Final Review Report 2022

Review of National Air Pollutant Emission Inventory Data 2022 under Directive (EU) 2016/2284 (National Emission reduction Commitments Directive) Service Contract No. 070201/2019/8159797/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
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)
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 2022 (hereafter referred to as the '2022 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 2022 (and resubmitted before 29 April 2022) 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.

4. The specific objectives of the 2022 NECD inventory review were:

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

[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

corrections 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 2021 and 2022 national inventory submissions for the pollutants NO_X, NMVOC, SO_2, NH_3, $PM_{2.5}$ and PM_{10} for the years 2005, 2018 and 2019.
- A review of the time series consistency with a special focus on the years 2005, 2019 and 2020 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] In cases where recommendations from the 2021 review cover pollutants to be reviewed as part of the 2022 NECD inventory review (main pollutants and PM_{10}) **and** any other pollutants previously reviewed under the NECD inventory review (BC, CO, BaP, PAHs, PCBs, HCB, Cd, Hg, Pb, PCDD/F), recommendations were screened by the initial checks team to determine their relevance for the 2022 NECD inventory review. Those found to be of significance to the emission estimates of main pollutants or PM_{10} were passed to the review team for full assessment, i.e. covering both main pollutants and PM_{10} as well as any of the other pollutants, in the follow-up to the 2021 NECD inventory review that was conducted as part of the 2022 NECD inventory review.

[3] NECD inventory review 2021 reports are available at https://environment.ec.europa.eu/topics/air/reducing-emissions-air-pollutants/emissions-inventories_en#review-of-national-emission-inventories

[4] The year 2005 was compared to the years 2006 to 2010 and the year 2020 was compared to 2015 to 2019.

[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 2022 NECD inventory review is summarised in Table 1.

Table 1: Scope of the 2022 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 2022	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
Years	2005, 2018-2020	In addition, time series consistency between the years 2019 and 2020 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 during the desk review and centralised review.

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

- **Lead Reviewers:** Kevin Hausmann, Ole-Kenneth Nielsen, Anne Misra
- **Energy:** Marlene Schmidt Plejdrup , Stephan Poupa, Dirk Wever
- **Transport:** Jean-Marc André, Giannis Papadimitriou, Katrina Young
- **IPPU – excl. solvents:** Kristina Saarinen, Ils Moorkens, Robert Stewart
- **IPPU – incl. solvents**: Traute Köther, Emma Salisbury, Rianne Dröge
- **Agriculture:** Jeremy Wiltshire, Etienne Mathias, Mette Hjorth Mikkelsen
- **Waste:** Céline Gueguen, Elisabeth Kampel, Romain Bort

This year, the desk review started with a review of flexibility applications under Article 5 of the NECD. This was followed by an in-depth desk review of the NECD submissions for SO_2, NO_X, $PM_{2.5}$, NH_3, NMVOC and PM_{10}, which lasted for four 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 technical expert review team 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 Levente Molnar supported the 2022 NECD inventory review.

9. The review was performed on the basis of NECD emission data officially reported by Germany by 15 February 2022 for emission inventories. The Informative Inventory Reports (IIR) reported by 15 March 2022 under the NECD informed the review. Resubmissions and other additional information officially submitted by Member States were taken into account until 29 April 2022.

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 any 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 2022 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 technical expert review team (TERT) during the course of the review.
TC	Technical correction: Issued by the technical expert review team 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 technical expert review team (TERT)[7].

[7] In previous reviews, unquantified potential technical corrections were assigned to issues when it was not possible for the technical expert review team to calculate a technical correction during the timeframe of the review or with reasonable effort. In the 2022 review, the TERT did not assign any issues as unquantified technical corrections. The TERT sought to quantify all potential technical corrections thus ensuring that all major issues that could have an impact on compliance are quantified. If uncertainty was too high and a quantification was not possible the issue was labelled as recommendation.

IV. Overall assessment of the quality of the submissions

13. The technical expert review team considers the inventory submission to be of very good quality in terms of completeness and accuracy. The IIR generally describes the methods transparently, but improvements could be made especially related to IPPU (non-solvents) and the waste sector

14. To improve the quality of these submissions, the technical expert review team suggests that Germany:

- Improve completeness by calculating missing emissions for sources even if the emissions are expected to be small, e.g. recommendation DE-3B4h-2022-0001;
- Further improve the transparency of the IIR by providing detailed information on assumptions and methodologies e.g. recommendation DE-2-2022-0002, DE-2H1-2022-0002, DE-5-2022-0001.

15. The technical expert review team considers that it received responses from Germany that were sufficient in order to undertake the NECD inventory review 2022.

V. Findings and Conclusions from the technical expert review team 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 technical expert review team assessed the implementation of all findings related to main pollutants and PM_{10} from the 2021 NECD inventory review[8].

17. The technical expert review team 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 2018 to 2020.

18. The assessment was based on the emission inventory submitted in 2022 by Germany pursuant to Directive (EU) 2016/2284 and on the German review report from the 2021 NECD inventory review.

19. Resubmissions and other additional information provided by Member States during the review were taken into account until 29 April 2022.

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 44. The table also shows the number of recommendations, revised estimates and technical corrections that were included in the 2022 NECD inventory review reports for other Member States in the form of a range from lowest to highest number.

21. Table 44 provides all the findings from the technical expert review team related to NO_X, NMVOC, SO_2, NH_3, $PM_{2.5}$ and PM_{10} including those made during the 2022 NECD inventory review and those not implemented from the 2021 NECD inventory review. The implementation of the recommendations will be followed up in the 2023 NECD inventory review.

Table 3: Overview of the number of findings included in the 2022 NECD inventory review report related to NO_X, NMVOC, SO_2, NH_3, $PM_{2.5}$ and PM_{10}[9]

	TC*	RE*	Recommendation
Number of findings included in the 2022 Review Report (see Table 4 below)	**0**	**1**	**13**
(Range for All Member States)	(0-7)	(0-4)	(2-47)

* TC = technical correction, RE = revised estimate

[8] In cases where recommendations from the 2021 review covered pollutants to be reviewed as part of the 2022 NECD inventory review (main pollutants and PM_{10}) and any other pollutant previously reviewed under the NECD inventory review (BC, CO, BaP, PAHs, PCBs, HCB, Cd, Hg, Pb, PCDD/F), recommendations were screened by the initial checks team to determine their relevance for the 2022 NECD inventory review. Those found to be of significance to the emission estimates of main pollutants or PM_{10} were passed to the review team for assessment in the follow-up to the 2021 NECD inventory review conducted as part of the 2022 NECD inventory review.

[9] 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 2022 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 2022 NECD inventory review and those not implemented from previous reviews

Review year of initial recommendation (number of years it has been recommended)	Observation	Key Category	NFR, Pollutant(s), Year(s)	RE, TC or UPTC in 2021	RE or TC in 2022	Tier 1 used for Key Category
2022 (1)	DE-3Dc-2022-0001	Yes	3Dc Farm-Level Agricultural Operations Including Storage, Handling and Transport of Agricultural Products, PM_{10}, 1990-2020	NA	RE	Yes
Recommendation For 3Dc Farm-Level Agricultural Operations Including Storage, Handling and Transport of Agricultural Products and particulate matter for all years, the TERT noted that Germany estimated emissions using a Tier 1 while the category is key. In response to a question raised during the review, Germany explained that all data were not available, but national data were combined with data from a neighbouring country (Denmark). Germany provided a revised estimate for all years. The TERT agreed with the revised estimate provided by Germany. **The TERT recommends that Germany include the revised estimate in its 2023 NFR and IIR submission.**						
Review year of initial recommendation (number of years it has been recommended)	Observation	Key Category	NFR, Pollutant(s), Year(s)	RE, TC or UPTC in 2021	RE or TC in 2022	Tier 1 used for Key Category
2018 (5)	DE-1A4ciii-2018-0001	No	1A4ciii Agriculture/Forestry/Fishing: National Fishing, SO_2, NO_X, NH_3, NMVOC, $PM_{2.5}$, PAHs, PCBs, Cd, Hg, Pb, 2014-2020	No	No	No
Assessment of the implementation of the initial recommendation For category 1A4ciii Agriculture/Forestry/Fishing: National Fishing and Activity data, the TERT noted that there is a lack of transparency regarding the high increase from 2014 onwards. This does not relate to an over- or under-estimate of emissions. This was raised during the 2018, 2019, 2020 and 2021 NECD inventory reviews. In response to a question raised during the review, Germany explained that allocation of maritime fuel consumption to sub sectors is done via a model using AIS data. This model could misallocate fuel consumption between maritime sub-sectors, but as fishing fuel consumption is very low and even emission factors could be different, it could not be above the threshold. **The TERT recommends that Germany check the model based on AIS data and recalculate, if necessary, the time series by reallocating fuel consumption via the model and provide the relevant documentation in its 2023 IIR submission.**						
Review year of initial recommendation (number of years it has been recommended)	Observation	Key Category	NFR, Pollutant(s), Year(s)	RE, TC or UPTC in 2021	RE or TC in 2022	Tier 1 used for Key Category
2022 (1)	DE-1A5b-2022-0001	No	1A5b Other, Mobile (Including Military, Land Based and Recreational Boats), NO_X, 2005	NA	No	No

Recommendation
For category 1A5b Other, Mobile (Including Military, Land Based and Recreational Boats) and NO_X for 2005, the TERT noted that there is a lack of transparency regarding the emissions outlier in 2005 compared to 2000-2010 emissions. 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 strong increase in NO_X emissions from 1A5b in 2005 is dominated by an even stronger increase in diesel oil input together with the high NO_X emission factors for diesel combustion in military ground vehicles and vessels.
The TERT recommends that Germany include the explanation provided during the review in the 2023 IIR submission.

Review year of initial recommendation (number of years it has been recommended)	Observation	Key Category	NFR, Pollutant(s), Year(s)	RE, TC or UPTC in 2021	RE or TC in 2022	Tier 1 used for Key Category
2022 (1)	DE-1A5b-2022-0002	No	1A5b Other, Mobile (Including Military, Land Based and Recreational Boats), $PM_{2.5}$, 2005	NA	No	No

Recommendation
For category 1A5b Other, Mobile (Including Military, Land Based and Recreational Boats) and $PM_{2.5}$ for 2005, the TERT noted that there is a lack of transparency regarding the emissions outlier in 2005 compared to 2000-2010 emissions. 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 strong increase in $PM_{2.5}$ emissions from 1A5b in 2005 is dominated by an even stronger increase in diesel oil input together with the high $PM_{2.5}$ emission factors for diesel combustion in military ground vehicles and vessels.
The TERT recommends that Germany include the explanation provided during the review in the 2023 IIR submission.

Review year of initial recommendation (number of years it has been recommended)	Observation	Key Category	NFR, Pollutant(s), Year(s)	RE, TC or UPTC in 2021	RE or TC in 2022	Tier 1 used for Key Category
2022 (1)	DE-2-2022-0002	No	2 Industry, NA, 1990-2020	NA	No	No

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. Germany reports emissions from this category as 'NE' or 'NA' but for no pollutant the notation key 'IE' is 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. Furthermore, 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 not available either in the inventory Guidebook 2019 or from other sources and hence, the right notation key for them is 'NE'. Germany indicated that the notation keys will be changed and the IIR text updated in the next submission.
The TERT recommends Germany to change the notation keys and to include the related explanation 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 or UPTC in 2021	RE or TC in 2022	Tier 1 used for Key Category

2022 (1)	DE-2D3c-2022-0001	Yes	2D3c Asphalt Roofing, $PM_{2.5}$, PM_{10}, 1990-2020	NA	No	No

Recommendation
For 2D3c Asphalt Roofing and particulate matter for all years, the TERT noted that Germany did not provide estimates and was using the notation key 'NA' (not applicable) in its NFR. In response to a question raised during the review, Germany explained that the estimation is based on the manufactured area (m^2) and an emission factor for PM (g/Mg single). A conversion factor is not provided by the EMEP/EEA Guidebook and is country specific. Furthermore, Germany stated that in the country a wide product range is used. Germany provided data for 1990-2020 to demonstrate that the issue is below the threshold of significance and stated that it will further improve the emissions estimates by including emissions estimates derived from industrial observations.

The TERT recommends that Germany include emission estimates for 2D3c for particulate matter in the 2023 NFR, or otherwise reports on the progress made implementing this improvement in the 2023 IIR submission.

Review year of initial recommendation (number of years it has been recommended)	Observation	Key Category	NFR, Pollutant(s), Year(s)	RE, TC or UPTC in 2021	RE or TC in 2022	Tier 1 used for Key Category
2022 (1)	DE-2G-2022-0001	Yes	2G Other Product Use, SO_2, $PM_{2.5}$, PM_{10}, 2020	NA	No	No

Recommendation
The TERT noted with reference to NFR 2G Other Product Use, SO_X and particles and the related IIR chapter that there is a lack of transparency regarding the drop in the emissions in 2020 from the previous rather steady trend. This does not relate to an over- or under-estimate of emissions. In response to a question raised during the review, Germany explained that there were simple reasons behind the enormous drop of emission levels in 2020 as due to corona virus the official sale of fireworks for New Year`s Eve 2020/2021 was forbidden in December 2020 by the federal government and many events and festivities were also not allowed for several months. This resulted in the overall consumption of fireworks declining more than 80 % compared to former years. The situation will persist in 2021. Germany stated that they would include a brief explanation in the IIR.
The TERT recommends Germany to include the information provided 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 or UPTC in 2021	RE or TC in 2022	Tier 1 used for Key Category
2022 (1)	DE-2H1-2022-0002	No	2H1 Pulp and Paper Industry, SO_2, NA, 1990-2020	NA	No	No

Recommendation

The TERT noted with reference to NFR 2H1 Pulp and Paper Industry, all pollutants and the related IIR chapter that there may be an under-estimate of emissions. This under-estimate may have an impact on total emissions that is above the threshold of significance. The TERT noted that this under-estimate may be because Germany reports 'IE' for all pollutants under NFR 1A2d and it could be assumed that the fuel-related emissions are thus allocated under 2H1 (while there is no indication in the IIR), however, for BC and CO the notation key 'NE' is used. The TERT also questioned whether the German SO_2 EF includes TRS (total reduced sulphur) compounds and whether checks on data reported by the plants for incidental emissions during exceptional situations, when NH_3 fumes and additional TRS emissions may occur, especially NH_3 from a possible acid-based sulphite process. In response to a question raised during the review, Germany responded that, within the IIR, the different allocations are explained under https://iir.umweltbundesamt.de/2022/sector/energy/fuel_combustion/industry/pulp_paper_and_print, and further that it is indicated in the IIR that emissions from fossil fired power plants and boiler systems are reported in 'NFR 1A2g viii: Other' and not in '2H1'. They went on to say that under https://iir.umweltbundesamt.de/2022/sector/ippu/pulp_paper_food/pulp_and_paper_industry/start the SO_2 emissions are explained, and we report these emissions within the NFR, too. Furthermore, Germany clarified that because of the odours of reduced sulphur, the two relevant plants are practically leak-proof - otherwise they would not be permitted in Germany. All residues end up in (liquor)-recovery boilers and do not emit in reduced form. Exceptions with ammonia emissions are prohibited and actually excluded. Both circumstances are therefore not relevant for Germany, but this can be explained in more detail in the IIR. During the commenting phase of this draft inventory review report Germany additionally explained that it is not possible to report combustion related emissions under the dedicated category 1.A.2.d for purposes of comparison as the emission estimates are based on a complete report of branches with EF for all occurring emissions in sum.

The TERT recommends that for transparency in their inventory Germany (1) improve the current documentation under 2H1 of the allocation of all emissions from the pulp and paper industry, (2) include an explanation of the management of process related sulphur and ammonia emissions for pulping processes occurring in Germany.

Review year of initial recommendation (number of years it has been recommended)	Observation	Key Category	NFR, Pollutant(s), Year(s)	RE, TC or UPTC in 2021	RE or TC in 2022	Tier 1 used for Key Category
2022 (1)	DE-2J-2022-0001	No	2J Production of POPs, SO_2, NO_X, NH_3, NMVOC, $PM_{2.5}$, BaP, PAHs, PCBs, HCB, Cd, Hg, Pb, PCDD/F, PM_{10}, CO, BC, TSP, 1990-2020	NA	No	No

Recommendation

For 2J Production of POPs and all pollutants for all years, the TERT noted that there is a lack of transparency regarding the use of notation keys because the notation keys 'NA' and 'NE' do not match the explanation in the IIR where it is stated 'Neither the twelve initial POPs under the Stockholm Convention (Aldrin, Dieldrin, Chlordane, Toxaphene, Mirex, Endrin, Heptachlor, Hexachlorobenzene (HCB), Polychlorinated biphenyls (PCB), DDT, Polychlorinated dibenzo-p-dioxins (PCDD), Polychlorinated dibenzofurans (PCDF)) nor PAHs are produced in Germany.'. This does not relate to an over- or under-estimate of emissions. In response to a question raised during the review, Germany confirmed that they will change the notation key to 'NO' (not occurring).

The TERT recommends that Germany change the notation keys and include the related explanations 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 or UPTC in 2021	RE or TC in 2022	Tier 1 used for Key Category
2022 (1)	DE-2K-2022-0001	No	2K Consumption of POPs and Heavy Metals, SO_2, NO_X, NH_3, NMVOC, $PM_{2.5}$, BaP, PAHs, PCBs, HCB, Cd, Hg, Pb, PCDD/F, PM_{10}, CO, BC, TSP, 1990-2020	NA	No	No

Recommendation
The TERT noted with reference to NFR 2K Consumption of POPs and Heavy Metals (e.g. electrical and scientific equipment), all pollutants that Germany reported either as 'NA' or 'NE' and in the IIR Chapter 2K, that there is lack of transparency on the use of these notation keys and the explanation provided in the IIR, where it is stated 'None of the twelve initial POPs under the Stockholm Convention (Aldrin, Dieldrin, Chlordane, Toxaphene, Mirex, Endrin, Heptachlor, Hexachlorobenzene (HCB), Polychlorinated biphenyls (PCB), DDT, Polychlorinated dibenzo-p-dioxins (PCDD), Polychlorinated dibenzofurans (PCDF)) is consumed / on sale in Germany.' During the commenting phase of this inventory review report Germany confirmed that the current use of notation keys is appropriate.
The TERT recommends that Germany update the IIR to provide a full and transparent justification for the use of these NKs in the 2023 IIR submission.

Review year of initial recommendation (number of years it has been recommended)	Observation	Key Category	NFR, Pollutant(s), Year(s)	RE, TC or UPTC in 2021	RE or TC in 2022	Tier 1 used for Key Category
2022 (1)	DE-3B4h-2022-0001	Yes	3B4h Manure Management - Other Animals, NMVOC, NH_3, 1990-2020	NA	No	No

Recommendation
For category 3B4h Manure Management - Other Animals, NMVOC and NH_3 for all years, the TERT noted that the notation key 'NE' (not estimated) is used. However, in the IIR note to Table 1 (Chapter 3B) it is mentioned that the numbers of other animals were estimated in a single year, with reference to Rösemann et. al. (2017) (Chapter 9). In the CRF it is mentioned that the category of other animals includes rabbits, ostriches and fur-bearing animals, but no estimates for the populations are provided. In response to a question raised during the review, Germany explained that the number of animals in category 3B4h is limited and has low impact on the total NH_3 and NO_X emissions, but Germany agreed to obtain further activity data for the entire time series and report the emissions in a future submission. The TERT noted that the issue is below the threshold of significance for a technical correction.
The TERT recommends Germany to collect the necessary data and to estimate and report the emissions from 3B4h Manure Management - Other Animals (rabbits, ostriches 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 or UPTC in 2021	RE or TC in 2022	Tier 1 used for Key Category
2022 (1)	DE-3D-2022-0001	Yes	3D Crop Production and Agricultural Soils, NO_X, NH_3, NMVOC, $PM_{2.5}$, PM_{10}, TSP, 1990-2020	NA	No	No

Recommendation
For 3D Crop Production and Agricultural Soils, the TERT noted that there is a lack of transparency regarding activity data reported in the NFR tables for years 1990-2020. The TERT acknowledges that activity data are mentioned in the IIR, but do not always include all years (for example 2006-2009). By including the activity data in the NFR, the transparency for emissions calculations would be improved, because all activity data for every single year would be available, and data could be read directly from the NFR during the review process. This does not relate to an over- or under-estimate of emissions. In response to a question raised during the review, Germany confirmed that activity data for all years will be entered into the NFR tables in the next submission.
The TERT welcomes this and recommends that Germany report activity data for all relevant subsectors under 3D 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 or UPTC in 2021	RE or TC in 2022	Tier 1 used for Key Category

2022 (1)	DE-3Da2a-2022-0001	No	3Da2a Animal Manure Applied to Soils, NMVOC, 1990-2020	NA	No	No

Recommendation
For category 3Da2a Animal Manure Applied to Soils and NMVOC for all years, the TERT noted the notation key 'NA' (not applicable) is used, whilst emission estimates are expected, because emissions from dairy cattle and non-dairy cattle are based on a Tier 2 approach. In response to a question raised during the review Germany explained that the NMVOC emissions are included in 3B and that the correct notation key would be 'IE'. The TERT noted that the issue is related to allocation of emissions.
The TERT recommends that Germany split NMVOC emissions from livestock production into the correct NFR categories; 3B, 3Da2a and 3Da3 in the next submission, or if this is not possible to correct the notation key.

Review year of initial recommendation (number of years it has been recommended)	Observation	Key Category	NFR, Pollutant(s), Year(s)	RE, TC or UPTC in 2021	RE or TC in 2022	Tier 1 used for Key Category
2022 (1)	DE-5-2022-0001	No	5D1 Domestic Wastewater Treatment, NH_3, 1990-2020	NA	No	No

Recommendation
For 5D1 Domestic Wastewater Treatment and NH_3 for all years, the TERT noted that there is a lack of transparency regarding dry toilets (including latrines). There is no information in the IIR to explain why NH_3 emissions are not estimated, and the notation key used by Germany in the NFR table is 'NA'. In response to a question raised during the review, Germany explained that according to national experts, dry toilets (including latrines) do not play a role in sewage treatment in Germany because they are not in compliance with the legislation and thus do not constitute a procedure of orderly wastewater disposal. This does not relate to an over- or under-estimate of emissions.
The TERT recommends that Germany provide this information in the IIR in the next submission and clarify when legislation came into force that meant that dry toilets were non-compliant.

VI. Effect of revised estimates and technical corrections on the national total and national total for compliance

22. The tables below show the direct changes to the national totals and national totals for compliance resulting from the 2022 NECD inventory review. These changes include all revised estimates and technical corrections. 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 year 2020, the national emission reduction commitments 2020 to 2029, as set out in Directive (EU) 2016/2284, have been applied to express the maximum allowed emission for 2020 in absolute numbers in order to allow for a comparison with the national total for compliance. 2005 emissions (E_{2005}) reported in the 2022 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 for 2020 ($MaxE_{2020}$). If the national total reported for 2020 and after taking into account any technical corrections and revised estimates is smaller than $MaxE_{2020}$, compliance is achieved.

Table 5: National totals for compliance as reported and, where relevant, national totals for compliance including revised estimates (RE) and technical corrections (TC) 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	2018	2019	2020
NO_X					
National total (row 141)	Annex I, 08/02/2022	1 631.620	1 182.944	1 108.822	979.224
National Total for Compliance (row 154)[11]	Annex I, 08/02/2022	1 514.513	-	-	870.648
Maximum allowed emissions stemming from the National Emission Reduction Commitments		-	-	-	923.853
NMVOC					
National total (row 141)	Annex I, 08/02/2022	1 487.128	1 098.973	1 072.229	1 035.775
National Total for Compliance (row 154)	Annex I, 08/02/2022	1 179.698	-	-	736.828
Maximum allowed emissions stemming from the National Emission Reduction Commitments		-	-	-	1 026.337
SO_2					
National total (row 141)	Annex I, 08/02/2022	472.755	289.719	259.697	232.686
National Total for Compliance (row 154)	Annex I, 08/02/2022	472.755	-	-	232.686
Maximum allowed emissions stemming from the National Emission Reduction Commitments		-	-	-	373.477
NH_3					
National total (row 141)	Annex I, 08/02/2022	603.132	593.892	574.998	537.268
National Total for Compliance (row 154)	Annex I, 08/02/2022	603.132	-	-	537.268
Maximum allowed emissions stemming from the National Emission Reduction Commitments		-	-	-	572.975
$PM_{2.5}$					
National total (row 141)	Annex I, 08/02/2022	134.865	94.470	89.910	81.181
National Total for Compliance (row 154)	Annex I, 08/02/2022	134.865	-	-	81.181

[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.

[11] The National Total for compliance is based on fuel sold data. For NMVOC and NO_x, emissions from agriculture (3B and 3D) were subtracted.

Description	Reference	Pollutant estimates (kt)			
		2005	2018	2019	2020
Effect (positive or negative) of the revised estimate provided by Germany and accepted by the technical expert review team					
3Dc Farm-Level Agricultural Operations Including Storage, Handling and Transport of Agricultural Products	DE-3Dc-2022-0001	1.119	1.019	1.006	0.981
National total (row 141) including RE accepted by the TERT and TC accepted by Germany (calculated using data above)		135.984	95.489	90.916	82.162
National total for compliance: estimate including RE accepted by the TERT and TC accepted by Germany		135.984	-	-	82.162
Maximum allowed emissions stemming from the National Emission Reduction Commitments		-	-	-	100.628
PM_{10}					
National total (row 141)	Annex I, 08/02/2022	244.892	207.216	193.781	180.138
Effect (positive or negative) of the revised estimate provided by Germany and accepted by the technical expert review team					
3Dc Farm-Level Agricultural Operations Including Storage, Handling and Transport of Agricultural Products	DE-3Dc-2022-0001	5.006	3.942	3.911	3.767
National total (row 141) including RE accepted by the TERT and TC accepted by Germany (calculated using data above)		249.898	211.158	197.692	183.905

VII. Compliance with 2020 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 2022 NECD inventory review included a compliance check of 2020 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 2020 emission reduction commitments for the pollutants NO_X, NMVOC, SO_2, NH_3 and $PM_{2.5}$. 2005 emissions (E_{2005})[12] were used to perform the calculations underlying the compliance check. The % emission reduction commitments from the NEC Directive was applied to E_{2005}, which gives the maximum allowed emission in 2020 ($MaxE_{2020}$). If the national total for compliance for 2020 including technical corrections (accepted by Member State) and revised estimates (accepted by the TERT) (see also Table ***5***) is smaller than $MaxE_{2020}$, compliance is achieved.

Table 6 Overview of compliance with 2020 emission reduction commitments[13]

Pollutants	National total for compliance (kt) 2005	National total for compliance (kt) 2020	Emission reduction commitment 2020 (%)	Maximum allowed emissions (kt) 2020[a]	Compliant
NO_X	1,514.513	870.648	-39	923.853	Yes
NMVOC	1,179.698	736.828	-13	1,026.337	Yes
SO_2	472.755	232.686	-21	373.477	Yes
NH_3	603.132	537.268	-5	572.975	Yes
$PM_{2.5}$	135.984	82.162	-26	100.628	Yes

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

26. Germany is in compliance with its national emission reduction commitment for 2020 for NO_X (**Error! Reference source not found.**).

27. Germany is in compliance with its national emission reduction commitment for 2020 for NMVOC (**Error! Reference source not found.**).

28. Germany is in compliance with its national emission reduction commitment for 2020 for SO_2 (**Error! Reference source not found.**).

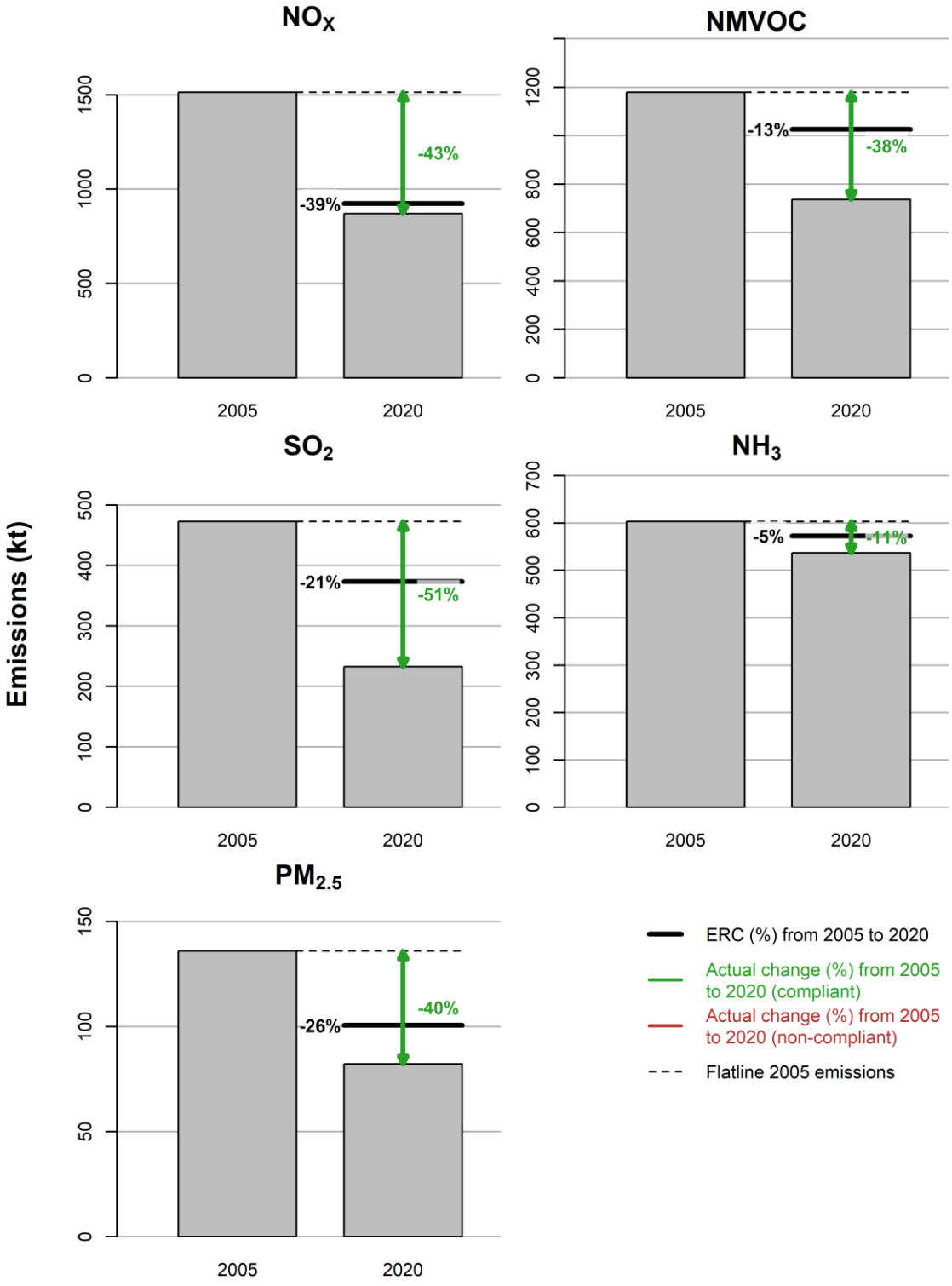
29. Germany is in compliance with its national emission reduction commitment for 2020 for NH_3 (**Error! Reference source not found.**).

[12] National total for compliance estimates including revised estimates accepted by the TERT and technical corrections accepted by Member State (see also Table ***5***) were used as 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.

30. Germany is in compliance with its national emission reduction commitment for 2020 for $PM_{2.5}$ (**Error! Reference source not found.**).

Figure 1 *Visual illustration of compliance with 2020 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 technical expert review team

31. Germany agrees with the calculated estimates in **Error! Reference source not found.Error! Reference source not found.**.

IX. Technical expert review team response to the statement from Germany

32. The TERT would like to thank Germany for comments provided on the draft version of this NECD inventory review report. The TERT revised recommendations in light of the comments received. For observation DE-2D3c-2022-0001, the recommendation was revised to acknowledge that Germany would be unable to implement the recommended improvement by the 2023 submission. Therefore, the TERT has recommended that Germany report progress on implementation in the 2023 submission of the IIR. For observation DE-2H1-2022-0002 the recommendation has been revised to focus on transparency in light of the comment from Germany that splitting emissions between combustion and process emissions is not readily feasible. For observation DE-2K-2022-0001 the recommendation was revised in acknowledgement of Germany's confirmation that the current use of notation keys is appropriate. The recommendation therefore now is to provide a full and transparent justification for the use of the notation keys in the 2023 submission of the IIR.

ANNEX I Technical corrections deemed necessary by the technical expert review team and revised estimates provided by Germany

33. Germany did not have any Technical Corrections and had 1 Revised Estimate(s) in the NECD Inventory Review 2022.

34. The technical expert review team calculated technical corrections for cases:

- where it did not agree with the way in which a revised estimate or technical correction from the 2021 NECD inventory review was implemented and where no revised estimate was accepted by the technical expert review team during the review
- and where the suggested finding of the technical expert review team would change the National Total by more than 0.5% and where no revised estimate was accepted by the technical expert review team during the review.

35. The methods for calculating the technical corrections are set up in the “Guidance on technical corrections” and use the EMEP/EEA inventory guidebook as a reference for methods and emission factors.

Table A1: Summary tables of revised estimates and technical corrections

1

EMRT ID:	DE-3Dc-2022-0001
EMRT URL:	https://emrt-necd.eionet.europa.eu/2022/DE-3Dc-2022-0001
Member State:	Germany
Sector:	3Dc Farm-level agricultural operations including storage, handling and transport of agricultural products
Pollutants:	PM_{10}, $PM_{2.5}$
Completed by (SE):	Mette Hjorth Mikkelsen
Reviewed by (LR):	Ole-Kenneth Nielsen
Reviewed by (Counterpart):	
Reviewed by (Quality Controller):	Rosie Brook

The underlying problem:	Germany was using a tier 1 methodology for a key category.
Summarise the methodology used:	Germany provided a revised estimate following the tier 2 methodology in the EMEP/EEA Guidebook.

2

Details of the corrected estimate

	Original Estimate (kt)						Notes
Year	NO_X	NMVOC	SO_X	NH_3	$PM_{2.5}$	PM_{10}	
2005					0.654	17.007	
2018					0.671	17.443	
2019					0.670	17.414	
2020					0.664	17.271	

	Revised Estimate received from MS (kt)						Notes
Year	NO_X	NMVOC	SO_X	NH_3	$PM_{2.5}$	PM_{10}	
2005					1.773	22.013	
2018					1.690	21.384	
2019					1.675	21.325	
2020					1.645	21.039	

	Difference between Original Estimate and Revised Estimate (kt)						Notes
Year	NO_X	NMVOC	SO_X	NH_3	$PM_{2.5}$	PM_{10}	
2005					1.119	5.006	
2018					1.019	3.942	
2019					1.006	3.911	
2020					0.981	3.767	

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

National Emission reduction Commitments Directive reporting status 2022, Copenhagen. https://www.eea.europa.eu/publications/national-emission-reduction-commitments-directive-2022

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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EU 2022. Dore C., Air Emission Inventory Review Guidelines 2022 https://ec.europa.eu/environment/air/documents/Air_Emission_NECD_InventoryReviewGuidelines_2021_v2.pdf

NEC Directive 2001, DIRECTIVE 2001/81/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL ,of 23 October 2001 on national emission ceilings for certain atmospheric pollutants http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02001L0081-20130701&from=EN

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