Final Review Report 2023

Review of National Air Pollutant Emission Inventory Data 2023 under Directive (EU) 2016/2284 (National Emission reduction Commitments Directive) Service Contract No. 070201/2019/815979/SER/ENV.C.3

Germany

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Abbreviations

AD	Activity data
BaP	Benzo[a]pyrene
BC	Black Carbon
C	Confidential
Cd	Cadmium
CLRTAP	Convention on Long-range Transboundary Air Pollution: the first international treaty to deal with air pollution on a broad regional basis signed by the UNECE in 1979 – 'the Air Convention'
CO	Carbon Monoxide
E-PRTR	European Pollutant Release and Transfer Register
EC	European Commission
EEA	European Environment Agency
EF	Emission factor
EIONET	European Environment Information and Observation Network
EMEP	The co-operative programme for monitoring and evaluation of the long-range transmission of air pollutants in Europe (unofficially 'European Monitoring and Evaluation Programme' = EMEP)
EMRT-NECD	EEA Emission Review Tool (EMRT) for the National Emission reduction Commitments Directive (NECD)
ERC	Emission Reduction Commitment
EU	European Union
GHG	Greenhouse gas
HCB	Hexachlorobenzene
Hg	Mercury
HM	Heavy metals
IEF	Implied emission factor
kt	Kilotonnes
NA	Not applicable
NECD	National Emission reduction Commitments Directive
NFR	Nomenclature for reporting
NH_3	Ammonia
NMVOC	Non-methane volatile organic compounds
NO_X	Nitrogen oxides
NR	Not relevant
PAHs	Polycyclic aromatic hydrocarbons
Pb	Lead
PCB	Polychlorinated biphenyls
PCDD/F	Polychlorinated dibenzo-p-dioxins and dibenzofurans

PM_{10}	Fine particulate matter: particles with an aerodynamic diameter equal to or less than 10 micrometres (µm)
$PM_{2.5}$	Fine particulate matter: particles with an aerodynamic diameter equal to or less than 2.5 micrometres (µm)
POPs	Persistent organic pollutants
PTC	Potential technical correction
RE	Revised estimate
SO_2	Sulphur dioxide
SO_X	Sulphur oxides
TC	Technical correction
TERT	Technical expert review team
TSP	Total suspended particulates
UPTC	Unquantified potential technical correction

I. Introduction

1. The review of the air pollutant emission data submitted by Member States under the European Union's National Emissions reduction Commitments Directive (Directive (EU) 2016/2284[1]) is established in Article 10(3):

"The Commission, assisted by the European Environment Agency and in consultation with the Member States concerned, shall review the national emission inventory data in the first year of reporting and regularly thereafter. That review shall involve the following:

(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.

Where the Member State concerned and the Commission are unable to reach an agreement on the necessity or on the content of the technical corrections pursuant to point (c), the Commission shall adopt a decision laying down the technical corrections to be applied by the Member State concerned."

2. The technical review of the National Emission reduction Commitments Directive (NECD) inventories in 2023 (hereafter referred to as the '2023 NECD inventory review') was undertaken in accordance with the NECD air emission inventory review guidelines established at the beginning of the project.

II. Objectives of the review

3. The general objective of the technical review of Member States' NECD inventories as reported in February 2023 (and resubmitted before 27 April 2023) is to provide recommendations to drive improvements of transparency, consistency, comparability, completeness and accuracy of information submitted. As such the review will contribute to establishing accurate, reliable and verified emission inventories for all Member States, which will also be used for compliance checks with article 4.1 of the NEC Directive.

4. The specific objectives of the 2023 NECD inventory review were:

- A detailed review to verify that Member States have integrated all of the open recommendations, unquantified potential technical corrections, technical corrections

[1] DIRECTIVE (EU) 2016/2284 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 14 December 2016 on the reduction of national emissions of certain atmospheric pollutants, amending Directive 2003/35/EC and repealing Directive 2001/81/EC

and revised estimates for the pollutants[2] NO_X, NMVOC, SO_2, NH_3, $PM_{2.5}$ and PM_{10} identified in the previous NECD inventory reviews[3].

- A review of the recalculations between the 2022 and 2023 national inventory submissions for the pollutants NO_X, NMVOC, SO_2, NH_3, $PM_{2.5}$ and PM_{10} for the years 2005, 2019 and 2020.
- A review of the time series consistency with a special focus on the years 2005, 2019, 2020 and 2021 for the pollutants: NO_X, NMVOC, SO_2, NH_3, $PM_{2.5}$ and PM_{10}[4].
- In accordance with the requirements of the NECD (Article 5 and Annex IV) and in line with the "Technical guidance for Parties making adjustment applications and for the expert review of adjustment applications (ECE/EB.Air/130)"[5] and the technical guidance on "Inventory adjustments in the context of emission reduction commitments"[6], an expert review of:
    i. All flexibility applications as detailed in Article 5 of the NECD, including an assessment whether the conditions listed in Article 5 were fulfilled.
    ii. In particular, for adjustment applications, the review of the supporting documentation as requested in part 4 of Annex IV to the NECD and an assessment of whether the adjustment application is consistent with the circumstances described therein.
- A comparison of the reviewed national totals for compliance, for each pollutant, with the maximum allowed emission levels calculated on the basis of the national emission reduction commitments set out in the NECD.

[2] Recommendations initially raised in previous review years that cover pollutants to be reviewed as part of the 2023 NECD inventory review (main pollutants and PM_{10}) **and** recommendations that cover any other pollutant previously reviewed under the NECD inventory review (BC, CO, BaP, PAHs, PCBs, HCB, Cd, Hg, Pb, PCDD/F) and that are of significance to the emission estimates of main pollutants or PM_{10} will be included in the 2023 NECD review. This means that Member States might receive follow-up questions in relation to HMs, POPs, BC and CO in cases where observations also relate to a pollutant subject to the 2023 NECD inventory review.

[3] NECD inventory review reports from previous years are available at https://environment.ec.europa.eu/topics/air/reducing-emissions-air-pollutants/emissions-inventories_en#review-of-national-emission-inventories

[4] Checking whether the 2005 emission value is a high outlier within the 2000-2010 time series. Checking if there is a factor of 2 difference for pollutant emissions between 2019/2020 and 2020/2021 for the top 10 sectors for a Member State and across all Member States. Note that transport sectors are excluded from the check between 2019/2020 and 2020/2021 as they have been severely impacted by the effects of Covid-19.

[5] Available at https://www.ceip.at/fileadmin/inhalte/ceip/4_adjustments/ece_eb_air_130_av_for_the_web.pdf

[6] Available at https://www.ceip.at/fileadmin/inhalte/ceip/00_pdf_other/2022/technical_guidance_for_erc_adjustments_issue1.1.pdf

III. Review approach, team and scope

5. The scope of the 2023 NECD inventory review is summarised in Table 1.

Table 1: Scope of the 2023 NECD inventory review (under Directive (EU) 2016/2284)

Element	Scope	Further information
Geographical coverage	EU geographical coverage of the Member States as of 1 January 2023	Includes the geographical territory of the Member States, their exclusive economic zones and pollution control zones. Excludes the Canary Islands, the French overseas departments, Madeira, and the Azores, as per Article 2 of the NECD.
Years	2005, 2019-2021	In addition, time series consistency for 2005 and between the years 2019- 2020 and 2020 - 2021 was reviewed.
Pollutants	Main pollutants NO_X, NMVOC, SO_2, NH_3, $PM_{2.5}$, and PM_{10}	See also NECD (Directive (EU) 2016/2284) Annex I
Categories	All NFR categories, including selected memo items	All NFR categories that contribute to the national total, and the national total itself, shall be considered. The following memo items shall also be included: 1A3ai(ii) International aviation cruise (civil) 1A3aii(ii) Domestic aviation cruise (civil) 1A3di(i) International maritime navigation 1A3 Transport (fuel used) – where it is used for compliance purposes
National totals	National total and national total for compliance	Rows 141 and 154 in Annex 1 of reporting guidelines

6. The review was split into two phases:

a) **Initial checks** were carried out by the project team. Significant findings from the initial checks that were not resolved within the initial checks phase were followed up by the technical expert review team (TERT) during the desk review and centralised review.

b) **A desk review and centralised review** were performed by the TERT. The TERT consisted of the following experts:

- **Lead Reviewers:** Ole-Kenneth Nielsen, Anne Misra, Kristina Saarinen
- **Energy – stationary combustion:** Stephan Poupa, Katrina Young, Melanie Hobson
- **Transport – mobile combustion:** Thamara Vieira da Rocha, Giannis Papadimitriou, Yvonne Pang
- **IPPU – excl. solvents:** Erik Honig, Ioannis Sempos, Robert Stewart
- **IPPU – incl. solvents**: Mirela Polijanac, Ardi Link, Nadine Allemand
- **Agriculture:** Rikke Albrektsen, Richard German, Bernard Hyde
- **Waste:** Céline Gueguen, Katja Pazdernik, Dirk Wever

This year, the review started with a desk review of the NECD submissions for SO_2, NO_X, $PM_{2.5}$, NH_3, NMVOC and PM_{10} and of flexibility applications under Article 5 of the NECD, which lasted for five weeks. Member States then had two weeks to reply to questions from the desk

reviewers. After this, the centralised review took place for one week, during which the TERT could send follow-up questions to Member States.

7. The desk review and centralised review were coordinated by the project team (led by Sabine Schindlbacher and Chris Dore).

8. The EEA Review Secretariat led by Agnieszka Griffin supported the 2023 NECD inventory review.

9. The review was performed on the basis of NECD emission data officially reported by Germany by 15 February 2023 for emission inventories. The Informative Inventory Reports (IIR) reported by 15 March 2023 under the NECD informed the review. Resubmissions and other additional information officially submitted by Member States were taken into account until 27 April 2023.

10. To avoid any potential conflicts of interest, the lead reviewers and sector experts did not review emission inventories of Member States where these individuals had themselves contributed to the compilation of that inventory, or presently are or have been part of the decision-making process related to the compilation of that inventory. Reviewers who are nationals of the Member State whose inventory is concerned, did not act as main sector expert for this Member State.

11. All sector experts signed confidentiality agreements in which they agreed to keep information received by Member States confidential.

12. Definitions for findings included in the Final Review Report can be found in Table 2.

Table 2: Definitions for finding classifications of the 2023 NECD inventory review.

Recommendation	A finding where an identified issue has not been resolved during the course of the review, but which is not above the threshold of significance.
RE	Revised estimate: a new estimate a Member State has provided in response to an issue raised (finding) by the TERT during the course of the review.
UPTC	Unquantified potential technical correction: findings for which quantifying a technical correction is not currently possible by the TERT. This is for cases where the expected impact is likely to exceed the determined thresholds of significance, but it is not possible to quantify the technical correction as part of the review. The situations where this may arise include but are not limited to situations where Tier 1 methods are used to make emission estimates for a key category[7]. Where possible, issuing Unquantified potential technical corrections was avoided following the approach set out in item 36 of the Air Emission Inventory Review Guidelines 2023.
TC	Technical correction: Issued by the TERT for findings identified which result in an over- or under-estimate of more than a 0.5% of the national total in one of the reported years under review and where Member States did not provide a revised estimate which was accepted by the TERT.

[7] UPTCs were used in NECD inventory reviews prior to 2022. In the 2022 NECD inventory review, the TERT did not assign any issues as unquantified technical correction, but labelled issues for which uncertainty was too high and a quantification was not possible as recommendation. UPTCs were reintroduced in the 2023 NECD inventory review in order to clearly label issues where the TERT has not been able to quantify a potential technical correction.

IV. Overall assessment of the quality of the submissions

13. The technical expert review team considers the inventory submission to be of good quality in terms of completeness and accuracy. The IIR describes the methods transparently, but improvements could be made related to the solvent use categories.

14. To improve the quality of these submissions, the TERT suggests that Germany:

- improve completeness by calculating missing emissions for sources even if the emissions are expected to be small, e.g. recommendations DE-2D3c-2022-0001 and DE-3B4h-2022-0001;
- further improve the transparency of the IIR by providing detailed information on activity data and allocations, e.g. recommendations DE-2D-2023-0001 and DE-2D3i-2023-0001.

15. The technical expert review team considers that it received responses from Germany that were sufficient in order to undertake the NECD Review 2023.

V. Findings and Conclusions from the TERT for the in-depth review of national emission inventories for NO_X, NMVOC, SO_2, NH_3, $PM_{2.5}$ and PM_{10}

16. The TERT assessed the implementation of all findings from the 2022 NECD inventory review.

17. The TERT carried out in-depth checks to verify the transparency, accuracy, consistency, comparability and completeness of the main pollutants and PM_{10} inventory. The focus was on the years 2005 and 2019 to 2021.

18. The assessment was based on the emission inventory submitted in 2023 by Germany pursuant to Directive (EU) 2016/2284 and on the German review report from the 2022 NECD inventory review.

19. Resubmissions and other additional information provided by Member States during the review were taken into account until 27 April 2023.

20. Table 3 gives an overview of the number of recommendations, revised estimates and technical corrections for NO_X, NMVOC, SO_2, NH_3, $PM_{2.5}$ and PM_{10} that are described in detail in Table 4. The table also shows the number of recommendations, revised estimates, technical corrections and unquantified potential technical corrections that were included in the 2023 NECD inventory review reports for other Member States in the form of a range from lowest to highest number.

21. Table 4 provides all the findings from the TERT related to NO_X, NMVOC, SO_2, NH_3, $PM_{2.5}$ and PM_{10}, including those additionally made during the 2023 NECD inventory review and those not implemented from the 2022 NECD inventory review. The implementation of the recommendations will be followed up in the 2024 NECD inventory review.

Table 3: Overview of the number of findings included in the 2023 NECD inventory review report related to NO_X, NMVOC, SO_2, NH_3, $PM_{2.5}$ and PM_{10}[8]

	TC*	RE*	UPTC*	Recommendation
Number of findings included in the 2023 Review Report (see Table 4 below)	**0**	**0**	**0**	**13**
(Range for all Member States)	(0-7)	(0-4)	(0-2)	(4-40)

* TC = technical correction, RE = revised estimate, UPTC = unquantified potential technical correction

[8] The numbers here represent the sum of findings originally issued in previous years and not yet implemented and of new findings first issued as part of the 2023 NECD inventory review.

Table 4: All findings for NO_x, NMVOC, SO_2, NH_3, $PM_{2.5}$ and PM_{10}, including those made during the 2023 NECD inventory review and those not implemented from the 2022 NECD inventory review

Review year of initial recommendation (number of years it has been recommended)	Observation	Key Category	NFR, Pollutant(s), Year(s)	RE, TC in 2022	RE, TC, or UPTC in 2023	Tier 1 used for Key Category
2023 (1)	DE-1A3di(i)-2023-0002	No	1A3di(i) International Maritime Navigation - Memo Item, $PM_{2.5}$, 2005	NA	No	No
Recommendation For 1A3di(i) International maritime navigation - Memo Item and $PM_{2.5}$ for 2005, the TERT notes that there is a lack of transparency regarding the applied emissions factors (EF) presented in Table 2 of 1A3di(i) section in Germany's IIR. In response to a question raised during the review, Germany informed the TERT that basic emission factors are derived from the 2019 EMEP/EEA Guidebook and adapted in the country-specific model to take into account the impact of decreasing sulphur contents in fuels. The TERT notes the evolution of SO_2 and $PM_{2.5}$ EFs for this category reflect the evolution of world regulation. However, this does not explain why Germany has the highest $PM_{2.5}$ implied emission factor (IEF) when compared to the other Member States for the same category and year, while the SO_2 IEF is comparable to the average. Germany answered that the assumptions and procedures used to develop the annual country-specific PM emission factors will be further checked by the experts for the next annual submission. **The TERT recommends that Germany include the assumptions that explain this issue in the 2024 submission.**						
Review year of initial recommendation (number of years it has been recommended)	Observation	Key Category	NFR, Pollutant(s), Year(s)	RE, TC in 2022	RE, TC, or UPTC in 2023	Tier 1 used for Key Category
2022 (2)	DE-2-2022-0002	No	2 Industry, SO_2, NO_x, NH_3, NMVOC, $PM_{2.5}$, BaP, PAHs, PCBs, HCB, Cd, Hg, Pb, PCDD/F, PM_{10}, CO, BC, TSP, 1990-2021	No	No	No
Assessment of the implementation of the initial recommendation For 2C4 Magnesium production and all pollutants for all years, the TERT noted that there is a lack of transparency regarding the use of notation keys. This does not relate to an over- or under-estimate of emissions. Germany reports emissions from this category as 'NE' or 'NA'; the notation key 'IE' is not used, while in the IIR it is stated: There is no primary magnesium production in Germany (not occurring - 'NO'). Any emissions from the production of secondary magnesium are reported in sub-category 1A2b. In response to a question raised during the review, Germany responded that the notation keys for 2C4 in the NFR tables were not consistent with the description in the IIR. In Germany, secondary production of magnesium occurs in some rather small foundries and that in addition to emissions arising from combustion activities in the production process, dust and metals could also be emitted as process emissions. Germany also noted that for these pollutants no emission factors are available in neither the 2019 EMEP/EEA Guidebook nor from other sources and hence, the right notation key for them is 'NE', while for combustion related pollutants (NO_x, NMVOC, SO_2, NH_3 and CO), the correct notation key is 'IE'. Germany indicated that the notation keys will be changed and the IIR text updated in the next submission. **The TERT recommends that Germany change the notation keys and include the explanation in the IIR in the next submission.**						

Review year of initial recommendation (number of years it has been recommended)	Observation	Key Category	NFR, Pollutant(s), Year(s)	RE, TC in 2022	RE, TC, or UPTC in 2023	Tier 1 used for Key Category
2023 (1)	DE-2A5a-2023-0001	Yes	2A5a Quarrying and Mining of Minerals other than Coal, $PM_{2.5}$, PM_{10}, TSP, 1990-2021	NA	No	Yes

Recommendation

For 2A5a Quarrying and mining of minerals other than coal, pollutants PM_{10}, $PM_{2.5}$ and TSP, all years, the TERT notes that a Tier 1 method is applied for a part of a key category. The IIR for the 2023 submission describes that this category consists of two parts: (1) sands and rocks, and (2) salts. For sand and rocks, a Tier 2 methodology is used, but for salts, a Tier 1 methodology is used. The table at the top of the section in the online IIR states that a Tier 1 methodology is used. Partial use of a Tier 1 method may lead to over-/under-estimation of emissions that is above the threshold of significance. In response to a question, Germany answered that the overview table is wrong, and that it should be corrected to Tier 1/Tier 2. The Tier 2 methodology for the extraction of sands and rocks represents an overwhelming majority of the emissions from this sector. The Tier 1 methodology for the emissions from salt mining represents only a small portion of emissions from this sector - about 4%, depending on the PM fraction. Considering the limited scale of the activity, the issue can be considered to be below the significance threshold for a technical correction. It was not clear how Germany had estimated the share of 4%.

The TERT recommends that Germany include an explanation for how the 4% has been determined in the next submission.

Review year of initial recommendation (number of years it has been recommended)	Observation	Key Category	NFR, Pollutant(s), Year(s)	RE, TC in 2022	RE, TC, or UPTC in 2023	Tier 1 used for Key Category
2023 (1)	DE-2D-2023-0001	No	2D Non Energy Products from Fuels and Solvent Uses, SO_2, NO_X, NH_3, NMVOC, $PM_{2.5}$, BaP, PAHs, PCBs, HCB, Cd, Hg, Pb, PCDD/F, PM_{10}, CO, BC, TSP, 1990-2021	NA	No	No

Recommendation

For 2D3a Domestic solvent use including fungicides, 2D3d Coating applications, 2D3e Degreasing, 2D3f Dry cleaning, 2D3g Chemical products, 2D3h Printing, 2D3i Other solvent use, 2G Other product use, all pollutants for all years, the TERT notes that there is a lack of transparency regarding reporting of activity data. For categories 2D3a, 2D3g, 2D3h, 2D3i, 2G, activity data are reported with notation key ´NA´ (Not Applicable), and for 2D3d, 2D3e, 2D3f empty cells are reported. In the IIR, the time series of activity data used for the emission calculations is missing. This does not relate to an over- or under-estimate of emissions. In response to a question raised during the review, Germany explained that in the national NFR tables the notation key ´NA´ for activity data is used for those categories where the activity of different products cannot be summed (e.g. 2G includes amounts of firework, tobacco and charcoal used), and their contribution to emissions of pollutants is different (e.g. only fireworks causes SO_2 emissions, and NMVOC emissions are only caused by tobacco consumption and CO emissions are caused by both fireworks and tobacco consumption). Germany also noted that if the amount of charcoal is included as activity data, this will skew the implied emission factors. In Germany's view the best notation key for activity data for the category 2G will remain ´NA´. Germany will check whether a value could be filled in or whether the notation key ´NA´ must be used for 2D3d, 2D3e and 2D3f in the 2024 submission. The TERT agrees with Germany that for some categories notation key ´NA´ can be used for activity data when the NFR tables does not allow it to be reported in a meaningful way, that the activity data should be estimated and included in the IIR. Where activity data is not provided in the IIR, the correct notation key would be ´NE´ (Not Estimated). Germany stated it will endeavour to report activity data in the NFR and/or IIR. For 2D3h, the activity data is confidential, will be reported as ´C´ in the next submission.

The TERT recommends that Germany include activity data in the NFR, where possible, and when it is not meaningful to include it in the NFR, to include the activity data in the IIR.

Review year of initial recommendation (number of years it has been recommended)	Observation	Key Category	NFR, Pollutant(s), Year(s)	RE, TC in 2022	RE, TC, or UPTC in 2023	Tier 1 used for Key Category
2023 (1)	DE-2D3a-2023-0001	Yes	2D3a Domestic Solvent Use Including Fungicides, NMVOC, 1990-2021	NA	No	No

Recommendation

For 2D3a Domestic solvent use including fungicides and NMVOC for 1990-2021, the TERT notes that there is a lack of transparency regarding reporting of NMVOC emissions for household disinfectant products and hand sanitizers in the IIR. This does not relate to an over- or under-estimate of emissions. In response to a question raised during the review, Germany explained that NMVOC emissions from household disinfectant products and hand sanitizers are included in the inventory but due to different classifications there are no stand-alone national figures for them. In the national production statistics, disinfectants are counted under the registration number 2041 32 599 (alcohol cleaner, liquid and non-liquid); this registration number also includes all-purpose floor cleaner. Germany stated its intent to improve the description for 2D3a Domestic solvent use in the 2024 IIR.

The TERT recommends that Germany include this information in the IIR for the next submission.

Review year of initial recommendation (number of years it has been recommended)	Observation	Key Category	NFR, Pollutant(s), Year(s)	RE, TC in 2022	RE, TC, or UPTC in 2023	Tier 1 used for Key Category
2022 (2)	DE-2D3c-2022-0001	No	2D3c Asphalt Roofing, $PM_{2.5}$, PM_{10}, 1990-2021	No	No	No

Assessment of the implementation of the initial recommendation

For 2D3c Asphalt roofing and $PM_{2.5}$ and PM_{10} for all years, the TERT notes that Germany uses the notation key 'NA' (not applicable) whilst a Tier 1 method is available in the 2019 EMEP/EEA Guidebook. Hence, there may be an under-estimation of emissions. Due to a lack of applicable activity data for the 2019 EMEP/EEA Guidebook methodology, the TERT is unable to determine if this under-estimate is above or below the threshold of significance. This was raised during the 2022 NECD inventory review. Germany performed calculations to document that the issue was below the threshold of significance. However, the TERT notes that the notation key 'NA' is still used rather than including an emission estimate or changing notation key to 'NE'.

The TERT recommends that Germany implement the recommendation to preferably include an emission estimate, or if this is not possible, to change the notation key and provide a justification in the next IIR submission.

Review year of initial recommendation (number of years it has been recommended)	Observation	Key Category	NFR, Pollutant(s), Year(s)	RE, TC in 2022	RE, TC, or UPTC in 2023	Tier 1 used for Key Category
2023 (1)	DE-2D3e-2023-0001	Yes	2D3e Degreasing, NMVOC, 1990-1993	NA	No	No

Recommendation

For 2D3e Degreasing and NMVOC in the period 1990-1993, the TERT notes that there is a trend inconsistency, and no category-specific improvements are planned. Germany uses the same numerical value (113.99 kt) for NMVOC emissions for 1990-1993 which is approximately 2.8 times higher than average numerical value (40.54 kt) of the period 1994-2021. In response to a question raised during the review, Germany explained that a rough expert estimation was made for one year and applied to 1990-1993 due to a lack of updated expert estimations for these years, and that from 1994 onwards, more detailed data was available allowing for more reliable emission estimations but causing a drop in emissions from 1993 to 1994. Germany stated that the only possible solution to smooth the drop in emissions is to interpolate emissions from 1990 to 1994. However, it would not be possible to check the accuracy of this method, and it would be more accurate to maintain existing drop. The TERT notes that the issue is below the threshold of significance for a technical correction related to a non-mandatory year.

The TERT recommends that Germany investigate the possibility of using surrogate data (i.e. the Gross Domestic Product for Industry linked to 2D3e) to create a more realistic estimation for the years 1990-1993.

Review year of initial recommendation (number of years it has been recommended)	Observation	Key Category	NFR, Pollutant(s), Year(s)	RE, TC in 2022	RE, TC, or UPTC in 2023	Tier 1 used for Key Category
2023 (1)	DE-2D3i-2023-0001	Yes	2D3i Other Solvent Use, NMVOC, 1990-2021	NA	No	No

Recommendation

For 2D3i Other solvent use, NMVOC, for all years, the TERT notes that there is a lack of transparency regarding allocation of activities. The NMVOC emissions from activities: plant protectives, concrete additives and use of lubricants are reported in category 2D3i instead of in 2G Other product use as defined in the 2019 EMEP/EEA Guidebook. Also, as stated in the IIR, the NMVOC emissions from cooling lubricants, lubricants and use of shoes are not reported. In response to a question raised during the review, Germany did not agree with the TERT findings and explained that moving emissions to 2G will not increase transparency as all NMVOC emissions will be agglomerated e.g. with emissions from tobacco, and this change will not align with the reporting of greenhouse gases where lubricants are allocated to 2D. Germany clarified that cooling lubricants are part of metalworking fluids, as reported in their IIR. From the 2019 EMEP/EEA Guidebook they could not see a requirement to report NMVOC emissions related to the use of shoes as only the manufacturing of shoes is included in 2G. The manufacturing of shoes is included in 2D3i application of glues and adhesives.

The TERT recommends that Germany consider the allocation of NMVOC emissions from lubricants, concrete additives and plant protectives to source category 2G and provide information for not calculating the emission from use of shoes, and clarification about reporting NMVOC from lubricants and cooling lubricants in the 2024 submission.

Review year of initial recommendation (number of years it has been recommended)	Observation	Key Category	NFR, Pollutant(s), Year(s)	RE, TC in 2022	RE, TC, or UPTC in 2023	Tier 1 used for Key Category
2022 (2)	DE-3B4h-2022-0001	No	3B4h Manure Management - Other Animals, NH_3, NMVOC, 1990-2021	No	No	No

Assessment of the implementation of the initial recommendation

For 3B4h Manure management - Other animals, NMVOC and NH_3 for 1990-2021, the TERT notes that the notation key 'NE' (not estimated) is used. This was raised during the 2022 NECD inventory review. The TERT notes that the issue is below the threshold of significance for a technical correction. The TERT notes that the IIR chapter 8.2 states that the issue has been included in the list of

improvements and that the recommendation will be addressed in the 2024 submission.

The TERT reiterates the recommendation that Germany collect the necessary data and estimate and report the emissions from 3B4h Manure management - Other animals (rabbits, ostrich and fur-bearing animals) in the next submission.

Review year of initial recommendation (number of years it has been recommended)	Observation	Key Category	NFR, Pollutant(s), Year(s)	RE, TC in 2022	RE, TC, or UPTC in 2023	Tier 1 used for Key Category
2023 (1)	DE-3Da2c-2023-0001	No	3Da2c Other Organic Fertilisers Applied to Soils (including compost), NO_X, 1990-2021	NA	No	No

Recommendation

For 3Da2c Other organic fertilisers applied to soils (including compost) and NO_X for all years, the TERT notes that there is a lack of transparency regarding conversion of NO to NO_X in the IIR Chapter 3.D.a.2.c – Methodology. This does not relate to an over- or under-estimate of emissions. In response to a question raised during the review, Germany explained that emission factor for NO_X for 3D is obtained by multiplying 0.012 kg NO-N per kg N (EF from Stehfest and Bouwman (2006) with the molar weight ratio 46/14 for NO_2:NO, but that Germany calculates NO_X emissions as if they were NO emissions (which have to be converted to NO_X emissions by using the factor 46/30).

The TERT recommends that Germany harmonise the description of conversion of the emission factor for NO_X throughout all Chapters for 3D Agricultural soils in the IIR in the next submission.

Review year of initial recommendation (number of years it has been recommended)	Observation	Key Category	NFR, Pollutant(s), Year(s)	RE, TC in 2022	RE, TC, or UPTC in 2023	Tier 1 used for Key Category
2023 (1)	DE-3Dc-2023-0001	No	3Dc Farm-Level Agricultural Operations including Storage, Handling and Transport of Agricultural Products, $PM_{2.5}$, PM_{10}, TSP, 1990-2021	NA	No	No

Recommendation

For 3Dc Farm-level agricultural operations including storage, handling and transport of agricultural products, $PM_{2.5}$, PM_{10} and TSP, 1990-2021, the TERT notes that there is a lack of transparency regarding the IIR Chapter 3.D –Agricultural soils because in the overview table it is stated that a Tier 1 method is used, but in the Chapter 3.D.c it is stated that a Tier 2 method is used. This does not relate to an over- or under-estimate of emissions. In response to a question raised during the review, Germany explained that the Tier 2 method was used for the calculations and that Tier 1 in the overview table is an error.

The TERT recommends that Germany correct the error in the IIR in the next submission.

Review year of initial recommendation (number of years it has been recommended)	Observation	Key Category	NFR, Pollutant(s), Year(s)	RE, TC in 2022	RE, TC, or UPTC in 2023	Tier 1 used for Key Category

2023 (1)	DE-5A-2023-0001	No	5A Biological Treatment of Waste - Solid Waste Disposal on Land, $PM_{2.5}$, PM_{10}, TSP, 1990-2021	NA	No	No

Recommendation

For 5A Biological treatment of waste - Solid waste disposal on land, $PM_{2.5}$, PM_{10} and TSP and for all years, the TERT noted that the activity data used does not include all amounts of mineral waste handled. In the IIR, activity data are described as total amount of solid waste (AD) treated in managed above-ground landfilling. However, the particulate original emission factor reference is from US EPA 2006 (chapter 13.2.4 Miscellaneous sources/aggregate handling and storage piles/table), in which AD is presented as the amount of waste handled (especially mineral waste). The definition of this term is provided (sand, clay, misc. fill materials) and includes handling of construction/demolition waste. Consequently, the TERT considers, the activity data to be the total amount of waste handled (including reuse as backfilling) and not only waste disposed in landfills. This under-estimate does not have an impact on total emissions that is above the threshold of significance. Data is available from Eurostat for EU Member states. In response to a question raised during the review, Germany confirmed that the statistics used for the "total amount of solid waste (AD) treated in managed above-ground landfilling" contains the German mineral/construction/demolition wastes accordingly.

The TERT recommends that Germany estimate PM emissions from all mineral waste handled (including backfilling) in the 2024 submission or provide a justification in the IIR that the estimate includes all relevant emissions.

Review year of initial recommendation (number of years it has been recommended)	Observation	Key Category	NFR, Pollutant(s), Year(s)	RE, TC in 2022	RE, TC, or UPTC in 2023	Tier 1 used for Key Category
2023 (1)	DE-5E-2023-0001	Yes	5E Other Waste, $PM_{2.5}$, PM_{10}, 1990-2021	NA	No	No

Recommendation

For 5E Other Waste, $PM_{2.5}$ and PM_{10} and for all years, the TERT notes that there is a lack of transparency regarding the methodological description. Indeed, Germany is not applying the default emission factor proposed in the 2019 EMEP/EEA Guidebook to the total number of fires but to a full-scale equivalent number of fires. There is no detailed description of this country specific approach in the online IIR. In particular, the conversion of different types of fires to full-scale fires is not explained and there is no justification that the default emission factors refer to full-scale fires. In response to a question raised during the review, Germany provided a more detailed, but incomplete, methodological description. This does not relate to an over- or under-estimate of emissions.

The TERT recommends that Germany include the information provided during the review (weighting factors applied for each type of buildings/car fires in order to derive the number of full-scale fires, justification that the default emission factors refer to full-scale burning) and complete the description with detailed activity data split by type of fire (small, medium, major) and category of buildings, including the sources of the data.

VI. Effect of revised estimates, technical corrections and flexibilities recommended to be approved on the national total and national total for compliance

22. The tables below show the changes to the national totals and national totals for compliance resulting from the 2023 NECD inventory review. These changes include all revised estimates, technical corrections and flexibility assessments. The tables also show the impact that these changes have on the reported national total (row 141, Annex I) and national total for compliance (row 154, Annex I).

23. For the years 2020 and 2021, the national emission reduction commitments 2020 to 2029, as set out in Directive (EU) 2016/2284, have been applied to the 2005 emissions to express the maximum allowed emission per annum in absolute numbers in order to allow for a comparison with the national total for compliance. 2005 emissions (E_{2005}) reported in the 2023 inventory submission after taking into account any technical corrections and revised estimates were used for the calculation. The emission reduction commitment for 2020 to 2029 from the NECD was applied to E_{2005}, which gives the maximum allowed emission per year ($MaxE_{p.a.}$). If the national total reported for a given year and after taking into account any technical corrections and revised estimates is smaller than $MaxE_{p.a.}$, then compliance in that year is considered achieved. If not, a flexibility application can be considered.

Table 5: National totals for compliance as reported and, where relevant, national totals for compliance[9] including revised estimates (RE), technical corrections (TC) and flexibility applications for NO_X, NMVOC, SO_2, NH_3, $PM_{2.5}$, PM_{10} and maximum national allowed emissions calculated on the basis of the national emission reduction commitments [10]

Description	Reference	Pollutant estimates (kt)			
		2005	2019	2020	2021
NO_X					
National total (row 141)	Annex I, 10/02/2023	1,616.365	1,107.200	975.646	968.780
National Total for Compliance (row 154)	Annex I, 10/02/2023	1,497.106	-	865.668	860.953
Maximum allowed emissions stemming from the National Emission Reduction Commitments		-	-	913.235	913.235
NMVOC					
National total (row 141)	Annex I, 10/02/2023	1,490.211	1,066.245	1,028.445	1,044.191
National Total for Compliance (row 154)	Annex I, 10/02/2023	1,184.141	-	732.371	753.606
Maximum allowed emissions stemming from the National Emission Reduction Commitments		-	-	1,030.203	1,030.203
SO_2					
National total (row 141)	Annex I, 10/02/2023	473.115	260.559	241.263	254.469
National Total for Compliance (row 154)	Annex I, 10/02/2023	473.115	-	241.263	254.469
Maximum allowed emissions stemming from the National Emission Reduction Commitments		-	-	373.761	373.761
NH_3					
National total (row 141)	Annex I, 10/02/2023	611.944	570.449	529.778	515.770
National Total for Compliance (row 154)	Annex I, 10/02/2023	611.944	-	529.778	515.770
Maximum allowed emissions stemming from the National Emission Reduction Commitments		-	-	581.347	581.347
$PM_{2.5}$					
National total (row 141)	Annex I, 10/02/2023	135.215	90.213	81.464	83.388
National Total for Compliance (row 154)	Annex I, 10/02/2023	135.215	-	81.464	83.388

[9] The national total for compliance is based on fuel sold data. For NMVOC and NO_x, emissions from agriculture (3B and 3D) were subtracted from the national total.

[10] The tables presented in this report show numbers rounded to three decimal places for presentation purposes. However, for all calculations, all available decimal places were used. Therefore, a calculation undertaken with the data with three decimal places shown in this table may lead to slightly different results than from the calculations undertaken with the precise data used for the assessment.

Description	Reference	Pollutant estimates (kt)			
		2005	2019	2020	2021
Maximum allowed emissions stemming from the National Emission Reduction Commitments		-	-	100.059	100.059
PM_{10}					
National total (row 141)	Annex I, 10/02/2023	248.767	195.887	182.126	183.993

VII. Compliance with Emission Reduction Commitments (ERCs)

24. The national emission reduction commitments listed in Annex II of the NEC Directive 2016/2284 are applicable from 2020 to 2029. Therefore, the 2023 NECD inventory review included a compliance check of 2020 and 2021 air pollutant emission data against emission reduction commitments for 2020 to 2029 for the pollutants NO_X, NMVOC, SO_2, NH_3 and $PM_{2.5}$.

25. Table 6 provides an overview of Germany's compliance with the emission reduction commitments for the pollutants NO_X, NMVOC, SO_2, NH_3 and $PM_{2.5}$ for emissions 2020 and 2021. 2005 emissions reported in 2023 (E_{2005})[11] were used to perform the calculations underlying the compliance check. The % emission reduction commitment from the NEC Directive was applied to E_{2005}, which gives the maximum allowed emission per year ($MaxE_{p.a.}$) in the period 2020-2029. If the national total for compliance for a given year including technical corrections (accepted by the Member State), revised estimates (accepted by the TERT) and flexibility applications (which the TERT recommended DG Env to accept) (see also Table 5) is smaller than $MaxE_{p.a.}$, compliance is considered achieved in that given year.

26. Table 6 provides an overview of the margin of compliance and non-compliance with the emission reduction commitments for NO_X, NMVOC, SO_2, NH_3 and $PM_{2.5}$ in 2020 and 2021. Percentages express how much the national totals for compliance need to be reduced by (in case of percentages >0) to meet emission reduction commitments or, in case of percentages <0, how much the national total could increase by, while remaining compliant[12]. Green cells indicate where compliance is achieved, and red cells indicate where compliance is not achieved.

[11] National total for compliance estimates including revised estimates accepted by the TERT, technical corrections accepted by Member State and, where applicable, inventory adjustment applications which the TERT recommended DG ENV to accept (see also Table 5) were used as E_{2005}.

[12] The compliance margins were calculated using all decimal places provided by the Member State.

Table 6: Overview of compliance with emission reduction commitments based on 2023 inventory submission[13]

Pollutants	National total for compliance (kt) 2005	Emission reduction commitments 2020-2029	Maximum allowed emissions per year 2020-2029 (kt)[a]	National total for compliance (kt) 2020	National total for compliance (kt) 2021	Compliant in 2020	Compliant in 2021
NO_X	1,497.106	-39%	913.235	865.668	860.953	-5%	-6%
NMVOC	1,184.141	-13%	1,030.203	732.371	753.606	-41%	-37%
SO_2	473.115	-21%	373.761	241.263	254.469	-55%	-47%
NH_3	611.944	-5%	581.347	529.778	515.770	-10%	-13%
$PM_{2.5}$	135.215	-26%	100.059	81.464	83.388	-23%	-20%

[a] $MaxE_{p.a.} = E_{2005}$ -% emission reduction commitments 2020-2029 x E_{2005}

[13] The tables presented in this report show numbers rounded to three decimal places for presentation purposes. However, for all calculations, all available decimal places were used. Therefore, calculations undertaken with the data with three decimal places shown in this table may lead to slightly different results than calculations undertaken with the precise data used for the assessment.

27. Germany is in compliance with its national emission reduction commitment for NO_X in 2020 and is in compliance with its national emission reduction commitment for NO_X in 2021 (Figure 1).

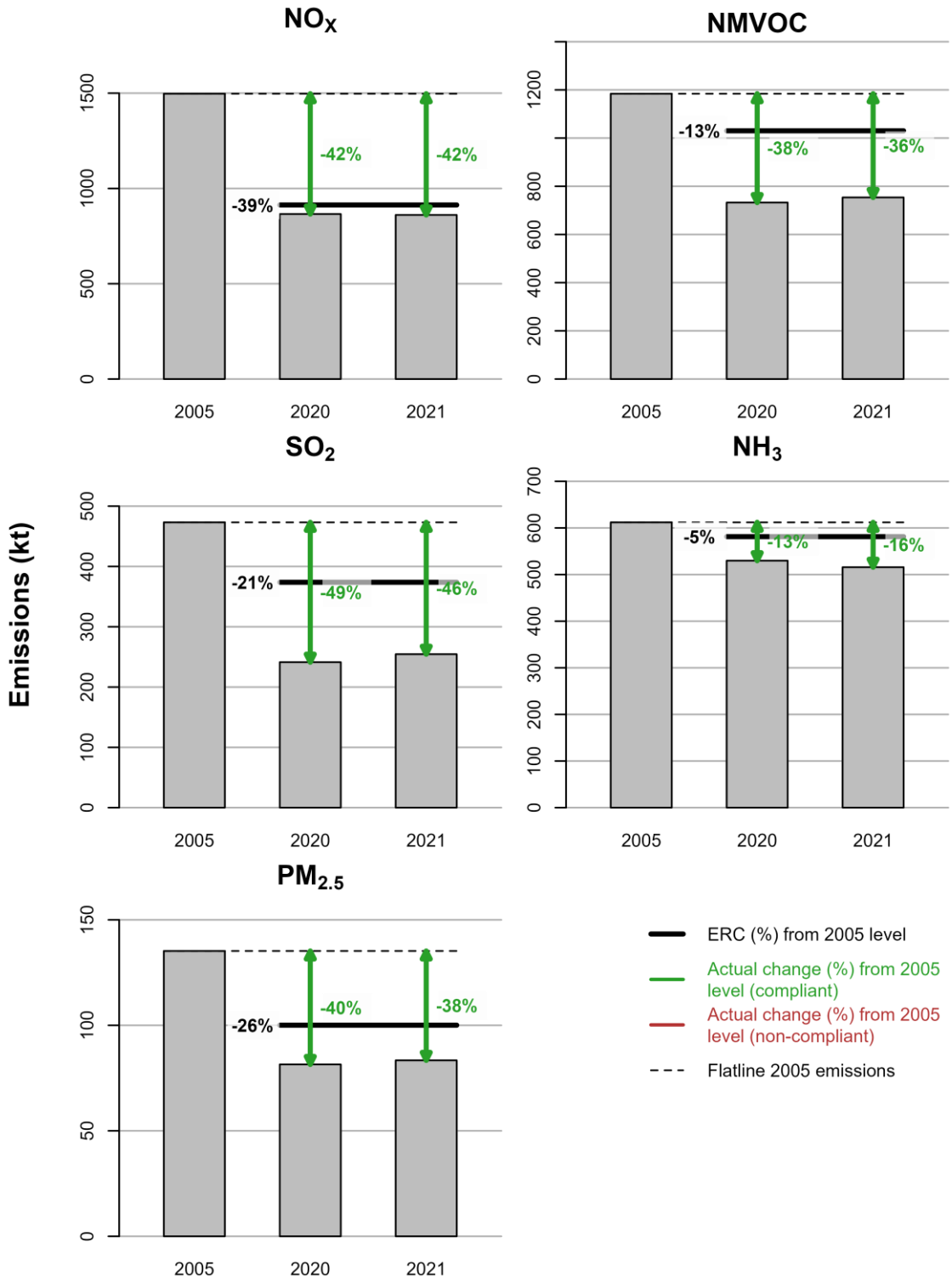
28. Germany is in compliance with its national emission reduction commitment for NMVOC for 2020 and is in compliance with its national emission reduction commitment for NMVOC for 2021 (Figure 1).

29. Germany is in compliance with its national emission reduction commitment for SO_2 for 2020 and is in compliance with its national emission reduction commitment for SO_2 for 2021 (Figure 1).

30. Germany is in compliance with its national emission reduction commitment for NH_3 for 2020 and is in compliance with its national emission reduction commitment for NH_3 for 2021 (Figure 1).

31. Germany is in compliance with its national emission reduction commitment for $PM_{2.5}$ for 2020 and is in compliance with its national emission reduction commitment for $PM_{2.5}$ for 2021 (Figure 1).

Figure 1: Visual illustration of compliance with emission reduction commitments for NO_X, NMVOC, SO_2, NH_3 and $PM_{2.5}$[14]



[14] The compliance checks are based on absolute numbers using all decimal places provided by the Member State. Figure 1 serves only as visual illustration.

VIII. Statement from Germany on the conclusions presented by the TERT

32. Germany agrees with the calculated estimates in Table 5.

IX. TERT response to the statement from Germany

33. Germany did not raise any issues with the calculated estimates presented in Table 5 and therefore no response from the TERT is required.

ANNEX I Technical corrections deemed necessary by the TERT and revised estimates provided by Germany

34. Germany did not have any Technical Corrections or Revised Estimates in the NECD Review 2023.

35. The TERT calculated technical corrections for cases:

- where it did not agree with the way in which a revised estimate or technical correction from the 2022 NECD inventory review was implemented and where no revised estimate was accepted by the TERT during the 2023 review
- and where the suggested finding of the TERT would change the National Total by more than 0.5% and where no revised estimate was accepted by the TERT during the review.

36. The methods for calculating the technical corrections are set up in the appendix to UNECE EB decision 2018/1 on technical revisions[15] and use the 2019 EMEP/EEA Inventory Guidebook as a reference for methods and emission factors.

[15] ECE/EB.AIR/142/Add.1

References and Supporting Documents

Annex I emission reporting template. Available at https://www.ceip.at/reporting-instructions

ECE/EB.AIR/111/Add.1: Decision 2012/3: Adjustments under the Gothenburg Protocol to emission reduction commitments or to inventories for the purposes of comparing total national emissions with them https://unece.org/DAM/env/documents/2013/air/ECE_EB.AIR_111_Add.1__ENG_DECISION_3.pdf

ECE/EB.AIR/113/Add.1: Decision 2012/12: Guidance for adjustments under the 1999 Protocol to Abate Acidification, Eutrophication and Ground-level Ozone to emission reduction commitments or to inventories for the purposes of comparing total national emissions with them https://unece.org/DAM/env/documents/2012/EB/Decision_2012_12.pdf

ECE/EB.AIR/125: 2014 Reporting Guidelines for Estimating and Reporting Emission Data under CLRTAP https://unece.org/fileadmin/DAM/env/documents/2013/air/eb/ece.eb.air.125_E_ODS.pdf

ECE/EB.AIR/127/Add.1: Decision 2014/1: Improving the guidance for adjustments under the 1999 Protocol to Abate Acidification, Eutrophication and Ground-level Ozone to emission reduction commitments or to inventories for the purposes of comparing total national emissions with them https://unece.org/DAM/env/documents/2014/AIR/EB/Decision_2014_1.pdf

ECE/EB.AIR/130: Technical Guidance for Parties Making Adjustment Applications and for the Expert Review of Adjustment Applications, 14 April 2015 https://unece.org/DAM/env/documents/2014/AIR/EB/ECE_EB_AIR_130_ENG.pdf

ECE/EB.AIR/142/Add.1: Decision 2018/1: Updated methods and procedures for the technical reviews of air pollutant emission inventories reported under the Convention https://www.ceip.at/fileadmin/inhalte/ceip/00_pdf_other/2019/decision_2018_1_advance_version_ece_eb.air_142_add.1.pdf

EEA 2023. Air pollution in Europe: 2023 reporting status under the National Emission reduction Commitments Directive, Copenhagen. https://www.eea.europa.eu/publications/national-emission-reduction-commitments-directive-2023

EMEP/EEA: EMEP/EEA air pollutant emission inventory guidebook 2013, EEA Technical report No 12/2013, European Environment Agency, Copenhagen. Available at: http://www.eea.europa.eu/publications/emep-eea-guidebook-2013

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EMEP/EEA: EMEP/EEA air pollutant emission inventory guidebook 2019, EEA Report No. 13/2019 European Environment Agency, Copenhagen. Available at: https://www.eea.europa.eu/publications/emep-eea-guidebook-2019 EU 2019

EU 2022. Dore C., Air Emission Inventory Review Guidelines 2022 https://circabc.europa.eu/ui/group/cd69a4b9-1a68-4d6c-9c48-77c0399f225d/library/d7783203-97d3-434a-a7a2-2f62ae1976e2/details?download=true

NEC Directive 2016, DIRECTIVE (EU) 2016/2284 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 14 December 2016 on the reduction of national emissions of certain atmospheric pollutants, amending Directive 2003/35/EC and repealing Directive 2001/81/EC. http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2016.344.01.0001.01.ENG

TFEIP (2022): "Inventory adjustments in the context of emission reduction commitments (ERC)" available at: https://www.ceip.at/fileadmin/inhalte/ceip/00_pdf_other/2022/technical_guidance_for_erc_adjustments_issue1.1.pdf