A consideration of future emissions inventory reporting under the CLRTAP

A technical paper from the TFEIP

1 Overview

The TFEIP has an important role in ensuring that Parties to the Convention on Long-range Transboundary Air Pollution (CLRTAP) provide relevant air pollutant emissions data to the Convention's stakeholders – including, amongst others, EMEP/WGE Centres, national bodies, and the research community.

Recognizing that the CLRTAP is preparing for discussions about the future of the Gothenburg Protocol, the TFEIP included an action in their 2023 workplan to ask the TFEIP community for their views on current emissions reporting, and future priorities for the emissions inventory technical area. Ahead of the 2023 annual meeting of the TFEIP, the TFEIP Secretariat circulated a questionnaire to the TFEIP community, with the specific aims of gathering view on:

- What submitted emissions data are currently being used for, and whether there are emissions data included in the submissions that are not being used.
- Whether it would be appropriate to propose revisions to the current emissions inventory reporting to better meet current needs of the wide range of stakeholders, and what those revisions might be.
- Whether there are emerging issues which need to be taken into account in proposing changes to the current emissions inventory reporting.

There was strong engagement with the questionnaire, with 163 emissions inventory experts and modellers responding, representing 40 different countries. The majority of respondents were emissions inventory compilers.

The total numbers of respondents by type are shown in Table 1 below. Respondents were able to skip questions that were not relevant to their role, and therefore the number of responses to individual questions was lower than the total numbers shown in Table 1. The term "respondents" is used in this paper to refer to respondents who provide a reply to a given question, rather than the totals shown below.

Table 1 Number of responses by role type

Respondent role type	Number of responses
Emission inventory compiler	97
Modeller/technical user of the data	56
Policy maker	10
Other	15

Results of the questionnaire were presented at the 2023 annual meeting of the TFEIP for discussion. Outcomes of the discussion are summarised in the sections that follow. The slides from the meeting can be found on the 2023 TFEIP meeting webpage.[1]

[1] https://www.tfeip-secretariat.org/oxford-2023

2 NOx, NMVOCs, SO_2, NH_3 and $PM_{2.5}$

There is a clear consensus amongst inventory experts and modellers that current mandatory reporting requirements for NOx, NMVOC, SO_2, NH_3 and $PM_{2.5}$ should be retained.

These pollutants are therefore not considered further in this paper.

3 Particulates and carbon monoxide

3.1 PM_{10}, TSP, BC, CO

The questionnaire results indicated that the majority of respondents to this question were in favour of annual reporting for PM_{10}, TSP, BC and CO, as shown in Table 2. Of the four pollutants described, respondents gave the least support for annual reporting of TSP. Some stakeholders added further comments to explain that they do not use TSP emission estimates and do not think it is necessary to report this metric. However, one inventory compiler stated that it was essential for checking estimates of other particulate emissions, and one modeller commented that it was a useful metric to have for analysing PM fractions.

Overall, there is clear consensus that current reporting for PM_{10}, TSP, BC, CO should be retained. During the TFEIP meeting, discussion highlighted the importance of distinguishing whether these pollutants should be included for reporting or checking purposes.

Table 2 Responses to statement 'Annual reporting is necessary for the following pollutants'

Pollutant	Agree/Strongly agree	No view	Disagree/Strongly disagree
PM10	86%	12%	2%
TSP	65%	22%	13%
BC	76%	15%	9%
CO	72%	19%	9%

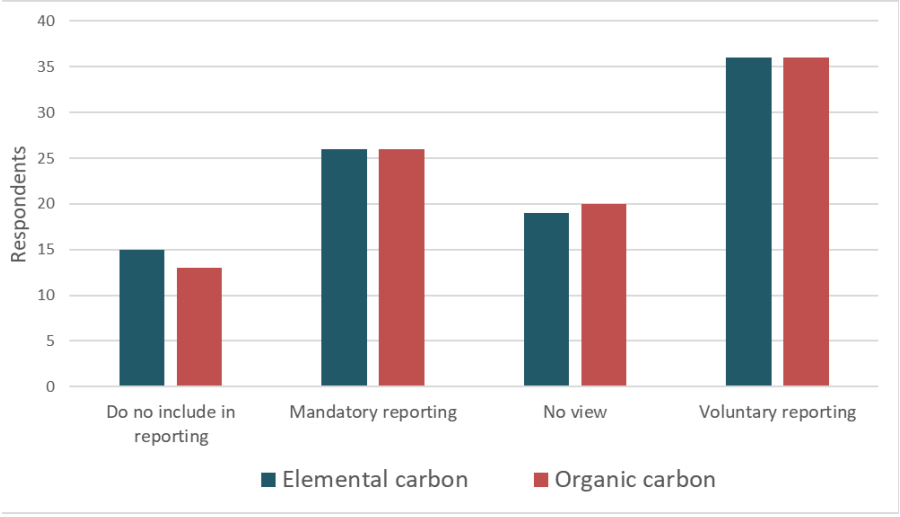
Note: 97 people responded to this question. Percentages do not take into account respondents that skipped this question.

3.2 Elemental carbon and organic carbon

Whilst reporting of black carbon (BC) is voluntary within CLRTAP reporting, there are currently no requirements to report similar metrics such as elemental carbon and organic carbon. The majority of respondents would like these pollutants to be included in emissions reporting (see Figure 1 below), citing reasons such as health impacts and use for modelling purposes. However, many respondents raised concerns about data availability and quality.

Discussions with inventory experts confirmed the view that **there is a need to improve the accuracy and specificity of BC emission factors in the existing EMEP/EEA Air Pollutant Emissions Inventory Guidebook ("EMEP/EEA Guidebook") before consideration can be given to the inclusion of EC or OC emissions reporting.** Significant resources and time would be required to develop the underlying methodologies before such additional reporting could be implemented. **So, it is proposed that the inclusion of EC and OC is taken as a longer-term aim of the CLRTAP.**

Figure 1 Answers to the question: 'Should elemental carbon and organic carbon be added to reporting requirements?



3.3 Condensable PM

The results in Table 3 below indicate that many of the respondents believe that condensables should be reported where possible. Following discussion at the 2023 annual TFEIP meeting, there was a clear consensus that the **aims of the CLRTAP should be to continue to focus on improved transparency and consistency of reporting condensable PM**, and as far as practicable, support should be given to the ongoing initiatives across all parts of the CLRTAP in this regard. The TFEIP community recognised that time is needed to continue to build the evidence base before emissions inventories could comprehensively report either filterable PM only or filterable and condensable PM.

Table 3: How do you think condensable PM should be reported?

Response	Number of respondents
Condensables should not be reported	5
Include condensables where possible	41
Report filterable PM and the corresponding condensables PM emissions separately	27
Report filterable PM with separate voluntary reporting of the corresponding condensable component	13

4 Heavy metals and POPs

4.1 Heavy metals

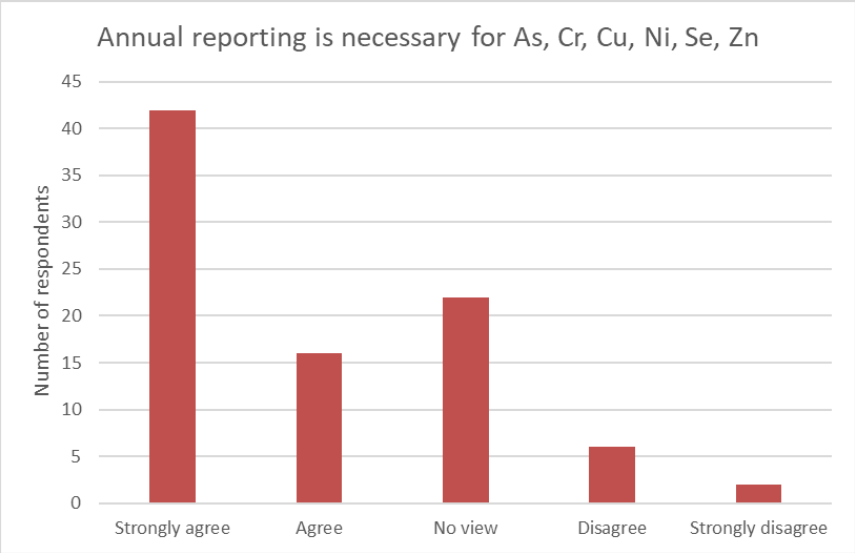
The questionnaire covered heavy metals that have mandatory reporting requirements as well as those that are currently reported voluntarily. When asked about the mandatory reporting of Pb, Cd and Hg, roughly half of respondents reported using this data, demonstrating **that it is important that Pb, Cd and Hg remain included in emissions reporting requirements.**

Figure 2, below, illustrates that the majority of respondents supported annual reporting for heavy metals that are currently reported on a voluntary basis. Stakeholders were also asked about the potential impact on their work if these emissions were not reported. Responses were varied, and demonstrated the varying nature of roles and research that respondents undertake.

When these results were discussed at the 2023 annual TFEIP meeting, **there was a clear preference to retain the current scope of voluntary reporting of heavy metals (As, Cr, Cu, Ni, Se, and Zn).** There was some discussion about whether all of these should be retained, and whether it was beneficial to

identify one or more pollutants which were not needed, thus reducing the reporting burden. However, emissions inventory compilers explained that the removal of an individual pollutant would not have a large impact on the burden of reporting. It was acknowledged that work is needed to improve the heavy metal emission factors provided in the Guidebook, which have not been given much attention across the recent updates of the EMEP/EEA Guidebook.

Figure 2 Is annual reporting necessary for As, Cr, Cu, Ni, Se, and Zn?



4.2 POPs

Nearly a half of respondents reported that they used the emissions of PAHs, dioxins, furans, PCBs, or HCB in air pollutant studies. The questionnaire invited to respondents to comment on the mandatory nature of reporting of these substances, and there were no indications that these pollutants should be removed from reporting requirements, although a limited number of respondents commented on the need for better quality data.

Discussions at the 2023 annual TFEIP meeting showed **a clear consensus to retain current reporting requirements for POPs (PAHs, dioxins, furans, PCBs, or HCB).** However, as with heavy metals, the emission factors that are provided in the EMEP/EEA Guidebook for theses pollutants need improving.

5 New pollutants

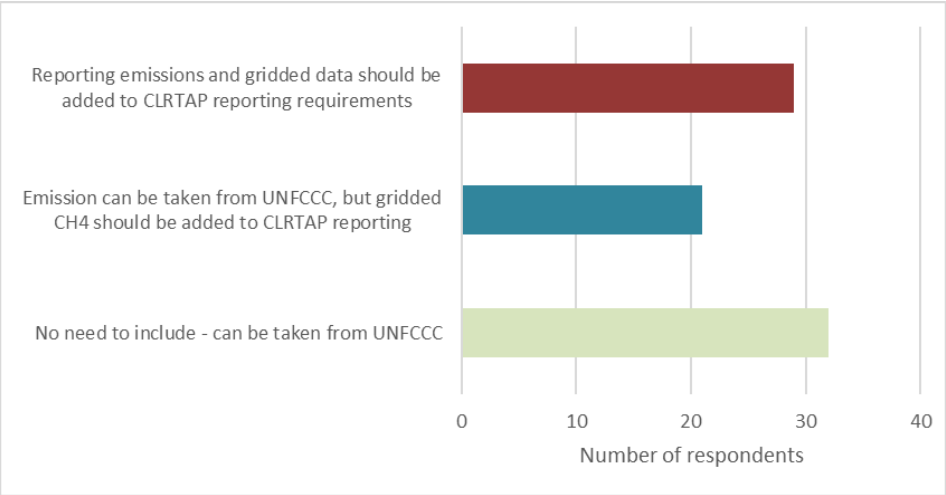
5.1 Methane

Over 80 respondents replied to a question asking whether methane should be including in reporting requirements, and how this should be done. Just over 30 respondents believed that there was no need to include this data within CLRTAP reporting, suggesting that the data can simply be taken from UNFCCC reporting. However, **the majority of respondents indicated that methane emissions data should be included in CLRTAP reporting requirements in some form**, whether gridded data only or gridded data and reported emissions, as shown in Figure 2 below.

The support for including gridded data may be well-intended but misdirected. Emission inventory experts probably support this reporting in the belief that this is needed for modelling purposes, but MSC-West have indicated that it is not essential for their modelling work. Furthermore, concerns were raised that the inclusion of gridded methane emissions may result in a duplication of effort, because some modelling groups indicated a preference to create their own datasets. Further consultation with

modellers is needed to provide definitive feedback on whether gridded data would be used if it was added to reporting requirements.

Figure 3 How should methane be included within CLRTAP reporting?



5.2 PM_1, $PM_{0.1}$, and Particle Numbers

The questionnaire included a question on whether particle numbers, PM_1 and/or $PM_{0.1}$ should be added to the current voluntary emissions reporting requirements. A third of respondents indicated that they had no view, suggesting that a limited number of people felt able to provide an informed opinion. A quarter of respondents reported that they would not include these pollutants on the basis that users requiring these emissions estimates could derive them by applying PM fractionation profiles to PM emission estimates that are already included in the reporting requirements. However, on average across all three pollutants, just over a third of respondents indicated that this reporting should be included on a voluntary basis, often citing the use of these data in health impact studies. However, many respondents raised concerns about poor data quality.

A concern frequently expressed was that particle count would be a particularly challenging metric to estimate (although an emissions inventory of particle count has been compiled for Europe by a research institute). Based on the responses it is proposed **that PM emissions reporting continues as it is currently, with the longer-term aim of improving guidance on PM size fractionation profiles.**

5.3 Additional POPs

The results from the questionnaire indicate that there is less interest in including additional POPs (e.g. additional PAHs, PFAS, PFOS, SCCPs and BDE-99) than there is in including additional particulate metrics. Respondents were asked about the different POP groups separately, but responses were almost identical for each group, with:

- Just over a half indicating that they had no view
- Approx. a quarter did not believe that these pollutants should be reported annually, and
- Approx. a fifth believed that reporting of these additional POPs should be annual.

There was consensus agreement that improving the quality of the existing POPs data should be prioritised over increasing the current scope of reporting.

6 Memo items and non-anthropogenic sources

It is possible that emissions estimates for memo items (such as international shipping and aviation) and non-anthropogenic sources (such as forests and natural vegetation) could be improved if they were calculated by a single institution for the entire geographical scope of the CLRTAP, rather than by individual Parties. Around half those that responded to this question were in favour of such a centralised approach to the emissions estimation and reporting for selected memo items and non-anthropogenic sources, citing reasons such as better comparability and consistency within the calculations.

Whilst very few respondents were strongly against the proposal, some did raise concerns, such as a single institutions' lack of understanding of country specific conditions. One respondent believed that some Parties already produce high quality inventories for these categories and that centralised emissions estimates would result in a reduction of data quality for these countries. Another raised concerns that some countries may still wish to produce their own national estimates (for reasons of "ownership" and ensuring high quality), which could result in multiple versions of the data.

Shipping and aviation were considered to be good candidate emission sources for using a centralised approach for emissions estimation and reporting, and it is recommended that the EMEP/WGE Steering Body consider possible options for using this approach for these sources. However, this would result in changes of responsibilities (and relevant funding streams) within the CLRTAP, which may mean that it is complex to implement.

If earth observation datasets can be used to produce reliable emission estimates of natural fires (wildfires) and of building and car fires, then it may also be useful to apply a centralised approach for these. Earth observation datasets may also be a useful tool for identifying emissions from landfill fires, although it is suspected that 'backyard fires' may be more challenging, depending on the spatial resolution of the datasets available. The TFEIP will undertake discussions with earth observation experts to better understand the benefits that might arise from using earth observation data and will then make recommendations accordingly..

7 Gridded data

The questions relating to gridded data received mixed responses, with many stakeholders either not providing a response or selecting the 'No view' option. Results are presented in Table 4 below, and indicate that **there is little support for adding new pollutants to the existing reporting requirements for gridded data.**

Table 4 Number of responses to questions about gridded data

	Agree/Strongly agree	No view	Disagree/ Strongly disagree
There is no need to add other pollutants	23	16	14
Reporting gridded data every four years is sufficient	21	9	23
The quality of data is sufficient for my needs	24	11	16

During discussions at the TFEIP Meeting, it became clear that **there is a need to focus on improving the quality of the gridded data being reported, rather than increasing the scope or detail requirements of the reported data.**

8 Large point source data

The results from the questionnaire suggest that there are more respondents who believe that **the large point source data currently reported under the CLRTAP is sufficient** than those who do not.

9 Projections

Overall, feedback received from both the questionnaire and discussion illustrated that the large majority of air quality experts believe that **the quality of projections data reported under CLRTAP is sufficient.**

There was comparable support for retaining 4-yearly reporting and changing to more frequent reporting. At the 2023 annual TFEIP meeting, **inventory compilers explained that 2-yearly reporting of projections could be introduced with minimal increases to workloads**, as EU Member States already report projections data every two years under the National Emissions reduction Commitments Directive.

10 Conclusions and Recommendations

In addition to being able to draw out key messages from the questionnaire, on some topics the respondents provide a variety of opinions and priorities. This reflects the fact that there are a wide variety of roles and niche experts included in the air quality experts who provided their opinions. There is some interest from different users in all pollutants raised through the questionnaire, as well as new emerging substances. However, this interest does not always necessarily translate into a need or request for increased mandatory reporting, and respondents acknowledged that changing reporting and adding new pollutants can present significant challenges.

Although results from the questionnaire indicate that there is interest in adding new pollutants to reporting requirements, for example elemental carbon or organic carbon, discussions at the TFEIP meeting revealed that improving the quality of the data that is already included in current reporting requirements is of higher priority. Pollutants such as organic or elemental carbon and condensable PM could be included in the CLRTAP emissions reporting requirements in the future but should be considered as a longer-term aim. Adding these pollutants to current reporting requirements may present considerable challenges, and time is needed to build an evidence base and improve the data availability relating to these pollutants.

Other changes to reporting requirements could be implemented without a significant increase in reporting burden for inventory compilers, but further review is needed before such changes are implemented.

A significant amount of work will be needed before any decisions are made about changing emissions inventory reporting commitment within the CLRTAP. However, the table below

summarises the current views of the emissions inventory community at this early stage, and is provided to support upcoming discussions about future changes:

Table 5 A summary of conclusions from the consultation on the future of emissions reporting

Reporting component	Conclusions
"Main" pollutants	• There is a clear consensus that current reporting requirements for the following pollutants should be retained: NOx, NMVOC, SO_2, NH_3, $PM_{2.5}$, PM_{10}, TSP, BC, CO.
BC, EC, OC	• There is a need to improve the accuracy and specificity of BC emission factors in the EMEP/EEA Guidebook before consideration can be given to the inclusion of EC or OC emissions reporting. • It is proposed that the inclusion of EC and OC is taken as a longer-term aim of the CLRTAP.
Condensable PM	• The CLRTAP should aim to continue to focus on improved transparency and consistency of reporting for condensable PM.
Heavy metals:	• Pb, Cd and Hg should remain included in emissions reporting requirements, and the current voluntary reporting of heavy metals should be retained (for As, Cr, Cu, Ni, Se, and Zn). • Work is needed to improve the heavy metal emission factors provided in the Guidebook.
POPs:	• The current reporting requirements for POPs (PAHs, dioxins, furans, PCBs, or HCB) should be retained. • Work is needed to improve the POPs emission factors provided in the Guidebook. • Improving the quality of the existing POPs data should be prioritised over increasing the current scope of reporting.
Methane:	• Methane emissions data should be included in CLRTAP reporting requirements in some form (but this does not necessarily mean reporting in addition to the UNFCCC).
PM_1, $PM_{0.1}$, & Particle Numbers	• The current PM emissions reporting should continue, with the longer-term aim of improving the PM size fractionation profiles.
Centralised emissions estimation and reporting	• It is recommended that the EMEP/WGE Steering Body consider options for using a centralised approach for estimating and reporting emissions estimates from shipping and aviation.
Gridded emissions data	• There is a need to focus on improving the quality of the gridded data being reported. • There is little support for adding new pollutants to the existing reporting requirements for gridded data.
Large Point Sources	• The large point source data currently reported under the CLRTAP is sufficient.
Projections	• The quality of projections data reported under CLRTAP is sufficient. • 2-yearly reporting of projections could be introduced with minimal increases to workloads of EU Parties.