Position on Clean Air in Cities

From the UNECE/LRTAP Expert Panel on Clean Air in Cities (EPCAC)

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Preamble

This document contains the table of contents with subjects for the first position paper by the Expert Panel on Clean Air in Cities (EPCAC). According to the work plan in the founding document, EPCAC should "prepare a position paper to raise awareness among national and local policy makers of the multi-scale interactions. To be followed by other relevant guidance documents". The mission of the EPCAC is to analyse and communicate the potential benefits of multi-scale air quality management and find an optimal mix of local, national and international policy actions.

Key questions to be addressed by EPCAC:

- Which actions at which government level are most effective to reduce the negative health impact of air pollution (expressed as loss of life years)?
- Can we say more about the cost-effectiveness of measures at different government levels?
- What knowledge should be improved for robust policy advice? (e.g. on emission data, dispersion modelling, health impact assessment, costs and effects of measures, multi-scale multi objective policy design.)

This first position paper is meant as an introduction into the subject and addressing these key questions. It is based in part on an EPCAC meeting in Bratislava (in 2019) and online meetings (in 2020, 2021, and 2022). The position papers explores possibilities for following guidance documents and further research. In the table of contents it is indicated what will be discussed in each chapter with preliminary conclusions/messages.

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also contribute significantly to air pollution in cities with contributions from ammonia from agriculture.

g) Air quality is strongly linked with climate change measures; this offers options for win-win solutions, but required careful analyses to prevent adverse effects. Other sustainable development policies, such as green, clean, smart or circular cities could improve air quality.

Box: City based on administrative boundaries versus population extent

- There are large differences between cities, with large conglomerates of cities closely connected (e.g. Paris), cities in large industrial areas, and cities surrounded mostly by agricultural land.
- Urban health impacts are more related to the reduction of (average) population exposure and less to the number of exceedances of local limit values.
- Measures in the core of large cities might be sufficient to meet the NO_2 limit values, but might not significantly reduce exposure in the whole city.
- Cities have administrative boundaries for which local policies can be implemented, but measures in greater city area (or even beyond) will be needed to sufficiently reduce population exposure.
- Multi-layered government actions are needed to reduce population exposure.
- The challenge will be to organize this politically (with some examples, e.g. Berlin, Paris, London, …)

2) The role of cities

a) Cities are an important source of air pollution for surrounding regions.

b) At the same time a large part of urban air pollution comes from sources outside the city itself. This is especially the case for secondary inorganic aerosols (SIA), resulting from ammonia emissions from agriculture and NO_2 and SO_2 emissions from combustion. Also mention organic PM here.

c) The contribution of local measures to improve air quality is limited because air pollution has not only local sources and the jurisdiction of cities is limited. Therefore, collaboration/coordination at the international, national, regional, and city levels is necessary.

d) Multi-level coordination could offer more cost-effective solutions than separate local measures.

e) Positive actions to improve the air quality have been demonstrated for several cities and countries (mention a few examples).

f) Ineffective or counterproductive examples have also been shown (mention a few examples)

g) Coherence with various policy domains, such as, the energy transition, agricultural policy, mobility, and urban planning could offer win-win solutions.

3) Sources of air pollution in cities

The contribution of different sectors and regions to the concentration levels in cities differ among cities. Source apportionment is the first step in designing a cost-effective multi-scale air quality strategy. The JRC-urban PM2.5-atlas and calculations by EMEP/GAINS on the contributions show the relative importance of transboundary, regional and local sources to urban air quality.

a) Transboundary sources

- For **particulate matter** concentrations the contribution of transboundary sources can be significant, especially in medium sized cities (less than 1 million inhabitants). An important part of this transboundary contribution are secondary aerosols: mainly aerosol formation in the atmosphere from ammonia and nitrogen oxides, or from ammonia and sulfur oxides). However, also primary PM-emission sources, contribute: wood burning, agricultural waste burning, forest fires, as well large industrial combustion plants (that in some regions are also still an important source of sulfur dioxide emissions).
- Cities emit large quantities of **nitrogen oxides**, especially during rush hours. Although concentrations decline rapidly with increasing distance from the source, nitrogen oxides still are an important element of transboundary air pollution. Nitrogen oxides contribute to nitrogen deposition on nature areas, to the formation on secondary aerosols (if ammonia is available) or to the formation on ozone.
- **Ozone** is a typical transboundary pollutant. It is formed in the atmosphere from anthropogenic and biogenic emissions of nitrogen oxides, NMVOCs, and methane, under the influence of sunlight. Primary emission sources can be thousands kilometers away from the place where high ozone concentrations are experienced. Due to relatively high share of NO close to NOx-emission sources, reduction of NOx-emissions in urbanized areas could lead to higher ozone formation (titration-effect).

Effectively tackling the abovementioned sources requires internationally coordinated actions.

b) National and regional sources

- Potentially important additional national and regional sources of primary particulate matter and nitrogen oxides are highways, airports, large industrial plants, harbor activities, ships, and agriculture (both intensive livestock farming and greenhouse-agriculture). Many of such facilities depend on permits from national or regional authorities. However, they contribute to the urban background concentrations. It illustrates the important role that national and regional governments play in achieving clean air in cities.

c) Local sources

Sources that can be tackled by city governments are:

- **Particulate matter** from residential heating, road traffic, non-road mobile machinery (e.g. construction equipment, ships).
- **Nitrogen oxides** from road traffic, residential heating.

4) Measures

Solutions to improve air quality in cities will be listed (and ranked) in this para. Catalogues of measures exist to help cities (e.g. https://fairmode.jrc.ec.europa.eu/measure-catalogue and annex 8 of the proposed EU Air quality Directive). The question is to what extent local measures will be applicable and sufficient for solving local poor air quality. The main challenges to tackle at city level are transport and domestic combustion. At the national and international level, tackling industrial emissions and ammonia (as a precursor for PM, as well as ozone precursors (NOx, VOC, methane) are important.

a) Examples and experiences of measures taken:
   i) Measures at city level
   ii) Measures at the regional/national level
   In general the same measures as urban measures, but at a larger scale. The extra measures could be: policies regarding large industries, power plants and waste processing outside the city, plus of course tackling ammonia from agriculture
   What can we learn from GAINS-analyses for cities in Europe and Asia?
   iii) Measures at a transboundary level
b) Ranking of measures. E.g. Ranking Joaquin, 2016).
   i) Measures that reduce emissions in a wider region could result in more health gains than specific local measures or changing the spatial location of sources. Adaptation measures seems to be ineffective (trees and scrubs, catalytic paint, street sweeping).
   ii) The larger the region where measures are taken, the more health gains.
   iii) Most health benefits come from reduction of the average exposure in a region, not from reduction of exposure at a certain hotspot.
   iv) Focusing on (traffic) hotspots could lead to more dispersion of emission sources (e.g. due to changes in traffic circulation and to higher average exposure.
c) Non-technical measures
   i) xyz

5) Conclusion

- Exposure to poor air quality is relatively high in cities with differences between EU and no-EU countries.
- Focus should not only be on hotspots but also on the average exposure.
- The contribution of local sources to the air quality in cities is limited, making regional, national, and international action essential to achieve improvements in air quality.
- Co-benefits from other policy domains could be a key to success, while avoiding detrimental effects.
- Sources of air pollution and most effective measures will differ among cities, but multi-level air quality management remains needed. National Air Pollution Control Programs (NAPCP) could serve as a potential instrument in this.
- Local information on sources in cities in combination with model calculations are needed to assess which sectors are most important for specific cities.

6) Further research needed (the known unknowns) on

a) The combined health impacts of PM, NO2 and ozone
b) The combined impacts of air pollution impacts and heat stress
c) The impact of climate change on concentrations of air pollutants

Annex I

What knowledge is needed to develop a local air quality plan aimed at local health gains?

- emission sources
- air quality measurements
- modeling / source attribution
- inventory of emission abatement measures at various scales
- assessment of costs and health impacts of mitigation measures