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Report for the Stage 3 in-depth review of emission inventories submitted under the UNECE LRTAP Convention and EU National Emissions Ceilings Directive for:

European Union

CONTENT

INTRODUCTION

1.   The mandate and overall objectives for the emission inventory review process under the LRTAP Convention is given by the UNECE document '*Methods and Procedures for the Technical Review of Air Pollutant Emission Inventories reported under the Convention and its Protocols'* [1] – hereafter referred to as the 'Methods and Procedures' document.

2.   This annual review has concentrated on SO_2, NOx, NMVOC, NH_3, plus PM_{10} & $PM_{2.5}$ as well as Persistent Organic Pollutants (POPs) for the time series years 1990 – 2010, reflecting current priorities from the EMEP Steering Body and the Task Force on Emission Inventories and Projections (TFEIP). Heavy Metals (HMs) have been reviewed to the extent possible.

3.   This report covers the stage 3 centralised reviews of the UNECE LRTAP Convention and EU NEC Directive inventories of the EU coordinated by the EMEP emission centre CEIP acting as review secretariat. The review took place from 25th – 29th June 2012 in Copenhagen, Denmark, and was hosted by the European Environment Agency (EEA). The following team of nominated experts from the roster of experts performed the review: Generalist – Melanie Hobson (UK), Energy - Stephan Poupa (Austria) and Emmanuel Deflorenne (France), Transport & Mobile Sources – Jean-Marc Andre, Industry – Kristina Saarinen (Finland), Solvents – Ioannis Sempos (Greece), Agriculture & Nature - Bernard Hyde (Ireland), Waste – Kees Peek (The Netherlands).

4.   Chris Dore (United Kingdom) was the lead reviewer. The review was coordinated by Katarina Marečková (EMEP Centre on Emission Inventories and Projections - CEIP)).

5.   The EU emissions inventory is compiled by aggregating information from a large number of countries. The unique nature of this inventory means that the ERT needed to modify the standard approach to the Stage 3 review. For example, the lack of consistency in a national inventory is not considered good practice; however, it is an inherent part of the EU inventory. Similarly, for some of the recommended actions to address shortcomings in national emissions inventories it is simply not practical to implement them in the EU emissions inventory.

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[1] Methods and Procedures for the Technical Review of Air Pollutant Emission Inventories reported under the Convention and its Protocols. Note by the Task Force on Emission Inventories and Projections. ECE/EB.AIR/GE.1/2007/16 http://www.unece.org/env/documents/2007/eb/ge1/ece.eb.air.ge.1.2007.16.e.pdf

PART A: KEY REVIEW FINDINGS

6.   The ERT found that reviewing the EU inventory was particularly challenging, because the existing review framework has not been designed for reviewing an inventory that represents a compilation of numerous national emission inventories. As a result, some aspects of the review process were not well suited to assessing some features of the EU inventory data and IIR, and so a modified approach was needed.

7.   The review process was undertaken in two stages – the inventory was reviewed broadly in the same way as national inventories (bearing in mind the fact that it is a compilation of national emission inventories). There are many recommendations which are concerned with the same underlying features of the EU emissions inventory, so consideration was given to more strategic issues and recommendations. The conclusions from the detailed technical parts of the review are given in the individual sectoral chapters (Part B). These are summarised in Part A of this report, but are then also accompanied by more strategic considerations.

8.   In many cases, the ERT is not in a position to make specific recommendations relating to strategic issues. However, with the aim of being constructive, some options for making improvements are presented as potential ideas that might be taken up.

9.   The inventory is generally in line with the *EMEP EEA Inventory Guidebook* and the *UNECE Reporting Guidelines* and the ERT appreciates the effort that goes into compiling the EU inventory. However, there are significant shortcomings associated with a lack of completeness, and the use of Tier 1 methodologies for key sources. A lack of consistency was also noted by the ERT, but it is recognised that this is an inherent issue associated with the EU inventory. Whilst it would be possible to improve the consistency of the inventory, the ERT considered that this would require substantial investment and would deliver little or no significant improvement to the quality of the inventory. The ERT therefore chose not to focus on the consistency of the inventory as an issue.

10.   The EU inventory is heavily dependent on the quality (and particularly the completeness) of the MS's inventories. The act of summing MS inventories means that quality issues at the MS level reflect on the EU inventory to a great extent[2]. Gap-filling procedures are used to address common issues. These have been well designed, but it is challenging to address all issues arising in an automated way. The ERT found numerous examples of dips and jumps that were not adequately explained in the IIR, or where the gap filling procedures did not deliver data that was considered to be an accurate representation of the EU emissions. Whilst there are many source/pollutant combinations that are considered to be of good quality, there are significant issues associated with accuracy that arise from the lack of completeness at the MS level. Consequently, the EU inventory overall is not currently

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[2] For example, 15 MS inventories each with only a single error might all be regarded as being of good quality. However, summing up the inventories may result in an emissions inventory that has issues associated with 15 different source sectors.

considered to be of a comparable quality to an inventory that uses Tier 2 or higher methodologies for key categories, and Tier 1 methodologies for all other sources. A number of issues relating to this are considered in more detail in subsequent sections of this report.

11.   The ERT recognises that many improvements have been made to the IIR provided as part of the 2012 submission. For example, additional pollutants are reported and more information is provided on data sources and completeness.

INVENTORY SUBMISSION

12.   In the 2012 submission, the EU has reported emissions for its Protocol base years (1990) and a full time series to 2010 (the latest year) for its protocol pollutants (NOx, SO_2, NMVOC, NH_3, PM, HMs and POPs) in the NFR09 format. The EU has also submitted a detailed IIR.

13.   Emissions are reported in NFR09 categories; however, the notation keys NE and NR are used where Member States have not reported information or where data is not required to be provided. Transport emissions are based on a mixture of fuel sold and fuel used.

14.   The EU inventory is considered to be of a reasonable quality, but not comparable to an inventory that uses Tier 2 or higher methodologies for key categories, and Tier 1 methodologies for all other sources. The majority of the emission estimates that are reported from the MS and hence used in the EU inventory are considered to be of good quality. However, the act of combining estimates from the MS means that the issues reflect on the EU inventory. Common issues identified in the EU inventory include the following:

- There are examples where the gap filling procedures do not generate emission estimates which are considered to be a good representation of the emissions from the source;
- Emission estimates in the EU inventory which appear to be outliers are not sufficiently explained in the IIR;
- Tier 1 methods have been used by the MS for estimating emissions for key categories.

The IIR has been substantially improved, and the structure and content are generally in line with best practice.

KEY CATEGORIES

15.   The EU has compiled and presented in its IIR a Key Source Category Analysis for the following pollutants: NOx, CO, NMVOC, SOx, NH_3, TSP, PM_{10} and $PM_{2.5}$, heavy metals and POPs. The assessment is performed for 2010 for all pollutants. Due to the EU inventory being reliant on individual Member State's inventories, the KCA presented in the IIR is not a key driving force for improvements to the inventory; rather, can be used as a tool to indicate the sectors where the EU needs to encourage MS to improve their inventories.

QUALITY

The EU inventory is compiled from national emissions inventories, and this makes it unique in its nature. So it is important to consider the different quality criteria in this context, and include a realistic assessment of whether improvements can be made, and whether it is practical.

Quality Criteria	Comment on the level in the EU Inventory	Comment on whether improvements are relevant or practical
Transparency	Inevitably, the EU inventory is not described in as much detail as that of a national emissions inventory.	It is not practical to compile the EU inventory to the same detailed level as national inventories. So a balance needs to be struck between summary and detailed information.
Completeness	There are substantial shortcomings associated with completeness in some parts of the inventory.	This is an area where improvement is practical/possible.
Consistency	MS use different approaches/methodologies, so the level of internal consistency is not good.	It is not important to improve the consistency (as long as the MS use methods that are in line with good practice).
Comparability	The inventory is reported in NFR09.	No improvements required.
Accuracy	The levels of accuracy are currently influenced most by completeness.	See completeness.

Transparency

16.   The ERT recognises the level of effort undertaken by the EU in collating information from the Member States. The EU's IIR is generally detailed and well presented. However, the IIR could be improved by providing further clarity on the largest sources included and not included in particular sectors. More detail is provided in the individual sector chapters (Part B) of this report.

17.   The EU data submission uses the following notation keys: NE (where emissions are "Not Estimated") and NR (where emissions are "Not Relevant") for reporting where estimates are not available or necessary. However, this does not always provide a true reflection of the status. The ERT recognises the challenges associated with reporting aggregated data that contains notation keys, but recommends that improvements are made to the way in which notation keys are handled by the QA/QC process. Specific examples are given in the chapters of Part B (see paragraphs 47, 77, 114, 118, and 135).

18.   Recalculations were undertaken for all pollutants. In some cases the rationale behind the reasons for the recalculations is not provided due to this information not

being available from the individual Member States. The ERT therefore encourages the EU to request this information from MS in subsequent years, to encourage provision of more complete information from the MS to the EU for inclusion in the IIRs. There are many different approaches that the EU might use to promote more complete reporting from MS, including initiatives above and beyond current measures.

19.   Individual MS are required to have QA/QC processes in place. The EEA (through the ETC – ACM), however, also undertake their own QA/QC analysis of the data. Should any clarifications be needed or inconsistencies be detected, MS are contacted and asked for further information. Data gaps are gap-filled and compiled into an EU inventory. The ERT recommends that further information is provided in future IIRs on the exact QA/QC procedures that are undertaken.

20.   Despite the EU having their own QA/QC procedures in place, it appears that there are errors in the final dataset. There are examples of numerical data being incorrectly entered by MS into the wrong column in the NFR tables (where the source / pollutant combination should be reported as 'NA'). This has not been detected by the existing QA/QC procedures (an example is detailed in the agriculture chapter). It is therefore recommended that the existing QA/QC routines are reviewed and improved to capture these types of issues.

Completeness

21.   The ERT recognises the effort to which the EU has gone to provide estimates of emissions for all sub-sectors and all pollutants reviewed.

22.   Significant improvements have been made to the completeness of the EU's inventory since the previous publication. Whilst not all of the individual MS inventories were complete, gap filling has been undertaken to reduce the number of missing values. However, a number of data gaps still remain in the data provided by the Member States, particularly for years prior to 1990. Examples include:
- Activity data is only reported by 17 MS for 1990 to 2010, making it impossible to report data that is sufficiently accurate .
- Two MS reported inventories only for 2010 and some other countries did not report emissions for all pollutants.

23.   Improving the completeness of reporting from the MS is considered to be the highest priority in improving the quality of the EU inventory. Currently, the EU primarily relies on the improvement plans in the individual MS. The ERT encourages the EU to develop the EU level inventory improvement programme, which should include actions at the EU level to target improvements of the completeness of reporting from the MS. It may be that more complete reporting from the MS to the EU can only be achieved by the introduction of more binding/stringent requirements. Alternatively, the EU might consider adding emission estimates based on proxies, to address data gaps.

Consistency, including recalculations and time-series

24.   The EU inventory uses the notation keys provided by the individual Member States and whilst queries may be sent to the MS, if no response is received, then no modifications are made (even if the notation key is thought to be erroneous). The ERT encourages the EU to review the current procedures of handling notation keys. It may be more appropriate to amend notation keys when they are considered to be erroneous and no information is forthcoming from the relevant MS. Furthermore, the notation key "NE" is treated as a zero entry when summing emissions from MS. The ERT considers this to give rise to potential underestimations. More detailed comments are included in paragraphs 47, 77, 114, 118, and 135.

25.   There are a number of sectors for which the time series is not consistent due to incomplete reporting by Member States. Comments on improving the completeness of reporting from MS are made above in paragraphs 21-23.

Comparability

26.   The ERT notes that the inventory of the EU is comparable with those of other reporting parties. The allocation of source categories follows that of the EMEP/UNECE Reporting Guidelines. The ERT encourages the EU to continue with this approach to national inventory calculation.

CLRTAP/NECD comparability

27.   No comparison has been made of the data presented in the IIR (which provides information for the EU-27) with that required under the National Emission Ceilings Directive (which covers the EU-15) as this data was not directly available.

Accuracy and uncertainties

28.   The EU has not compiled uncertainty estimates for its UNECE submission. The EU explained that this is because uncertainty estimates were not available from all individual MS; only 7 MS undertake this type of analysis. However, the ERT reminds the EU that it is good practice to compile an uncertainty analysis, and that this may be achieved by using complete datasets, or by using procedures such as gap filling and expert judgement to address data gaps. Hence, recognising the value of an uncertainty analysis, the ERT strongly encourages the EU to produce an uncertainty analysis for the emissions inventory. The ERT considers that it is for the EU to decide whether this is achieved by encouraging the MS to provide improved supporting information (ideally in the form of uncertainty analyses), or by the addition of expert judgement and possibly proxy data.

29.   The EU inventory for road transport is based on a mixture of fuel sold and fuel used, depending on what MS choose to report. This may lead to inaccuracies in the dataset and potential double-counting. The ERT recognises the challenges associated with aligning the reports from all MS, but recommends that consideration is given to reporting emissions data on a consistent basis. It may be that this approach is simply considered to be impractical (either due to a lack of available data, or excessive working time requirements). However, the ERT recommends that this assessment of practicality is included in the IIR.

Verification and quality assurance/quality control approaches

30. The ERT commends the EU on its general quality assurance/quality control (QA/QC) activities that it undertakes on MS' data. However, the ERT encourages the EU to include more detailed information in subsequent IIRs.

FOLLOW-UP TO PREVIOUS REVIEWS

31. No previous Stage 3 reviews have been undertaken of the EU inventory.

AREAS FOR IMPROVEMENT IDENTIFIED BY THE EU

32. The ERT recognises the support provided by the EU to the Stage 3 review process, which is a key activity in helping to improve the emission estimates of the MS, and also the funding that is provided to support the EMEP/EEA Emissions Inventory Guidebook.

33. However, the ERT notes that the Stage 3 reviews of MS inventories do not provide a comprehensive review of all input data for the EU inventory on an annual basis, to allow a prioritised list of improvement actions to be compiled annually. Neither does the Stage 3 review (as it is currently structured) ensure that recommendations are acted upon in a timely fashion (countries are scheduled to be reviewed every 5 years). Some quality checks are made on the MS data when the EU inventory is compiled, and gap filling is also undertaken. But these procedures are not particularly effective in driving the continuous improvement of the quality of the data provided by the MS.

34. The IIR has identified several areas for improvement. However, the majority of the items identified are statements acknowledging that a particular issue exists, and there is no clear annual improvement plan that explains how the issue will be addressed or even solved. Items which do call for specific actions include:
- Further improvements to the gap-filling procedure.
- An assessment of outliers found in MS submissions in order to improve the accuracy of the EU inventory.
- A further review of the sectoral methods supplied by MS will be undertaken.

35. The ERT therefore recommends that the EU assess, on an annual basis, the data that is provided by the MS, and compile a prioritised list of improvements. Each of these improvements should be accompanied by an action to ensure that the improvement can be delivered to a specified timescale.

PART B: RECOMMENDATIONS FOR IMPROVEMENTS TO THE PARTY

CROSS-CUTTING IMPROVEMENTS IDENTIFIED BY THE ERT

36.   The ERT identifies the following cross-cutting issues for improvement:

37.   The IIR could be improved by providing more detailed information on the sources which are included/not included in particular sectors. More information is provided in the sector chapters of this report.

38.   The ERT also recommends that more detailed information is provided in the IIR on the QA/QC procedures that are used to process the data from the MS.

39.   The ERT encourages the EU to request information on recalculations from MS in subsequent years, so that more complete information on this topic can be included in the IIRs.

40.   The ERT recognises the activities supported and funded by the EU in helping to promote the delivery of improvements to the MS emission inventories (for example the support of the Stage 3 Review process and the EMEP/EEA Emissions Inventory Guidebook, and occasional projects that review the quality of MS reporting, or progress being made). However, the ERT makes the following points:

- It is good practice to secure data provision from data providers: This is achieved well by the EU through current reporting requirements.

- It is good practice to review the quality of the input data: This is achieved in the EU inventory by undertaking several types of data assessment annually. The ERT is of the opinion that datasets provided by some of the MS are not of sufficient quality.

- It is good practice to use this assessment to annually identify a list of prioritised improvements, and take action to ensure that these improvements are delivered in time for the next submission: The EU currently supports several improvement initiatives, and holds a meeting with MS where improvements are discussed. However, as far as the ERT could tell from the IIR, the EU does not annually target specific datasets at the individual MS and sector level for improvement. Neither does the EU, as far as the ERT could tell from the IIR, routinely check on an annual basis whether improvement recommendations are followed through by MS or not (the Stage 3 review process typically provides a check every five years). As a result, the EU is not well placed to ensure that prioritised improvement actions are identified and undertaken in time for the next submission.

41.   Therefore, the ERT strongly recommends that MS data are assessed by the EU (at the individual sector level) on an annual basis, and that a prioritised list of improvements is compiled, with the associated actions required to deliver these

improvements before the next inventory submission. The ERT also strongly recommends that the EU considers new initiatives that will ensure that the identified improvement actions are delivered (typically by the MS) before the next inventory submission. All of this information should be presented in the IIR as the annual improvement programme, and it should be identified whether improvement initiatives have been successful, and future plans for delivering further improvements should be included. The ERT recognises that careful planning will need to take place for any changes associated with driving the improvement of the EU inventory, but the ERT considers this to be the most important initiative for delivering on-going improvement to the quality of the EU inventory. The ERT suggests that the EU first target the improvement of the completeness of reporting from selected MS.

42. The ERT acknowledges that it is not straightforward to aggregate data that is a mixture of data and notation keys; however, it is recommended that the current QA/QC systems for handling and processing notation keys are reviewed and improved. Specific actions are identified in the chapters of Part B (see paragraphs 47, 77, 114, 118, and 135).

43. The ERT strongly encourages the EU to produce an uncertainty analysis for the inventory, and comments are included in paragraph 28. The ERT recognises that this may require a considerable amount of expert judgement and a number of assumptions to be made. However, the ERT considers that a complete uncertainty analysis for each pollutant would provide important information for planning improvements to the EU inventory.

SECTOR SPECIFIC RECOMMENDATIONS FOR IMPROVEMENTS IDENTIFIED BY ERT

ENERGY

Review Scope

Pollutants Reviewed		SO_2, NOx, NMVOC, NH_3, PM_{10} & $PM_{2.5}$, POPs, HM		
Years		1990 – 2006 + (Protocol Years)		
NFR Code	**CRF_NFR Name**	**Reviewed**	**Not Reviewed**	**Recommendation Provided**
1.A.1.a	public electricity and heat production	X		X
1.A.1.b	petroleum refining	X		
1.A.1.c	Manufacture of solid fuels and other energy industries	X		X
1.A.2.a	iron and steel	X		X
1.A.2.b	non-ferrous metals	X		
1.A.2.c	chemicals	X		
1.A.2.d	pulp, paper and print	X		
1.A.2.e	food processing, beverages and tobacco	X		X
1.A.2.f.i	Stationary Combustion in Manufacturing Industries and Construction: Other (Please specify in your IIR)	X		
1.A.2.f.ii	Mobile Combustion in Manufacturing Industries and Construction: (Please specify in your IIR)	X		
1 A 3 e	Pipeline compressors ?		X	
1.A.4.a.i	commercial / institutional: stationary	X		
1.A.4.a.ii	commercial / institutional: mobile ?	X		
1.A.4.b.i	residential plants	X		X
1.A.4.b.ii	household and gardening (mobile)	X		
1.A.4.c.i	Agriculture/forestry/fishing. stationary	X		X
1.A.4.c.ii	off-road vehicles and other machinery?	X		
1.A.4.c.iii	national fishing?	X		
1.A.5.a	other, stationary (including military)	X		
1.A.5.b	other, mobile (including military, land based and recreational boats)?	X		
1.B.1.a	coal mining and handling	X		
1.B.1.b	solid fuel transformation	X		
1.B.1.c	other fugitive emissions from solid fuels)	X		X
1 B 2 a i	Exploration, production, transport	X		X
1 B 2 a iv	Refining / storage	X		
1 B 2 a v	Distribution of oil products	X		
1 B 2 b	Natural gas	X		
1 B 2 c	Venting and flaring	X		
1 B 3	Other fugitive emissions from geothermal energy production , peat and other energy extraction not included in 1 B 2	X		X
Note: Where a sector has been partially reviewed (e.g. some of the NFR codes) please indicate which codes have been reviewed and which have not in the respective columns.				

General recommendations on cross-cutting issues.

Transparency:

44. As reported in Annex D of the IIR submitted by the EU, the gap-filling procedure has been applied for the energy sector for different years. The ERT commends the EU for the transparent reporting of the outcome from the gap-filling procedure in Annex D of the IIR.

45. The IIR includes explanations of methods and the data used by Member States for calculating emissions from the energy sector. The ERT commends the EU for including this level of detail in the IIR.

46. The ERT has noted that not all sub-sector jumps and dips are explained in the IIR. These features in the data are often caused by contributions from only one MS. The ERT understands the difficulties associated with explaining all of the dips and jumps at a detailed level with an inventory that is a sum of MS inventories. However, the ERT encourages the EU to explain the largest variations in trend, at least for the key categories.

Completeness:

47. The ERT has noted that the completeness of the reported emissions depends on the completeness of reporting from the MS. To improve completeness the EU has established a gap-filling procedure. The ERT commends the EU for this initiative. However, the ERT has noted that the notation keys NO, NA and NE reported by MS are treated as "0" for calculating the total emissions of the EU, without ensuring the correct use of NA and NO, and that no assessment of underestimations has been performed by the MS. Moreover, MS sometimes report data where no emission is expected (for example: dioxin emissions in 1B1a. The ERT considers the gap filling methodology therefore to give rise to a potential underestimation, and recommends that the EU undertake the following steps to address this:

- Review the use of NO and NA by the MS, in order to ensure correct use of these notation keys, and avoid a possible underestimation of emissions;

- Review the use of NE by MS, and, where necessary, perform proxy estimates (using simple Tier 1 methods and drivers like population data), in cooperation with the MS.

The ERT encourages the EU to report this information in future IIRs.

Consistency including recalculation and time series:

48. The ERT has noted that there are some problems with the consistency of the EU emissions dataset, caused by the underlying inconsistency of the individual MS datasets. This inconsistency can be seen in the jumps and dips occurring in the different energy sub-sectors. The ERT understands the difficulties associated with the consistency of an inventory complied from many MS, but encourages the EU to check the consistency of the data sent by the MS, at least for the key categories.

Comparability:

49.   The ERT has noted that different methods are used by the MS to select EFs and to compile the activity data. The EU reports the methods used by each of the MS in the IIR, and the ERT commends the EU on providing this information. However, the EU does not report activity data (notation key "NR" is used) because not enough MS report activity data in a consistent way. As a result, IEFs cannot be calculated and compared to data from other parties. The ERT encourages the EU to obtain activity data from each MS, to allow complete reporting.

Accuracy and uncertainties:

50.   The EU explains in the IIR that it is not possible to calculate uncertainties, because an uncertainty analysis is not provided by all MS. There are alternative approaches which can be used to estimate uncertainty. Whilst these may require a number of assumptions to be made, the information that would be provided on uncertainties would prove to be valuable. So the ERT encourages the EU to develop a methodology which allows the estimation of uncertainties to improve the transparency of inventory uncertainties. This would also allow the EU to target improvement activities in particular sectors, pollutants or MS.

Improvement:

51.   The ERT commends EU for its efforts for improvement of the 2012 submission concerning the transparency, consistency and completeness of reporting on the energy sector (e.g. reporting of methodologies applied per MS, gap-filling procedure, etc.). The ERT encourages the EU to continue with, and further develop, these activities in future submissions.

Sub-sector Specific Recommendations.

52.   The ERT has identified many problems with the trends in time series and with data consistency in the different sub-sectors fo the energy sector and pollutants. Some examples are presented below. As an over-arching action, the ERT recommends that the EU checks data in more detail, and then requests the relevant MS to provide supporting information and explanations of sufficient quality. .

Category issue 1: 1.A.4.b.i – NOx, SOx & Pb / 1.A.1.A – SOx / 1.A.4.c.i – SOx, NMVOC & Pb

53.   The ERT has noted that the trends of the pollutant emissions have dips and jumps in the time series. The EU replied to ERT questions on this topic, and indicated that the dips and jumps are due to the gap-filling procedures and the fact that Poland reports inconsistent data across the time series (data in some years, and notation keys in others). The ERT encourages the EU to check the data from Poland, to include an explanation in the IIR, and also to try to develop the gap filling procedures to avoid similar issues in future data submissions.

Category issue 2: 1.A.1.c Hg / 1.A HCB / 1.A.2.a SOx / 1.A.2.e & 1.B.1.c NMVOC / 1.A.4.c.i & 1.B.1.c - NH3 / 1.B.2.a.i & 1.B.3 - TSP

54.   The ERT has noted that the trends of pollutants emissions have dips and jumps. The EU provided an explanation, indicating that these are due to data from

different MS depending on the pollutant. The explanations include: use of notation keys, the result of gap-filling procedures, mistakes in units etc. The EU could not always provide explanations for all issues, as some MS do not provide an IIR. The ERT encourages the EU to check the data in more detail, and to request MS to provide explanations for dips and jumps in the time series.

Category issue 3: 1A1a, 1A1c, 1A2fi, 1A4ai, 1A4bi, 1B1b – TSP

55.   The ERT has noted that the ratio of TSP emissions to PM10 and PM2.5 emissions for the years 1990 to 1994 is much higher than for years after 1995 (see chart below as an example of 1A1a). The ERT found that this was caused by data from Germany. The ERT recommends that the EU include the ratio of TSP to PM10 and PM2.5 as a check on the data submitted by the MS, and and that it request the MS to provide explanations for unusual features in the data. This should improve time series consistency between these pollutants.
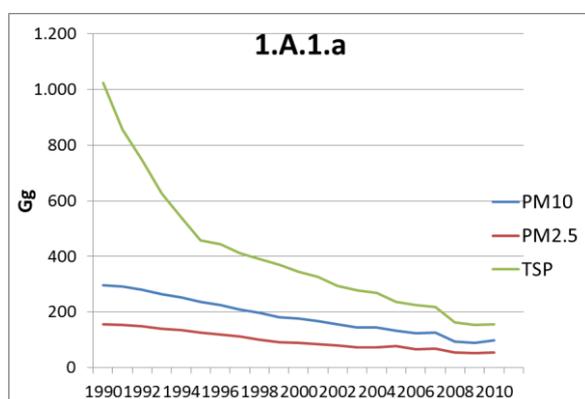
TRANSPORT

Review Scope

Pollutants Reviewed		SO$_2$, NOx, NMVOC, NH$_3$, PM$_{10}$ & PM$_{2.5}$, POP's, HM		
Years		1990 – 2010 + (Protocol Years)		
NFR Code	**CRF_NFR Name**	**Reviewed**	**Not Reviewed**	**Recommendation Provided**
1.A.3.a.i.(i)	international aviation (LTO)	X		X
1.A.3.a.i.(ii)	international aviation (cruise)	X		X
1.A.3.a.ii.(i)	civil aviation (domestic, LTO)	X		X
1.A.3.a.ii.(ii)	civil aviation (domestic, cruise)	X		X
1.A.3.b.i	road transport, passenger cars	X		X
1.A.3.b.ii	road transport, light duty vehicles	X		X
1.A.3.b.iii	road transport, heavy duty vehicles	X		X
1.A.3.b.iv	road transport, mopeds & motorcycles	X		X
1.A.3.b.v	road transport, gasoline evaporation	X		X
1.A.3.b.vi	road transport, automobile tyre and brake wear	X		X
1.A.3.b.vii	road transport, automobile road abrasion	X		X
1.A.3.c	railways	X		X
1.A.3.d.i (ii)	international inland navigation	X		X
1.A.3.d.ii	national navigation	X		X
1.A.4.b.ii	household and gardening (mobile)		X	
1.A.4.c	agriculture / forestry / fishing		X	
1.A.4.c.ii	off-road vehicles and other machinery		X	
1.A.4.c.iii	national fishing		X	
1.A.5.b	other, mobile (including military, land based and recreational boats)		X	
1 A 3 d i (i)	International maritime navigation	X		X
1 A 3	Transport (fuel used)		X	
Note: Where a sector has been partially reviewed (e.g. some of the NFR codes) please indicate which codes have been reviewed and which have not in the respective columns.				

General recommendations on cross-cutting issues.

Transparency:

56.   The EU has provided a generally transparent transport sector emissions inventory. However, the transparency of the inventory can be improved by the provision of activity data (none is provided at the EU level due to incomplete reporting from the individual MS). To further improve the transparency of the inventory, the ERT encourages the EU to include more information on sector description, time series of emissions and explanations of trends and activity data.

57.   In the NFR there is no "Additional Info" table, so no information was provided regarding the use of notation keys IE and NE, although information is included in the IIR. The ERT recommends that the EU include this information in the "Additional Info" table for future submissions.

58.   The emissions from international/domestic aviation and shipping are reported as a sum of the emissions from each of the MS. This does not represent emissions divided into those occurring within the EU and those from activities which cross the geographical boundary of the EU. The EU explained that the Guidelines define international emissions as those which start in one country and finish in another. The EU therefore considers that they are in compliance with the Guidelines, and the ERT agrees with this conclusion. However, the ERT considers that improvement is needed for the transparency of reporting. As a minimum, the ERT recommends that explanations and contextual information be included in the IIR. The ERT also notes that data from the NFR tables may be used by users without referring to supporting information in the NFR. So the ERT asks the EU to consider options that would ensure that the data reported in the NFR tables on domestic and international shipping and aviation are provided with supporting information to ensure that they are not used inappropriately by users. One way of achieving this would be to report the data as "NR", and then provide the data with an explanation in the "Additional Info" sheet that is provided with the NFR tables. The ERT also encourages the EU to explore whether it is possible to obtain information (from MS or otherwise) that allows aviation and shipping emissions to be split into activities within the geographical boundary of the EU, and activities that cross the geographical boundary of the EU – although it recognises that the EU are under no obligation to do so.

Completeness:

59.   The ERT considers the transport sector to be as complete and as comprehensive as possible given the available MS data and methodology descriptions. However, the ERT recommends that improvements are made to completeness, by requesting MS to provide emissions with complete and consistent time series.

Consistency including recalculation and time series:

60.   The EU has recalculated its inventory for almost all sectors between the two last submissions. The IIR includes explanations for all of the major revisions, and the ERT commends the EU on including this information.

Comparability:

61.   The EU did not provide any activity data with their data submission. It is therefore not possible to calculate EU-specific IEFs for comparison with other countries. The ERT recognises the challenges associated with compiling activity data from enough MS to provide suitably complete and accurate data. However, the ERT recommends that the EU strives to obtain activity data from MS to allow IEFs to be determined and therefore comparability studies to be undertaken.

Accuracy and uncertainties:

62.   The ERT understands the difficulties in obtaining uncertainty analyses from MS, but also recognises the important role that an uncertainty analysis has in providing the context for emission estimates and helping to prioritise efforts to improve the emissions inventory. As it is not possible to combine the uncertainty

analyses from all MS, the ERT recommends that the EU investigate alternative techniques for making uncertainty estimates for the emissions inventory.

63.   The EU has provided information on the QA/QC checks that are undertaken in order to identify and explain the many dips and jumps in the time series. However, the ERT encourages the EU to implement sector-specific QA/QC procedures that investigate the data in more detail, and allow a more thorough explanation of the observed dips and jumps.

Improvement:

Sub-sector Specific Recommendations.

64.   The ERT identified many problems with trends in the time series and with data consistency in the different categories and pollutants. Some examples are included below. The over-arching recommendation from the ERT is that the EU checks the data in more detail, in order to explain the observed dip and jumps in the dataset.

Category issue 1: 1.A.3.a.ii(i) : Civil aviation (Domestic, LTO) - NOx, SOx, PM10, Cd, Hg, Cr, Cu, Ni, Zn, PCD/PCDF, BaP, Bbf, BkF, IndPy, PAH, HCB, PCB

65.   The ERT has noted that the trends of the pollutant emissions have dips and jumps. The EU has explained that this arises from the data submitted by individual MS (the MS varies by pollutant). The explanations are various: NA, NE notation keys used in parts of the time series, no IIR submitted, different approaches used, etc. The EU could not always provide an explanation. The ERT encourages EU to check the emissions data in more detail, and request MS to provide explanations of dips and jumps in the emissions data.

Category issue 2: 1.A.3.a.i(i): International aviation (LTO) – Zn, BaP, BbF, BkF, PAH, HCB

66.   See comment under Category 1.

Category issue 3: All 1.A.3.b: Road transport - PM10, PM2.5, TSP, Cd, Hg, Ni, BaP, BbF, BkF, IndPy, PAH, PCB

67.   See comment under Category 1.

Category issue 4: 1.A.3.c: Railways – SOx, PCDD/PCDF, BaP, BbF, PCB

68.   See comment under Category 1.

Category issue 5: 1.A.3.d.i(ii): International inland waterways – SOx, Pb, Hg, As, PCDD/PCDF, BaP, BbF, BkF, IndPy, PAH

69.   See comment under Category 1.

Category issue 6: 1.A.3.d.ii: National navigation (Shipping) – Cd, Hg, As, Cu, PAH

70.   See comment under Category 1.

Category issue 7: 1 A 3 a ii (i) Civil Aviation (Domestic, LTO), 1 A 3 a ii (ii) Civil Aviation (Domestic, Cruise), 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 – All pollutants

71.   The EU inventory is compiled by summing the different national emission inventories. As a result, the emissions reported as "domestic" do not represent emissions from all sources starting and finishing within the EU (emissions associated with aviation and shipping that start and finish in different EU countries are assigned to international). The ERT recognises that this approach is in agreement with the Guidelines. However, the ERT recommends that some changes are made. These are detailed in paragraph 58.

INDUSTRIAL PROCESSES

Review Scope

		All pollutants		
Pollutants Reviewed				
Years		1990-2010		
NFR Code	**CRF_NFR Name**	**Reviewed**	**Not Reviewed**	**Recommendation Provided**
2.A.1	Cement production	x		x
2.A.2	Lime production	x		x
2.A.3	Limestone and dolomite use	x		x
2.A.4	Soda ash production and use	x		x
2.A.5	Asphalt roofing	x		x
2.A.6	road paving with asphalt	x		x
2.A.7.a	Quarrying and mining of minerals other than coal	x		x
2.A.7.b	Construction and demolition	x		x
2.A.7.c	Storage, handling and transport of mineral products	x		x
2.A.7.d	Other Mineral products (Please specify the sources included/excluded in the notes column to the right)	x		x
2.B.1	Ammonia production	x		x
2.B.2	Nitric acid production	x		x
2.B.3	Adipic acid production	x		x
2.B.4	Carbide production	x		x
2.B.5.a	Other chemical industry (Please specify the sources included/excluded in the notes column to the right)	x		x
2.B.5.b	Storage, handling and transport of chemical products (Please specify the sources included/excluded in the notes column to the right	x		x
2.C.1	Iron and steel production	x		x
2.C.2	Ferroalloys production	x		x
2.C.3	Aluminium production	x		x
2.C.5.a	Copper Production	x		x
2.C.5.b	Lead Production	x		x
2.C.5.c	Nickel Production	x		x
2.C.5.d	Zinc Production	x		x
2.C.5.e	Other metal production (Please specify the sources included/excluded in the notes column to the right)	x		x
2.C.5.f	Storage, handling and transport of metal products (Please specify the sources included/excluded in the notes column to the right)	x		x
2.D.1	Pulp and paper	x		x
2.D.2	Food and drink	x		x
2.D.3	Wood processing	x		x
2.E	Production of POPs	x		x
2.F	Consumption of HM and POPs (e,g. Electrical and scientific equipment)	x		x
2.G	Other production, consumption, storage, transportation or handling of bulk products (Please specify the sources included/excluded in the notes	x		x

	column to the right)			
Note: Where a sector has been partially reviewed (e.g. some of the NFR codes) please indicate which codes have been reviewed and which have not in the respective columns.				

General recommendations on cross-cutting issues

Transparency:

72.   The European Union has provided an IIR with information on general emission trends and some observations on the development of emissions. The IIR also includes a good overview of the methods used in the different Member States to estimate emissions. The ERT commends the EU for providing this information.

73.   The documentation related to the industrial sources inventory is rather limited, and as a result the ERT found it challenging to evaluate the quality of the reported data. The ERT therefore recommends that the EU improves the descriptions in the IIR regarding which industrial activities are included in the EU inventory. Additional information, such as statistical data available from other sources would enable a better evaluation of the level and development of emissions over time. This kind of supporting information might include, for instance, MS industrial production statistics in the different EU Member State groupings (EU12, EU15, EU27) as well as comparisons between the development of activities and emissions over the time series.

Completeness:

74.   The ERT considers it likely that not all of the industrial sources in the MS are included in the emissions inventory. To improve the comprehensiveness of the industrial sector inventory, the ERT recommends that the EU perform completeness checks based on information from other sources. For example, a comparison of reported data with statistical information from Eurostat or European Industrial Associations should provide an insight into the levels of completeness.

75.   The ERT further recommends that the EU perform completeness checks by comparing emissions reported by the countries for specific source sectors. To do this properly, identification of the industrial activities in the Member States is necessary (as explained above). In particular, the ERT considers that the emission inventories for industrial heavy metals and persistent organic compounds may be significantly underestimated, due to incomplete reporting from individual MS.

76.   The CLRTAP Reporting Guidelines (ECE/EB.AIR/97, Annex 1 Chapter 1 paragraphs 1 and 2) explain which compounds which should be reported as sulphur oxides (SO_x)[3] and nitrogen dioxide (NO_2)[4]. Based on the information provided, the

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[3] This issue is especially related to certain sulphur compounds originating in industrial processes, such as sulphur trioxide (SO_3), sulphate, sulphuric acid (H_2SO_4) and emissions of non-oxygenated compounds of sulphur (Total Reduced Sulphur compounds, TRS), such as hydrogen sulphide (H_2S), methyl mercaptan (CH_3SH), dimethyl sulphide (C_2H_6S), dimethyl disulphide $(C_2H_6S_2)$, carbon disulphide (CS_2) and carbonyl sulphide (COS), which all should be converted into SO_2 and summed up with the other SO_2 estimates. These emissions originate from certain industrial sources such as kraft pulp mills, certain chemical processes, smelting of non-ferrous ores, steel

ERT considers it very likely that that not all of these compounds are included in the Member States' emission estimates, and are also missing from the EU inventory. The ERT therefore recommends that the EU develops further checks to ensure that compounds which should be included as components of the SO_x and NO_2 emissions are captured in the individual MS emissions inventories.

77.   The EU reports the notation key NE (or zero) for several pollutants, where the ERT considers NA to be more appropriate. The ERT recommends that the EU review the use of the NE notation key, and revise to NA where necessary. In addition, the ERT recommends changes to the gap filling procedures as outlined in paragraph 47.

78.   For all sources that are not estimated, the ERT recommends that the EU provide an explanation in the IIR as to why the emissions are not estimated, and - which is also important – that it include current plans for addressing these shortcomings.

Consistency including recalculation and time series:

79.   The ERT notes that there are dips and jumps in the emission time series. Due to a lack of detailed documentation on the sources and possible reasons for the dips and jumps (e.g. changing activity levels), the ERT has not been able to assess the consistency of the reported emission values. The ERT therefore recommends that the descriptions of the sources are substantially improved in the IIR, and that activity data are also reported. Examples of jumps and dips in the time series are presented in the sectoral chapters below.

80.   The ERT also recommends that the allocation of emissions between the industrial processes and energy sectors is checked, and that MS are encouraged to allocate emissions to the correct reporting categories.

Comparability:

81.   The ERT concludes that the comparability of the EU industry sector emissions depends mostly on the comparability of methods used by the individual Member States. The ERT therefore recommends that the EU develop tools to ensure the comparability of the data between the Member States. The first step would be to ensure that MS are providing enough supporting information with their emissions data (including issues identified by ERT reviews of the MS).

Accuracy and uncertainties:

82.   The ERT notes that the EU has not performed an uncertainty analysis for the EU inventory as a whole, but that it has instead compiled information on uncertainty analysis undertaken by MS. The ERT recommends that the EU perform an

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mills and the manufacture of certain abrasives, and could for some countries contribute to a significant part of national SO_2 emissions. Other non-industrial sources include livestock farming and sewage treatment facilities.

4 For nitrogen oxides (NO_X), compounds to be converted into NO_2 include nitric oxide (NO) and nitrogen trioxide (NO_2).

uncertainty analysis for the EU inventory. This may well require a specific study and an approach that is different to that used by the individual MS. This would allow the EU to assess the current accuracy and reliability of the compiled data and to help identify improvement needs in the inventory.

Improvement:

83.   The EU has not identified areas for improvement in the industrial sector inventory. The ERT recommends that the EU identify and prioritise areas for further improvement based on e.g. aspects identified by the ERT, and issues identified by MS.

Sub-sector Specific Recommendations.

84.   It has not possible for the ERT to evaluate the quality of the emission values reported due to a lack of information on the sources included and the development of the different industrial activities over the years. To do this, emissions would need to be compared with activity data (i.e. comparisons with industrial production statistics). Therefore the review below is based on finding major discrepancies in the reported time series.

Category issue 1: 2A1 Cement production- All Pollutants

85.   A comprehensive set of pollutants have been reported under this source. However, the emission levels for some pollutants appear to be inconsistent (in this case CO, NMVOC and NO_x during 1990-2010). The ERT recommends that the EU check the emission levels for defective or missing data as well as the allocation of emissions between the industry and energy sector reporting categories. The ERT recommends that the EU then liaise with the MS to ensure that emissions are allocated to the correct reporting categories. The ERT also recommends that the EU check completeness of sources included under this sector using e.g. the methods indicated above in the general comments section, and revise incorrect uses of NE and any zero values.

Category issue 1: 2A2 Lime production - All Pollutants

86.   See recommendations in paragraph 75 (completeness), 77 (notation keys), 79 (time series checks and explanations) and 80 (the allocation of emissions to industrial processes vs energy).

Category issue 1: 2A3 Limestone and dolomite use - All Pollutants

87.   Emissions of particles and HCB have been reported for this source. The emission levels of particles during 1990-2010 appear to be inconsistent and the emissions of HCB for 1990-2009 are reported as zero. See recommendations in paragraphs 75 (completeness), 77 (notation keys), 79 (time series checks and explanations) and 80 (the allocation of emissions to industrial processes vs energy).

Category issue 1: 2A4 Soda ash production and use - All Pollutants

88.   A comprehensive set of pollutants has been reported under this source. The emission levels, for example for CO, NH_3 and all particles during 1990-2010, appear

to be inconsistent. See recommendations in paragraph 75 (completeness), 77 (notation keys), 79 (time series checks and explanations) and 80 (the allocation of emissions to industrial processes vs energy).

Category issue 1: 2A5 Asphalt roofing - All Pollutants

89.   A comprehensive set of pollutants has been reported under this source. The emission level, for example for NMVOC, is indeed fluctuating and all particles during 1990-2010 seem to be inconsistent, especially for TSP after 2004. For NO_x and SO_2 small values are reported only for 2007. See recommendations in paragraphs 75 (completeness), 77 (notation keys), 79 (time series checks and explanations) and 80 (the allocation of emissions to industrial processes vs energy).

Category issue 1: 2A6 Road paving with asphalt - All Pollutants

90.   A comprehensive set of pollutants have been reported under this source. However, the emission levels for e.g. CO, NMVOC, NO_x, SO_2 and all particles appear to be inconsistent for the years 1990-2010. See recommendations in paragraphs 75 (completeness), 77 (notation keys), 79 (time series checks and explanations) and 80 (the allocation of emissions to industrial processes vs energy).

Category issue 1: 2A7a Quarrying and mining of minerals other than coal - All Pollutants

91.   A comprehensive set of pollutants has been reported under this source; however, the emission levels for all pollutants appear to be inconsistent over the years 1990-2010. See recommendations in paragraphs 75 (completeness), 77 (notation keys), 79 (time series checks and explanations) and 80 (the allocation of emissions to industrial processes vs energy).

Category issue 1: 2A7b Construction and demolition - All Pollutants

92.   All particle emissions from this source have been reported. The emission levels appear to be slightly inconsistent for the years 1990-2010. See recommendations in paragraphs 75 (completeness), 77 (notation keys), 79 (time series checks and explanations) and 80 (the allocation of emissions to industrial processes vs energy).

Category issue 1: 2A7c Storage, handling and transport of mineral products - All Pollutants

93.   All particle emissions from this source have been reported but the emission levels appear to be inconsistent for the years 1990-2010. See recommendations in paragraphs 75 (completeness), 77 (notation keys), 79 (time series checks and explanations) and 80 (the allocation of emissions to industrial processes vs energy)

Category issue 1: 2A7d Other Mineral products - All Pollutants

94.   A comprehensive set of pollutants has been reported for this source. There are inconsistencies for CO emissions (which have dropped drastically after 2004) and for NH_3 and NO_x (large inconsistencies over the time series since 1990). See recommendations in paragraphs 75 (completeness), 77 (notation keys), 79 (time

series checks and explanations) and 80 (the allocation of emissions to industrial processes vs energy).

Category issue 1: 2B1 Ammonia production - All Pollutants

95.   A comprehensive set of pollutants has been reported for this source. There are inconsistencies for CO emissions (which have dropped drastically after 2004) and with respect to NMVOC for 2010. See recommendations in paragraphs 75 (completeness), 77 (notation keys), 79 (time series checks and explanations) and 80 (the allocation of emissions to industrial processes vs energy).

Category issue 1: 2B2 Nitric acid production - All Pollutants

96.   A comprehensive set of pollutants has been reported for this source. However, there are inconsistencies for CO and particle emissions as regards the completeness of the time series, as well as between the different years for NO_x emissions. See recommendations in paragraphs 75 (completeness), 77 (notation keys), 79 (time series checks and explanations) and 80 (the allocation of emissions to industrial processes vs energy).

Category issue 1: 2B3 Adipic acid production - All Pollutants

97.   A comprehensive set of pollutants has been reported for this source. However, the time series is not consistent and there are some inconsistencies in the emission levels between the different years for CO, NO_x and particle emissions. See recommendations in paragraphs 75 (completeness), 77 (notation keys), 79 (time series checks and explanations) and 80 (the allocation of emissions to industrial processes vs energy).

Category issue 1: 2B4 Carbide production - All Pollutants

98.   A comprehensive set of pollutants has been reported from this source. There are some inconsistencies in the emission levels between the different years and missing estimates for CO, NO_x and particle emissions. See recommendations in paragraphs 75 (completeness), 77 (notation keys), 79 (time series checks and explanations) and 80 (the allocation of emissions to industrial processes vs energy).

Category issue 1: 2B5a Other chemical industry - All Pollutants

99.   A comprehensive set of pollutants has been reported for this source. The emission levels for 2009-2010 are inconsistent with the levels from the previous years for CO, NMVOC, SO_2 and TSP. For $PM_{2.5}$ and PM_{10} particle fractions, NH_3, CO, NMVOC, particles and NO_x there are inconsistencies in the emission levels over the years reported. See recommendations in paragraphs 75 (completeness), 77 (notation keys), 79 (time series checks and explanations) and 80 (the allocation of emissions to industrial processes vs energy).

Category issue 1: 2B5b Storage, handling and transport of chemical products - All Pollutants

100.   A comprehensive set of pollutants has been reported for this source. The emission levels for particles seem to be consistent while the time series of NH_3,

NMVOC are inconsistent and some values are missing for the earlier years. For SO_x and NO_x only 2010 estimates are included. See recommendations in paragraphs 75 (completeness), 77 (notation keys), 79 (time series checks and explanations) and 80 (the allocation of emissions to industrial processes vs energy).

Category issue 1: 2C1 Iron and steel production- All Pollutants

101. A comprehensive set of pollutants has been reported for this source and the emission levels seem to be consistent, taking into account the fluctuation of the industrial process activities over the years. The ERT recommends, however, in order to ensure the quality of the inventory, that more thorough checks are made on the data, as outlined in the general comments section of this chapter.

Category issue 1: 2C2 Ferroalloys production - All Pollutants

102. A comprehensive set of pollutants has been reported for this source. CO, particles and NMVOC emission levels appear to be incomplete or emissions are allocated differently between the years. See recommendations in paragraphs 75 (completeness), 77 (notation keys), 79 (time series checks and explanations) and 80 (the allocation of emissions to industrial processes vs energy).

Category issue 1: 2C3 Aluminium production - All Pollutants

103. A comprehensive set of pollutants has been reported for this source and the emission levels look generally consistent over the years, although the NMVOC emissions for the latest years appear to be incomplete. See recommendations in paragraphs 75 (completeness), 77 (notation keys), 79 (time series checks and explanations) and 80 (the allocation of emissions to industrial processes vs energy).

Category issue 1: 2C5b Lead production - All Pollutants

104. A comprehensive set of pollutants has been reported for this source and the emission levels look generally consistent over the years in the time series. Some emissions are reported only for the latest years e.g. NH_3. See recommendations in paragraphs 75 (completeness), 77 (notation keys), 79 (time series checks and explanations) and 80 (the allocation of emissions to industrial processes vs energy).

Category issue 1: 2C5c Nickel production - All Pollutants

105. A comprehensive set of pollutants has been reported for this source. The emission levels of particles have dropped significantly since 1999 and NH_3 is reported only for 2000-2004 and 2006-2010. See recommendations in paragraphs 75 (completeness), 77 (notation keys), 79 (time series checks and explanations) and 80 (the allocation of emissions to industrial processes vs energy).

Category issue 1: 2C5d Zinc production - All Pollutants

106. A comprehensive set of pollutants has been reported for this source. The emission levels of particles and lead have dropped significantly since 2002 while reporting on CO, NMVOC, NH_3 and other heavy metals over the years is incomplete. See recommendations in paragraphs 75 (completeness), 77 (notation keys), 79 (time

series checks and explanations) and 80 (the allocation of emissions to industrial processes vs energy).

Category issue 1: 2C5f Storage, handling and transport of metal products - All Pollutants

107.   PAH-4, lead and particle emissions are reported for this source. The emission levels of particles have increased significantly after 2007 and for 2010 many other pollutants are included but these emission levels are very low. See recommendations in paragraphs 75 (completeness), 77 (notation keys), 79 (time series checks and explanations) and 80 (the allocation of emissions to industrial processes vs energy).

Category issue 1: 2D1 Pulp and paper - All Pollutants

108.   A comprehensive set of pollutants has been reported for this source. The emission levels of pollutants other than SO_2 (which has decreased by 60%) have remained rather stable since 1990 except for small fluctuations over the years. See recommendations in paragraphs 75 (completeness), 77 (notation keys), 79 (time series checks and explanations) and 80 (the allocation of emissions to industrial processes vs energy).

Category issue 1: 2D2 Food and Drink - All Pollutants

109.   A comprehensive set of pollutants has been reported for this source. It appears that the time series between the TSP and the $PM_{2.5}$ and PM_{10} fractions are inconsistent. See recommendations in paragraphs 75 (completeness), 77 (notation keys), 79 (time series checks and explanations) and 80 (the allocation of emissions to industrial processes vs energy).

Category issue 1: 2D3 Wood processing - All Pollutants

110. $NMVOC$, NO_x, CO, particle and SO_x emissions have been reported for this source since 1990. There are inconsistencies in the time series of the pollutants and there appear to be different allocations of emissions between the energy and industry sector reporting categories over the years. See recommendations in paragraphs 75 (completeness), 77 (notation keys), 79 (time series checks and explanations) and 80 (the allocation of emissions to industrial processes vs energy).

Category issue 1: 2E Production of POPs - All Pollutants

111.   HCB and NMVOC emissions have been reported since 1990 for this source. See recommendations in paragraphs 75 (completeness), 77 (notation keys), 79 (time series checks and explanations) and 80 (the allocation of emissions to industrial processes vs energy).

Category issue 1: 2F Consumption of POPs and heavy metals - All Pollutants

112.   PCDD/F, HCH, mercury, ammonia, NMVOC and PCB emissions have been reported for this source since 1990. The emission levels seem to be consistent over the years. See recommendations in paragraphs 75 (completeness), 77 (notation keys), 79 (time series checks and explanations) and 80 (the allocation of emissions to industrial processes vs energy).

Category issue 1: 2G Consumption of POPs and heavy metals - All Pollutants

113.   A comprehensive set of emissions has been reported for this source since 1990. The emission level of SO_x emissions has dropped significantly after 1999 and there are inconsistencies in the time series of NMVOC emissions over the years. See recommendations in paragraphs 75 (completeness), 77 (notation keys), 79 (time series checks and explanations) and 80 (the allocation of emissions to industrial processes vs energy).

SOLVENTS

Review Scope

NFR Code	CRF_NFR Name	Reviewed	Not Reviewed	Recommendation Provided
Pollutants Reviewed		SO$_2$, NOx, NMVOC, NH$_3$, PM$_{10}$ & PM$_{2.5}$, POPs		
Years		1990 – 2010		
3.A.1	Decorative coating application	X		
3.A.2	Industrial coating application	X		
3.A.3	Other coating application (Please specify the sources included/excluded in the notes column to the right)	X		
3.B.1	Degreasing	X		
3.B.2	Dry cleaning	X		
3.C	Chemical products,	X		
3.D.1	Printing	X		
3.D.2	Domestic solvent use including fungicides	X		
3.D.3	Other product use	X		
Note: Where a sector has been partially reviewed (e.g. some of the NFR codes) please indicate which codes have been reviewed and which have not in the respective columns.				

General recommendations on cross-cutting issues

Completeness:

114.   The ERT has noted that the completeness of the reported emissions is highly dependent on the completeness of reporting from the individual MS. The EU has established a gap-filling procedure, which aims to improve the completeness of the inventory. The ERT commends the EU for this initiative. However, the ERT has noted that the notation keys NO, NA and NE reported by MS are treated as "0" for calculating the total emissions of the EU inventory, without ensuring the correct use of NA and NO, and that no assessment of potential underestimations has been performed. The ERT encourages the EU, at least for the key categories of NMVOC emissions of the solvent sector, to establish the procedures as outlined in paragraph 47.

115.   The ERT noted that the EU reported PAH emissions from NFR 3C NE. PAHs are emitted from Asphalt blowing. In the EMEP/EEA Air Pollutant Emission Inventory Guidebook, there is a simple-to-apply Tier 2 method for estimating these emissions by using asphalt produced as activity data. During the review, the EU indicated that no MS reported any emission values, and that they either report a notation key (NE, NA, NO) or zero. In order to improve completeness of reporting on PAH emissions, the ERT encourages the EU, in collaboration with the MS, to estimate and include these emissions in the next submission.

116.   The EU reported PCDD / PCDF, PAHs, HCB, HCH and PCBs emissions from 3A1, 3D2 and 3D3 source categories. During the review, the EU provided detailed information on the emissions per MS. The ERT noted that for each source category

and pollutant combination the emissions originate from one (or a limited number of) MS, while the remaining MS reported the emissions as NA, NE or NO. The ERT considers it unlikely that an activity which results in POP emissions would take place in only one or a very limited number of MS, and concluded that POP emissions from 3A1, 3D2 and 3D3 may have been underestimated. The ERT recommends that the EU use the information currently reported by MS, and consult with the MS which do not report these emissions. This process should improve the completeness of POP reporting for the above mentioned categories. The ERT encourages EU to report in the next IIR the actions that it will undertake to assess this issue and, if needed, the actions to tackle this possible underestimation in the next IIR.

117. **Transparency**:

118. The ERT has noted that in the NFR tables either data or "NE" have been reported. No "NO" and "NA" notation keys appear. During the review, the EU indicated that if no data values were reported by the MS (i.e. only notation keys were used), then NE was reported. The ERT recognises the difficulties associated with reporting aggregated information that includes notation keys, but encourages the EU to improve the use of notation keys for reporting emissions, so as to better reflect reporting from the MS. Recommendations are made in paragraph 47.

119. As reported in Annex D of the IIR submitted by EU, the gap-filling procedure has been applied for solvents for different years, mainly for NMVOC emissions by using CRF (UNFCCC) data. The ERT commends EU for its transparent reporting on the gap-filling procedure outcomes in Annex D of the IIR.

Accuracy and uncertainties:

120. The EU reported in their IIR that it was not possible to evaluate uncertainty at EU level overall, since only 9 out of 27 MS had reported uncertainty analysis. The ERT acknowledges the challenges associated with estimating uncertainties if not all MS have reported uncertainties. However, it is possible to estimate uncertainties by other means, for example through consultation with MS and expert judgement. The ERT strongly encourages the EU to perform an uncertainty analysis at least for the key categories of the solvents sector, in order to prioritise improvement actions (at the EU level) and to provide a more complete indication of the reliability of the inventory data.

121. The ERT has noted that the gap-filling procedure applied by the EU, mainly to the NMVOC emissions of solvent categories, contributes to the reduction of uncertainty at EU level. The ERT commends the EU for this.

122. The EU has a well-structured QA/QC system in place for ensuring the reliability of the inventory, and the ERT commends EU for this. However, the ERT has noted that no specific QA verification procedures are applied for the solvents sector. The ERT encourages the EU to develop and implement sector specific verification procedures and report accordingly in the next submission. The EU can

exploit reporting / information gathered through the implementation of EU Directives 1999/13/EC, 2004/42/EC, 2010/75/EC and any other directives relevant to NMVOCs emissions from solvents use. Moreover, the EU could also use other verification techniques for the solvents sector, e.g. through estimation and comparison of emissions per capita or GDP across the MS.

Comparability:

123.   The ERT has noted that a variety of methods and EFs are used by MS for estimating emissions from the solvents sector. However, the EU, for the first time (in the 2012 submission), reported on the methods and data used by MS. The ERT commends the EU for this improvement and recognises that providing this information is a starting point for assessing the comparability of methodological choices and data sources used by MS. The ERT encourages the EU to continue to develop this initiative in the next submission.

Consistency including recalculation and time series:

124.   The ERT noted that the EU did not include information in the IIR regarding recalculations in the solvents sector. However, during the review, the EU provided data that detailed recalculations of NMVOC emissions at the individual MS level. The ERT encourages the EU to include information on "significant" recalculations in the IIR (i.e. the recalculations that contribute most to the EU recalculations), the rationale behind them (at MS level), and their impact on the sectoral emission total. This would increase the transparency of reporting.

125.   The ERT identified some jumps and dips, and peculiar steps in the time series of almost all NMVOC emission categories. During the review, the EU provided information about the emissions of MS that dominate each of the source categories of the solvents sector, and which typically are the only cause of these erratic emission trend profiles. However, due to the limited information contained in the IIR of the MS, the EU indicated that they were not able to provide an explanation for all anomalies. The ERT recommends that the EU liaise with the MS whose data cause unusual trends in the EU emissions time series (2-3 MS per source category) and try to explain or solve these possible time-series inconsistency issues. The ERT recommends that the EU report the outcomes of this initiative in the next submission.

Improvement:

126.   The ERT commends the EU for the efforts undertaken to improve the 2012 submission compared to previous years, particularly with regard to transparency, consistency and completeness (in particular the increased methodological detail in the IIR on the individual MS emission estimates and gap-filling procedures). The ERT encourages the EU to continue and develop this work in future submissions.

Agriculture

Review Scope:

NFR Code	CRF_NFR Name	Reviewed	Not Reviewed	Recommendation Provided
Pollutants Reviewed		SO_2, NOx, NMVOC, NH_3, PM_{10} & $PM_{2.5}$		
Years		1990 – 2010 + (Protocol Years)		
4 B 1 a	Cattle dairy	NO_x, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP		
4 B 1 b	Cattle non-dairy	NO_x, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP		
4 B 2	Buffalo	NO_x, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP		
4 B 3	Sheep	NO_x, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP		
4 B 4	Goats	NO_x, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP		
4 B 6	Horses	NO_x, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP		
4 B 7	Mules and asses	NO_x, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP		
4 B 8	Swine	NO_x, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP		
4 B 9 a	Laying hens	NO_x, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP		
4 B 9 b	Broilers	NO_x, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP		
4 B 9 c	Turkeys	NO_x, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP		
4 B 9 d	Other poultry	NO_x, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP		
4 B 13	4 B 13 Other	NO_x, NH_3, $PM_{2.5}$, PM_{10}, TSP		
4 D 1 a	Synthetic N fertilisers	NO_x, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP		
4 D 2 a	Farm-level agricultural operations including storage, handling and transport of agricultural products	NO_x, NH_3, $PM_{2.5}$, PM_{10}, TSP		
4 D 2 b	Off-farm storage, handling and transport of bulk agricultural products	NH_3, $PM_{2.5}$, PM_{10}, TSP		
4 D 2 c	N excretion on pasture range and paddock unspecified	NO_x, NH_3,		
4 F	Field burning of agricultural wastes	All excl. HCH & PCBs		
4 G	Agriculture other(c)	NO_x, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP, CO, Zn, PCDD/PCDF, PAHs, HCB, HCH		
11 A	(11 08 Volcanoes)	SOx		
11 B	Forest fires	NO_x, NMVOC, SOx NH_3, $PM_{2.5}$, PM_{10}, TSP		
Note: Where a sector has been partially reviewed (e.g. some of the NFR codes) please indicate which codes have been reviewed and which have not in the respective columns.				

General recommendations on cross-cutting issues

Transparency:

127.   The EU IIR would benefit from an explanation of the dips and jumps in all air pollutants reported for the agriculture sector and in sector 11b, with a particular focus on the main pollutants. In addition, where there are unique circumstances governing the reporting of a particular pollutant(s) due to specific circumstances in a particular Member State, the ERT suggests that this should be highlighted in the IIR. Some examples of where these issues occur are as follows: HCB emissions from pesticide use in sector 4G are reported only by a number of MS; inclusion of NH_3 emissions from legumes in sector 4G by Austria; estimates of SO_2 from volcanoes reported by Italy in sector 11A.

128.   The Netherlands reports emissions of NO from stable and manure storage under 11C and thus these emissions are reported in this sector by the EU. The ERT identifies this as a misallocation of these emissions and they should be reported in sector 7B. Finland misallocates emissions of HCB from pesticides to 4D1 for the years 1990-2004 instead of 4G. A possible misallocation of emissions also exists for example with the inclusion of emissions from stationary combustion in agriculture in sector 4G in the UK inventory as outlined on page 181 UK IIR 2012; these should be reported under sector 1A4c.

129.   The ERT encourages the EU to review the use of notation keys for pollutant/source category combinations both for the EU inventory and for the MS. There are a number of pollutant/source combinations which do not actually occur. For example, 4D1 is not a source of Indeno (1,2,3-cd) pyrene and therefore the notation key "NA" should be used. But, as a number of MS report "NO" or "NR", the EU reports "NE".

Completeness:

130.   The ERT considers the agriculture sector to be as complete and comprehensive as can be expected from the aggregation of data from 27 MS. However, the ERT encourages the EU to undertake enhanced QA/QC measures in future submissions so that the allocation of emissions to particular source categories such as those identified (see the section on transparency above) are fully understood, relayed to the MS, explained, rectified and highlighted in the IIR.

The ERT notes that activity data for the agriculture sector has not been reported. The ERT understands that activity data is not reported by all 27 MS; however, there are a number of data sources available which could be used, for example FAOSTAT, EUROSTAT. This may be a useful tool which could be used to calculate implied emission factors for sub-sectoral categories in the EU inventory, thus allowing comparison with MS.

WASTE

Review Scope:

		NOx, NMVOC, SOx, NH$_3$, PM$_{10}$, PM$_{2.5}$, TSP, HM, POPs		
Pollutants Reviewed				
Years		1990 – 2010		
NFR Code	**CRF_NFR Name**	**Reviewed**	**Not Reviewed**	**Recommendation Provided**
6.A	solid waste disposal on land	X		X
6.B	waste-water handling	X		X
6 C a	Clinical waste incineration (d)	X		X
6 C b	Industrial waste incineration (d)	X		X
6 C c	Municipal waste incineration (d)	X		X
6 C d	Cremation	X		X
6 C e	Small-scale waste burning	X		X
6.D	other waste (e)	X		X
Note: Where a sector has been partially reviewed (e.g. some of the NFR codes) please indicate which codes have been reviewed and which have not in the respective columns.				

Introduction

131.   As a general observation, the ERT considers that the EU has submitted an incomplete overview of emissions in the EU, and too little inter-country comparison. Consequently, the following recommendations are dominated by those referring to the need for more work on inter-country comparison.

General recommendations on cross-cutting issues

Completeness:

132.   The ERT has noted that the completeness of the reported emissions strongly depends on the input of the Member States (MS). To improve the completeness of the inventory the EU has developed a gap-filling procedure and the ERT compliments the EU for this improvement.

133.   However, the ERT believes that with the current approach it is not possible to prepare an overview of the emissions from the MS with sufficient quality that excludes underestimation. Therefore, the ERT strongly encourages the EU to include important inter-country comparisons (for more details see the sections on comparability and improvements).

Transparency:

134.   The EU explained that the notation keys 'NA' or 'NO' were used as a basis for the gap-filling process. But no information was provided in the IIR on how the notation key "NE" was treated. In response to questions from the ERT, the EU explained that a notation key is never gap-filled with an emission value - i.e. when summing up the individual MS datasets, notation keys are treated as 0. The ERT considers that this method gives rise to a potential for underestimation, and recommends that the EU undertake the steps outlined in paragraph 47.

135.   Annex D of the IIR shows that the gap-filling procedure has also been used for the waste sector for several years. The ERT commends the EU for such transparent reporting. However, as already mentioned, the ERT believes that it is not possible to prepare an overview of emissions from the individual MS of sufficient quality and without underestimations. To avoid underestimations it is important to address emissions which are expected to be present but which are not reported (mostly reported as NE) by MS. For that reason the ERT strongly encourages the EU to introduce important inter-country comparisons into the QA/QC procedures.

136.   The ERT has noted that not all of the jumps and dips in the waste sector have been explained in the IIR. An example is provided in the sub-sector section below.

Accuracy and uncertainties:

137.   The ERT has noted that the EU has performed several QA/QC checks to ensure the reliability of the inventory. There are no sector-specific QA/QC procedures for the waste sector, and the ERT recommends that the EU introduce sector-specific QA/QC checks.

138.   The ERT noted that only 9 of the 27 EU MS reported uncertainty analysis. Therefore it is not possible to evaluate the uncertainty at the overall EU level by combining the information provided. Yet, this is a very good example of a valuable comparison across the different countries that could be undertaken. The ERT encourages the EU to perform a simple uncertainty analysis (which might include the use of expert judgement) so that it will be possible to evaluate the uncertainty at the overall EU level. The ERT also recommends that the EU assist the other 18 EU MS in setting up an uncertainty analysis.

Comparability:

139.   The ERT has noted that the following inter-country comparisons are already included in the EU submission:

-   uncertainty analysis;
-   methods used in Member States;
-   **p**er sector: overview of methods and data used by Member States to calculate emissions.

140.   The ERT has asked the EU whether this information is also available at a more detailed level (for an example, see table below). The EU indicated that this was the first year for which information was provided on methods and data (at an aggregated sectoral level). They also explained that it is very time consuming to collate this information from the MS' IIRs – which is why it is not provided on a more detailed level. However, the EU also indicated that this could be improved by trying to provide this information for key sources for the MS making the largest emission contributions. They concluded that this would be a useful check to see whether the largest contributions to EU key sources were using appropriate tier methods. The ERT agrees with this conclusion, and whilst recognising the additional work required, strongly encourages the EU to include this assessment in the future, and continue to develop the QA/QC procedures.

Table with an example :

Member State (MS)	NFR code	Compound	Key source (Y/N)	AD	EF	Method used
X	6A	NH3	N	National Statistics	Default	T1
X	6B	NH3	Y	National Statistics	Default	T1
X	6Ca	DIOX	Y	Plant Data	Plant-specific	T3
X	6Cb	Pb	Y	Plant Data	Plant-specific	T3
X	6Ce	PM10	Y	National Statistics	Default	T2
Y	6A	etc, …..	…..	…..	…..	…..

Note: This overview also shows which key sources have been used the Tier 1 method.

Consistency including recalculation and time series:

141.   During the review, the EU explained that recalculations are only carried out for the national totals (although - if/when large differences are noted, the MS is asked to provide an explanation). The ERT recognises that undertaking recalculations at an aggregated sectoral level would require an increased effort, but recommends that the EU consider this because it would detect irregularities on a more detailed level.

Improvement:

142.   The ERT commends the EU for its efforts to improve the 2012 submission compared to previous years. But in spite of this improvement (and recognising that it will take more time), the ERT strongly encourages the EU to conduct important inter-country comparisons and include these in future submissions. Examples of inter-country comparisons are: - the use of Tier 1 for (important) key sources (see also Table in the comparability section); - when and how many times the notation key NE has been used; - when country- or plant-specific EFs have been used; - which MS have used similar QA/QC procedures.

Sub-sector Specific Recommendations.

Category issue 1: 6Cb Industrial waste incineration

143.   The ERT has noted that NFR 6Cb is a key source for Pb, and that jumps and dips (after 2003) occur in Figure 3.20 on page 121 of the IIR. In response to questions from the ERT, the EU explained that:

(a)   The increase between 2003 and 2004 was due to Poland, and the further unstable trend was due to Portugal (see excel file). In the Polish IIR no explanation could be found.

(b)   The Portuguese IIR states the following (pp. 8-15): Data from 2004 onwards refer to data collected under the Waste Registry (Mapa Integrado de Registo de Resíduos (MIRR)) on the framework of SIRAPA (APA website *for the communication between APA and environmental stakeholders). Data provided by the different waste operators and industrials on the amounts of*

non-urban waste generated are then statistical treated by the INE (Statistical Institute) in order to extrapolate the information for the scope of each economic branch. Therefore, data from 2004 onwards represent a break from previous years, as data in earlier years were not extrapolated to consider non-responses.

144.   The ERT recommends that the EU includes explanations for all jumps and dips in the key sources of the IIR for future submissions.

List of additional materials provided by the Country during the Review

1. The EU provided responses to all questions raised prior to and during the review:
   - Generalist questions Q1-5
   - Energy questions Q1-17
   - Transport questions Q1-38
   - Industrial Processes questions Q1
   - Solvents questions Q1-9
   - Agriculture questions Q1-2
   - Waste questions Q1-5

2. The EU also provided data files relating to some of the questions raised by the ERT:
   - EU12_LRTAP_EU27_Gap_filled.xls
   - Transport_review_initial questions.xls
   - Solvents_review_initial questions.xls
   - Agriculture_review_initial questions.xls
   - Waste_review_initial questions.xls

3. EU Stage 2 S&A report

4. EU Stage 1 report 2008

5. EU IIR 2008