REVIEW OF THE EMEP/EEA AIR POLLUTANT EMISSION INVENTORY GUIDEBOOK 2023

Final Report for European Commission – DG Environment

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Contact:
Anne Misra
Ricardo Energy & Environment
30 Eastbourne Terrace, Paddington, London, W2 6LA, United Kingdom

Registered office:
Ricardo
Gemini Building, Harwell, Didcot, OX11 0QR, United Kingdom

t: +44 (0) 1235 753214
e: anne.misra@ricardo.com

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Ricardo Nederland B.V. and Ricardo-AEA ("Ricardo") are part of the Ricardo Group of entities.

Report authors:
Jekabs Jursins, Joe Hague

Appendix A authors:
Chris Dore, Annie Thornton, Melanie Hobson, Céline Gueguen, Bernard Hyde, Barbara Amon, Thamara Braish, Yvonne Pang, Rob Stewart, Gareth Horton, Dan Wakeling, John Norris

Approved by:

e-verif: 4186

C J Dore

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TABLE OF ABBREVIATIONS

Abbreviation	Definition
C&I	Combustion & Industry
CLRTAP	Convention on Long Range Transboundary Air Pollution
EAER	European Aviation Environment Report
EEA	European Environment Agency
EEDB	Engine Emissions Databank
EFDB	Emission factor database
EIONET	European Environment Information and Observation Network
EMEP	European Monitoring and Evaluation Programme
EPA	Environmental Protection Agency
ESIG	European Solvents Industry Group
ETS	Emission trading system
GHG	Greenhouse gas
ICAO	International Civil Aviation Organization
IPCC	Intergovernmental Panel on Climate Change
MARKAL model	Market Allocation model
NAPCP	National Air Pollution Control Programme
NECD	National Emission reduction Commitment Directive (2016/2284/EU)
(NM)VOC	(Non-methane) volatile organic compounds
PM	Particulate matter
PRIMES model	Price-Induced Market Equilibrium System model
TFEIP	Task Force on Emission Inventories and Projections
TFTEI	Task Force on Techno-Economic Issues
UNECE	United Nations Economic Commission for Europe
UNFCCC	United Nations Framework Convention on Climate Change

1 INTRODUCTION

1.1 This report

This report sets out the methodology of the comprehensive review of the EMEP/EEA Air Pollutant Emission Inventory Guidebook (henceforth "the Guidebook"), and the identification of available alternative methods and data sources for emission factors, and sources of harmonised activity data. The results of the review are presented as proposed improvements per emission sector and are provided as an appendix (Appendix A). Additionally, a summary of the improvements, including the type and priority of each improvement, is provided in this report.

1.2 Motivation for the study

The Guidebook and the accompanying emission factor database (EFDB) are key resources for Member States, acting as a central reference manual and guidance document for emission inventory teams preparing their submissions to both the National Emission reduction Commitment Directive (2016/2284/EU) (NECD) and the Convention on Long Range Transboundary Air Pollution (CLRTAP). Despite its importance, updates to the Guidebook are not funded by CLRTAP and rely on voluntary contributions from Parties. **As a result, it is challenging to plan and implement updates to the content of the Guidebook so that it reflects the most up to date scientific understanding of air pollutant emission sources.**

It is the responsibility of the Air Convention's Task Force on Emission Inventories and Projections (TFEIP) to manage the content of the Guidebook. This requires the organisation and management of technical experts to regularly review the content of the Guidebook to identify the priorities for improvement, and then manage the delivery of updated Guidebook chapters and ultimately co-ordinating the publication of an updated Guidebook in its entirety. To support technical discussions and co-ordinate inputs into the maintenance and improvement of the Guidebook, the TFEIP is organised into several expert panels, covering the technical areas of Combustion and Industry, Transport, Agriculture, Waste, Projections, and User Engagement. **The expert panel leaders, along with the TFEIP management team, are the individuals who are ultimately responsible for the content of the Guidebook.**

As part of their responsibilities, the TFEIP management team and the expert panel leaders maintain a prioritised Guidebook improvement list. Expert panel leaders were recently requested by the TFEIP co-Chairs to update their improvement lists and provide them to the TFEIP Secretariat so that improvements could be compiled into a 'master list'. The progress and relevancy of the 'master list' is somewhat variable across emission sectors.

Updates to the content of the Guidebook have typically only been undertaken for specific sections when needed or when resources were available, or where there have been changes to the parallel guidance for greenhouse gas (GHG) emissions inventories published by the United Nations Framework Convention on Climate Change (UNFCCC). However, there are now new innovations, technologies, fuels and approaches available to the air quality community which should be considered when planning updates to the Guidebook's content.

Therefore, there is a need to have a thorough review of the Guidebook, to establish an up-to-date comprehensive list of improvements.

1.3 Aims and objective of the study

The **aims** of the study are to establish a comprehensive understanding of the amendments necessary to update the 2023 version of the EMEP/EEA Guidebook, and the practical steps that would deliver those updates. The co-chair of the TFEIP, in agreement with the TFEIP's expert panel leaders, will present results of this study at the 2025 TFEIP meeting. This will support the TFEIP in defining a clear programme of work for the Guidebook update.

The **objectives** of the study are to:

- carry out a systematic and comprehensive review of all Guidebook chapters;
- carry out a prioritisation exercise to guide the future update of Guidebook chapters;
- compile all identified improvements in a single document.

The implementation of the identified improvements to the Guidebook are not within the scope of this study. However, the prioritisation list that will be made available as a main deliverable of this project, will allow funding organisation to support the work of the Guidebook improvement.

1.3 Aims and objective of the study

2 REVIEW METHODOLOGY

2.1 Structure of the EMEP/EEA Guidebook 2023

The Guidebook chapters which are considered in the review are presented in Box 1.

Box 1 Structure of the EMEP/EEA Guidebook 2023

Part A: General Guidance Chapters
1. Introduction
2. Key Category Analysis and Methodological Choice
3. Data Collection
4. Time Series Consistency
5. Uncertainties
6. Inventory Management Improvement and QA/QC
7. Spatial Mapping of Emissions
8. Projections

Part B: Sectoral Guidance Chapters
1. **Energy**
   o Combustion
     - Energy Industries
     - Combustion in Manufacturing Industries and Construction
     - Aviation
     - Road Transport
     - Railways
     - Navigation (Shipping)
     - Pipeline Transport
     - Non-Road Mobile Machinery
     - Small Combustion
   o Fugitive Emissions from Fuels
     - Solid Fuels (Coal Mining and Handling)
     - Oil and Natural Gas (Exploration, Production, Transport, Refining, Storage, Distribution)
     - Venting and Flaring
2. **Industrial Processes and Product Use**
   o Various industrial processes and their emissions
3. **Agriculture**
   o Emissions from agricultural activities
4. **Waste**
   o Emissions from waste management and treatment
5. **Other Sources**
   o **Other sources included and excluded from national totals**

2.2 Framework for the review

The approach of the review of the EMEP/EEA Guidebook 2023 is split into three components:

1. Considerations of general guidance under Part A.
2. Considerations of sectoral guidance under Part B.
3. Considerations of new chapters & topics which are not currently in the Guidebook.

While all chapters of the Guidebook have been reviewed, particular attention has been paid to those chapters that include categories generally contributing to: i) the greatest share of national pollutant emissions totals; and ii) the greatest uncertainty in existing methodologies, default data and emission factors. Applying these two criteria, the sectoral chapters (i.e. Part B) has been a priority in the review.

The outcomes have been targeted on chapter improvements that will best drive advances in the accuracy of national level reporting.

The review of each chapter of the Guidebook and the associated emission factor database has followed a systematic framework as 'checks', presented in Table 2.1. For each proposed improvement presented in Appendix A, it has been indicated which checks are applicable to the improvement proposed.

Table 2-1 - framework for the review of Guidebook chapters by criteria

Criteria	Check ID
Part A General guidance chapters	
Whilst many parts of the general guidance chapters will not require significant review and improvement, it is important to **check that all references to other guidance material and reports remain valid and identify needed updates/additions** – particularly in relation to the latest version(s) of GHG emissions guidelines.	A(i)
Consider whether the general guidance chapters such as data gathering and uncertainties cover all aspects of reporting and **whether there may be gaps due to new methodologies** available across the sectoral guidebook.	A(ii)
Checking that the general chapters **reflect current understanding of 'best science'** - for example how satellite/real-time data techniques impact on associated inventory activities such as verification and spatial outputs.	A(iii)
Checking overall **consistency of information** and remaining cross-references between the general and sectoral chapters.	A(iv)
Consider whether **guidance on projections** (particularly sectoral annexes) is **correct and up to date**, specifically focusing on listed policies and other recommended drivers for generation of projections scenarios.	A(v)
Consider **where the quality of writing** (clarity/language/structure) **could be improved**	A(vi)
Part B Sectoral chapters and associated emission factor database	
Assess whether there are **gaps in the coverage of emission sources within the sectoral chapters**, and the Part A non-sectoral chapters. This includes **potential future sources of emissions, as well as gaps associated with current sources** (i.e. key source analysis)	B(i)
Review introductory sections of sectoral chapters and identify any needs to **update to bring in line with emissions in current years**.	B(ii)
Assess **whether there are sources included**, but without complete Tier 1, Tier 2 (and Tier 3) methodologies.	B(iii)
Based on expert knowledge and current scientific understanding, assess whether **updates to existing methodological approaches are likely available**, with regards to approach, detail level, and emission factors.	B(iv)
Consider whether all relevant pollutants are covered by each sector and whether **any methodologies are missing for any relevant pollutants.**	B(v)
Consider the extent to which the methodology draws on **a limited number of studies, and the age of the studies**.	B(vi)
Consider the **uncertainty information provided with the emission factors.**	B(vii)
Consider whether **regional emission factors are needed**, and whether it will be possible to determine/derive/add them.	B(viii)
Consider **other emission reporting requirements** (for example, those under UNFCCC) and whether there are **opportunities to harmonise** the methods and data.	B(ix)
Consider the historical development of the chapters and **how methodologies have changed within versions**.	B(x)
Consider the benefit in **further standardising** any of the guidance information in relation to recommended methodologies and dataset(s) for this sector, source or pollutant.	B(xi)
Consider **where quality of writing** (clarity/language/structure) **could be improved.**	B(xii)

The proposed improvement lists are built upon the prioritised improvement lists from previous updates.

2.3   Identifying data sources to inform potential improvements and innovative approaches

From the list of checks set out in Table 2-1, the review considered the necessity to focus on the suitability of data sources:

- Suitability of **existing** data sources referenced in the Guidebook that will need to be **updated** – checks A(i), A(v), B(ii), B(iii), B(iv), and B(vi).
- Potential **new** data sources to add to the Guidebook fill in gaps in methodology or new **innovative approaches** – checks A(ii), A(iii), B(i), B(v), B(viii), and B(ix).

In general, the review has considered the following existing data sources:

- Existing EMEP/EEA 2023 Guidebook and the associated emission factors database.
- Ongoing improvement lists developed by the TFEIP prior to the review.
- Literature and other resources suggested by the TFEIP expert panel leaders.
- Guidance documents that have been prepared by the TFEIP which are not yet incorporated into the Guidebook (e.g. on estimating emissions from solvent use).
- A focused review of activities and/or publications from other emission reporting platforms (e.g. UNFCCC).

For some of the proposed improvements, it has not been possible to undertake a sufficiently detailed and comprehensive literature review within the constraints of this project. Consequently, there are some improvements which recommend a first step of undertaking a detailed literature review – typically to provide sufficient information to improve specific emission factors.

A project currently being funded by the Swedish Environmental Protection Agency (EPA), has reviewed the availability of relevant literature from global regions outside the scope of the CLRTAP. It has found that there is very limited information beyond Europe and the USA. This is relevant for the contents of the Guidebook because it suggests that there is little to be gained by searching for information from studies outside of the CLRTAP's geographical scope. The study also found that many "global" emissions datasets and countries outside the geographical scope of the CLRTAP are applying the EMEP/EEA Guidebook methodologies and emission factors, because they have no suitable alternatives.

The identified main new/updated data sources that are included in the list of potential improvements are presented in Table 2-2[1]. These data sources do not include a detailed literature survey that could potentially identify a volume of relevant scientific papers that will need to be reviewed as part of the implementation of recommended improvements.

As mentioned above, further literature review as part of the adopted improvements may find additional data sources that can be adopted for use in the Guidebook. Beyond these named sources, the improvements may also be supplemented with:

- Satellite measurements to monitor emissions from soils and wildfires, diffuse and fugitive sources, and to provide constraining data for verification studies.
- Real-time data (e.g. electricity generation, traffic congestion data, flight paths for aviation, AIS data for shipping) to refine diurnal profiles or determine season-specific emission factors.

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[1] Table 2-2 does not include improvements that relate to corrections to references (e.g. missing references, broken URLs) if the referenced document remains unchanged or a replacement reference is not identified. These improvements are presented in Appendix A.

Table 2-2 – identified new and updated data sources to improve EMEP/EEA Guidebook 2023 Part A and Part B (split by emission sectors)

New or update to data source	NFR code	ID (Appendix A)	Identified area for improvement	Potential data source(s) to facilitate improvement (see Appendix A)
Part A General guidance chapters				
Update	n/a	5	**A8 Projections:** - Section 1 Overview - Section in need of update to refer to more up to date GHG projection guidelines and updated emission projections reporting guidelines under the UNECE LRTAP Convention.	• Guidelines from Partnership on Transparency in the Paris Agreement and the NDC Partnership. • 2023 Guidelines for Reporting Emissions and Projections Data under the CLRTAP.
Update	n/a	6	**A8 Projections:** All sub-sections - A general check is required on the whole chapter to ensure that it is still in line with the UNFCCC latest GHG projection guidelines or knowingly diverts and that the latest GHG projection guidance is referred to. At the moment, the UNFCCC 2016 guidance is often referred to.	• UNFCCC 2023 guidance.
New	n/a	7	**A8 Projections:** All sub-sections. It is recommended that a review of National Air Pollution Control Programme (NAPCP) reporting is undertaken to see whether any valuable lessons can be learnt that can be included in the Projections Chapter.	• NECD projections review reports. • NAPCP review reports.
Update	n/a	9	**A8 Projections:** Section 5.7 and Consistency - refer to the new Annex IV reporting template.	• Annex IV reporting template.
Update	n/a	10	**A8 Projections:** Section 5.10.2 - update references to the following data sources as the hyperlinks no longer work: PRIMES, MARKAL, Scenario 2030, Fertilizers Europe, Trans-tool, Eurocontrol, UN Production Statistics for Solvents	• PRIMES (Price-Induced Market Equilibrium System model), • MARKAL (Market Allocation model), • Scenario 2030, • Fertilizers Europe, • Trans-tool, • Eurocontrol, • UN Production Statistics for Solvents
Transport				
Update	1A3a	4	Particulate matter emissions (non-volatile particulate matter (nvPM) and volatile particulate matter (vPM) are of increasing importance, both for local air quality and for climate impacts (with the role of PM emissions in the formation of contrails and contrail-induced cirrus	• nvPM data from ICAO (International Civil Aviation Organization) Engine Emissions DataBank

New or update to data source	NFR code	ID (Appendix A)	Identified area for improvement	Potential data source(s) to facilitate improvement (see Appendix A)
			clouds being recognised). The section mentions the agreement on regulation of nvPM, and the availability of certification data in the EEDB (Engine Emissions Databank), but other references (including Annex 2 and Annex 3) are out of date, as they describe the use of other sources of data for PM.	
Update	1A3a	7	Description of Tier 3B references the EUROCONTROL AEM model. However, this has been superseded by the IMPACT model.	• EUROCONTROL IMPACT tool
Update	1A3a	14	The tools provided as Annex 5 should be updated to use the latest versions of the IMPACT model and the latest EEDB.	• EUROCONTROL IMPACT tool • ICAO Engine Emissions DataBank
Update	1A3a	15	Annex 1 presents projections based on the European Aviation Environment Report (EAER) 2022, although it also says that it is mainly based on the 2016 version. The 2025 version of the EAER has now been published.	• European Aviation Environment Report 2025
New	1A3c	28	The 1.A.3.c Railways Guidebook chapter currently does not include any guidance or emission factors in estimating non-exhaust emissions from the rail sector, and so there is a gap in reporting (although some countries have reported this source). EIONET Report (ETC/ATNI 2020/5) also quoted that there is particular concern on non-exhaust PM emissions in subway systems, given the closed environment.	• EIONET (European Environment Information and Observation Network) Report (ETC/ATNI 2020/5)
Update	1A3d	34	Improve guidance, examples, tables on power vs GT, main/aux power, cruise speeds (Tables 3-9, 3-17, 3-19, 3-18, 3-10), also considering ETS data.	• Latest EU Emissions Trading System (ETS) data
Update	1A4	42	Emission factors for all pollutants have not been updated for many years. Many references for EFs in the GB are prior to 2016.	• Portable Emissions Measurement Systems (PEMS) measurements • European Research on Mobile Emission Sources (ERMES).
Combustion & Industry				
Update	1A1a	24	LCP BAT-C data in the annex are derived from the old BREF.	• Large Combustion Plan BAT Reference Document 2021
Update	B1b	55	Charcoal/biochar is missing.	• 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories
New	2A1	65	Cement grinding plant and cement mixing/batching plant which should sit under NFR code 2A1 because they have no/limited combustion but are not covered by GB (there are factors/methodology in USEPA AP42). Note that pre-calciner kilns tend to have high NMVOC emission from organic material in the raw meal (depends on amount in raw	• US Environmental Protection Agency – AP-42: Compilation of Air Emission Factors from Stationary Sources

New or update to data source	NFR code	ID (Appendix A)	Identified area for improvement	Potential data source(s) to facilitate improvement (see Appendix A)
			materials) which is liberated when suspended in the hot exhaust gases from the kilns - this should be considered as another 'process emission'.	
New	2A5a	68	Quarrying and mining: introduce a Tier 3 methodology, keeping in mind that the method should be robust enough to allow countries to use it if not all very detailed data are available.	• US Environmental Protection Agency – AP-42: Compilation of Air Emission Factors from Stationary Sources
Update	2D3	90	NMVOC from solvents: update chapters with new information e.g. from European Solvents Industry Group (ESIG).	• ESIG – Solvent VOC Emission Inventory
Update	2D3i/2G	100	Concerns emissions from the use of shoes. The text in the Guidebook is not clear whether the method presented is for the use or production of shoes.	• Expert Group on Techno-Economic Issues
New	2I	112	A method for chipboard production needs to be developed.	• US Environmental Protection Agency – AP-42: Compilation of Air Emission Factors from Stationary Sources
New	2D3f	123	Process Description paragraph (p:3): *The use of tetrachloroethylene (PER) has sharply decreased, and regulations to phase it out have been implemented in California and France due to its health impact (CMR cat. 3).* Several alternatives exist nowadays including: hydrocarbons, SolvonK4, propylene glycol ethers, cyclic volatile methyl siloxane, and n-propyl bromide + update control measures: emerging techniques (liquid CO_2 cleaning and waterless machines).	• Task Force on Techno-Economic Issues (TFTEI) - Background informal technical document on the analysis of the impact of decarbonisation on emissions of air pollutants in selected industrial sectors
Agriculture				
New	3B	1	Chapter 3B. Need for guidance on integration of abatement options.	• Task force on Reactive Nitrogen Ammonia 'Options for Ammonia Mitigation'
Update	3B	2	Chapter 3B. Update reference percentage contributions/indicators throughout chapter based on a more recent inventory year.	• Centre on Emission Inventories and Projections database
Update	3B	5	Chapter 3B. Reference to 2006 Intergovernmental Panel on Climate Change (IPCC) guidelines needs to be reviewed.	• 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories
New	3B	12	Chapter 3D. Need for guidance on abatement options and abatement factors.	• Hutchings et al 2024
Waste				
No specific data sources identified for given improvements in the Waste sector.				
Other				
No specific data sources identified for given improvements for other sectors.				

2.4 Prioritisation methodology

To strive for a balance between consistency and suitability of the prioritisation of all the recommendations made across the Guidebook chapters, a **three-step prioritisation approach** has been applied to prioritise the individual recommendations presented in Appendix A**.**

2.4.1 Quantified prioritisation score

A prioritisation score is calculated for each individual improvement based on the significance and relevancy of the improvement across different categories (Table 2-3). The score is calculated as the **product** of prioritisation adjustment factors rounded to the nearest integer. A maximum score of 55 is achievable if an improvement is scored as 'high' (or 'yes') across all categories.

Table 2-3 – prioritisation adjustment factors

Relevance of improvement	Description	Prioritisation adjustment factor			
		Yes / High	Partly / Medium	No / Low	Unknown
Source size	Is the target area of improvement related to emissions source(s) that would relate into significant change in the quantification of the emission inventory? • **High** - one of the largest sources (or sources that sum to this) • **Medium** - other key sources. • **Low** - non-key sources.	5	3	1	1
Current uncertainty	What is the uncertainty in the current estimations of emissions of the relevant pollutant? • **High** – high uncertainty (most heavy metal and persistent organic pollutant sources). • **Medium** – medium uncertainty (most NH_3 sources). • **Low** – low (most NO_X sources).	3	2	1.5	1.5
New or increasing source	Is the source new or increasing? (**Yes, No**)	1.1		1	
Large change in emission	What is the expected absolute change in emissions (ktonnes) as a result of implementing the improvement? • **High** – applicable to emission sources that have not had revised methodologies for many years • **Medium** – as above, but updated more regularly • **Low** – applicable to regularly updated sources (e.g. road transport)	1.5	1	0.8	1

Relevance of improvement	Description	Prioritisation adjustment factor			
		Yes / High	Partly / Medium	No / Low	Unknown
Improved methodology/data exists	Is an improvement methodology/existing dataset known and readily available? • **Yes** – this will result in an easier update • **No/Unknown** – a literature review will be necessary to determine whether an improved methodology/dataset exists	2	1	0.8	
Harmonisation with other data reporting	Is the improvement harmonised with other data reporting obligations to other international commitments? **(Yes/Partly/No/Unknown)**	1.1	1	0.8	0.8

Where any of the above relevance criteria cannot be assigned a rating, the result defaults to 'unknown'.

The development of this prioritisation scheme is based on expert judgement, because there is no scheme that already exists. Although experts may have different views on the specific weightings that have been applied to different criteria, this approach meets the need of providing an initial priority score across all of the different improvement proposals.

The prioritisation factors in Table 2-2 are presented in the *'Prioritisation Modifiers'* in Appendix A.

2.4.2   Resource-weighted prioritisation score

As updates to the Guidebook are not funded by CLRTAP, and rely on voluntary contributions from Parties, it is challenging to plan and implement updates to the content of the Guidebook so that it reflects the most up to date scientific understanding of air pollutant emission sources. In addition to identifying prioritised proposals for improvements, consideration must be given to the **estimated resource** required to conduct the work.

Where possible, each improvement (Appendix A) has been given an indicative length of time for one sector expert to conduct the work. For this high-level costing, it is assumed that one sector expert is costed at a rate of €1000/day for a full day of work (8 hours). It is assumed that a week constitutes 5 working days, and a month constitutes 20 working days. As with the prioritisation scoring, this is an estimate of the actual effort needed based on expert judgement.

The priority ratings determined under Section 2.4.1 can be adjusted with an additional adjustment factor reflecting these estimates of the time taken by a sector expert to implement the improvement (Table 2-3).

Table 2-3 – resource-weighted prioritisation adjustment factors

Time required	Time required (days)	Maximum estimated cost (EUR)	Resource adjustment factor
Up to a half-day	0.5 days	500	5
One day	1 day	1,000	3
One week	5 days	5,000	2
Two weeks	10 days	10,000	1
One month	20 days	20,000	0.8
Three months	60 days	60,000	0.5
More than three months	>60 days	No maximum	0.2

The approach here gives increased priority to "quick fixes" to the EMEP/EEA Guidebook – i.e., corrections or updates to outdated datasets where the approach is known or well-established. More time is required for improvements where, for example, the methodology of the approach must be developed (e.g. conducting a literature review to find the most up-to-date best practice), and would therefore result in a lower resource-weighted prioritisation score.

The prioritisation factors in Table 2-3 are presented in the *'Prioritisation Modifiers'* in Appendix A.

2.4.3   Categorisation into four prioritisation groups

The prioritisation scores established in Section 2.4.1 and 2.4.2 allow for a 'ranking' of the individual improvements across chapters. However, it is necessary to establish boundaries to clearly set out what is 'high' or 'low' priority, or what can be excluded from a final short list.

As part of a 'first pass' prioritisation exercise, a prioritisation matrix is used to automatically sort and group the individual improvements (Figure 2-1). The thresholds that establish the boundary between high, medium, and low within each priority rating are shown in brackets.

In summary:

- High Priority – these improvements **should** be implemented **as soon as possible**, as there is **major impact** on the quality of the EMEP/EEA Guidebook if not included.
- Medium Priority - these improvements **should** be implemented, as there is either: a) **major impact** on the quality of the EMEP/EEA Guidebook if not included, but will take significant resource to implement, or b) **considerable impact** yet not too take much resource to implement.
- Low Priority – these improvements **should** be implemented as there is either: a) **considerable impact** on the quality of the EMEP/EEA Guidebook if not included, but will take significant/unknown resource to implement, or b) **minor impact** yet not too take much resource to implement.
- Nice-to-have – these improvements **could** be implemented, if available timeframe and budget allows, as there is only **minor impact** on the quality of the EMEP/EEA Guidebook if not included but will take significant/unknown resource to implement.

Figure 2-1 – prioritisation matrix to categorise improvements into four priority groups

		Resource-Weighted Priority Rating		
		High (>=25)	Medium (>=9)	Low (<9)
Priority Rating	High (>=15)	High Priority	High Priority	Medium Priority
	Medium (>=5)	Medium Priority	Medium Priority	Low Priority
	Low (<5)	Low Priority	Low Priority	Nice-to-have

As an example, an improvement that scored '20' in the Priority Rating would meet the 'High' threshold. However, if it costs EUR 100,000 to implement, it will score '4' (after applying an adjustment factor of 0.2) and meet the 'Low' threshold for Resource-Weighted Priority Rating. Using these two scores in the matrix in Figure 2-1, the example improvement would fall into the 'Medium Priority' bracket.

The thresholds between each priority rating in Figure 2-1 are presented in the *'Prioritisation Modifiers'* in Appendix A.

2.4.4   Second pass prioritisation results

Following from the 'first pass' prioritisation results, the sector experts and TFEIP panel leaders reviewed the suitability of the automatic priority grouping. Where necessary, manual updates were made to the priority grouping based on expert opinion. For example, if the automatic grouping classified an improvement as a "high priority", a sector expert and/or TFEIP panel leader may have amended it to a "medium priority" based on a factor that was not considered in the automatic grouping. These amendments were discussed in bilateral discussions during the project in order to establish a final proposed list for each priority group.
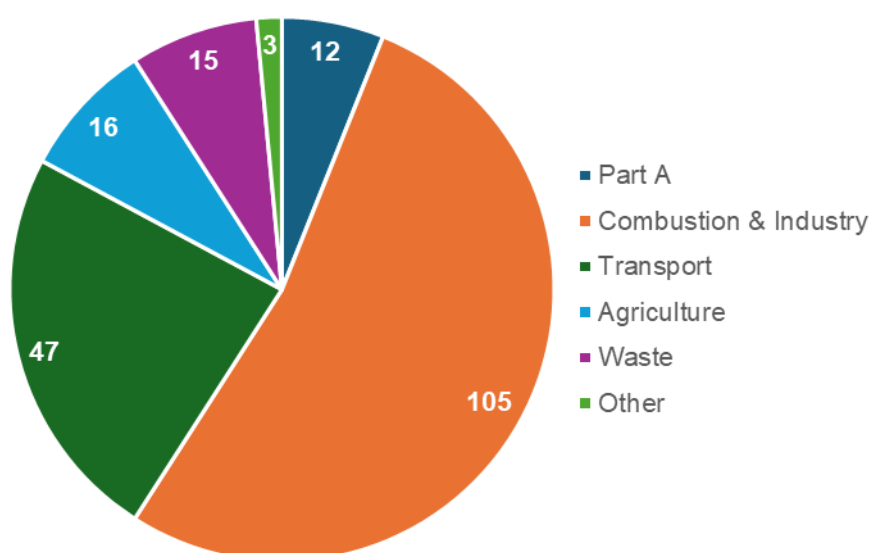
3 RESULTS OF THE REVIEW

3.1 Overview (Task 1.2)

The full list of recommendations is presented in Appendix A.

Figure 3-1 presents a summary of the allocation for the improvements made under this study by sector. In total, there are 198 recommendations. This is a simple count of improvements, and does not take into account any thinking on importance or "size" in terms of resource needs. Specifically, the number of recommendations related to combustion & industry (C&I) emissions chapters is considerably greater than the other sectors. This is understandable, since there are a much greater number of C&I chapters in the EMEP/EEA Guidebook compared to other source sectors. To minimise and simplify the number of recommendations, all the editorial recommendations concerning the C&I chapters were grouped into one recommendation.

Figure 3-1 – number of individual improvements recommended for each EMEP/EEA Guidebook chapter

3.2 Improvements to the general guidance (Part A)

Table 3-1 presents the number of improvements for each type of check conducted in the review under Part A of the Guidebook (Table 2-1).

In summary, 12 recommendations are made to improve Part A of the EMEP/EEA Guidebook. The majority of recommendations concern improvements to guidance on projections (A(v)) set out in Chapter A8 of the Guidebook. The least common type of recommendations relates to improving the consistency of information (A(iv)) and improvements on clarity or chapter structure (A(vi)).

Table 3-1 – number of each type of improvements applicable to Part A of the EMEP/EEA Guidebook
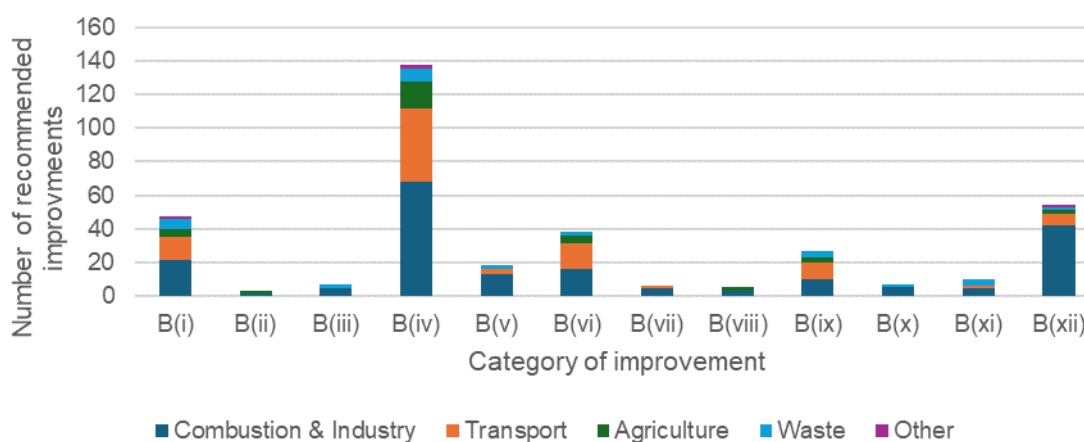
Criteria	Check ID	Number of improvements
Part A General Guidance Chapters		
Whilst many parts of the general guidance chapters will not require significant review and improvement, it is important to **check that all references to other guidance material and reports remain valid and identify needed updates/additions** – particularly in relation to the latest version(s) of GHG emissions guidelines.	A(i)	5
Consider whether the general guidance chapters such as data gathering and uncertainties **cover all aspects of reporting** and **whether there may be gaps due to new methodologies** available across the sectoral guidebook.	A(ii)	3
Checking that the general chapters **reflect current understanding of 'best science'** - for example how satellite/real-time data techniques impact on associated inventory activities such as verification and spatial outputs.	A(iii)	3
Checking overall **consistency of information** and remaining cross-references between the general and sectoral chapters.	A(iv)	2
Consider whether **guidance on projections** (particularly sectoral annexes) is **correct and up to date**, specifically focusing on listed policies and other recommended drivers for generation of projections scenarios.	A(v)	8
Consider where **clarity or chapter structure could be improved**	A(vi)	2
Total number of recommendations		12

Note – some recommendations are applicable to multiple types of improvement, such that the sum of the number of each type of improvement is greater than the total number of improvements

3.3   Improvements by emission source sector (Part B)

Table 3-2 presents the number of improvements for each type of check conducted in the review under Part A of the Guidebook (Table 2-2), with a summary shown in Figure 3-2. In summary, 188 recommendations are made to improve Part B of the EMEP/EEA Guidebook. The majority of recommendations concern improvements to existing methodological approaches with regards to approach, level of detail and emission factors (137 improvements, B(iv)) and improvements to clarity of wording and chapter structure (53 improvements, B(xii)).

Figure 3-2 –number of individual improvements recommended for each EMEP/EEA Guidebook chapter per check under Table 2-2.

The definition of the "B" improvement categories is included in the table below. Note that a recommended improvement may be allocated to multiple improvement categories.

Table 3-2 – number and type of improvements applicable to Part B of the EMEP/EEA Guidebook

Criteria	Check ID	Number of improvements					Total
		Transport	C&I	Agriculture	Waste	Other	
Part B Sectoral chapters and associated emission factor database							
Assess whether there are **gaps in the coverage of emission sources within the sectoral chapters**, and the Part A non-sectoral chapters. This includes **potential future sources of emissions, as well as gaps associated with current sources** (i.e. key source analysis)	B(i)	14	22	5	6	1	48
Review introductory sections of sectoral chapters and identify any needs to **update to bring in line with emissions in current years**.	B(ii)	0	0	2	0	0	2
Assess **whether there are sources included**, **but without complete** TIER 1, TIER 2 (and TIER 3) **methodologies**	B(iii)	0	3	0	3	0	6
Based on expert knowledge and current scientific understanding, assess whether **updates to existing methodological approaches are likely available**, with regards to approach, detail level, and emission factors	B(iv)	44	67	16	8	2	137
Consider whether all relevant pollutants are covered by each sector and whether **any methodologies are missing for any relevant pollutants.**	B(v)	3	12	0	2	0	17
Consider the extent to which the methodology draws on **a limited number of studies, and the age of the studies**.	B(vi)	15	15	5	2	0	37
Consider the **uncertainty information provided with the emission factors**	B(vii)	2	3	0	0	0	5
Consider whether **regional emission factors are needed**, and whether it will be possible to determine/derive/add them.	B(viii)	1	2	2	0	0	5
Consider **other emission reporting requirements** (for example, those under UNFCCC) and whether there are **opportunities to harmonise** the methods and data.	B(ix)	10	9	3	4	0	26
Consider the historical development of the chapters and **how methodologies have changed within versions**.	B(x)	0	4	0	2	0	6
Consider the benefit in **further standardising** any of the guidance information in relation to recommended methodologies and dataset(s) for this sector, source or pollutant.	B(xi)	2	3	0	4	0	9
Consider where **clarity or chapter structure could be improved**	B(xii)	7	41	2	2	1	53
Total number of unique improvements per sector (Part B)		47	105	16	15	3	198

Note – some recommendations are applicable to multiple types of improvement, and consequently the sum of the number of each type of improvement is greater than the total number of unique improvements

Additional comments are provided for each individual improvements in Appendix A.

3.3.1 Transport

47 recommendations are made to improve the Part B of the EMEP/EEA Guidebook relating to transport emissions. The most common types of recommendations concern improvements to existing methodological approaches with regards to approach, level of detail and emission factors (44 improvements, B(iv)) and improvements in the number and age of references that the methodologies are based on (15 improvements, B(vi)).

The full list of recommendations is presented in the 'Transport' sheet in Appendix A.

3.3.2   Combustion & Industry

105 recommendations are made to improve the Part B of the EMEP/EEA Guidebook relating to non-transport combustion & industry emissions. The most common types of recommendations concern improvements to existing methodological approaches with regards to approach, level of detail and emission factors (67 improvements, B(iv)) and improvements to clarity of wording and chapter structure (41 improvements, B(xii)).

The full list of recommendations is presented in the 'C&I' sheet in Appendix A.

3.3.3   Agriculture

16 recommendations are made to improve the Part B of the EMEP/EEA Guidebook relating to agriculture emissions. The most common types of recommendations concern improvements to existing methodological approaches with regards to approach, level of detail and emission factors (16 improvements, B(iv)) and improvements in gaps in the coverage of emission sources within the sectoral chapters (5 improvements, B(i)).

The full list of recommendations is presented in the 'Agriculture' sheet in Appendix A.

3.3.4   Waste

15 recommendations are made to improve the Part B of the EMEP/EEA Guidebook relating to waste emissions. The most common types of recommendations concern improvements to existing methodological approaches with regards to approach, level of detail and emission factors (8 improvements, B(iv)) and improvements in gaps in the coverage of emission sources within the sectoral chapters (6 improvements, B(i)).

The full list of recommendations is presented in the 'Waste' sheet in Appendix A.

3.3.5   Other

Three recommendations are made to improve the Part B of the EMEP/EEA Guidebook relating to emissions arising from "other" sectors. Two recommendations concern improvements to existing methodological approaches with regards to approach, level of detail and emission factors (B(iv)) and the third recommends improvement in gaps in the coverage of emission sources within the sectoral chapters (B(i)).

The full list of recommendations is presented in the 'Other' sheet in Appendix A.

3.4   Prioritisation of recommended improvements

3.4.1   Overview

Table 3-4 presents the number of recommended improvements for each priority grouping per sector. The table also indicates the estimated total resource (as working days) required for each priority grouping per sector.

Improvements by sector: In summary, the chapters relating to transport emissions have both the most high priority and medium priority recommended improvements. The chapters relating to C&I emissions have the most low priority and nice-to-have recommended improvements.

Improvements by priority: The majority of the high, medium and low priority recommended improvements concern improvements to existing methodological approaches with regards to approach, level of detail and emission factors (B(iv)). Additionally, the majority of the nice-to-have recommended improvements also relate to improvements to existing methodological approaches but also a significant portion concern improvements to the clarity or chapter structure (B(xii)).

Improvements by required resource: Table 3-4 also indicates that the high priority improvements have the highest amount of resource required to be implemented, of which approximately half relate to chapters associated with transport emissions. Regarding all the recommended improvements, it is also noted that whilst there are more nice-to-have improvements than high priority improvements, the total estimated resource required to implement the nice-to-have improvements is lower than the resource required for the high priority improvements.

Additionally, the number of high priority improvements is similar to the number of medium priority improvements, 45 and 44 respectively. However, the amount of resource required for the high priority recommended improvements is considerably greater than the medium priority recommended improvements. Consequently, in general, the high priority recommended improvements require a larger resource per improvement relative to the medium priority and nice-to-have improvements. Additionally, in general, the amount of resource per improvement required for the high priority improvements is similar to the low priority improvements.

Table 3-4 – number of recommended improvements per priority grouping and estimated resource required per priority grouping

Chapter	High priority		Medium priority		Low priority		Nice-to-have	
	Number of improvements	Associated estimated resource (days)	Number of improvements	Associated estimated resource (days)	Number of improvements	Associated estimated resource (days)	Number of improvements	Associated estimated resource (days)
Part A	6	35	6	18	0	-	0	-
C&I	6	185	17	145	22	419	60	424
Transport	16	327	13	278	11	94	7	69
Agriculture	13	66	3	2	0	-	0	-
Waste	2	21	4	15	3	0.75	6	12
Other	2	3	1	1	0	-	0	-
Total	**45**	**637**	**44**	**459**	**36**	**513.75**	**73**	**505**

3.4.2   Part A

There are six high priority and six medium priority improvements relating to improvements to the general guidance (Part A). The majority of the high priority improvements (four out of six) and medium priority improvements (four out of six) relate to improvements to existing methodological approaches (B(iv)).

There was no low priority or nice-to-have improvements identified concerning Part A of the guidebook.

The full list of recommendations and priority grouping is presented in the 'Part A' sheet in Appendix A.

3.4.3   Combustion & Industry

Four of the six high priority improvements relating to C&I emissions concern improvements to existing methodological approaches with regards to approach, level of detail and emission factors (B(iv)). Additionally, three of the six high priority recommendations relate to other emission reporting requirements (for example, those under UNFCCC, B(ix)).

The majority of the medium priority improvements also relate to improvements to existing methodological approaches (14 out of 17 improvements, B(iv)) with a smaller portion (7 out of 17 improvements) relating to improvements to clarity of wording and chapter structure (B(xii)).

Similarly, the majority of the low priority and nice-to-have improvements relate to improvements to existing methodological approaches (B(iv)), 16 out of 22 and 33 out of 60 of the improvements, respectively. Additionally, a smaller portion relate to improvements to clarity of wording and chapter structure (B(xii)): 7 out of 22 and 26 out of 60 of the low priority and nice-to-have improvements, respectively.

The full list of recommendations and priority grouping is presented in the 'C&I' sheet in Appendix A.

3.4.4   Transport

15 of the 16 high priority improvements relating to transport emissions concern improvements to existing methodological approaches with regards to approach, level of detail and emission factors (B(iv)). Additionally, 6 of the 16 high priority recommendations include improvements in the number and age of the references that the methodologies are based on B(vi)).

The majority of the medium priority improvements also relate to improvements to existing methodological approaches (12 out of 13 improvements, B(iv)) with a smaller portion (4 out of 13 improvements) relating to improvements in the number and age of references that the methodologies are based on B(vi).

Similarly, the majority of the low priority and nice-to-have improvements relate to improvements to existing methodological approaches (B(iv)): 11 out of 11 and 6 out of 7 of the improvements, respectively.

The full list of recommendations and priority grouping is presented in the 'Transport' sheet in Appendix A.

3.4.5   Agriculture

All of the 13 high priority and all of the 3 medium priority improvements relating to agriculture emissions concern improvements to existing methodological approaches with regards to approach, level of detail and emission factors (B(iv)). Additionally, two of the three medium priority improvements relate to improvements concerning the gaps in the coverage of emission sources (B(i)) and reviewing and updating the introductory sections of sectoral chapters to bring in line with emissions in current years (B(ii)).

There was no low priority or nice-to-have improvements identified concerning agricultural emissions.

The full list of recommendations and priority grouping is presented in the 'Agriculture' sheet in Appendix A.

3.4.6   Waste

Two high priority improvements relating to waste emissions were identified. One of these improvements relates to the EMEP/EEA Guidebook including an inconsistent definition of PCBs amongst the chapters (B(iii), B(vi) and B(xi)) and the other relates to missing waste sources of emissions in the guidebook, e.g. landfill burning, tyres burning and construction and demolition waste burning (B(i) and B(iv)).

Three of the four medium priority improvements relate to improvements to existing methodological approaches (B(iv)). Additionally, two of the three improvements concern the benefit in further standardising any of the guidance information in relation to recommended methodologies and dataset (B(xi)).

Three low priority recommendations are identified to improve the Part B of the EMEP/EEA Guidebook relating to waste emissions. Two of these relate to chapter 5C and concern the PM_{10} and $PM_{2.5}$ emission factor being the same for crematorium plumes (B(i), B(v) and B(x)) and the lack of emission factors for uncontrolled incinerators (B(iii) and B(ix)). The other low priority improvement relates to chapter 5B and details that the default Tier 1 emission factor for anaerobic digestion does not specify if it is referring to wet or dry weight (B(xii).

Additionally, four of the six nice-to-have improvements relate to improvements to existing methodological approaches (B(iv)) and/or improvements concerning the gaps in the coverage of emission sources (B(i)).

The full list of recommendations and priority grouping is presented in the 'Waste' sheet in Appendix A.

3.4.7   Other

Three recommendations are made to improve Part B of the EMEP/EEA Guidebook relating to emissions arising from "other" sectors. Two of these improvements are high priority, of which one relates to restructuring the 11C chapters into other chapters to reduce the number of 11C chapters (B(i) and B(xii)) and the other concerns improving the methodology for estimating emissions from forest fires (B(iv)).

The one medium priority improvement relates to improving the methodology for estimating emissions from volcanoes (B(iv)).

There was no low priority or nice-to-have improvements identified concerning emissions from other sectors.

The full list of recommendations and priority grouping is presented in the 'Other' sheet in Appendix A.

4 CONCLUSIONS

A systematic review of the EMEP/EEA air pollutant emission inventory Guidebook 2023 has been conducted to produce a long list of improvements for consideration across the technical areas of Combustion and Industry, Transport, Agriculture, Waste, Other sources, and Projections (Part A).

Almost 200 individual recommendations (198) have been made to improve the 2023 EMEP/EEA air pollutant emission inventory Guidebook. Over half of these improvements (105) apply to Part B chapters relating to stationary combustion & industry emission sources. The next largest group of recommendations are targeting Part B chapters concerning transport emissions (47). Recommendations have also been made to the Part B chapters targeting agriculture (16), waste (15) and other areas for improvement (3). Several improvements were also recommended to update Part A (12), most of which specifically target projections (8).

The majority of recommendations concern improvements to existing methodological approaches with regards to approach, level of detail and emission factors (137 improvements) and improvements to clarity of wording and chapter structure (53 improvements).

A three-step prioritisation approach was undertaken to prioritise the individual recommendations into four prioritisation groups:

- <u>High Priority</u> – these improvements **should** be implemented **as soon as possible**, as there is **major impact** on the quality of the EMEP/EEA Guidebook if not included.
- <u>Medium Priority</u> - these improvements **should** be implemented, as there is either: a) **major impact** on the quality of the EMEP/EEA Guidebook if not included, but will take significant resource to implement, or b) **considerable impact** yet not too take much resource to implement.
- <u>Low Priority</u> – these improvements **should** be implemented as there is either: a) **considerable impact** on the quality of the EMEP/EEA Guidebook if not included, but will take significant/unknown resource to implement, or b) **minor impact** yet not too take much resource to implement.
- <u>Nice-to-have</u> – these improvements **could** be implemented, if available timeframe and budget allows, as there is only **minor impact** on the quality of the EMEP/EEA Guidebook if not included but will take significant/unknown resource to implement.

An initial prioritisation score of the recommendations was calculated based on the product of six adjustment factors and was further adjusted considering the estimated resource required for each recommendation. The results of the initial prioritisation were compiled and discussed between sector experts, TFEIP panel leaders, the European Commission and the European Environment Agency to determine the suitability of the priority scoring. Where necessary, the sector experts and TFEIP panel leaders manually updated the priority scoring based on their professional opinion rather than the automatic priority grouping.

The final prioritisation grouping exercise identified that the nice-to-have recommendations made up the largest fraction of the recommendations (73 out of 198). This was followed by high (45), medium (44) and low (36) priority recommended improvements.

The high priority improvements have the highest amount of estimated resource required to be implemented, of which approximately half relate to chapters associated with transport emissions. Additionally, the high priority improvements were identified to have a high amount of resource required per improvement relative to the medium priority and nice-to-have recommended improvements. The amount of resource per improvement required for the high priority improvements is similar to the low priority improvements.

APPENDIX A – COMPILED LIST OF RECOMMENDATIONS FROM THE REVIEW

Provided as separate file.