

NMR-Condensables workshop, March 2020, Key Messages

(Short report from EMEP MSC-W, Sep 14, 2020)

In March 2020 EMEP MSC-W hosted an expert workshop on condensables (funded by the Nordic Council of Ministers, NMR), which brought together experts in emissions, measurements, inventories, and policy from Europe and North America, with the aim to suggest how to harmonise and improve approaches to PM inventory emissions and modelling, accounting for so-called condensable compounds.

About 35 experts took part in the meeting, including EMEP Chairs (EMEP Steering Body, TFIAM, TFMM, TFEIP, TFTEI), EMEP Centres (MSC-W, CEIP, CIAM), inventory developers (TNO, CIAM, COPERT, and national experts from UBA - Germany, SINTEF - Norway, IVL, ACES, Swedish EPA - Sweden, CITEPA, INERIS - France, ECCC - Canada, Univ. Patras - Greece), measurement experts (PSI - Switzerland, INERIS - France, Univ. York - England, NC State University - USA), industry (CONCAWE), the US EPA and the European Commission. The workshop discussed a number of approaches for dealing with this important class of compounds. This short document presents some of the key messages from the workshop. A report will also be prepared for NMR, containing more background and addressing the technical matters in more detail.

Key Messages

1. The current situation regarding PM emissions and condensables is untenable and unfair, in that the same activity (eg burning one unit of wood) produces very different PM emissions in national reporting from different countries. Assumptions behind these national emissions are not documented, and methods can change from year to year.
2. The workshop participants agree that condensables should be included in future emission inventories and modelling. Residential Wood Combustion (RWC) emissions are a priority, but it is also important to take stock of other sources (e.g. road transport) that might prove to be important.
3. The issue is not just “are condensables included or not?”, but “how are they included?”. As an example, in previous years Norway had much higher emission factors (EFs) than Sweden for RWC since Norway included and Sweden excluded condensables. Since 2019 Sweden has included condensables, but Norway still has higher EFs -- the two countries make different assumptions about factors such as fuel and operating conditions, aiming to reflect real-world usage.
4. The issues are complex, with emission factors (EFs) for condensables depending on a large number of factors, including measurement methods, fuels, usage, and even ambient conditions. There is a clear need for clarification and standardisation of the methods used to define and report PM emissions.
5. Need to increase the knowledge about activity statistics and condensables in national inventories and TNO, IIASA, COPERT/HBEFA methodologies. For example,

appliance type (for RWC) has a major impact on the emission factor (EF). A good overview of appliance types by country and the amount of solid fuel being burnt by appliance type would reduce uncertainties – or at least make them quantifiable

6. Current emission limit values for residential heating (e.g. in the ecodesign directive) have not been designed with air pollution emissions in mind, and omit the condensable component. Options to better align these standards with air quality and health targets need to be investigated and defined (promising examples were presented in the workshop)
7. The current split of organic emissions into either PM or NMVOC is artificial, in that some compounds can exist in both phases at the same time. Further, some compounds fall into an intermediate volatility range that is between two ‘traditional’ categories (organic PM and NMVOCs), and their important properties are not well represented in the current inventories. Research-grade modelling is using the ‘Volatility Basis Set’ (VBS) framework to represent the full range. Ideally we would deal with organic emissions as a spectra ranging from non-volatile PM components to volatile gases, with the inventory providing emissions for each VBS bin, and/or for explicit VOC compounds.
8. An interim solution whereby countries report the condensable fraction separately from the solids using consistent (or at least clearly specified) methods, would aid transparency, and make it easier to compare and contrast country estimates. This might enable use of condensable EFs developed in some countries to gap-fill emissions in countries lacking in-country estimates of condensables. The suggested emissions of PM would then be split into for example EC, POMsolids, POMcondensables, particulate-SO₄ and remainingPPM.
9. Although the workshop was focused on semi-volatile VOC (SVOC) and PM, it is important to follow up with a discussion on intermediate-volatility VOC (IVOC), which are associated more with VOC emissions, but not included in the inventories.
10. The workshop agreed that the TNO Ref2 emissions provide a good no-regret step towards a harmonised emission methodology, but that these top-down estimates should be increasingly replaced by national estimates once procedures for quantifying condensables in a more harmonised way are agreed on and implemented. Such improvements will need detailed discussion among the emission inventory communities (e.g. TFEIP, TFTEI, national experts) as well as with modellers who will have to account for the complex issues regarding volatility within the condensables and PM fractions.
11. Longer-term
 - (a) Consider how to deal with organic emissions as a spectra ranging from very low-volatility (always condensed in the atmosphere) components to volatile gases, with the inventory providing emissions for each VBS bin (or explicit VOC compound).
 - (b) The US SPECIATE database is very extensive (with both VBS and explicit VOC speciation), and should be explored more for Europe, especially in the context of (a)
 - (c) There is a need for a major effort through a scientific cooperation between several research groups to find the estimates for different sectors, appliances etc. scientific based emission database in order to support a better science-based

emission database. The issue should warrant for example a major EU project, open to many groups, in order to develop best possible emission estimates but also to identify and estimate uncertainties.

- (d) Consider the use of an effective ambient PM emission factor, $PMEA$, which defines emissions at a standard temperature and ambient C_{OA} concentration.

12. A roadmap (see Fig.) was suggested to bridge the short and long-term scales, with a cyclic approach:

- (a) In year 1 the TNO Ref2 data is used in an initial estimate for residential combustion emissions, with modellers making educated choices about SVOC emissions and the VBS framework
- (b) In subsequent years these top-down estimates should be increasingly replaced by national estimates once procedures for quantifying condensables in a more harmonised way are agreed on and implemented.
- (c) Such improvements will need detailed discussion among the emission inventory communities (e.g. TFEIP, TFTEI, national experts) as well as with modellers who will have to account for the complex volatility issues surrounding the condensables
- (d) Approach/updates should be tied to EMEP TFEIP meetings, etc
- (e) Needs guidance and support! Voluntary contributions will lead to new mixtures of inconsistent assumptions.

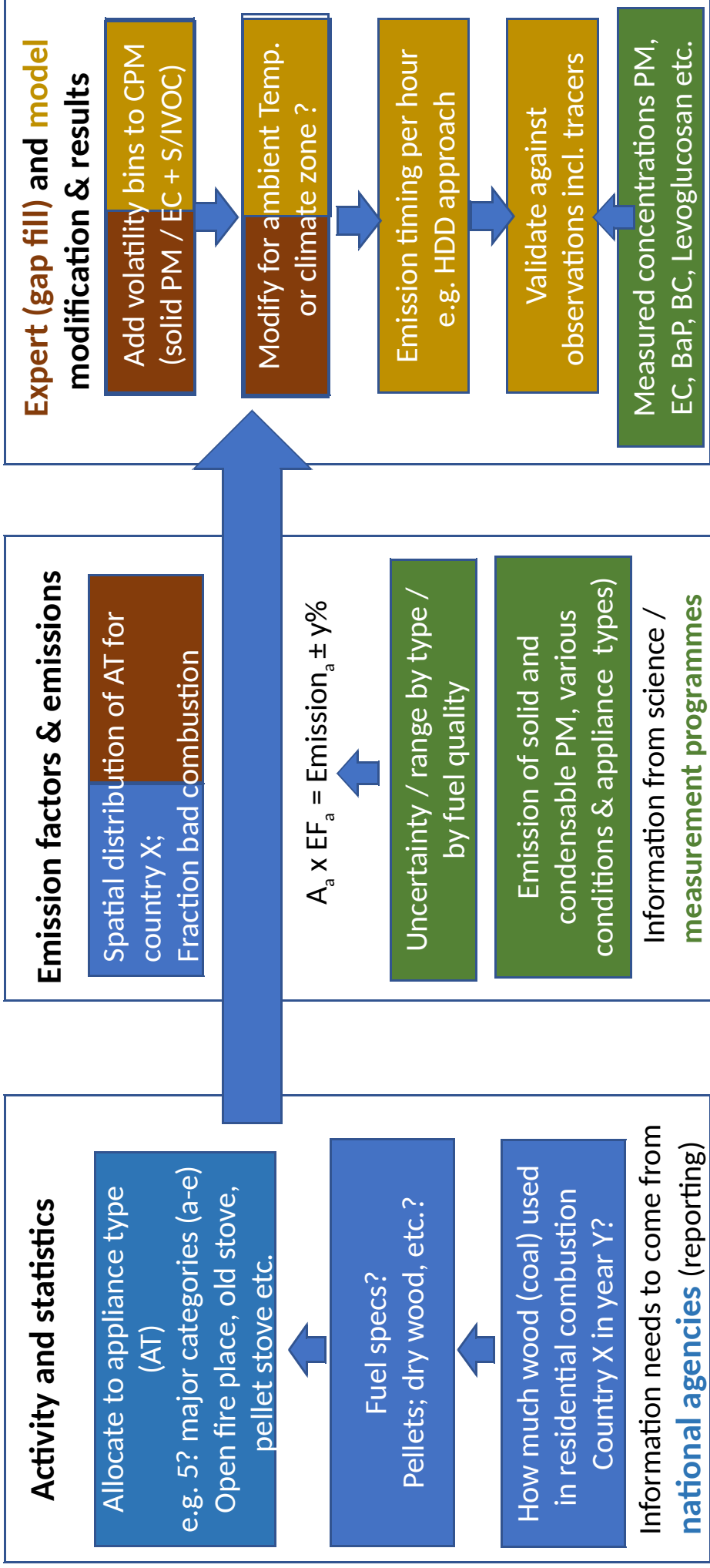
13. The workshop recognises that the proposition to put larger focus on condensables might have policy implications and asks policy makers to consider possible implications with respect to potential adjustments of policy targets and base-year emissions.

14. Note that for the review process of the Gothenburg protocol we face several (competing) challenges:

- (a) The need for emission data a.s.a.p. that are consistent across countries in order to get a fair 'optimized' distribution of emission abatement efforts aimed at improving health and ecosystems protection targets;
- (b) The difficulties to change existing practices of some countries;
- (c) The wish of scientists to start multi-year work programs for the best possible way to define condensable emissions and/or secondary PM formation in the atmosphere.
- (d) Need to assess the available options for short and longer term actions in terms of e.g. time frame (feasibility), scientific credibility (or possible systematic bias) and costs for countries.

A flow chart as a way forward?

Towards Transparency (essential) and choices (who to do what?)



* Colours indicate different disciplinary groups; agencies; measurements; emission experts; modellers