170
Georgia	12	8	12	8	12	8	12	8	12	8	12	8
Germany	255	168	255	168	255	168	255	168	219	133	206	119
Greece	66	49	66	49	66	49	66	49	67	49	61	43
Hungary	47	26	45	24	43	24	48	27	37	26	37	24
Iceland	3	3	3	3	3	3	3	3	3	3	3	3
Ireland	21	14	17	12	15	11	17	11	18	11	15	9
Italy	270	207	270	207	270	207	270	207	182	131	149	98
Kazakhstan [c]	22	11	22	11	22	11	22	11	22	11	22	11
Latvia	5	3	5	3	5	3	5	3	8	6	6	5
Lithuania	20	17	20	17	20	17	20	17	18	14	15	12
Luxembourg	4	3	4	3	4	3	4	3	4	3	4	2
Malta	0,81	0,58	0,81	0,58	0,81	0,58	0,81	0,58	0,67	0,42	0,65	0,38
Netherlands	48	29	44	26	43	26	40	24	50	27	48	24
Norway	63	57	62	56	64	58	60	54	24	19	20	15
Poland	299	212	303	142	303	142	303	142	206	147	156	104
Portugal [c]	58	46	58	46	58	46	58	46	48	39	48	37
Republic of Moldova	3	2	3	2	5	1	6	3	38	21	24	14
Romania	161	106	161	106	161	106	161	106	135	86	115	71
Russian Federation [c]	1382	882	1382	882	1382	882	1382	882	1388	864	1371	874
Serbia and Montenegro	92	44	92	44	92	44	92	44	76	39	81	42
Slovakia	28	18	32	23	36	28	33	25	22	14	21	13
Slovenia	21	15	17	12	13	10	9	7	14	10	11	7
Spain [c]	208	139	209	141	215	144	214	144	160	110	142	90
Sweden	66	45	66	45	67	45	70	48	58	47	52	41
Switzerland	22	13	22	11	22	11	22	11	13	7	12	6
TFYR of Macedonia	21	10	21	10	21	10	21	10	16	8	15	8
Turkey	414	302	414	302	414	302	414	302	365	258	390	270
Ukraine	518	315	518	315	518	315	518	315	457	273	470	288
United Kingdom	168	100	169	101	150	92	140	87	130	79	117	67
North Africa	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Remaining Asiatic areas [d]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Baltic Sea	22	21	22	21	22	21	22	21	29	27	37	35
Black Sea	8	7	8	7	8	7	8	7	10	9	13	12
Mediterranean Sea	114	108	114	108	114	108	114	108	148	140	192	182
North Sea	42	40	42	40	42	40	42	40	54	51	70	66
Remaining N-E Atlantic Ocean	36	34	36	34	36	34	36	34	47	44	60	57
Natural marine emissions	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Volcanic emissions	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL 2005	5634	3705	5611	3618	5551	3586	5525	3568	4817	3211	4658	3081

[a] Grey shaded cells contain expert estimates. Reported values are displayed with white background.
[b] Projections (Base Line Scenario) provide by IIASA (December 2004) in grey boxes. Reported values in white.
[c] The part within the EMEP domain
[d] "Remaining Asian areas" refers to Syria, Lebanon, Israel and parts of Uzbekistan, Turkmenistan, Iran, Iraq and Jordan.