Clean air in Europe for all! Taking stock of the proposed revision to the ambient air quality directives: a joint ERS, HEI and ISEE workshop report

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Ambient air pollution is a major public health concern. Comprehensive new legislation is currently being considered to improve air quality in Europe. There is a unique opportunity to maximise public health benefits in Europe and beyond. https://bit.ly/3r5E9xV

Cite this article as: Turner MC, Andersen ZJ, Neira M, *et al*. Clean air in Europe for all! Taking stock of the proposed revision to the ambient air quality directives: a joint ERS, HEI and ISEE workshop report. *Eur Respir J* 2023; 62: 2301380 [DOI: 10.1183/13993003.01380-2023].

Received: 15 Aug 2023
Accepted: 13 Sept 2023

Background

Ambient air pollution is a major public health concern and comprehensive new legislation is currently being considered to improve air quality in Europe. The European Respiratory Society (ERS), Health Effects Institute (HEI) and International Society for Environmental Epidemiology (ISEE) organised a joint meeting on 24 May 2023 in Brussels, Belgium, to review and critically evaluate the latest evidence on the health effects of air pollution and discuss ongoing revisions of the European Ambient Air Quality Directives (AAQDs). A multidisciplinary expert group of air pollution and health researchers, patient and medical societies, and policy representatives participated. This report summarises key discussions at the meeting.

Proposal for revision of the European AAQDs and potential to improve health

In 2021, the World Health Organization (WHO) released new air quality guidelines (AQGs) based on a comprehensive synthesis of scientific evidence on the health effects of air pollution [1]. WHO recommended that annual mean concentrations of particulate matter ⩽2.5 µm in aerodynamic diameter ($PM_{2.5}$) and nitrogen dioxide (NO_2) should not exceed 5 µg·m^{-3} and 10 µg·m^{-3}, respectively. The 2021 AQG levels are more stringent than the previous 2005 AQG levels of 10 µg·m^{-3} for $PM_{2.5}$ and 40 µg·m^{-3} for NO_2 [2]. The current air quality legislation in Europe, the 2008 AAQDs, sets limit values for the annual mean of $PM_{2.5}$ and NO_2 to 25 and 40 µg·m^{-3}, respectively [3].

Despite continued trends of decreasing air pollution concentrations in Europe [4], 95% and 75% of monitoring stations recorded values above 2021 WHO AQG levels for $PM_{2.5}$ and NO_2, respectively, in 2021 [5]. $PM_{2.5}$ concentrations were highest in Central and Eastern Europe, and NO_2 in cities with high road traffic volume. Inequalities exist, with regions with lower gross domestic product (GDP) per capita generally experiencing higher air pollution concentrations (figure 1). The European Environment Agency (EEA) attributed 238 000 deaths to $PM_{2.5}$ concentrations above 5 µg·m^{-3} in the 27 European Union (EU) countries in 2020 [6, 7]. These deaths are preventable, and the estimate does not include millions of cases of non-fatal diseases, years lived with disability, attributable hospitalisations, or health effects from other pollutants [8].

Findings from the 3rd Clean Air Outlook, analysing existing and future policies in Europe, reveal substantial projected reductions in sulfur dioxide (SO_2), nitrogen oxides (NO_x), and primary $PM_{2.5}$ emissions, and associated expected decreases in total $PM_{2.5}$ concentrations for 2030 and 2050 [9], achieving the EU target of reducing premature deaths by 55% from 2005 to 2030 [10]. However, projected reductions of ammonia (NH_3) emissions (mainly from intensive livestock farming) are modest.

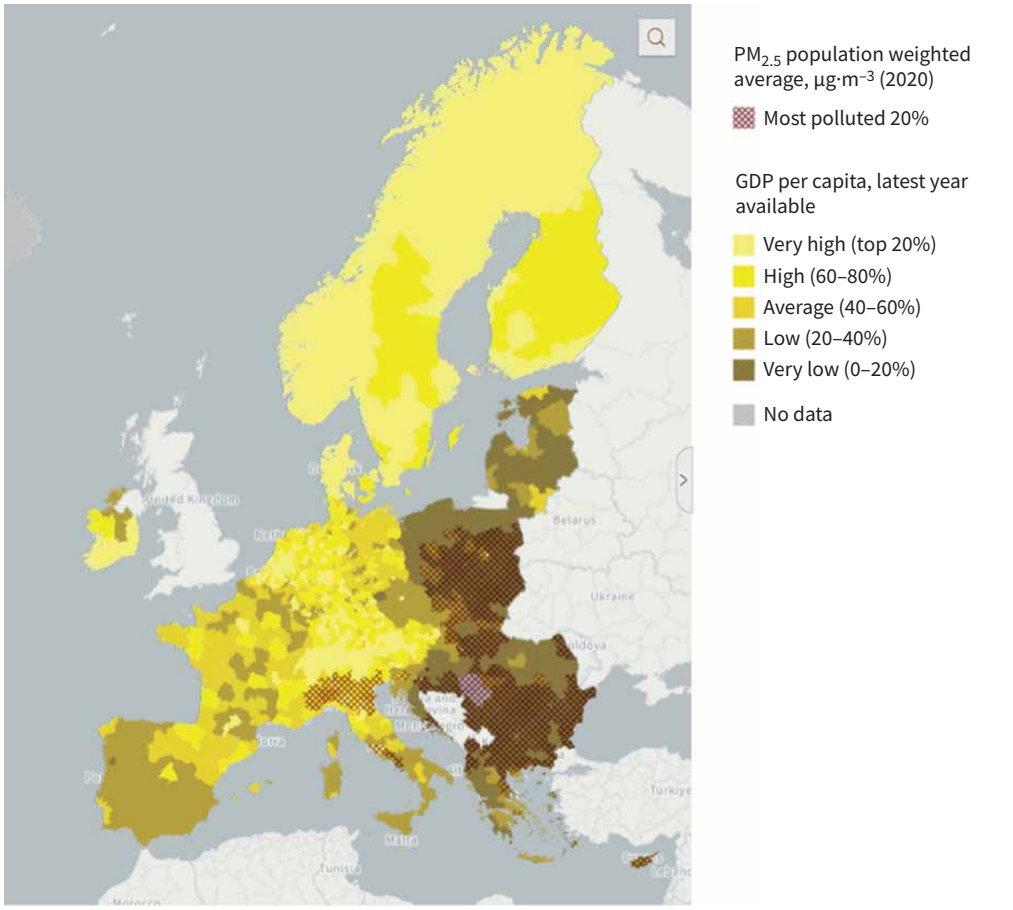

FIGURE 1 Combined risks and inequalities. Particulate matter ⩽2.5 µm in aerodynamic diameter ($PM_{2.5}$) *versus* gross domestic product (GDP) per capita. Reproduced with permission from [50].

Importantly, the currently foreseen reductions in emissions will still cause exceedances of the WHO AQG level for $PM_{2.5}$ in large areas of Europe. Further mitigation potential exists, and additional policy measures are needed, including more stringent limit values, technical emission controls, accelerated energy transition, and large-scale shifts towards safe and active mobility, among others (see below).

To reduce the health and financial burden of air pollution, and achieve EU Green Deal goals, the European Commission (EC) published in October 2022 a proposal for revision of the 2008 EU AAQDs, which has been undergoing consideration by the European Parliament and Council [11, 12]. The proposed new annual limit value for $PM_{2.5}$ by 2030 was 10 $\mu g \cdot m^{-3}$ and for NO_2 20 $\mu g \cdot m^{-3}$. The proposal also included non-binding target values and long-term objectives for O_3, as well as additional monitoring and modelling requirements, including of ultrafine particles (UFPs) and black carbon (BC), a regular review mechanism, and access to justice for non-compliance.

The proposed EC limit values were estimated to result in total gross benefits of EUR 42 billion per year that outweigh by seven times mitigation costs of EUR 5.6 billion per year, and result in a positive net GDP impact of +0.38% [11, 12]. Although the EC proposal presented important steps toward cleaner air in Europe, it fell short of complete alignment with the 2021 WHO AQGs, which would ensure additional health benefits and further reduce the health burden from air pollution [12–14].

Latest science on air pollution and health

The HEI-funded ELAPSE study is the most recent and comprehensive European study investigating health effects of low levels of air pollution [15–17]. ELAPSE documented adverse effects of long-term exposure to $PM_{2.5}$ and NO_2 at levels below current EU limit values, and to BC, with total and cardiorespiratory mortality in an analysis of 28 million individuals.

Associations for $PM_{2.5}$ and NO_2 were stronger in ELAPSE than summary estimates from systematic reviews underpinning the 2021 WHO AQGs, and European burden and impact assessments [6, 18]. The WHO AQG systematic reviews included studies published up to September 2018 worldwide and did not include the ELAPSE findings, which were published later. To use the most relevant and recent evidence for Europe, the EC and EEA conducted additional analyses using the concentration–response functions of ELAPSE for $PM_{2.5}$ and NO_2, which resulted in higher attributable mortality estimates, indicating that the current health and financial burden of air pollution may be underestimated in Europe [12, 19, 20].

Recent research shows a range of impacts of air pollution on morbidity. Exposure to air pollution in pregnancy and early childhood can adversely impact lung function trajectories across the life course [21, 22], impair cognitive growth and development in children [23, 24], and accelerate cognitive decline in older adults [25, 26]. Findings from Stockholm, Sweden, indicated adverse effects of air pollution on lung function in infants and improvements in lung function in children with reductions of air pollution, even at levels below the EC proposal [27, 28]. There is robust evidence of adverse effects of $PM_{2.5}$ on incidence of stroke, ischaemic heart disease, atrial fibrillation and heart failure [29]. ELAPSE and other studies in Europe showed a relationship between $PM_{2.5}$ and lung cancer incidence, even at low air pollution concentrations [30], as well as with cancers other than lung cancer [31–34].

For UFPs and BC/elemental carbon, which are currently not regulated, there is a need to further develop emission inventories, systematic monitoring, source apportionment and research on health effects [1]. UFPs and BC are closely linked and likely responsible for systemic impacts of combustion-related particles on organs beyond the lung [35].

There has been an increase in pollutants from so-called “natural” sources, including desert dust and wildfires, which are closely linked with climate change, and an increase in extreme weather events, such as droughts, heatwaves and storms [36–39]. Evidence on adverse health effects of pollution from wildfires and dust storms is growing [40, 41]. Pollution from natural sources often occurs simultaneously with heatwaves and during the high tropospheric ozone (O_3) season, raising concerns about additional adverse health effects of these synergistic exposures. In the current AAQDs, natural contributions are only considered regarding exceedances of PM limit values if they occur with anthropogenic (non-natural or resulting from human activities) emissions. However, in line with the 2021 WHO AQGs, measures to reduce exposure to natural source pollutants should be implemented; the need for reductions in anthropogenic emissions is also further emphasised [42].

There are increasing concerns about air pollution and climate change interactions on health, with initial research showing synergistic effects of short-term exposure to heat and $PM_{2.5}$ on respiratory and

cardiovascular mortality [43]. Air pollution and climate mitigation and abatement policies have substantial overlaps, leading to important opportunities and co-benefits in exposure reduction and prevention of acute and chronic diseases.

Perspectives towards clean air

Cities across Europe are taking actions to reduce air pollution. Implementing multimodal urban and transportation policies in policy packages is most effective at reducing emissions and ambient air pollution levels in cities, while at the same time targeting climate-friendly and health-promoting environments [42, 44]. In Paris, implementation of the first phases of low emission zones, decreasing speed limits, increasing bicycle paths, limiting traffic on streets near schools and closing of streets on specific days to cars were effective in decreasing $PM_{2.5}$ and NO_x. A new online catalogue of urban and transportation policy studies summarises the evidence base for decision-makers [45]. Some of the most studied policies for emission reductions included alternative fuel technologies, vehicle retrofitting, road pricing, low emission zones and parking charges.

Focus on Eastern Europe

In Eastern and Southeastern Europe, there is a paucity of research on the health effects of air pollution. Over 70% of the Southeastern European population live in areas that exceed the current annual $PM_{2.5}$ EU limit value of 25 $\mu g \cdot m^{-3}$ [46]. Main air pollution sources in the region include coal combustion for energy production, and wood and coal for domestic heating and cooking. There is a need for air quality monitoring, investment in research and sustained, targeted actions [46, 47]. Previous initiatives included campaigns during the home heating season and individual behavioural nudging. Challenges linked to socioeconomic conditions remain, including energy poverty, access to clean energy and information for citizens.

Where do we go from here?

The current policy debate regarding the EU AAQDs and alignment with the 2021 WHO AQGs [13] has important repercussions in Europe, and also worldwide. Ambitious new European air quality legislation is of importance for motivating action. Most recently on 13 September, 2023, the European Parliament voted on a revision of the AAQDs. The Parliament proposed, with a clear majority, new annual limit values of 10 $\mu g \cdot m^{-3}$ for $PM_{2.5}$ and 20 $\mu g \cdot m^{-3}$ for NO_2 across the EU by the year 2030, and full alignment with the 2021 WHO AQGs by 2035. This is more ambitious than the previous EC proposal described above. This vote is in line with the June decision of the Parliament's leading environment committee, ENVI, to ensure full alignment with the 2021 WHO AQGs, but the time frame for achievement was extended to the year 2035 rather than 2030. As a next step, the proposal will undergo consideration in the EU Council, and final negotiations are expected over the next several months. Although there are differences in legislative and policy-making processes in Europe compared to other regions (for example in consideration of achievability, cost–benefit, implementation and enforcement), the final version of the updated AAQDs in Europe will set an international benchmark.

It is imperative to support research to maintain a robust and up-to-date evidence base of emissions, exposure and health effects of ambient air pollution, and to monitor the impacts of policies and practices to maximise public health benefits. There are opportunities to reinforce linkages of air pollution reduction with broader efforts to reduce environmental pollution, mitigate and adapt to climate change, increase sustainable agriculture and food production, prevent biodiversity loss, improve productivity and fiscal policies, and reduce healthcare costs.

There is a need for further efforts to improve communication and information about air pollution to the general public, patients and patient organisations, health professionals, scientific societies, and decision-makers. Citizens, as well as citizen scientists, play an important role in ensuring clean air through improving awareness, exerting political pressure, supporting and performing research, and sharing and adapting knowledge on best practices. It is important to harmonise air pollution communications, indices and alert systems across Europe, for example, there is the recent EEA mobile phone application on the European air quality index in 24 languages [48].

Further support to cities and networks sharing experiences in air quality interventions, local spatial planning and development, and policies, are important public health measures showcasing successes and helping to avoid unwanted negative impacts. It is important to engage health professionals more systematically in policy discussions. Increased efforts to reinforce training of health and medical professionals on the environment, air pollution and health is needed. Emerging clinical guidance for healthcare professionals should be disseminated broadly [49].

The adverse health effects caused by air pollution are serious, debilitating diseases that result in a large burden to society. The ongoing revision of the EU AAQDs provide a unique opportunity to be bold in its ambitions, and to maximise public health benefits for Europe and beyond.

Acknowledgements: The authors acknowledge the ERS, HEI and ISEE for providing funding to hold the workshop. The event was also supported by Bloomberg Philanthropies. Detailed workshop materials are available on the HEI website: www.healtheffects.org/meeting/brussels-meeting-air-pollution-and-health-taking-stock-proposed-revision-ambient-air-quality. The authors also acknowledge the following workshop participants who provided an opening address: Virginijus Sinkevičius, European Commissioner for Environment, Oceans and Fisheries, and Javi Lopez, EU Parliament, Rapporteur for the Ambient Air Quality Directive (video address); and Alexander Simidchiev, Bulgarian National Assembly Parliament, for participation as a discussant.

Disclaimer: The views expressed in this commentary are those of the authors and do not necessarily represent the views or policies of their parent organisation/body, nor of the funders.

Conflict of interest: H. Boogaard and P. Pant work at the Health Effects Institute, an organisation jointly funded by the US Environmental Protection Agency (EPA) and certain motor vehicle and engine manufacturers. The views expressed in this article are those of the authors and do not necessarily reflect the views of the Health Effects Institute or its sponsors. The remaining authors have no conflict of interest to declare.

Support statement: The workshop on which this publication is based was funded by ERS, HEI and ISEE, and also supported by Bloomberg Philanthropies. M.C. Turner is funded by a Ramón y Cajal fellowship (RYC-2017-01892) from the Spanish Ministry of Science, Innovation and Universities and co-funded by the European Social Fund. ISGlobal acknowledges support from the Spanish Ministry of Science and Innovation through the “Centro de Excelencia Severo Ochoa 2019–2023” programme (CEX2018-000806-S), and support from the Generalitat de Catalunya through the CERCA programme. I. Markevych is supported by the “NeuroSmog: Determining the impact of air pollution on the developing brain” (number POIR.04.04.00–1763/18–00) which is implemented as part of the TEAM-NET programme of the Foundation for Polish Science, co-financed from EU resources, obtained from the European Regional Development Fund under the Smart Growth Operational Programme and by the “Strategic research and innovation program for the development of Medical University – Plovdiv” number BG-RRP-2.004-0007-C01, establishment of a network of research higher schools, national plan for recovery and resilience, financed by the European Union – NextGenerationEU. Funding information for this article has been deposited with the Crossref Funder Registry.

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