

## **Non-paper from the European Union and its Member States on condensable particles in emission inventories (residential heating)**

### **1. Introduction**

In order to improve atmospheric modelling and support the design of efficient and relevant policy for reducing the levels of air pollutants, scientists and policy makers need to be able to rely on complete, accurate and comparable emission inventory data representing real world emissions. Today, reported **PM emissions from certain sectors and in particular residential heating are under-estimated because they do not take into account the condensable part** in a consistent and harmonised way. This has been analysed and discussed within EMEP, TFMM (Task Force on Measurements and Modelling) and TFEIP (Task Force on Emission Inventories and Projections) over a couple of years and brought to the attention of WGSR and EB in 2018 and 2019.

In addition, TFTEI (Task Force on Techno-Economic Issues) have intensively worked on PM emissions from residential heating including wood burning, resulting in a Code of Good Practice<sup>1</sup> in 2019. The WGSR “Thematic Session on solid fuel residential heating as a source of air pollution and short-lived climate forcers” on 24 May 2018 provided an in-depth review of the state of the art with respect to the emission measurements, source apportionment and abatement measures<sup>2</sup>.

Based on the results of the research work done by the scientific community, EMEP SB proposed actions and a stepwise approach to address this issue (Report of the 5<sup>th</sup> joint session of the EMEP SB and WGE)<sup>(3)</sup>.

The EB supported the proposed general approach at its 38<sup>th</sup> session (2018). The EB at its 39<sup>th</sup> session (2019) took note of the step-wise approach to the treatment of the condensable part in particulate matter as agreed by EMEP SB; requested the WGSR to discuss policy implications of condensables reporting at its 58<sup>th</sup> meeting and to report back to the EB at its 40<sup>th</sup> session; reiterated its request to the EMEP SB in cooperation with other relevant bodies to continue its scientific work for accounting for the condensable part of particulate matter in scientific assessments of the Convention and to report on progress to the EB at its 40<sup>th</sup> session.

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<sup>1</sup> Code of good practice for wood-burning and small combustion installations (document ECE/EB.AIR/2019/5):  
[http://www.unece.org/fileadmin/DAM/env/documents/2019/AIR/EB/ECE\\_EB.AIR\\_2019\\_5-1916518E.pdf](http://www.unece.org/fileadmin/DAM/env/documents/2019/AIR/EB/ECE_EB.AIR_2019_5-1916518E.pdf)

<sup>2</sup> See <http://www.unece.org/index.php?id=45535> for individual presentations, and the Chair’s summary in the annex to the report of the WGSR 56<sup>th</sup> session

<sup>3</sup> See ECE/EB.AIR/GE.1/2019/2–ECE/EB.AIR/WG.1/2019/2, para 32

## 2. Considerations

Even though the EMEP proposal on the necessity of accounting for condensables in PM emissions is generally accepted, many complex questions related to reporting and policy issues, on top of the problems of technical and scientific nature (e.g. unharmonised and incomplete measurement methods and process conditions, difficulty in determining reliable emission factors for various emission sources depending on their, size, type and age, as well as operation mode, etc.), remain open. Some of these issues are:

- Accounting for condensables in PM emissions could be presently challenging for some Parties because of their national legislation, lack of knowledge or concerns related to compliance issues;
- There is insufficient transparency in PM reporting; it is not clear which inventories are including/excluding condensable particles.
- Mandatory PM emission reporting, including condensables, has a policy dimension, especially in the perspective of the review of the Gothenburg Protocol.
- A transition towards the inclusion or non-inclusion of the condensable part of condensables in PM reporting could have a significant impact on the emission trend and on the importance of different source categories. In many countries category 1.A.4 would become by far the most significant source category for PM when condensables would be included and would largely determine the national emission trend for PM.
- Implications for compliance with the emission reduction commitments will therefore need to be further considered and discussed in next steps.
- Compliance with PM emission limit values may also become an issue when switching to a different measurement technique for better total PM reporting.

## 3. Measurement methods – brief overview of examples

For historical reasons, different measurement methods for determining/checking performance and emission characteristics of small combustion appliances are used in Europe. The majority of the EU Member States<sup>4</sup> are using *heated filter* measurements - gravimetric method for determination of mass concentration of PM (with a very low share of condensable particles included in the results). The Norwegian standard includes measurements with *dilution tunnel, different load conditions and combustion air settings, natural draft* (condensable particles included in the results to a large extent). This method is also used in certain other northern European countries. Variants of dilution tunnel method with differing operation conditions than the Norwegian standard are also applied, e.g. in the United Kingdom where a method with electrostatic precipitator is used. The heated filter method is also accepted in the UK and a 20-fold correction factor is applied to the results.

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<sup>4</sup> *Heated filter* measurements are a legal requirement presently in Germany, Croatia, Switzerland and Austria, and are planned to be in the Netherlands (from 2020 onwards); HF is the measurement method to be used for the French quality label and regional requirements in Italy; it is the preferred measurement method in Eastern EU countries.

#### **4. Objective**

As there is a considerable lack of knowledge on real life emissions of condensables this has the potential to reduce the credibility of the inventory unless methodology is further developed and improved.

A transition to PM reporting that includes the condensable particles may result in unverifiable changes to emission inventories, introduction of significant uncertainties and with possible consequences for compliance with emission reduction commitments. On the other hand, condensables are part of the overall PM emissions, so reporting condensables will give a more realistic picture of source-specific and overall emissions. These data are important, notably for atmospheric modelling purposes.

Hence, it is very important to find a more reliable solution that enables harmonisation of methods used, intercomparability of results and decreasing the uncertainty.

#### **5. Uncertainties of reporting condensable components of PM emissions from residential heating**

Emissions inventories for small combustion installations are compiled by multiplying emission factors for a range of different types and age categories of stoves and boilers with the relevant activity data (wood and coal burned in the relevant installation class). Emission factors are usually derived from measurements, which are based on at least three different measurement methods. Good estimates on activity data per type and age category of stoves are often lacking. Irrespective of the method used, a number of assumptions have to be made for reporting, and uncertainties are generally high for small-scale combustion in the residential sector. Different emission measurement methods are only one factor in the overall uncertainty.

According to the most recent EMEP Guidebook, the condensable fraction of emissions from stoves is strongly dependent on the type and age of the stoves, the fuel quality and the user behaviour. This uncertainty adds to the already existing uncertainty of (non-condensable) PM emissions from domestic heating. Since these factors change with time, a possible conversion factor for the condensable fraction cannot be used for the whole time series.

Furthermore, there should be consistency between the condensable share in PM emissions and the NMVOC inventory.

More research, information and methodology development is needed for further improvement of the situation, with the aim of moving towards a better evidence-base for policy making.

#### **6. Consequences for compliance**

Emission reduction commitments for PM<sub>2.5</sub> exist within the UNECE framework and for EU Member States within Directive (EU) 2016/2284 on the reduction of national emissions of certain atmospheric pollutants (the NEC Directive). Adding to the inventories a component (condensable fraction) with uncertainty attached to it makes compliance checks less reliable while also changing the basis on which the emission reduction commitments were originally set. If the reduction targets were based on emission factors using heated filter measurements when those targets were set, changing the method to dilution tunnel measurements during the commitment period can change the achievement percentages remarkably.

For instance, “soft measures” like information, advice to operators on fuels and operation, checks on the technical functionality of appliances in households, requirements on fuel quality etc. will be more effective for condensables than for other PM emissions as all those measures aim at reducing incomplete combustion. For the inclusion of those measures in the emission inventory, more solid evidence is needed on the effectivity of such programmes. Otherwise, it would increase opportunities of non-transparent and unverifiable changes to emission inventories with possible consequences for compliance with emission reduction commitments.

The relative contribution of small scale combustion for residential heating compared to other sources would in many cases rise.

The possibility for inventory adjustments was originally intended for well-delineated exceptional circumstances. It has been questioned whether its use for fixing fundamental and systematic changes in the inventories, such as including condensables, may overstretch the limits to its application.

These issues will require further analysis and discussion ahead, as noted and agreed at the 39<sup>th</sup> session of the EB.

## **7. Proposed way forward: science aspects**

Despite the challenges outlined above, it is clear that atmospheric models and integrated assessment need consistent and complete emission data (inventories and projections), without increasing uncertainties in the compliance assessment. Indeed, there is underestimation in the current reporting of PM emissions, when condensables are excluded.

Science questions that will need to be analysed and explored include:

- Definition of ‘condensable’ in the context of atmospheric modelling;
- Methodology for best estimates of the condensable part, taking different existing measurement methods into account with a view to improving these measurement methods;
- Assumptions /factors for condensables in the context of atmospheric modelling;
- The suitability of measurement methods for low PM concentrations;
- Methodological issues related to the appropriate measurement conditions (dilution ratio, temperature, ...);
- The need for the ratio condensable/non-condensable to be re-validated every reporting year;
- Analyses of the influence of combustion and abatement technology on the ratio condensable/ non-condensable fraction;
- Further consider the potential links with NMVOC inventories;
- Health impact of condensables as compared to other PM.

We therefore propose, with respect to the reporting of PM emissions from residential heating (category 1.A.4.b.i), the following steps:

- The inventories should, with respect to residential heating (category 1.A.4.b.i), report PM emissions including the condensable part and – for those parties not reporting on that basis yet – both the information on the condensable and non-condensable part. This information related to reporting of PM emissions including condensables is, for those parties not yet reporting on that basis, not to be used for compliance purposes; it serves the needs of emission inventory improvement and modelling.
- Parties should provide information on the method used for the calculation of the condensable part of PM in the IIR (measurements, guidebook factors).
- As explained above, there is an urgent need to improve the methodology for including condensables into the inventory. These methodology discussions need to bring together several areas of expertise, notably TFTEI, TFEIP, TFMM, TFIAM and other national or international research institutes, to guide the work further on these issues during a specified timeframe.
- The workshop planned for March 2020, organised by MSC-W, should be used as a starting point to identify priority needs for further research and measurements and to propose a way forward in addressing this issue by **proposing a roadmap**.
- The roadmap should outline the additional actions, workshops, meetings and discussions likely needed (and identify the right target expertise for various roadmap steps), notably to:
  - Provide support and inputs for a review of the current EMEP/EEA Guidebook for 1.A.4.b.i with focus on the representative emission factors with assessed uncertainty levels.
  - Share information on experiences and knowledge gained so far, notably from parties who are more advanced in analysing the situation; exchanges of information among relevant national experts directly involved in measurements for the purposes of PM emission inventories.
  - Discuss the methodological issues related to the appropriate measurement conditions (dilution ratio, temperature ...) and other science questions as listed above.
  - Provide information and methodology to establish the link with the NMVOC inventories.
  - Discuss, within the appropriate task forces, the consistency of approach across sectors (beyond residential heating).

The timeline for the above mentioned steps, roadmap and finalisation of priority outputs should be aligned with the Work Plan 2020-2021, in order to provide inputs to the EMEP SB as from 2020 and to provide first inputs to initiate discussions on policy implications of condensables reporting at the 58<sup>th</sup> session of the WGSR, reporting back to the 40<sup>th</sup> session of the EB, followed by step-wise additional information and conclusions as timely inputs to the process of reviewing the amended Gothenburg Protocol initiated during the 39<sup>th</sup> session of the EB.