Report of the 4th meeting of the Expert Panel on Clean Air in Cities (EPCAC) held online on Nov. 16, 2022

Key messages

Poor air quality is at the top of all environmental health impacts in the EU with 300 000 premature deaths annually. Additionally, there are social, economic and environmental impacts, such as disproportional effects for vulnerable groups, loss of workdays, and eutrophication and acidification of ecosystems. Although air quality in Europe has improved since the 1980s and the EU air quality limit values are met in many countries, meeting the WHO (2021) air quality guideline levels requires large additional reductions in emissions of most air pollutants in many countries.

The link between air pollution and health effects is reinforced by several (review) studies. Although different PM fractions have a different toxicity, total $PM_{2.5}$ remains the most used metric for air pollution related health effects.

In 2022, the European Commission published a proposal for the revision of the EU ambient air quality directive. The objective is zero pollution no later than 2050 with interim targets for 2030: 10 µg m^{-3} for $PM_{2.5}$ and 20 µg m^{-3} for NO_2 (annual averages). This is projected to reduce premature deaths by more than 75% by 2030 (while 50% reduction would be reached without this policy). The proposal also includes a regular review mechanism, a refined approach to air quality monitoring, monitoring of pollutants of emerging concern, improved enforceability, and communication of more up to date air quality information.

The proposed EU air quality limit value for NO_2 in the EU is a challenge and will likely require additional local measures, next to national and international measures that need to be taken. The expectation is that most countries will be able to achieve it everywhere in 2050, when implementing EU-emission limit values and net-zero carbon policies. To meet the limit value for $PM_{2.5}$ everywhere in 2030 is a large challenge, but possible for 2050, when ammonia emissions are further reduced with lower livestock numbers.

Measurements and modelling studies show that a range of different sectors contribute to air pollution, such as traffic, industry, residential heating, and agriculture. These sectors contribute differently to the air pollution in different cities in the EU, West Balkans, and EECCA countries. Local urban sources from traffic and residential heating contribute most to the NO_2 pollution in large cities, while industrial and agricultural sources from outside the city contribute most to PM_{10} and $PM_{2.5}$. Models provide the necessary information for local and national authorities for decisions related to air quality in combination with other policies, such as spatial planning, energy, and climate policies.

Multilevel governance is necessary for achieving the health objectives (both from an efficiency and an equity perspective). Also, integrating policies is important; nitrogen and climate policies are important to meet air quality objectives, while the air quality objectives are also relevant for climate policies.

Positive actions to improve the air quality have been demonstrated for several cities and countries. These can serve as examples for other cities and regions. It was demonstrated that attention for communication and raising awareness of the local air quality is important. Citizen science is a powerful research and policy-making approach in support of cleaner air providing data, awareness, and actions. It is important to integrate citizen science in research and governance to achieve the zero pollution goals.

1. Around 100 participants (140+ registered participants) from national governments, cities, the scientific community, NGO's, industry, and the European Commission participated in a workshop that was held online on Nov. 16, 2022. Roald Wolters (Netherlands) and Guus Velders (Netherlands) chaired the meeting.
2. Poor air quality is at the top of all environmental health impacts in the EU with 300 000 premature deaths annually. With additional social, economic and environmental impacts, such as disproportional effects for vulnerable groups (children, elderly), lost workdays, and eutrophication and acidification of ecosystems. Exposure to air pollution in EU has been reduced over the past years. Currently, the largest exceedances of the WHO(2021) air quality guidelines for the EU urban population comes from for exposure to ozone, followed by PM_{10}, $PM_{2.5}$, and NO_2.
3. Michael Klinkenberg (European Commission) presented the proposal for the revision of the EU Ambient Air Quality Directives. The proposal focusses on:
    a. Environment & health: Zero pollution objective at the latest by 2050 with intermediate 2030 EU air quality standards, an update of other air quality metrics, and a regular review mechanism.
    b. Monitoring & assessment: Refined approach to air quality monitoring and increased use of modelling, and monitoring of pollutants of emerging concern (UFP, BC, ammonia).
    c. Governance & enforcement: Air quality plans to be more effective in ending and preventing exceedances of EU standards, improved enforceability, and more transboundary cooperation on air quality.
    d. Information & communication: More up to date air quality information, hourly reporting of air quality data, and informing the public about possible health impacts and provide recommendations.

    The commission proposes as interim target for 2030, 10 µg m^{-3} for $PM_{2.5}$ and 20 µg m^{-3} for NO_2 (annual averages). This is projected to reduce premature deaths by more than 75% by 2030 (50% than without this policy). The benefits far outweigh the costs: with annual total gross benefits estimated at €42 bn in 2030, compared to measures that costs less than €6 bn annually.
4. Rob Maas (co-chair TFIAM, RIVM) discussed the status of the Gothenburg protocol review. Two status reports are being produced for the review, in which three scenarios are presented: a Baseline scenario (current policies), a Maximum Technical Feasible Reduction (MTFR) scenario, and a Low scenarios for 2050 (including lower livestock numbers). Data for every 5 years are available. Only with the Low scenario the $PM_{2.5}$ WHO guidelines are met everywhere in the EU, but critical loads for acidification and eutrophication will still be exceeded in several nature areas. The reports will be discussed in December 2022 at the executive body. Items that are being discussed are, among other, how can we tackle methane and what instruments can be used to reduce ammonia emissions?

    The TFIAM request EPCAC for a policy brief on multi-level governance by June 2023.
5. Martin Lutz (Senatsverwaltung für Umwelt, Verkehr und Klimaschutz) gave a reflection from Eurocities on the revised EU framework on air quality. The first milestone in 2030 is considered ambitious. It is a good idea to have supersites for monitoring, but not only at background sites, also at hot spots. Eurocities supports that Legally binding limit values will be the key drivers to reduce air pollution in the EU, but is critical that the role of national regulations is reduced. Most of the $PM_{2.5}$ must be tackled on the EU and national level, because of its large-scale character.

6. Bruce Rolstad Denby (Norwegian Meteorological Institute) discussed whether the WHO air quality guidelines can be attained under a revised Gothenburg protocol and presented future scenarios for the EU, West Balkans and EECCA countries. Scenario calculations for 2015, 2030, 2050 have been performed with the EMEP/uEMEP models with a focus on NO2 and PM2.5 for the Baseline, MTFR, and Low scenarios. Achieving the proposed EU air quality limit values:
    a. 20 µg m^{-3} for NO_2 is a challenge for 2030 and will likely require additional local measures. Most countries will have achieved it everywhere in 2050.
    b. 10 µg m^{-3} for $PM_{2.5}$ everywhere is a large challenge in 2030, but possible in 2050. Around half of the countries (16) will have achieved $PM_{2.5}$ concentrations less than 10 µg m^{-3} everywhere in the 2030 MFTR scenario.
7. Gregor Kiesewetter (IIASA, Laxenburg) discussed the source contributions to city level $PM_{2.5}$ concentrations under future scenarios for Europe and EECCA countries. For this, the domain of the GAINS model was extended covering EECCA countries and the resolution was increased to 0.3 x 0.2 deg. Also, separate reduction for NO_x soil emissions was implemented, condensables were included, and grid-to-grid tracking for primary PM contributions was considered. In the EU, strong decreases of ambient PM concentrations in cities are expected by 2030 with current legislation (local measures were not considered). Secondary organics and inorganics have a significant contribution to PM concentrations in cities. In West Balkan and EECCA countries, residential emissions and power/heating plants dominate PM concentrations; local contributions are often higher than in Western Europe. Current legislation reduced concentrations, but there is scope for significant further reduction.
8. Xavier Querol (Institute of Environmental Assessment and Water Research, IDAEA-CSIC, Barcelona) showed levels and patterns of UFP and BC in urban Europe from the RI-URBANS project. Large difference were observed in UFP particle number concentrations between street locations, urban background, and regional background, with an increasing trend from North to South Europe. Large contributions are from airports and from coal fired powerplants (linked to SO2 emissions). There are also large differences between cities in Europe. It is important for the assessment of UFP, to harmonize the measurement methods.
9. Hanna Boogaard (Health Effects Institute, Boston) presented the results of a new systematic review of selected health effects of long-term exposure to traffic-related air pollution. The review included a full text read of about 1100 articles and about 350 articles were used in the final selection. Apart from exhaust emissions, attention was also paid to non-exhaust emissions and noise effects of traffic. The study finds an overall high or moderate-to-high level of confidence in an association between long-term exposure to traffic related air pollution and the adverse health outcomes: all-cause, circulatory and ischemic heart disease mortality, lung cancer mortality, asthma onset in children and adults, and acute lower respiratory infections in children. In light of the large number of people exposed, the findings indicate that traffic-related air pollution remain an important public health concern and deserve greater attention from the public and from policymakers.
10. Sasha Khomenko (Barcelona Institute for Global Health, ISGlobal) talked about a SHERPA modelling study on the spatial and sector-specific contributions to ambient air pollution and mortality in European cities. She concluded that the residential and agriculture sectors are the main contributors to PM2.5-related mortality in European cities and that transport is the main contributor to NO2-related mortality. The city contribution to air pollution mortality is 13% for PM2.5 and 34% for NO2, and higher for cities of largest

area and among European capitals (22-30% for PM2.5 and 52-63% for NO2). Strong variability between cities and a higher variety of sources for PM2.5 than for NO2 show the need of city specific policies and coordinate actions at multiple spatial levels (city, country, international).

11. Claudio Belis and Rita van Dingenen (EC, Joint Research Centre) presented the results of a study on the air pollution health impacts and cost estimation in Western Balkans' cities. They found that in 2019, the average mortality rate in Western Balkan cities was twice the average value in EU27. The external cost due to air pollution in the 33 studied cities was above 5 billion Euro with an average cost per city of at least 200 Million Euro (only mortality). The highest (absolute) impacts were observed in Serbia and Bosnia and Herzegovina. The relative impact of road transport in the Western Balkan was higher in the southern part of the region (Albania, Kosovo) and on average lower than EU27. Data from local networks was important to improve the data coverage and there is a need to improve the monitoring strategy in this area to reduce the uncertainty in the estimates.
12. Two presentations were given on the health impacts of specific PM species. It was concluded that at present $PM_{2.5}$ remains the most suitable metric for air pollution related health effects.
13. Michael Holland (EMRC) gave a presentation on an health impact assessment of specific PM species and the relation with NO2. The current approach is to treat each particle as equally harmful per unit mass, although the different PM fractions (metals, organics, inorganics, size fractions) have a different toxicity. The health effects of each fraction are hard to disentangle. More studies are needed to be able to do this, but that takes time. The question is: What is the pollution and policy situation in the future and what information do we need by then.
14. David Segersson (Swedish Meteorological and Hydrological Institute) asked if we should use separate risk functions for near-source and long-range PM. Increased mortality from PM in Stockholm and Gothenburg is mainly caused by long range transport. Using different relative risks for near source and long-range exposure, local sources become more important. Not using relative risks based on “within city” contrasts in exposure, likely leads to an underestimation of effects from local measures. Application of relative risks recommended by WHO may be misleading when comparing different abatement strategies. For example, if exhaust PM emissions are assumed more toxic than non-exhaust PM, relative risks using Black carbon as indicator are preferable, since it is less diluted by non-exhaust PM and more dominated by vehicle exhaust.
15. Positive actions to improve the air quality have been demonstrated for several cities and countries. These can serve as examples for other cities and regions. It was demonstrated that attention for communication and raising awareness of the local air quality is important. These are also several initiatives in cities to engage citizens.
16. Lara Aleluia Reis (RFF-CMCC European Institute on Economics and the Environment) showed the contribution of agriculture to the PM pollution in Lombardy based on analyzing data measured with machine learning techniques for the COVID19 lockdown. In rural areas the secondary inorganic aerosol (SIA) in Lombardy remained insensitive to the lockdown, showing that in these sites air pollution policies need to target livestock emissions. In traffic areas, the ammonia reductions (probably from traffic too) were instrumental in decreasing SIA. It is estimated that on average a 1% increase in cattle livestock intensity translates into an 1.8% increase in ammonia concentrations (up to 0.4 PM_{10} $\mu g\ m^{-3}$).
17. Joanna Strużewska (Institute of Environmental Protection - National Research Institute, IEP -NRI) studied the impact of traffic emissions on air quality in Warsaw using

measurements and the SHERPA model. Local observational data is analysed to assess traffic intensity. Estimated emission intensity differs from the profiles used so far in the model simulations. Data variability suggests that in the case of NO_2 concentrations follow traffic intensity estimates, but for PM_{10} the pattern may suggest that resuspension plays major role. For $PM_{2.5}$ the difference between traffic and urban background stations is relatively small. This may suggest that emissions from transport sector do not play a major role and the inventory may be overestimated for $PM_{2.5}$.

18. Paul Ruyssenaars (RIVM, Netherlands) presented the air quality plans and progress in the Netherlands and the attainability of 2021 WHO air quality guidelines. The health impacts of air pollution are the motivation for air quality policies by local governments. The goal is a reduction of 50% in loss of life expectancy in 2030, relative to 2016. Multilevel governance is necessary for achieving the health objectives (both for efficiency and equity perspective). Also, integrating policies is important; nitrogen and climate policies are helpful for the air quality objectives, while the air quality objectives are also relevant for climate policies. Large reductions in emissions of NO_x and ammonia are required in the Netherlands, but also in neighbouring countries. The WHO(2021) air quality guidelines are demanding for 2030 demanding; under interim target 4 some hotspots remain in the country.
19. Núria Castell (NILU – Norwegian Institute for Air Research) showed the importance of citizen science for cleaner air and healthier cities. Citizen science is a powerful research and policy-making approach in support of cleaner air, providing data, awareness, and actions. It is important to integrate citizen science in research and governance to achieve the zero pollution goals.
20. Mark Barrett (UCL Energy Institute) discussed modelling the effect of low carbon energy strategies on city air pollution. Renewable electricity (except biomass) and electrification are a general solution to reduce NO_2 concentrations on city and larger scales, and reduce greenhouse gas emission This requires city and (inter)national policy. PM is heterogeneous and primary PM from natural sources and non-exhaust vehicle and secondary PM from ammonia are hard to control.
21. Young Sunwoo (International Union of Air Pollution Prevention & Environmental Protection Associations, IUAPPA) informed the meeting of the international cooperation in East Asia, in the past, present and future. Air quality in Seoul has improved over the past years. High concentrations depend on oversees contributions and meteorology (stagnant days). International coorporation is therefore important and a range of institutions are in place, but the collaboration between countries is a challenge. The lessons learned in the CLTAP could be valuable for the region.
22. Chris Dore (AETHER) assessed the air quality in Bishkek (Kyrgyzstan). Bishkek is sometimes the most polluted city in the world, due to residential coal use, old road vehicles, mountainous terrain, and strong winter-time inversions. Limited information is available to support air quality policies. A start is made on building evidence base recommendations for future investments, recommendations to update air quality legislation, and explaining some fundamentals of air quality management to local counterparts. Clear communication and interaction with local policymakers is important. Coorporation with international organizations is setup for coordination of technical and donor meetings, and the generation of emission maps and modelling.