

Convention on Long-range Transboundary Air Pollution

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*Co-operative programme for monitoring  
and evaluation of the long-range  
transmission of air pollutants in Europe*

TECHNICAL REPORT CEIP  
5/2020

# Methodologies applied to the technical review of emission data 2020

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Technical report CEIP 5/2020

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## EXECUTIVE SUMMARY

Parties to the Convention on Long Range Transboundary Air Pollution (CLRTAP) have to report their air emission inventories in accordance with the latest *UNECE Reporting Guidelines* (UNECE, 2014) and the *EMEP/EEA Inventory Guidebook* (EMEP/EEA, 2016).

In the technical review of national air pollutant emission inventories, Parties' data submissions are checked and assessed in accordance with the review guidelines (UNECE, 2018) with a view to improving the quality of emission data and associated information reported to the LRTAP Convention and the National Emission Ceilings Directive (NECD). The present report provides an overview of the review methods. Details on the review results can be found in the annual CEIP Inventory Review reports<sup>1</sup>.

The Parties are invited to report on their annual air pollutant emission data together with projected national total emissions of main pollutants, activity data and updates regarding data for earlier years. Additional, Informative Inventory Reports (IIRs) should be reported annually. Gridded data and LPS information should be submitted every five years. It is considered good practice to report inventories which are complete, consistent, comparable, and transparent and neither overestimated nor underestimated according to the best judgement.

The review process of the emission inventories is carried out in three stages. At each stage, national experts have the opportunity to clarify issues or provide additional information.

**The stage 1 review** (initial review) consists of automated tests which assess the timeliness, completeness and format of the submitted national inventories. Sectoral data as well as national total emissions are checked within these tests.

**The stage 2 review** (extended review) assesses the recalculations, time series consistency, key category analysis, inventory comparison and comparability of the submitted national inventories. Recalculations are made to determine differences between national total emissions reported in the last and the last but one year. The time series consistency is checked with focus on the consistency of PM<sub>2.5</sub>, PM<sub>10</sub> and BC emissions. Key category analyses are made to assess the most important sources for each country, based on the latest submission. Inventories reported under NECD, LRTAP and UNFCCC are compared and also the share of aggregated sectors for each pollutant is assessed. Instances of dips and jumps in trends in time series of sectoral data and national totals are highlighted. Significant changes of the implied emission factors within time series and/or between Parties were identified. Finally a comparability of emissions per capita and emissions per GDP is performed.

**The Stage 3 review** (in-depth review) is a centralised review of selected inventories checking if inventories are consistent with EMEP/EEA inventory guidebook, complete, consistent over time, properly documented, comparable between the countries and accurate. Annually, approximately ten Parties are reviewed by expert review teams<sup>2</sup> set-up by CEIP based on nominations by countries<sup>3</sup>.

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<sup>1</sup><https://www.ceip.at/review-of-emission-inventories/technical-review-reports>

<sup>2</sup><https://www.ceip.at/review-of-emission-inventories/in-depth-review-of-ae-inventories>

<sup>3</sup>[https://www.ceip.at/fileadmin/inhalte/ceip/3\\_review/0\\_roster\\_2020.pdf](https://www.ceip.at/fileadmin/inhalte/ceip/3_review/0_roster_2020.pdf)

**The review of gridded data and LPS** information comprise a few standard tests. It is checked if sectoral gridded data or point sources for all pollutants/years are reported as requested by the UNECE Reporting Guidelines (UNECE, 2014). Within the tests, the position of the cells/LPS is checked. The grid-sum data are compared with national total emissions reported in the NFR table. Further, a comparison of LPS with E-PRTR facilities is planned for the future.

The officially reported emission data, gap-filled and gridded emission data are made available via the CEIP database (<https://www.ceip.at/webdab-emission-database>).

Review findings are annually published at the CEIP website (<https://www.ceip.at/>) or in the Inventory Review reports.

## 1 INTRODUCTION

The review process of emission data has been developed on the basis of feedback from Parties and from the Task Force on Emission Inventories and Projections (TFEIP) and is seen by Parties as efficient tool for the improvement of their national emission inventories.

**The technical review of national inventories** checks and assesses Parties' data submissions in accordance with methods and procedures for the technical review of air pollutant emission inventories reported under the Convention and its protocols (UNECE, 2018)<sup>4</sup> with a view to improving the quality of emission data and associated information reported to the Convention. The review process over the past years has facilitated the identification of a number of inventory-related issues, and improvements have subsequently been implemented.

### 1.1 Reporting obligations - Scope

Article 8 of 1979 Convention:

„The Contracting Parties, within the framework of the Executive Body referred to in article 10 and bilaterally, shall, in their common interests, exchange available information on:

Data on emissions at periods of time to be agreed upon, of agreed air pollutants, starting with sulphur dioxide, coming from grid-units of agreed size; or on the fluxes of agreed air pollutants, starting with sulphur dioxide, across national borders, at distances and at periods of time to be agreed upon;....”

Parties to the LRTAP Convention are invited to submit<sup>5</sup> air pollutant emission data together with projected national total emissions of air pollutants, activity data, and updates regarding data for earlier years annually to the CEIP or alternatively to post their data on the European Environment Agency's (EEA) Central Data Repository (CDR)<sup>6</sup> and notify the CLRTAP Secretariat thereof in accordance with the UNECE Reporting Guidelines (UNECE, 2014) by submitting a notification form.

The National Emissions Ceilings (NEC) Directive (2016/2284/EU) entered into force on 31 December 2016. Replacing earlier legislation, (Directive 2001/81/EC), the NEC Directive sets 2020 and 2030 emission reduction commitments for five main air pollutants.

The directive introduces a number of reporting requirements for Member States. These are defined in Annex I of the directive and include annual information on emissions of a number of pollutants. (EU, 2016)

Table 1.1 provides an overview of the reporting obligations under under CLRTAP.

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<sup>4</sup> <https://www.ceip.at/review-of-emission-inventories/review-process>

<sup>5</sup> For reportin guidelines see <https://www.ceip.at/reporting-instructions>

<sup>6</sup> [cdr.eionet.europa.eu](http://cdr.eionet.europa.eu)



**Table 1.1: Differences between reporting obligations under LRTAP Convention and the NEC Directive**

	CLRTAP		NECD	
	Reporting	Deadline	Reporting	Deadline
<ul style="list-style-type: none"> <li>• Sulphur (SO<sub>x</sub>)</li> <li>• Nitrogen oxides (NO<sub>x</sub>)</li> <li>• Ammonia (NH<sub>3</sub>)</li> <li>• Non-methane volatile organic compounds (NMVOC)</li> <li>• Carbon monoxide (CO)</li> <li>• Particulate matter (PM<sub>2.5</sub> and PM<sub>10</sub>)</li> <li>• Cadmium (Cd)</li> <li>• Lead (Pb)</li> <li>• Mercury (Hg)</li> <li>• Polycyclic aromatic hydrocarbons (PAHs)</li> <li>• Dioxins and furans (PCDD/F)</li> <li>• Polychlorinated biphenyls (PCBs)</li> <li>• Hexachlorbenzene (HCB)</li> </ul>	Annual reporting; covering all years from 1990 onwards (PMs: covering all years from 2000 onwards)	15 February	Annual reporting; covering all years from 1990 onwards to reporting year minus 2 (PMs: annual reporting; covering all years from 2000 to reporting year minus 2)	15 February
: <ul style="list-style-type: none"> <li>• Black Carbon (BC)</li> <li>• Total suspended particulate matter (TSP)</li> <li>• Arsenic (As)</li> <li>• Chromium (Cr)</li> <li>• Copper (Cu)</li> <li>• Nickel (Ni)</li> <li>• Selenium (Se)</li> <li>• Zinc (Zn)</li> </ul>	Annual reporting covering all years from 1990 onwards (BC: from the earliest year possible)	15 February	Annual reporting from 1990 (2000 for TSP) to reporting year minus 2	15 February
Informative Inventory report (IIR)	Annually	15 March (EU: 30 May)		
Large Point Sources (LPS)	Every four years (from 2017 onwards)	1 May (EU: 15 June)	Every four years for reporting year minus 2 (from 2017 onwards)	1 May
Gridded data	Every four years (from 2017 onwards)	1 May (EU: 15 June)	Every four years for reporting year minus 2 (from 2017 onwards)	1 May
Projections	Every four years (from 2015 onwards)	15 March	Every two years (from 2017 onwards)	15 March

Note: orange fields indicate differences between the two reporting obligations

**A summary of the reporting obligations can be downloaded from the CEIP website<sup>7</sup>.**

Parties to the Convention are requested to report emission inventory data using the nomenclature for reporting (NFR19) templates, any necessary time-series data or revisions to previous data and the IIRs in accordance with the UNECE Reporting Guidelines (UNECE, 2014), as adopted by the EMEP Executive Body at its thirty-second session (Geneva, 9–13 December 2013). As a minimum, data for the base year of the relevant protocol and from the year of entry into force of that protocol to the latest year should be reported. The Guidelines (in English, French and Russian) and their annexes I – VII, including reporting templates, can be accessed from the EMEP-CEIP website: <https://www.ceip.at/reporting-instructions>.

The use of the templates and the notation keys (see Annex B – Notation keys (UNECE, 2014)) is strongly encouraged to allow efficient processing and review of submissions. Submissions should consist of both quantitative and qualitative information. Qualitative data, including a description of methodologies, should be included in the voluntary informative inventory reports (IIR), which should be submitted annually by 15 March. The *European Union* should deliver the emission report by 30 April, and the compilation of the IIRs of the Member States by 30 May.

The European Union (EU) Member States also report their emissions under the **NEC Directive<sup>8</sup>** on national emission ceilings for certain atmospheric pollutants (EC, 2001), and emissions of NO<sub>x</sub>, CO, NMVOCs and SO<sub>2</sub> under the **EU Greenhouse Gas Monitoring Mechanism (EU, 2013)**. This information should also be copied by Member States to the EEA's Eionet Reportnet Central Data Repository (CDR)<sup>9</sup>.

The three reporting obligations differ in the number and type of air pollutants, **the geographical coverage** of Parties and the inclusion of domestic and international aviation and navigation in the national total, but for most Parties the differences are minimal. The CLRTAP and NECD reporting formats are identical, CLRTAP and UNFCCC emission inventories differ slightly in the sector split.

**Table 1.2: Main differences between the reporting obligations under the CLRTAP and the UNFCCC.**

	EU NEC Directive - NFR	LRTAP Convention —NFR (a)	EU-MM/UNFCCC —CRF (b)
Air pollutants	NO <sub>x</sub> , SO <sub>x</sub> , CO, NMVOCs, NH <sub>3</sub> , HMs, POPs, PM	NO <sub>x</sub> , SO <sub>x</sub> , CO, NMVOCs, NH <sub>3</sub> , HMs, POPs, PM	NO <sub>x</sub> , SO <sub>x</sub> , NMVOCs, CO
Domestic aviation (landing and take-off)	Included in national total	Included in national total	Included in national total
Domestic aviation (cruise)	Not included in national total (c)	Not included in national total (c)	Included in national total

<sup>7</sup> [http://www.ceip.at/reporting\\_instructions/](http://www.ceip.at/reporting_instructions/)

<sup>10</sup> Parties who submitted data on time in the previous year receive feedback in a password-protected site. Based on information in the CEIP Inventory review report (EEA/CEIP, 2014), as well as in the country specific review reports, Parties may wish to verify and, if necessary, correct or update previously submitted data, including time-series gaps in their inventories. Emission data, projections and activity data that have been reported earlier under the Convention can be found on EMEP's web-based emission database at: <https://www.ceip.at/webdab-emission-database>

<sup>10</sup> Parties who submitted data on time in the previous year receive feedback in a password-protected site. Based on information in the CEIP Inventory review report (EEA/CEIP, 2014), as well as in the country specific review reports, Parties may wish to verify and, if necessary, correct or update previously submitted data, including time-series gaps in their inventories. Emission data, projections and activity data that have been reported earlier under the Convention can be found on EMEP's web-based emission database at: <https://www.ceip.at/webdab-emission-database>

	EU NEC Directive - NFR	LRTAP Convention —NFR (a)	EU-MM/UNFCCC —CRF (b)
International aviation (landing and take-off)	Included in national total	Included in national total	Not included in national total (c)
International aviation (cruise)	Not included in national total (c)	Not included in national total (c)	Not included in national total (c)
National navigation (domestic shipping)	Included in national total	Included in national total	Included in national total
International inland shipping	Included in national total	Included in national total	Not included in national total (c)
International maritime	Not included in national total (c)	Not included in national total (c)	Not included in national total (c)
Road transport	Emissions calculated based on fuel sold (d)	Emissions calculated based on fuel sold (d)	Emissions calculated based on fuel sold

**Note:**

- (a) 'NFR' denotes 'nomenclature for reporting', a sectoral classification system developed by UNECE/EMEP for reporting air emissions.
- (b) 'CRF' is the sectoral classification system developed by UNFCCC for reporting of greenhouse gases.
- (c) Categories not included in national totals should still be reported by Parties as so-called 'memo items'.
- (d) In addition, Parties may report emission estimates on a fuel consumed basis as a 'memo' item.

Parties are encouraged to review feedback given on previous submissions<sup>10</sup>. Furthermore, Parties are requested to check their submissions for correct formatting, internal consistency and completeness before transmitting them to the CEIP secretariat for reviews. To facilitate this task, the latest update of the electronic data-checking tool, RepDab, was made available to Parties at: <https://www.ceip.at/repdab>.

### 1.1.1 Geographical coverage

According to the definition given in the Protocol on Long-term Financing of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP): "The geographical scope of EMEP means the area within which, coordinated by the international centres of EMEP, monitoring is carried out." This definition has been referred to in all following protocols to the Convention. The new EMEP domain will cover the geographic area between 30oN-82oN latitude and 30oW-90oE longitude.

Under CLRTAP, countries are invited to report data for the EMEP domain Definition of the EMEP domain (Figure 1.1) see section 8.2 or consult the [CEIP website](#).

<sup>10</sup> Parties who submitted data on time in the previous year receive feedback in a password-protected site. Based on information in the CEIP Inventory review report (EEA/CEIP, 2014), as well as in the country specific review reports, Parties may wish to verify and, if necessary, correct or update previously submitted data, including time-series gaps in their inventories. Emission data, projections and activity data that have been reported earlier under the Convention can be found on EMEP's web-based emission database at: <https://www.ceip.at/webdab-emission-database>

**Figure 1.1: EMEP domain**

Under NECD, countries are asked to report data only within the geographical scope of the NEC Directive<sup>11</sup>. Table 1.3 provides information on differences in the geographical coverage between those two reporting obligations.

**Table 1.3: Difference in the geographical coverage between CLRTAP and NECD for selected countries**

Country	CLRTAP	NECD
France	Data excluding emissions from overseas departments	Data excluding emissions from overseas departments
United Kingdom	Data excluding emissions from overseas departments	Data include the whole national territory
Netherlands	Data excluding emissions from overseas departments	Data include the whole national territory
Spain	Data without emissions of Canary Islands	Data excluding emissions of Canary Islands
Portugal	Data including emissions from Azores and Madeira	Data excluding emissions from Azores and Madeira

The extended guidance on reporting of national totals on the CEIP homepage provides further information on the geographical scope.

### 1.1.2 International air and sea traffic<sup>12</sup>

**International Shipping:** Emissions from fuels used by vessels of all flags that are engaged in international water-borne navigation. The international navigation may take place at sea, on inland lakes and waterways and in coastal waters. The definition includes emissions from journeys that depart in one country and arrive in a different country and excludes consumption by fishing vessels.

<sup>12</sup> The below definitions apply to the present Guidelines and are taken from chapters 3.5.1 and 3.6.1 of volume 2 of the IPCC Guidelines (IPCC, 2006).

<sup>12</sup> The below definitions apply to the present Guidelines and are taken from chapters 3.5.1 and 3.6.1 of volume 2 of the IPCC Guidelines (IPCC, 2006).

**International Aviation:** Emissions from flights that depart in one country and arrive in a different country. Include take-offs and landings for these flight stages. Emissions from international military aviation can be included provided that the same definitional distinction is applied.

### 1.1.3 Transparency and Informative Inventory Reports (IIRs)

Transparency means that Parties provide clear documentation (IIR) and report emissions and activity data at a level of disaggregation, which provides sufficient understanding of how the inventory was compiled, assuring it meets good practice requirements.

According to the UNECE Reporting Guidelines (UNECE, 2014) Parties should submit annually Informative Inventory Report (IIR) along with their emission data. The IIRs are to be submitted in one of the working languages of the UNECE (English, French or Russian), and where relevant, Parties are encouraged to submit also an English translation of their reports. For the transparency of inventories, it is essential that information such as reasons for recalculations, new (closed) large emission sources, explanation of trends and the implementation of country-specific methods/data are provided in a transparent manner (see Annex II to the UNECE Reporting Guidelines “Informative Inventory Report”).

Parties are urged to use the template for the recommended structure of IIRs submitted under the CLRTAP as contained in Annex II to the Emission Reporting Guidelines.

The provision of an IIR is essential for an efficient centralised stage 3 review.

### 1.1.4 Reporting of adjusted inventories

Inventories shall be calculated without corrections or normalization relating, for example, to climate variations or trade patterns of electricity. Parties may apply to adjust their emission reduction commitments or inventory data in extraordinary circumstances, as defined in Executive Body decisions 2012/3 and 2012/4 (see ECE/EB.AIR/111/Add.1). A Party applying an adjustment to its inventory for the purpose of comparing total national emissions with emission reduction commitments shall include supporting documentation in its IIR or in a separate report. Parties shall report details of their adjusted aggregated emissions using the appropriate row contained in the main emissions reporting template (annex I), as well as report detailed information by pollutant and sector for each adjustment using the template provided in annex VII to these Guidelines.

Reporting of information on adjusted emissions in no way removes the mandatory requirement for Parties to report unadjusted emissions as laid down in section V, subsections A to D, of these Guidelines.

### 1.1.5 Fuel sold fuel used

For emissions from transport, all Parties should calculate emissions consistent with national energy balances reported to Eurostat or the International Energy Agency. Emissions from road vehicle transport should therefore be calculated on the basis of the fuel sold in the Party concerned. In addition, Parties may voluntarily calculate emissions from road vehicles based on fuel

used or kilometres driven in the geographic area of the Party and report in memo items. The method for the estimate(s) should be clearly specified in the IIR.

## 1.2 Quality parameters of the inventory

Parties shall as a minimum use the methodologies in the latest version of the EMEP/EEA Guidebook, as approved by the Executive Body to estimate emissions and projections for each source category. Parties can use, as an alternative to the EMEP/EEA Guidebook, national or international methodologies that they consider better able to reflect their national situation, provided that the methodologies produce more accurate estimates than the default methods, are scientifically based, are compatible with the EMEP/EEA Guidebook and are documented in their IIRs, as described in annex II to these Guidelines.

Submitted inventories should be in accordance with *EMEP/EEA air pollutant emission inventory guidebook* (EMEP/EEA, 2019). **It is considered good practice to report inventories which are complete, consistent, comparable, and transparent and neither overestimated nor underestimated according to the best judgement.**

*“**Transparency**” means that Parties should provide clear documentation and report a level of disaggregation that sufficiently allows individuals or groups other than the designated emission expert or the compiler of the inventory or projection to understand how the inventory was compiled and assure it meets good practice requirements. The transparency of reporting is fundamental to the effective use, review and continuous improvement of the inventory and projection;*

*“**Consistency**” means that estimates for any different inventory years, gases and source categories are made in such a way that differences in the results between years and source categories reflect real differences in emission estimates. Annual emissions, as far as possible, should be calculated using the same method and data sources for all years, and resultant trends should reflect real fluctuations in emissions and not the changes resulting from methodological differences. Consistency also means that, as far as practicable and appropriate, the same data are reported under different international reporting obligations. For projections, consistency means that a year of the submitted inventory is used as a basis;*

*“**Comparability**” means that the national inventory and projection is reported in such a way that allows it to be compared with other Parties. This can be achieved by using accepted methodologies as elaborated in section V below, by using the reporting templates and through the use of the harmonized Nomenclature for Reporting (NFR), as specified in annex III to these Guidelines;*

*“**Completeness**” means that estimates are reported for all pollutants, all relevant source categories and all years and for the entire territorial areas of Parties covered by the reporting requirements set forth in the provisions of the Convention and its protocols. Where numerical information on emissions under any source category is not provided, the appropriate notation key defined in section II.C of annex I to the Reporting guidelines should be used when filling in the reporting template and their absence should be documented;*

*“**Accuracy**” means that emissions are neither systematically overestimated nor underestimated, as far as can be judged. This implies that Parties will endeavor to remove bias from the inventory estimates and minimize uncertainty;*

Parties are also encouraged to reduce uncertainties of estimates as far as practicable.

## 2 REVIEW PROCESS

### 2.1 Technical review

#### 2.1.1 Review under the LRTAP Convention

At the 38th session of Executive Body (EB) to EMEP (Geneva, December 2018) the document '**Updated methods and procedures for the review of emission inventories**' was adopted (Decision 2018/1) with amendments proposed by EU, US and Canada. This document shall be used for the review of submitted emission inventories from 2019 onwards. **The Appendix on Technical Revisions** provides guidance on the quantification of necessary technical corrections if the data are found to be inconsistent with recommended methodologies of the EMEP/EEA Guidebook or where the emission estimates are not provided for an NFR source category.

**The technical review of national inventories checks and assesses Parties' data submissions with a view to improve the quality of emission data and associated information reported to the Convention.** The technical review is carried out annually by EMEP and the EEA. It is performed in accordance with the *Methods and procedures for the technical review of air pollutant emission inventories* endorsed by the Executive Body of the CLRTAP at its 25<sup>th</sup> session in December 2007 (UNECE, 2007) and in line with the actual work plan of the Convention (UNECE, 2014). In 2017 the *Proposal for updating the 'Methods and procedures' document laying down the process for the EMEP emission inventory review* was tested during the review. Key changes compared to the existing '*methods and procedures*' document (UNECE, 2018) are a significant shortening of text that is no longer relevant, the inclusion of a proposal to increase the frequency of In-depth (Stage 3) reviews for Parties where significant quality issues were identified by the Expert Review Team (ERT) and a proposal to enable the ERT to calculate "technical corrections" where reported data is found to be inconsistent with recommended methodologies of the EMEP/EEA Guidebook or where estimates are not provided for a NFR source category (TFEIP, 2016). The process of determining and calculating Technical Revisions is described in the TFEIP discussion paper *A Process for Technical Revisions During CLRTAP Emissions Inventory Review* (TFEIP, 2017).

The process is carried out in three stages. The technical review of inventories is carried out in the following three stages:

- *initial review (Stage 1)*: An initial check of submissions for timeliness, completeness and formats;
- *extended review (Stage 2)*: A synthesis and assessment of all national submissions with respect to consistency, comparability, KCA, trends and IEFs of data with recommendations for data quality improvement;
- *in-depth reviews (Stage 3)*: In-depth reviews of selected inventories, by pollutant, country or sector, as in the workplan approved by the EMEP Steering Body. Up to ten countries are checked annually by two review teams.

At each stage, national experts have the opportunity to clarify issues or provide additional information. They may also express their views at meetings of the Task Force on Emission Inventories and Projections. **Nominated CEIP contact points** are provided with passwords which allow them

to access the review findings. Parties are requested to respond within four weeks after the notification.

### 2.1.2 Review under the NEC Directive

This section provides information on the review under the NEC Directive<sup>13</sup>. The NEC Directive foresees a review of the national emission inventory data in the first year of reporting and regularly thereafter. This is a separate and independent process financed by the European Commission and not part of the work of CEIP. The scope of the NECD Review is exclusively on the EU Member States. In selected cases the cooperation between the CLRTAP and the NECD review processes is of advantage. In the NEC Directive the following components of the review are listed:

- (a) checks to verify the transparency, accuracy, consistency, comparability and completeness of information submitted;
- (b) checks to identify cases where inventory data is prepared in a manner which is inconsistent with the requirements set out under international law, in particular under the LRTAP Convention;
- (c) where appropriate, calculation of the resulting technical corrections necessary, in consultation with the Member State concerned.

The scope of the NECD Review varies between years (see Table 2.1).

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<sup>14</sup> EEA DataService: [dataservice.eea.europa.eu/dataservice/](https://dataservice.eea.europa.eu/dataservice/)



**Table 2.1: Scope of the NECD review 2017, 2018, 2019 and 2020**

2017	2018	2019	2020
review of main pollutants	follow-up of previous reviews  initiation of an in-depth review of the national emission inventories of the POPs and heavy metals	follow-up of previous reviews  in-depth review of the national emission inventories of the POPs and heavy metals	follow-up of previous reviews  review of gridded data and LPS data
Review of adjustment applications			

The technical review in 2020 comprised the following activities:

- Preparation of review guidelines and a review report template
- Initial checks of the implementation of the recommendations from the NECD Review 2017,2018 and 2020
- Initial checks of the submitted LPS data
- Initial checks of the submitted gridded data
- Up-date of checking tools: These tools highlight data that should be checked by the TERT in detail.
- Comprehensive review: the technical expert review teams (TERT) undertook a detailed review of Member States submissions in two stages:
  - a. Desk review:
  - b. Centralised review (that was held as a remote centralised review in 2020 due to COVID-19 measures)
- Preparation of a Review Report for each Member State
- Preparation of a Final Report

Similar to the review process under the LRTAP Convention, Member States can clarify issues and provide additional information at each stage.

## 2.2 Access to the data and review results

The review assesses emission data (including gridded data and LPS) reported under the CLRTAP to the UNECE Secretariat and emissions reported by EU Member States under the National Emission Ceilings Directive submitted before 31 May.

The information submitted by Parties during the reporting rounds can be accessed from the CEIP webpage: <https://www.ceip.at/status-of-reporting-and-review-results>. In addition, the *officially reported emission data* are made available via the CEIP database on 30 June (<https://www.ceip.at/webdab-emission-database/reported-emissiondata>). *Gap-filled and gridded emission data* for modellers are completed by 16 April and distributed to all EMEP centres. This

data are also made available on the CEIP website on 30 June (<https://www.ceip.at/webdab-emission-database/emissions-as-used-in-emep-models>).

The data reported under the National Ceilings Directive is made available to the public through the EEA's Data Service website<sup>14</sup>. Annual stage 1 *Status reports* (23 March) and stage 2 *Synthesis and assessment reports* (31 May) are posted on the web and national contact points were provided with user names and passwords for on-line access to the data and provision of feedback to CEIP.

Review findings of the Stage 1 and Stage 2 review under CLRTAP and NECD are published at CEIP website: <https://www.ceip.at/status-of-reporting-and-review-results/2020-submissions/>, summaries of findings are annually published in the *Inventory review report* (CEIP, 2020).

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<sup>14</sup> EEA DataService: [dataservice.eea.europa.eu/dataservice/](https://dataservice.eea.europa.eu/dataservice/)

### 3 INITIAL (STAGE I) REVIEW

The stage 1 review performed by CEIP consists of automated tests which assess the *timeliness, completeness and format* of the submitted national inventories. It presents results of these initial automated tests to countries and supports the subsequent Stage II and Stage III review process. Stage 1 tests are:

- Timeliness of reporting
- Format of submission
- Completeness per sector for emissions
- Completeness per pollutant for submitted time series (separately for 1980-1989, 1990-1999, and from 2000 on-going).

Sectoral data as well as national total emissions are checked within these tests.

The results of these initial automated tests are presented online, in the form of individual country *Stage 1 Status reports* annually in March. Parties are invited to provide comments or resubmissions, if applicable, within two weeks.

#### Data included in tests:

- Emissions reported under the Convention on LRTAP.
- Emissions reported under the NEC Directive to the European Commission and European Environment Agency.

#### 3.1 Timeliness

Example of feedback provided to country:

Date of submission of NECD: 10.02.2019, received **within** deadline 15.02.2020

Date of submission of CLRTAP: 15.02.2019, received **within** deadline 15.02.2020

Informative Inventory Report (IIR): Received

#### 3.2 Format

The submissions are checked against the '**NFR19' format** agreed by the EMEP Executive Body (EB) at its 27<sup>th</sup> session and amended taking into account changes to the POPs Protocol.

Parties are invited to submit entire time series in standard format to enable quality control of historical sector emissions, consistency of sectoral trends and a comparison of inventories between the Parties. It is highly recommended that Parties take advantage of consistency control (via RepDab) of their emission data upon submission (<https://www.ceip.at/repdab>) before the submission of their inventory to the UNECE secretariat, the EMEP Centre on Emission Inventories and Projections (CEIP) and/or the European Commission/European Environment Agency.

### 3.3 Completeness

The revised UNECE Reporting Guidelines (UNECE, 2014) ask Parties to submit emissions for 1980 – latest year for Main Pollutants, 1990 – latest year for HMs and POPs, and for 2000 – latest year for PM. It has to be noted that the pollutant-specific CLRTAP Protocols formally request reporting only from Parties which have ratified the Protocol for the Protocol base year, for the year after the entry into force of that Protocol and for subsequent years.

Parties to the Gothenburg Protocol shall report their latest available projections at least every five years, and provide any updated projections annually by 15 February, for the years 2010, 2015, 2020, 2030 and 2050. Parties to the Convention that are not Parties to the Protocol are also strongly encouraged to provide this information.

#### 3.3.1 Example of completeness check results per sector

In the figures below (Figures Figure 3.1 and Figure 3.2) shows for which sectors countries reported 'Not Estimated' in the latest year emission data (also the associated sectors are coloured). Sectors where countries reported only notation keys are listed as well, but without colouring. Only priority pollutants are included in this analysis. The end of the table provides statistics on how many sectors are listed and the number of reported 'NE' notation keys per pollutant. For NECD the sector completeness only for the last two reported years is provided.

Sector	NO <sub>x</sub>	NM <sub>VOC</sub>	SO <sub>x</sub>	NH <sub>3</sub>	PM <sub>2.5</sub>	PM <sub>10</sub>	TSP	CO	Pb	Cd	Hg	DIOX	PAH	HCB	HCH	PCB
1 A 1 a														NA	NA	NE
1 A 1 b														NA	NA	NE
1 A 1 c									NE	NE	NE			NA	NA	NE
1 A 2 a												IE		NA	NA	NE
1 A 2 b												NE		NA	NA	NE
1 A 2 c														NA	NA	NE
1 A 2 d														NA	NA	NE
1 A 2 e														NA	NA	NE
1 A 2 f i														NA	NA	NE
1 A 2 f ii	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	NA	NA	NA
1 A 3 a i (i)				NE					NE	NE	NE	NE		NA	NA	NE
1 A 3 a ii (i)				NE	NE	NE	NE		NE	NE	NE	NE	NE	NA	NA	NE
1 A 3 b i											NE			NE	NA	NE
1 A 3 b ii											NE			NE	NA	NE
1 A 3 b iii											NE			NE	NA	NE
1 A 3 b iv											NE		IE	NE	NA	NE
1 A 3 b v	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NE	NA	NE	NA	NE
1 A 3 b vi	NA	NA	NA	NA				NA	NE	NE	NE	NA	NE	NE	NA	NE
11 B	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NA	NA
7 B	NE		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NA	NA
111 of 117 NFR09 Sectors listed																
Count of 'NE' sectors per pollutant	35	27	23	33	41	41	41	24	31	30	38	37	24	41	14	54

Figure 3.1: Example of findings: CLRTAP emission (Completeness per sector)

4 D 1 a	NE	NE	NA		4 D 1 a	NE	NE	NA	
4 D 2 a	NA	NA	NA	NA	4 D 2 a	NA	NA	NA	NA
4 D 2 b	NA	NA	NA	NA	4 D 2 b	NA	NA	NA	NA
4 D 2 c	NE	NA	NA		4 D 2 c	NE	NA	NA	
4 F	NO	NO	NO	NO	4 F	NO	NO	NO	NO
4 G	NE		NE	NE	4 G	NE		NE	NE
6 A	NA		NA	NE	6 A	NA		NA	NE
6 B	NA	NE	NA		6 B	NA	NE	NA	
6 C a	IE	IE	IE	NE	6 C a	IE	IE	IE	NE
6 C b				NE	6 C b				NE
6 C c				NE	6 C c				NE
6 C e	NE	NE	NE	NE	6 C e	NE	NE	NE	NE
6 D				NE	6 D				NE
7 A	NO	NO	NO	NO	7 A	NO	NO	NO	NO
1 A 3 a i (ii)				NE	1 A 3 a i (ii)				NE
1 A 3 a ii (ii)				NE	1 A 3 a ii (ii)				NE
11 A	NO	NO	NO	NO	11 A	NO	NO	NO	NO
11 B	NO	NO	NO	NO	11 B	NO	NO	NO	NO
7 B	NE		NE	NE	7 B	NE		NE	NE
78 of 117 NFR09 Sectors listed					78 of 117 NFR09 Sectors listed				
Count of 'NE' sectors per pollutant	31	27	21	29	Count of 'NE' sectors per pollutant	31	27	21	29

Figure 3.2: Example of findings: NECD emissions (Completeness per sector, two years)

### 3.3.2 Example of completeness check results per pollutant

The completeness of the data in the WebDab database of priority pollutants (**Stage 1 review**) is evaluated on the basis of the criteria outlined in the UNECE Reporting Guidelines (UNECE, 2014). Results shows tables with all numbers as a percentage of the total number of reporting template cells per component and time series (examples see Figures Figure 3.3 and Figure 3.4). Flagging occurs

- when the number of cells containing a value or a notation key is less than 80 % of the total number of cells,
- if there are more than 10 % zeroes reported,
- if 'Not Estimated' is reported in cells and/or
- if the number of values reported is less than 10 %.

The completeness of CLRTAP NFR Sectors is divided in three sections: 1980 to 1989, 1990 to 1999 and 2000 to latest year.

Component	% Value	% 0	% NO	% NE	% NA	% IE	% C	% NR	% All
NOx	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
NMVOc	73.3	0.0	0.0	26.7	0.0	0.0	0.0	0.0	100.0
SOx	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
NH3	66.7	0.0	0.0	33.3	0.0	0.0	0.0	0.0	100.0
PM2.5	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
PM10	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
TSP	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
CO	66.7	0.0	0.0	33.3	0.0	0.0	0.0	0.0	100.0
Pb	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
Cd	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
Hg	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
DIOX	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	100.0
PAH	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	100.0
HCb	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	100.0
HCH	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	100.0
PCB	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	100.0

"Value" – the cell contains a number > 0.005

"0" – the cell contains 0 or a number < 0.005

"NO", "NE", "NA", "IE", "C" and "NR" are notation keys as defined in Reporting Guidelines and NFR (Annex B)

In certain cases the total percentage value may not be exactly the sum of the other columns because of rounding differences

**Figure 3.3: Example for the results of test, CLRTAP (Completeness of National totals from 1980 to 2009 including NFR and SNAP)**

**NECD (Completeness of National Totals from 2001 to 2008 including NFR and SNAP):**

Component	% Value	% 0	% NO	% NE	% NA	% IE	% C	% NR	% All
NOx	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
NMVOG	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
SOx	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
NH3	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0

"Value" – the cell contains a number > 0.005;  
 "0" – the cell contains 0 or a number < 0.005;  
 "NO", "NE", "NA", "IE", "C" and "NR" are notation keys as defined in Reporting Guidelines and NFR;  
 In certain cases the total percentage value may not be exactly the sum of the other columns because of rounding differences

**NECD (Completeness of NFR Sectors from 2001 to 2008 without National Totals):**

Component	% Value	% 0	% NO	% NE	% NA	% IE	% C	% NR	% All
NOx	37.9	0.0	9.0	26.4	21.8	3.1	0.0	0.0	99.0
NMVOG	49.9	0.1	9.0	23.0	11.0	5.0	0.0	0.0	99.0
SOx	34.8	0.0	9.0	17.4	33.9	3.1	0.0	0.0	99.0
NH3	37.6	0.0	9.0	24.9	25.4	3.0	0.0	0.0	99.0

"Value" – the cell contains a number > 0.005;  
 "0" – the cell contains 0 or a number < 0.005;  
 "NO", "NE", "NA", "IE", "C" and "NR" are notation keys as defined in Reporting Guidelines and NFR;  
 In certain cases the total percentage value may not be exactly the sum of the other columns because of rounding differences

**Figure 3.4: Example for the results of test, NECD (Completeness of National totals from 2001 to 2008)**

## 4 EXTENDED (STAGE 2) REVIEW

The stage 2 tests assess the recalculations, key category analysis, inventory comparison, trends and time series of the submitted national inventories. The following stage 2 tests are performed:

- Recalculations
- Key category analysis – CLRTAP
- Key category analysis – NECD
- Inventory comparisons
- Time series
- Trends
- Implied emission factors (IEF)
- Emissions per capita and emissions per GDP/PPP.

Data included in the stage 2 review are the emissions submitted under the CLRTAP, emissions reported under the NECD to the European Commission and the EEA, and emissions reported under the UNFCCC and EEA before 1 May. The results of the tests are published annually in the form of individual synthesis and assessment reports on the CEIP website <https://www.ceip.at/status-of-reporting-and-review-results> by 31 May. Nominated CEIP contact points are provided with passwords which allow them to access the review findings. Parties are requested to respond within four weeks after notification.

### 4.1 Recalculations

It is considered good practice to recalculate the whole times series when new information (i.e. activity or emission factor data) becomes available in order to provide comparable and consistent data to the Convention. The magnitude of recalculations can also provide an indication of the general uncertainty of the emissions. The aim of this test is to identify differences between national totals submitted by Parties in the present year and the latest available national totals submitted in previous reporting years.

It is important and necessary to identify inventory recalculations and to understand their origin in order to correctly evaluate the officially reported emission data. This is especially the case when emission ceiling targets are expressed in absolute terms (as in the Gothenburg Protocol and NECD) and not as percentage reduction targets (as in the Kyoto Protocol for greenhouse gases).

**In this test, differences between national total emissions** reported by Parties to the CLRTAP in the last and the last but one year are determined and variances larger than  $\pm 10\%$  are flagged<sup>15</sup>. A minus value indicates that the latest available emission submitted in previous years is higher. Blank cells mean that data or notation keys in the present reporting year or in the previous reporting years are missing. 0 % is given when data (value or notation key) in the present reporting year and in the latest available previous reporting year are equal. If there is a

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<sup>15</sup> The formula used to calculate the magnitude of recalculations is  $100 * [(X_{\text{present year}} - X_{\text{previous year}}) / X_{\text{previous year}}]$ , where  $X_{\text{present year}}$  is emissions reported in the present year and  $X_{\text{previous year}}$  represents emission reported in the previous year.



number and a notation key reported, the difference is the number. An example for this test is given in Figure 4.1.

year	NOx	NMVOc	SOx	NH3	PM2.5	PM10	TSP	CO	Pb	Cd	Hg	DIOX	PAH	HCB	HCH	PCB
1990	-11.17	-0.24	2.60	-0.01	0	0	0	-10.57	46.25	-3.36	-0.00	0.32	-0.08	-3.93	0	0
1991	-10.83	5.32	2.89	-0.01	0	0	0	-9.17	46.94	-3.60	0.01	0.39	-0.07	0	0	0
1992	-10.65	6.05	1.23	-0.02	0	0	0	-9.68	39.70	-4.77	-0.00	0.50	-0.08	0	0	0
1993	-9.01	9.21	-0.48	-0.04	0	0	0	-7.69	37.58	-4.93	-0.00	0.49	-0.08	0	0	0
1994	-8.08	10.32	0.36	-0.05	0	0	0	-6.85	35.47	-4.96	-0.01	0.57	-0.08	0	0	0
1995	-10.10	9.08	0.77	-0.06	0	0	0	-9.95	34.23	-5.06	-0.00	0.65	-0.08	0	0	0
1996	-8.81	11.13	0.86	-0.09	0	0	0	-9.60	59.51	-4.69	-0.00	0.69	-0.07	0	0	0
1997	-9.78	8.29	1.06	-0.12	0	0	0	-9.95	107.23	-4.34	-0.00	0.79	-0.08	0	0	0
1998	-9.45	8.43	0.87	-0.18	0	0	0	-8.99	185.44	-4.50	-0.00	0.88	-0.08	0	0	0
1999	-9.25	9.10	4.55	-0.23	0	0	0	-9.70	1.95	-4.69	-0.00	0.92	-0.09	0	0	0
2000	-9.66	14.70	5.61	-0.34	0.84	10.39	20.77	-7.09	2.28	-5.50	0.00	0.93	-0.11	0.00	0	0
2001	-8.79	20.01	9.00	-0.41	0.82	10.03	22.45	-6.18	2.68	-5.83	1.10	0.87	-0.14	1.00	0	3.52
2002	-7.96	12.86	11.56	-0.51	0.90	10.84	25.57	-6.16	2.84	-6.25	1.32	1.03	-0.14	1.13	0	3.92
2003	-7.90	9.65	17.60	-0.56	0.90	10.80	27.27	-6.53	2.88	-6.64	0.23	1.00	-0.10	0.04	0	0.01
2004	-7.13	87.09	26.53	-0.67	5.07	40.57	158.68	-7.40	2.91	-6.87	0.30	1.06	-0.11	0.07	0	0.01
2005	-9.65	24.81	44.09	-0.15	1.71	16.64	49.42	-7.00	4.04	-7.09	0.14	1.36	0.02	0.05	0	0.01
2006	-9.51	28.09	58.05	-0.14	1.71	17.12	47.81	-6.50	4.05	-8.17	0.13	1.39	0.03	0.04	0	0.01
2007	-6.70	47.27	56.84	-0.02	2.21	21.09	64.94	-6.83	4.75	-9.02	0.02	1.44	0.01	0.01	0	-0.01
2008	-10.60	36.99	66.86	0.01	1.01	20.53	66.45	-8.10	4.00	-10.55	-2.11	-0.99	-1.24	-4.44	0	-0.02

Figure 4.1: Results for test, Example (CLRTAP)

The recalculation of whole time series used to indicate a revision of inventory methods and/or improvement of activity data. A less frequent recalculation of historical data might indicate inconsistent time series.

Also large recalculations (>30 %) in the inventories for NO<sub>x</sub>, NMVOCs, SO<sub>x</sub>, NH<sub>3</sub>, PM<sub>2.5</sub>, PM<sub>10</sub> and CO for the years 2005, 2010 and 2015 are determined and IIRs are checked for explanations for these recalculations. If no explanations are provided, the Parties are contacted to give further information. The findings are presented in form of a table in the Inventory review report.

## 4.2 Time series consistency

The time series is a central element of an air pollutant inventory because it provides information on historical emission trends and tracks the effects of strategies to reduce emissions at the national level. As is the case with estimates for individual years, emission trends should be neither over- nor underestimated. All emission estimates in a time series should be estimated consistently, which means that, as far as possible, the time series should be calculated using the same method and data sources in all years. Using different methods and data in a time series could introduce bias because the estimated emission trend will reflect not only real changes in emissions but also the pattern of methodological refinements (EMEP/EEA, 2019).

The aim of these tests is to highlight instances of dips and jumps in trends in time series of sectoral data and national totals reported by Parties. Sudden changes in subsequent years usually indicate an inconsistency of methods and/or of emissions factors and/or of activity data used in national inventories.

#### Time Series:

Only data reported in one of the NFR reporting formats and for which at least three years are reported are analysed. All years where only NFR02 sectors are available are converted to NFR14 and show only the converted sectors in the time series analysis. Reported time series data were log10 transformed prior to analysis to reduce intra-series variability and improve general time series linearity. A linear regression was subsequently applied to the log-transformed values for each time series. Time series with a large sigma (standard deviation > 0.2) have been generally flagged. An individual value within the time series is identified as a dip/jump, if the respective residual value (regression forecast value – reported value) is greater than two standard deviations from the mean of all residuals within the time series. Only time series responsible for a significant fraction (> 3 %) of the national total are included.

#### Trends:

The trend figures of national total emissions, are part of the stage 2 findings, include all submitted data irrespective of the chosen format of reporting (e.g. SNAP sectors and NFR sectors as well). Parties receive trend figures for all reported pollutants. Dips, jumps and not reported pollutants can be easily identified (see examples in Figure 4.2).

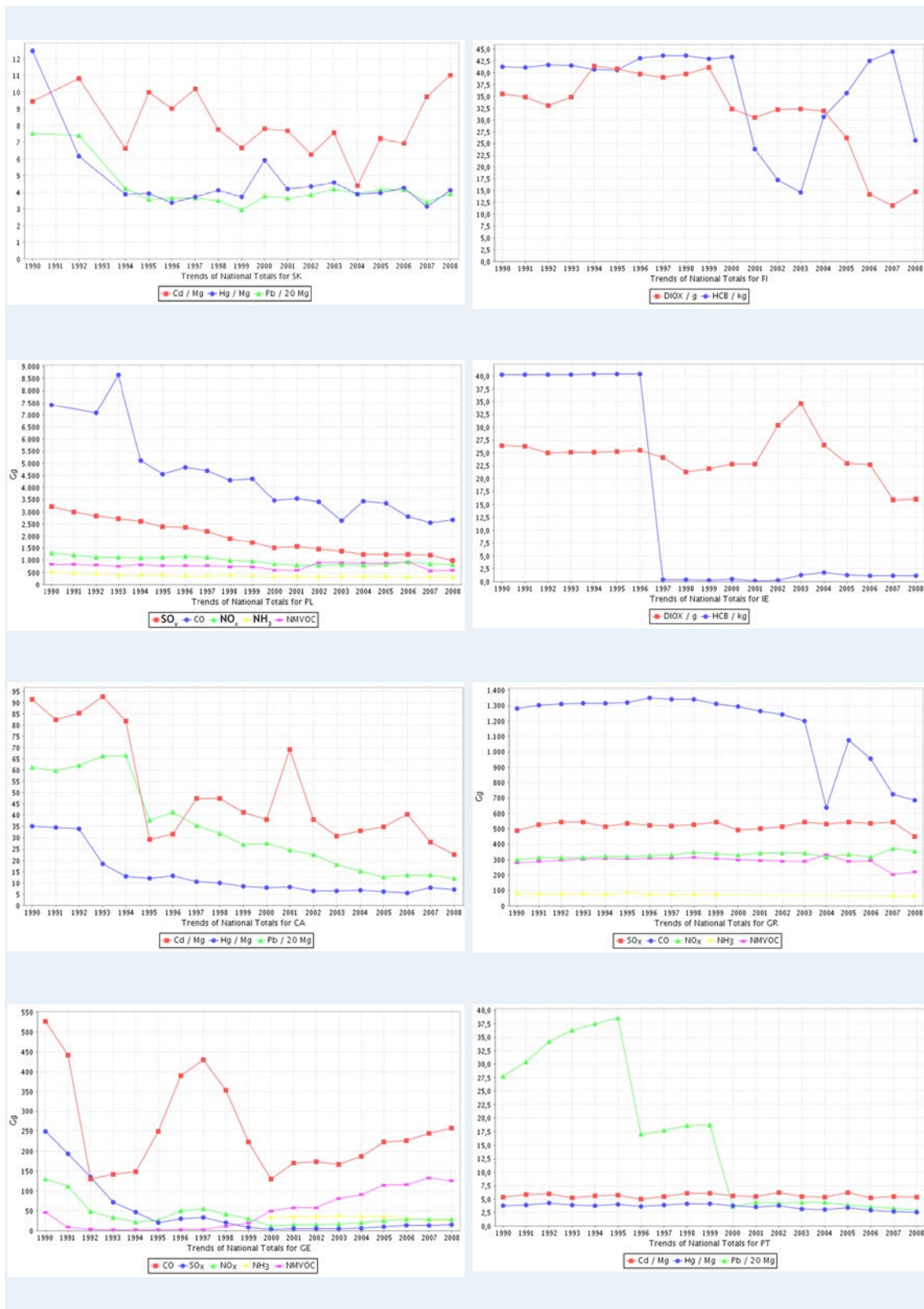


Figure 4.2: Examples of trends with dips and jumps highlighted in time series consistency tests.

### Consistency between PM<sub>2.5</sub>, PM<sub>10</sub> and BC emissions

To identify inconsistencies in reporting this check provides information whether a Party reports higher PM<sub>2.5</sub> emissions than PM<sub>10</sub> emissions (as PM<sub>2.5</sub> emissions are a subset of PM<sub>10</sub> emissions) by calculating the difference between national total emissions. X should be always >0.

$$PM_{10} - PM_{2.5} = X$$

The same formula was applied to identify inconsistencies in reporting BC (Black Carbon). As this is a subset of PM<sub>2.5</sub> emissions, the difference between national total emissions is calculated; X should be always >0:

$$PM_{2.5} - BC = X$$

### 4.3 Key category analysis (KCA)

It is good practice for each country to identify its national key categories in a systematic and objective manner. A key category is one that has significant influence on a country's total inventory in terms of absolute levels of emissions, the trend in emissions, or both. Following the revised EMEP/EEA Air Pollutant Emission Inventory Guidebook (EMEP/EEA, 2016), the **Key categories are those which, when summed up in descending order of magnitude, cumulatively add up to 80 % of the total level** (UNECE, 2009, Part A).

The key category analysis is a tool which provides interesting information on reported inventories. The key categories analysis is increasingly important in order to prioritize emission sources and identify where the implementation of improvements is most effective. Limited number of KCA for particular country and/or pollutant may indicate non-complete reporting.

**Key category analysis – Level assessment** is carried out both for the CLRTAP and the NECD inventories for all Parties that submit relevant information. The KCA is performed at the level of NFR categories as provided in the reporting template (Table 1). Each air pollutant emitted from each category is considered separately.

The contribution of each source category to the total national inventory level is calculated according to

$$\text{Key category level assessment} = |\text{source category estimate}| / \text{total contribution}$$

$$L_{x,t} = E_{x,t} / \sum E_t$$

Where:

*L<sub>x,t</sub>* = level assessment for source x in latest inventory year (year t)

*E<sub>x,t</sub>* = value of emission estimate of source category x in year t

$\sum E_t$  = total contribution, which is the sum of the emissions in year t, calculated using the aggregation level chosen by the country for the key category analysis

Key categories according to this equation are those, that – when summed together in descending order of magnitude – add up to 80 % of the sum of all *L<sub>x,t</sub>*.

The Stage 2 review on Key category analysis – CLRTAP and -NECD assesses the most important sources (the sources making up 80 % of the national total) for each country, based on the latest submission. An example of the results of test Key category analysis – CLRTAP is shown in Figure 4.3. Results of test Key category analysis – NECD are provided in the same format.

Component	Key categories (Sorted from high to low from left to right)												Total	
NOx	1 A 3 b iii (22.7%)	1 A 1 a (19.8%)	1 A 3 b i (15.1%)	1 A 2 f i (5.4%)	4 D 2 a (5.2%)	1 A 4 b i (4.7%)	4 D 1 a (4.5%)	1 A 4 c ii (2.9%)						80.2%
NM VOC	3 A 2 (11.5%)	3 D 3 (10.7%)	3 A 1 (7.9%)	3 D 1 (7.2%)	4 B 1 a (6.9%)	4 B 8 (6.8%)	3 D 2 (5.5%)	1 B 2 a iv (4.7%)	4 B 1 b (4.2%)	3 C (4.2%)	1 A 3 b i (4.0%)	1 B 2 a i (3.7%)	3 B 2 (3.5%)	80.8%
SOx	1 A 1 a (41.4%)	1 A 4 b i (10.1%)	1 A 1 b (9.6%)	1 A 2 f i (9.0%)	2 C 1 (6.1%)	2 B 5 a (5.7%)								81.9%
NH3	4 B 1 a (30.1%)	4 B 8 (20.8%)	4 B 1 b (18.2%)	4 D 1 a (13.2%)										82.4%
PM2.5	1 A 4 b i (23.0%)	3 D 3 (10.4%)	2 G (8.4%)	1 A 1 a (8.3%)	1 A 3 b vi (6.7%)	1 A 3 b iii (5.8%)	1 A 3 b i (4.0%)	1 A 3 b vii (3.8%)	1 A 2 f i (2.8%)	1 A 4 c ii (2.7%)	1 A 3 b ii (2.7%)	2 C 1 (2.0%)		80.7%
PM10	2 G (21.3%)	1 A 4 b i (13.4%)	4 D 2 a (10.4%)	1 A 3 b vi (6.8%)	3 D 3 (5.7%)	1 A 1 a (5.2%)	4 B 8 (4.6%)	1 A 3 b vii (3.8%)	1 A 3 b iii (3.2%)	1 A 3 b i (2.2%)	2 C 1 (1.9%)	2 A 7 b (1.8%)		80.4%
TSP	2 G (34.3%)	1 A 4 b i (9.7%)	4 D 2 a (7.4%)	1 A 3 b vi (6.4%)	1 A 3 b vii (5.4%)	1 A 1 a (4.1%)	3 D 3 (4.0%)	4 B 8 (3.3%)	2 A 7 b (2.5%)	2 C 1 (2.4%)	1 A 3 b iii (2.3%)			81.8%
CO	1 A 3 b i (29.3%)	1 A 4 b i (24.5%)	2 C 1 (18.0%)	1 A 2 f i (5.2%)	1 A 1 a (4.7%)									81.7%
Pb	1 A 3 b vi (48.4%)	2 C 1 (29.3%)	1 A 4 b i (4.6%)											82.3%
cd	1 A 1 b (31.4%)	2 C 1 (24.5%)	1 A 4 b i (13.7%)	1 A 3 b vi (7.4%)	1 B 1 b (5.7%)									82.6%
Hg	1 A 1 a (32.1%)	1 A 4 c iii (18.4%)	2 C 1 (16.3%)	2 A 1 (14.6%)										81.5%
DIOX	2 C 1 (35.8%)	1 A 4 b i (22.1%)	1 A 4 a i (14.0%)	1 A 1 a (7.2%)	1 A 4 c i (5.3%)									84.3%
PAH	1 A 4 b i (84.1%)													84.1%
HCB	1 A 4 b i (62.8%)	1 A 1 a (25.6%)												88.4%
PCB	1 A 1 a (40.3%)	2 C 1 (27.1%)	1 A 2 f i (18.3%)											85.7%

Figure 4.3: Example of results for Key category analysis – CLRTAP (CLRTAP 2009). Listed are identified key categories and the corresponding percentages

### Aggregated KCA

In addition, key category analysis of CLRTAP inventories for the EMEP West area<sup>16</sup> and the EMEP East area<sup>17</sup> for main pollutants, PM, BC, main HMs and priority POPs are undertaken. Emissions

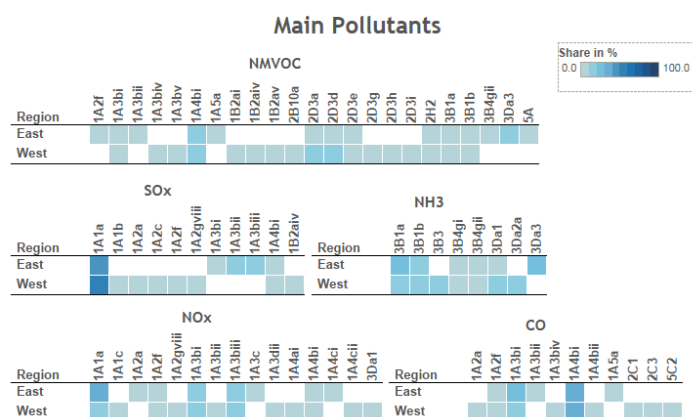
<sup>16</sup> EMEP West area comprises Albania, Austria, Belgium, Bosnia & Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Germany, Denmark, Estonia, European Union, Finland, France, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, FYR of Macedonia, Malta, Monaco, Montenegro, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

<sup>17</sup> EMEP East area comprises Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, FYR of Moldova, Russian Federation, Turkey and Ukraine.

reported by individual countries are summed to predefined groups and KCA is performed as described in the section above. Potential missing sectoral data are not gap filled.

Figure 4.4 shows an example for the share of the top ten key categories for two groups: EMEP West and EMEP East area. If the total number of key categories for a particular pollutant is more than 10, emissions are summed up in “Other KC”. “Other Cat” contains the remaining (non-key) categories.

The NFR14 reporting template does not offer the option of data aggregation, and so generally more sources were identified as key, and the KCA is now more accurate in reflecting the share of the main emission sources. However, Parties might still allocate emissions to NFR categories in a different way, some Parties make use of the emission inventory notation key IE (included elsewhere) or allocate emissions to the ‘Other’ (sub)category, which means that emission estimates for one NFR sector are included in emission estimates of a different sector. It is also important to note that the results of the KCA for individual Parties may differ from key sources determined for the country groups “EMEP West” and/or “EMEP East”.



**Figure 4.4: Example for the comparison of key categories between the EMEP East and EMEP West area for NMVOC, SOx, NH3, NOx and CO**

#### 4.4 Inventory comparisons

The aim of this test is to compare national totals reported under NECD, LRTAP and UNFCCC. The Stage 2 review test of inventory comparison shows these differences, in which 0 % indicates no difference, and “NA” means that no values in one or both inventories are given. Flagged values indicate difference of greater than 0.1 % between the respective national totals (LRTAP-NEC-UNFCCC). Performing a comparison of national totals from different inventory submissions immediately shows potential inconsistencies between inventories.

An example is shown in Table 4.1.

**Table 4.1: Example of results for inventory comparison. Differences between LRTAP and UNFCCC submissions** (Minus value indicates that emissions reported under UNFCCC is higher)

Year	NO <sub>x</sub>	CO	NMVOC	SO <sub>x</sub>
1990	1.6 %	-26.5 %	-1.6 %	3.9 %
1991	4.6 %	-29.5 %	-2.3 %	-4.0 %
1992	6.2 %	-40.0 %	-2.0 %	-12.5 %
1993	5.4 %	-42.4 %	-3.3 %	-13.2 %
1994	5.1 %	-44.0 %	-2.0 %	-7.8 %
1995	5.3 %	-45.3 %	-3.7 %	-9.9 %
1996	7.8 %	-34.7 %	-3.7 %	-4.4 %
1997	7.1 %	-30.6 %	-3.7 %	-1.0 %
1998	10.8 %	-35.8 %	-3.5 %	-3.6 %
1999	3.1 %	-5.9 %	-3.9 %	-4.5 %
2000	-0.2 %	3.7 %	-3.1 %	-8.1 %
2001	3.7 %	2.9 %	-5.5 %	-5.4 %
2002	-0.4 %	3.7 %	-3.0 %	-11.8 %
2003	0.4 %	-0.6 %	-6.1 %	-2.4 %
2004	0.3 %	0.1 %	-7.3 %	0.5 %
2005	1.1 %	0.1 %	-6.0 %	1.6 %
2006	-0.1 %	0.3 %	-3.1 %	1.0 %
2007	0.2 %	0.7 %	-2.7 %	0.7 %
2008	-1.5 %	4.5 %	1.3 %	2.3 %
2009	-0.9 %	2.3 %	1.5 %	0.6 %

The reasons for differences between emissions reported under the CLRTAP/NECD and the UNFCCC can be differences in reporting obligations (See details in Table 1.2).

Significant differences between data reported under different reporting obligations indicate room for improvement in the national communication. Errors in inventories, which would also lead to differences between inventories, cannot be identified by automated tests as they are currently designed and used. However these errors can only be detected during the stage 3 review.

#### Comparison of aggregated SNAP categories between the countries:

Comparison of differences in emission distribution among the main SNAP categories in individual Parties may help to identify inconsistencies in reporting. Information on the share of individual SNAP categories in the total emissions is also important for EMEP models. Emissions reported by Parties in NFR formats are by standard procedure aggregated to main SNAP categories.

## 4.5 Implied emission factor (IEF) test

The objective of the implied emission factors (IEF) test is to identify significant changes of IEFs within time series and/or between Parties. Implied emission factors are calculated for the sectors identified as key categories<sup>18</sup>. The pollutants examined are NO<sub>x</sub>, NMVOCs, SO<sub>x</sub>, NH<sub>3</sub>, CO, PM<sub>10</sub> and PM<sub>2.5</sub>, but not all identified key categories are keys for each pollutant (for more information please refer to Section 4.3).

The implied emission factor (IEF) test is conducted for selected key categories (1A1a, 1A1b, 1A2a, 1A2f, 1A3b, 1A4b, 1A4c, 3A, 3C, 4B1a, 4B1b, 4B8, 4B9, 4D1a and 4D2) for all Parties for which inventories in NFR categories and activity data are available.

IEF values are calculated from *emission data* reported by Parties to the CLRTAP and *sectoral activity data* reported to the European Commission under the EU-Monitoring Mechanism Decision (EC, 2004) or under the UNFCCC. The NECD inventories are not separately included in the IEF test, while according to the new UNECE Reporting Guidelines (UNECE, 2009) the inventories reported under LRTAP Convention and NEC Directive should be largely identical for most EU Member States.

The IEFs are analysed with the UNFCCC outlier tool<sup>19</sup>. Due to the multitude of the potential outliers resulting from the automated tests, the test results were evaluated manually. In general, dips and jumps of more than 40 % were listed and sent to the Parties for consideration. Examples of IEFs that have been flagged are shown in Figures Figure 4.5 and Figure 4.6.

Flagged IEF values do not necessarily indicate any underlying inconsistency in an inventory: dips and jumps within the time series might simply be due to industries having closed or to changes in the fuel splits in a single year, etc. Differences across Parties might similarly be due to different types of activity data used for calculation, use of different abatement equipment, different fuel splits, etc. However, Parties are encouraged to check and explain the findings.

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<sup>18</sup> The key categories change minimally between the years. Using the same key sources in tests enables comparisons to be made across different reporting years. The key category threshold was changed to 80% in 2009 (compared to 95% previously), and NFR categories were used instead of “aggregated” categories used in KCA 2006. Therefore KCA results from earlier years are not fully comparable.

<sup>19</sup> It has to be noted that despite activity data being reporting under the CLRTAP, we have not been able to perform the implied emission factor test using reported CLRTAP activity data due to missing data and a number of inconsistencies.



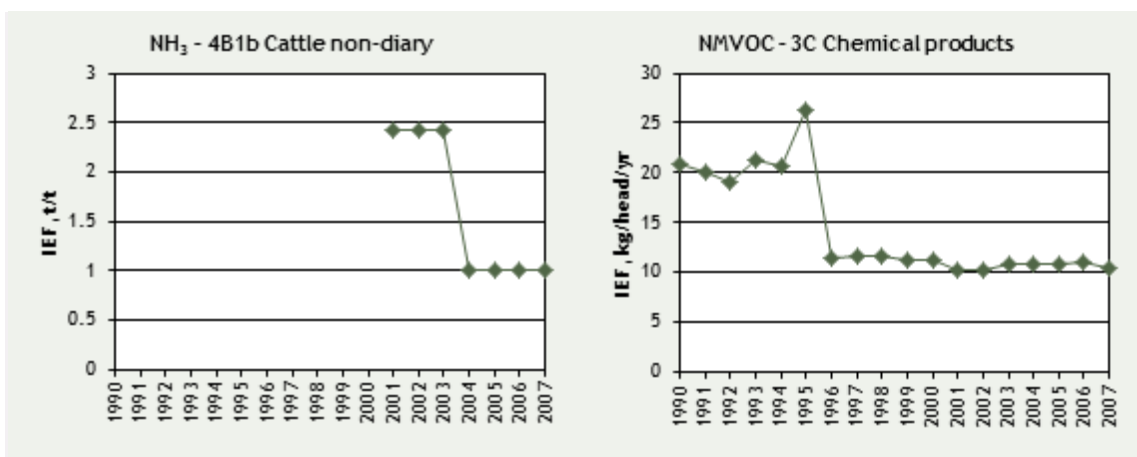


Figure 4.5: Example of IEF analysis showing data points that would be flagged as an outlier in the time series 1990-2007

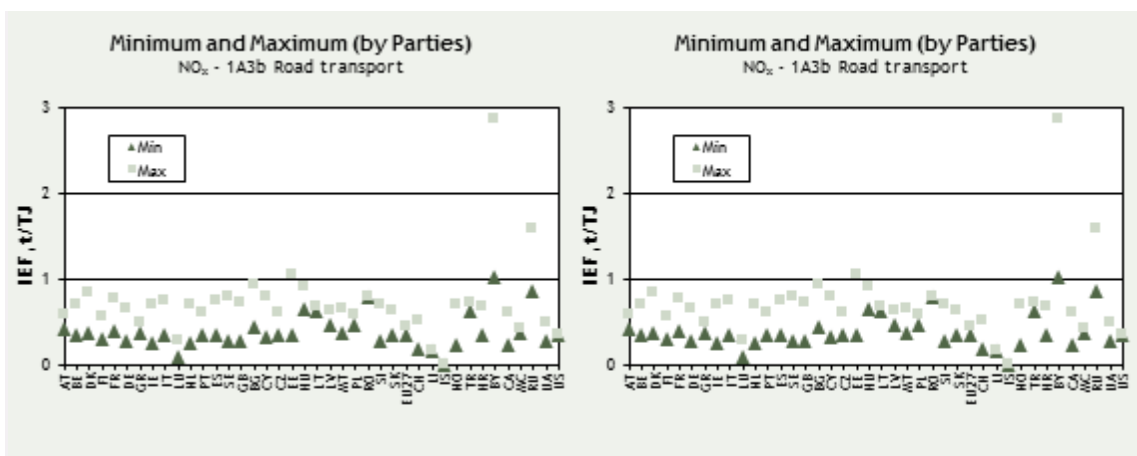


Figure 4.6: Examples of IEF analysis showing data points that would be flagged as outliers. The figure presents the highest and lowest IEF 1990-2007 for each country in two sectors.

#### 4.6 Comparability – Emissions per capita, emissions per GDP

Two indicators, namely national total *emissions per capita* and *emissions per GDP/PPP*<sup>20</sup> are calculated for all Parties which submit national total emissions of main pollutants, PM, HMs, PCDD/PCDF, PAHs and HCB to CEIP and for which population statistics and GDP/PPP data were available. Information on population and GDP/PPP comes from the “World Bank Database” (The World Bank Group, 2020).

Outliers might indicate differences in national economies, but also errors in calculations. Low per capita and per GDP/PPP emission in some Parties might also indicate incomplete national inventories, particularly for PM and POPs data.

<sup>20</sup> PPP/GDP is gross domestic product converted to international dollars using purchasing power parity rates. An international dollar has the same purchasing power over GDP as the U.S. dollar has in the United States.

Results are provided in form of tables with full time series and figures presenting per capita/GDP emissions for the year 1990 and the latest reported year.

## 5 REVIEW OF GRIDDED DATA AND LPS

Every four years from 2017 onward, Parties shall report for the year x-2 updated aggregated sectoral (GNFR) gridded emissions in a grid of 0.1 x 0.1 degrees and LPS emissions. As an alternative, a Party may report gridded emissions in the old 50 x 50 km<sup>2</sup> PS grid until it is technically and economically feasible to switch to 0.1 x 0.1 degrees.

### 5.1 Gridded data

It has to be noted that gridded emissions are used in models only on sectoral level (13 GNFRs 2018 onwards) and therefore only submitted gridded sectoral emissions can be used. The reporting of gridded national total emissions is not planned in the new reporting templates anymore. However, if Parties intend to submit also gridded national total emissions this can be done in the old template (Table 3a, version 2002-2).

By the annual review process CEIP is performing a few standard tests:

- check if sectoral gridded data for all pollutants/years are reported as requested by the revised UNECE Reporting Guidelines (UNECE, 2014)
- compare grid-sum data with national total emissions reported in NFR table
- check if all reported cells are inside the country (position of the cells)

### 5.2 Large Point Sources (LPS)

Large point sources (LPS) are defined as facilities<sup>21</sup> whose combined emissions, within the limited identifiable area of the site premises exceed the pollutant emission thresholds identified below which have been extracted from the full list of pollutants in the E-PRTR Regulation (EC, 2006, Annex II) and listed in Table 5.1 below.

**Table 5.1: List of pollutants to be reported for a LPS if the applicable threshold value is exceeded based on thresholds specified in E-PRTR Regulation (annex II)**

Pollutants/Substances	Thresholds in kg/year
SO <sub>2</sub>	150 000
NO <sub>x</sub>	100 000
CO	500 000
NMVOCS	100 000
NH <sub>3</sub>	10 000
PM <sub>2.5</sub>	50 000
PM <sub>10</sub>	50 000

<sup>21</sup> As defined in Article 2 (4) and (5) of the E-PRTR Regulation, “(4) ‘Facility’ means one or more installations on the same site that are operated by the same natural or legal person; (5) ‘Site’ means the geographical location of the facility;” (EC, 2006).

Pollutants/Substances	Thresholds in kg/year
Pb	200
Cd	10
Hg	10
PAHs	50
PCDD/F	0.0001
HCB	10

Parties that do not report combustion process emissions under any other international or EU wide protocols or decisions may limit their criteria for Combustion Process LPS selection to > 300 mw thermal capacity.

**Table 5.2: The stack height classes (physical height of stack) in the reporting templates**

Height class	
1.	Height class 1 < 45 metres;
2.	45 metres ≤ Height class 2 < 100 metres;
3.	100 metres ≤ Height class 3 < 150 metres;
4.	150 metres ≤ Height class 4 < 200 metres;
5.	Height class 5 < 200 metres.

By the annual review process CEIP is performing a few standard tests:

- check if point sources for all pollutants/years are reported as requested by the revised UNECE Reporting Guidelines (UNECE, 2014)
- check if all reported point sources are inside the country (position of the LPS)
- comparison with E-PRTR facilities (planned for the future)

## 6 CENTRALISED IN-DEPTH REVIEW (STAGE 3)

The Stage 3 review (in-depth review) is a centralised review of selected inventories checking if submitted inventories are complete, consistent through the time, properly documented, comparable between the countries and accurate. It is a centralized review of quantitative and qualitative information of selected inventories by pollutant, country or sector, as in the work plan agreed by the EMEP Executive Body. The plan is to check in detail the inventories of each Party at least once every five years. Annually, approximately ten Parties are reviewed. The annual in-depth review aims to be consistent across Parties and the process should ensure that the same approach is performed each year.

The review is performed by the experts nominated by Parties<sup>22</sup>. The expert review teams (ERTs) are set up by CEIP by the beginning of each review round. Two expert review teams (ERTs) check NFR tables and IIRs submitted by Parties under CLRTAP and NECD. The lead reviewers (LRs) are coordinating the work of ERTs and communicating questions to the Parties.

CEIP is preparing data, tools and templates for reviewers to ensure consistent approach across the teams and years. An introduction to the review process, including the timeschedule and templates, is provided at a password protected wiki website <http://unece-stage3.wiki-dot.com/start>.

### Initial checks

CEIP experts are running initial checks in May and provide the results to the review teams.

The basic principles of the review are to see if the provided data are easy to understand (transparent), compiled in a similar way to the recommendation in the guidebook, consistent across the time series and pollutants and as accurate as possible.

One of the key additions to the revised 'Emission Review Guidelines' document is the inclusion of 'Technical Corrections'. These allow the Expert Review Teams (ERT) to work together with Parties during the review process to develop revised emission estimates where reported data is found to be inconsistent with the recommended methodologies of the EMEP/EEA Guidebook or where emission estimates are not provided for an NFR source category. The objective of the Technical Revisions process is to establish improvements in completeness, consistency, comparability and accuracy of the reported emissions data from Parties.

During an emissions inventory review the ERT highlights an observation and issues questions to the Party. The ERT mentions in their questioning whether this could relate to a 'significant'<sup>1</sup> over or under estimate, and hence a possible Technical Revision.

The Party responds with clarifications and/or answers. The Party can provide a justification for their existing estimate, or propose a Revised Estimate that addresses the issue raised by the ERT. The Revised Estimate may span several sources, several pollutants, and be relevant for multiple years.

If the ERT agrees with the Party's response (i.e. a valid justification or Revised Estimate calculated and provided by the Party) the issue is considered closed and a recommendation is made in the Party's review report i.e. that the updated estimate should be included in the Party's next annual inventory submission. However, should the ERT not be able to reach agreement

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<sup>22</sup> [http://www.ceip.at/review\\_proces\\_intro/stage3\\_review\\_ae/](http://www.ceip.at/review_proces_intro/stage3_review_ae/), go to EMEP/CEIP roster

with the Party, then the ERT will calculate a Technical Correction which is sent to the Party for comment.

After the centralised review week, a Party can respond to indicate that they agree with the proposed Technical Correction. The issue is then dealt with as for a Revised Estimate. Alternatively, a Party can respond that they disagree with the Technical Correction proposed by the ERT, and provide a justification for their position.

e) If the ERT do not agree with the information provided by the Party (or no response is provided), they inform the Party, and include the Technical Correction in the draft review report that is sent to the Party. [TFEIP, 2017]

The findings are compiled in individual country reports. All countries have 4 weeks for comments. After considering comments, reports are published. The final country review reports can be downloaded as PDF documents from the [CEIP website](#). The review results individual country reports are published (i.e., posted at CEIP website) before the next annual EMEP Executive Body meeting.

The key outcomes of the review are the:

- Record of questions and answers which contain all questions submitted to the countries plus detailed responses from the countries
- Review report which contains the public findings and recommendations (sector tables in the template are updated with NFR14 - but in the text references to NFR09 might appear)
- Excel file with technical corrections

### History of stage 3 in depth reviews of air emission inventories 2008-2020

The EMEP Steering Body approved the first schedule (2008-2013) for the centralised in-depth reviews at the 33<sup>rd</sup> session in September 2009 (see Table 6.1). The list was updated in the following years at the 34<sup>th</sup> and 35<sup>th</sup> Steering Body meetings. The updated list is shown below (Table 6.1)

**Table 6.1: History<sup>23</sup> of stage 3 in depth reviews of inventories 2008-2020**

	Year	Countries
3 <sup>rd</sup> review round 2018-2020	2020	European Union, North Macedonia, Iceland, Kyrgyzstan, Switzerland. <i>Kazakhstan. Liechtenstein and Monaco did not submit data on time, review postponed to 2021.</i>
	2019	Albania, Georgia, Norway, Russian Federation, Serbia, Turkey
	2018	Moldova, Armenia, Finland, Belarus, Ukraine, Azerbaijan
2 <sup>nd</sup> review round 2013-2017	2017	Albania**, Armenia*, Austria, Malta*, EU, Kazakhstan, Kyrgyzstan*, Liechtenstein*, Monaco*
	2016	Estonia, Georgia, Iceland, Luxembourg, FYR of Macedonia, Russian Federation, Serbia, Switzerland, Turkey, United Kingdom
	2015	Azerbaijan, Belarus, Czech Rep., Ireland, Rep. of Moldova, The Netherlands, Slovakia, Slovenia and Ukraine
	2014	Belgium, Greece, Cyprus, Croatia, Denmark, Germany, Hungary, and Spain
	2013	Bulgaria, France, Italy, Latvia, Lithuania, Norway, Poland, Portugal, Romania and Sweden
1 <sup>st</sup> review round 2008-2012	2012	Albania*, Georgia*, European Community, Liechtenstein*, Malta*, Monaco*, Republic of Moldova*, Montenegro*, Serbia* and Turkey** Czech Republic, Belarus, Croatia, Estonia*, Greece*, Iceland, Luxembourg, The former Yugoslav Republic of Macedonia, Slovenia and Ukraine*
	2010	Austria, Cyprus, Germany, Italy, Netherlands, Romania, Russian Federation*, Slovakia, Switzerland and United Kingdom
	2009	Belgium, Bulgaria, Denmark, Finland, Hungary, Ireland, Latvia, Lithuania, Poland and Spain
	2008	France, Norway, Portugal and Sweden (voluntary)

**Note:**

\* Party did not submit a complete emission inventory in standard format or did not submit an IIR for the last three reporting rounds

\*\* Party did not submit neither inventory data nor an IIR for the last three reporting rounds

<sup>23</sup> The EMEP Steering Body approved the schedule (2008-2013) for centralised in-depth reviews at its 33<sup>rd</sup> session in September 2009.

## 7 UNITS AND ABBREVIATIONS

kg	1 kilogram = 10 <sup>3</sup> g (gram)
t	1 tonne (metric) = 1 megagram (Mg) = 10 <sup>6</sup> g
Mg	1 megagram = 10 <sup>6</sup> g = 1 tonne (t)
TJ	1 terajoule
kPa	1 kilopascal
K	1 Kelvin
µm	1 micrometre
Cd	cadmium
CDR	central data repository of EEA's Eionet Reportnet
CEIP	EMEP Centre on Emission Inventories and Projections
CLRTAP	LRTAP Convention
CO	carbon monoxide
CRF	common reporting format (UNFCCC for greenhouse gases)
EEA	European Environment Agency
Eionet	European environmental information and observation network
EMEP	Co-operative Programme for Monitoring and Evaluation of the Long-range Transmissions of Air Pollutants in Europe
E-PRTR	European Pollutant Release and Transfer Register
ETC/ACM	European Topic Centre on Air Pollution and Climate Change Mitigation of the EEA
EU	European Union
GDP, PPP	gross domestic product converted to international dollars using purchasing power parity rates
GNFR	nomenclature for reporting of gridded data and LPS
H <sub>2</sub> S	hydrogen sulphide
H <sub>2</sub> SO <sub>4</sub>	sulphuric acid
HCB	hexachlorobenzene
Hg	mercury
HMs	heavy metals
IIASA	International Institute for Applied Systems Analysis
IIR	informative inventory report
IEF	implied emission factor
KC	key category
KCA	key category analysis
LRTAP Convention	UNECE Convention on Long-range Transboundary Air Pollution
LPS	large point source
Main pollutants	NO <sub>x</sub> , NMVOCs, SO <sub>x</sub> , NH <sub>3</sub> and CO
Main HMs	Cd, Hg and Pb
NECD	National Emission Ceilings Directive (EC, 2001)



NFR .....	UNECE nomenclature for reporting of air pollutants
NH <sub>3</sub> .....	ammonia
NMVOCs .....	non-methane volatile organic compounds
NO <sub>2</sub> .....	nitrogen dioxide
NO <sub>x</sub> .....	nitrogen oxides
PAHs .....	polycyclic aromatic hydrocarbons
Pb.....	lead
PCDD/PCDF.....	dioxines and furanes
PM .....	particulate matter
PM <sub>10</sub> .....	particulate matter, with a 50 per cent efficiency cut-off at 10 µm aerodynamic diameter or less
PM <sub>2.5</sub> .....	particulate matter, with a 50 per cent efficiency cut-off at 2.5 µm aerodynamic diameter or less
PM <sub>coarse</sub> .....	particulate matter, the difference between PM <sub>10</sub> and PM <sub>2.5</sub>
BC .....	black carbon
POPs .....	persistent organic pollutants
SNAP .....	selected nomenclature for air pollution
SO <sub>x</sub> .....	sulphur oxides
SO <sub>2</sub> .....	sulphur dioxide
SO <sub>3</sub> .....	sulphur trioxide
TFEIP .....	UNECE Task Force on Emission Inventories and Projections
TSP .....	total suspended particles
UNECE.....	United Nations Economic Commission for Europe
UNFCCC .....	United Nations Framework Convention on Climate Change

## 8 DEFINITIONS AND GLOSSARY

### 8.1 Pollutants

**Sulphur oxides (SO<sub>x</sub>)** is emitted when fuels containing sulphur are burned. It contributes to acid deposition, the impacts of which can be significant: adverse effects on aquatic ecosystems in rivers and lakes, and damage to forests. Further, the formation of sulphate particles results in reflection of solar radiation, which leads to net cooling of the atmosphere.

**Nitrogen oxides (NO<sub>x</sub>)** are emitted during fuel combustion, as practiced by industrial facilities and the road transport sector. It contributes to acid deposition but also to eutrophication of soil and water. NO<sub>x</sub> also contribute to the formation of secondary inorganic particulate matter and tropospheric (ground-level) ozone with associated climate effects.

**Ammonia (NH<sub>3</sub>)** contributes to both eutrophication and acidification. The vast majority of NH<sub>3</sub> emissions — around 94 % in Europe — come from the agricultural sector, in connection with activities such as manure storage, slurry spreading and the use of synthetic nitrogenous fertilisers.

**Non-methane volatile organic compounds (NMVOCs)** are emitted from a large number of sources including paint application, road transport, dry-cleaning and other solvent uses.

**Heavy metals** (i.e. cadmium, lead, mercury; and additional heavy metals: arsenic, chromium, copper, nickel, selenium, zinc) and their compounds are emitted mainly as a result of various combustion processes and industrial activities, like metal works and smelters. Heavy metals can reside in or be attached to PM. As well as polluting the air, HMs can be deposited on terrestrial or water surfaces and subsequently builds up in soils or sediments.

**Persistent organic pollutants (POPs):**

- **Polycyclic aromatic hydrocarbons (PAHs)** are a large group of POPs that contribute to different harmful effects in the environment and to human health. PAHs are released by combustion processes, as well as being emitted via evaporation from materials treated with creosote, mineral oils, pitch, etc.
- **Dioxins and furans (PCDD/F)** are formed by the combustion of fuels and wastes, the processing of metals and the production of pulp and paper.
- **Hexachlorobenzene (HCB)** is used in the manufacture of chlorinated organic solvents. It is released to the environment as a by-product of coal burning, waste incineration and some metal processes.

**Carbon monoxide (CO)** is produced as a result of fuel combustion. The road transport sector, businesses and households, and industry are important sources. CO can react with other pollutants to produce ground-level ozone.

**Particulate matter (PM<sub>10</sub> PM<sub>2.5</sub>), and TSP (total suspended particulate matter)** is emitted from many sources, and is a complex heterogeneous mixture.

**Black carbon (BC)** means carbonaceous particulate matter that absorbs light. The main sources of BC are fossil fuel and biomass combustion.

## 8.2 Other

### CEIP

The EMEP Centre on Emission Inventories and Projections (CEIP) collects emissions and projections of acidifying air pollutants, heavy metals, particulate matter and photochemical oxidants from Parties to the LRTAP Convention. CEIP prepares data sets as input for long-range transport models. It reviews submitted inventories to assist the Parties improving the quality of reported data and provides support to the Parties, UNECE secretariat and the Implementation Committee.

### CLRTAP

The Convention on Long-Range Transboundary Air Pollution, which has 51 Parties, was the first international legally binding instrument to deal with air pollution on regional bases. The aim of the Convention is that Parties shall endeavour to limit and, as far as possible, gradually reduce and prevent air pollution including long-range transboundary air pollution by developing policies and strategies to combat the discharge of air pollutants through exchanges of information, consultation, research and monitoring.

### EMEP

The European Monitoring and Evaluation Programme (EMEP) provides scientific support to the LRTAP Convention on:

- Atmospheric monitoring and modelling
- Emission inventories and emission projections
- Integrated assessment modelling

The EMEP programme is carried out in collaboration with a broad network of scientist and national experts.

### The geographical scope of EMEP

The geographical scope of EMEP is defined as “the area within which, coordinated by the international centres of EMEP, monitoring is carried out.” Since its adoption in 1984, this definition has been referred to in all protocols to the LRTAP Convention. As Parties have ratified or acceded to the EMEP Protocol, the geographical scope of EMEP has become larger and the EMEP grid has been modified twice so far, once in the late 1990s, then in 2008 and than again in 2014.

The EMEP domain covers the geographic area between 30°N-82°N latitude and 30°W-90°E longitude.

### Party

The term “Parties” in all the documents refers to Parties of the LRTAP Convention, unless otherwise specified.

### TFEIP

Task Force on Emission Inventories and Projections (TFEIP)<sup>24</sup> supports Parties in reporting of air emissions and projections to the Convention by providing technical forum and expert network to identify problems and establish methodologies for the emission estimation.

### UNECE

The (United Nations Economic Commission for Europe) is one of 5 regional commissions of UN. It brings together 56 countries ([http://www.unece.org/oes/nutshell/member\\_states\\_representatives.html](http://www.unece.org/oes/nutshell/member_states_representatives.html)) and its major aim is to promote pan-European economic integration. The UNECE region (<http://www.unece.org/oes/nutshell/ecemap.html>) covers more than 47 million km<sup>2</sup> and is home of about 20 % of the world population. UNECE negotiated five environmental treaties (<http://www.unece.org/env/welcome.html>), including the LRTAP Convention, which entered into force in 1983.

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<sup>24</sup> <http://tfeip-secretariat.org/>

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## ANNEX A – SUBSTANCES LISTED IN UNECE GUIDELINES 2014<sup>25</sup>

### A) Substances for which there are existing emission reporting obligations according to the UNECE Reporting Guidelines (UNECE, 2014)

#### Sulphur oxides (SO<sub>x</sub>)

which means all sulphur compounds expressed as sulphur dioxide (SO<sub>2</sub>) (including sulphur trioxide (SO<sub>3</sub>), sulphuric acid (H<sub>2</sub>SO<sub>4</sub>), and reduced sulphur compounds, such as hydrogen sulphide (H<sub>2</sub>S), mercaptans and dimethyl sulphides, etc.)

#### Nitrogen oxides (NO<sub>x</sub>)

which means nitric oxide and nitrogen dioxide, expressed as nitrogen dioxide (NO<sub>2</sub>).

#### Ammonia (NH<sub>3</sub>)

#### Non-methane volatile organic compounds (NMVOCs)

which means, all organic compounds of an anthropogenic nature, other than methane, that are capable of producing photochemical oxidants by reaction with nitrogen oxides in the presence of sunlight;

#### Carbon monoxide (CO)

#### Particulate matter (PM)

which is an air pollutant consisting of a mixture of particles suspended in the air. These particles differ in their physical properties (such as size and shape) and chemical composition. Particulate matter refers to:

- “PM<sub>2.5</sub>”, or particles with an aerodynamic diameter equal to or less than 2.5 micrometres (µm);
- “PM<sub>10</sub>”, or particles with an aerodynamic diameter equal to or less than 10 (µm);

#### Cadmium (Cd) and its compounds;

#### Lead (Pb) and its compounds;

#### Mercury (Hg) and its compounds

#### Persistent organic pollutants:

- Polycyclic aromatic hydrocarbons (PAHs) For the purposes of emission inventories, the following four indicator compounds shall be used: benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, and indeno(1,2,3-cd)pyrene;
- Dioxins and Furans (PCDD/F) which are polychlorinated dibenzo-p-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF), tricyclic, aromatic compounds formed by two benzene rings, connected by two oxygen atoms in PCDD and by one oxygen atom in PCDF, and the hydrogen atoms of which may be replaced by up to eight chlorine atoms;
- Polychlorinated biphenyls” (PCBs), which means aromatic compounds formed in such a manner that the hydrogen atoms on the biphenyl molecule (two benzene rings bonded together by a single carbon-carbon bond) may be replaced by up to 10 chlorine atoms;

<sup>25</sup> Any departure from the definitions below should be clarified in the IIR.

- Hexachlorobenzene (HCB)

## **B) Substances for which parties are encouraged to report emission data according to the UNECE Reporting Guidelines (UNECE, 2014)**

### **Black Carbon (BC)**

which means carbonaceous particulate matter that absorbs light;

### **Total suspended particulate matter (TSP):**

#### **Additional heavy metals**

- Arsenic (As),
- Chromium (Cr),
- Copper (Cu),
- Nickel (Ni),
- Selenium (Se)
- Zinc (Zn) and their compounds



## ANNEX B – NOTATION KEYS (UNECE, 2014)

Notation key	Description
<b>Not estimated (NE)</b>	For activity data and/or emissions by sources of pollutants which have not been estimated but for which a corresponding activity may occur within a Party. Where NE is used in an inventory to report emissions of pollutants, the Party should indicate in the IIR why such emissions have not been estimated. Furthermore, a Party may consider that a disproportionate amount of effort would be required to collect data for a pollutant from a specific category that would be insignificant in terms of the overall level and trend in national emissions and in such cases use the notation key NE. The Party should in the IIR provide justifications for their use of NE notation keys, e.g., lack of robust data, lack of methodology, etc. Once emissions from a specific category have been reported in a previous submission, emissions from this specific category should be reported in subsequent inventory submissions.
<b>Included elsewhere (IE)</b>	For emissions by sources of pollutants estimated but included elsewhere in the inventory instead of under the expected source category. Where IE is used in an inventory, the Party should indicate, in the IIR, where in the inventory the emissions for the displaced source category have been included, and the Party should explain such a deviation from the inclusion under the expected category, especially if it is due to confidentiality.
<b>Confidential information (C)</b>	For emissions by sources of pollutants of which the reporting could lead to the disclosure of confidential information. The source category where these emissions are included should be indicated.
<b>Not applicable (NA)</b>	For activities under a given source category that do occur within the Party but do not result in emissions of a specific pollutant. If the cells for categories in the NFR tables for which NA is applicable are shaded, they do not need to be filled in.
<b>Not occurring (NO)</b>	For categories or processes within a particular source category that do not occur within a Party.
<b>Not relevant (NR)</b>	According to paragraph 37 in the Guidelines, emission inventory reporting for the main pollutants should cover all years from 1990 onwards if data are available. However, NR is introduced to ease the reporting where reporting of emissions is not strictly required by the different protocols, e.g., emissions for some Parties prior to agreed base years..

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