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Executive Body for the Convention on Long-range Transboundary Air Pollution

Steering Body to the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe

Working Group on Effects

Ninth joint session
Geneva, 11–15 September 2023
Item 9 (a) of the provisional agenda
Progress in activities and workplan for 2024–2025 of effects-oriented activities: air pollution effects on health

Effects of air pollution on health

Report of the Joint Task Force on the Health Aspects of Air Pollution on its twenty-sixth meeting

Summary

The present report is being submitted for the consideration of the Steering Body to the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe and the Working Group on Effects, in accordance with both the 2022–2023 workplan for the implementation of the Convention (ECE/EB.AIR/2021/2, items 1.1.1.27, 1.1.1.28, 1.2.3, 1.3.5 and 1.3.6) and the revised mandate for the Joint Task Force on the Health Aspects of Air Pollution (Executive Body decision 2019/21).[a]

The report presents the results of the discussions on the health impacts of ambient air pollution and other workplan items at the Joint Task Force's twenty-sixth meeting (in-person and online, 16 and 17 May 2023).

[a] Available at https://unece.org/DAM/env/documents/2019/AIR/EB_Decisions/Decision_2019_21.pdf

I. Introduction

1. The present report summarizes the discussions on the health impacts of ambient air pollution presented at the twenty-sixth meeting of the Joint Task Force on the Health Aspects of Air Pollution (Task Force on Health) under the World Health Organization (WHO) European Centre for Environment and Health (ECEH) and the United Nations Economic Commission for Europe (ECE) Executive Body for the Convention on Long-Range Transboundary Air Pollution (in-person and online, 16 and 17 May 2023). The report also provides a summary of workplan items discussed at the meeting, in accordance with both the 2022–2023 workplan for the implementation of the Convention on Long-Range Transboundary Air Pollution (ECE/EB.AIR/2021/2, items 1.1.1.27, 1.1.1.28, 1.2.3, 1.3.5 and 1.3.6) and the revised mandate for the Task Force on Health (Executive Body decision 2019/21).[1]

2. In total, 41 representatives from 38 Parties to the Convention attended the twenty-sixth meeting, as well as one representative of the Convention Secretariat and one representative of the International Institute for Applied Systems Analysis (Austria). The European Union – a Party to the Convention – was represented by the European Commission and the European Environment Agency. The meeting was chaired by Dr. Dorota Jarosińska (WHO European Centre for Environment and Health). Dr. Dennis Schmiege (WHO European Centre for Environment and Health) acted as rapporteur. Ten temporary advisers participated in the meeting from the following organizations: French National Institute for Industrial Environment and Risks (France); German Environment Agency (Germany); Spanish Research Council (Spain); Universitat Jaume I (Spain); Swiss Tropical and Public Health Institute (Switzerland); Ecometrics Research and Consulting (United Kingdom of Great Britain and Northern Ireland); Imperial College London (United Kingdom of Great Britain and Northern Ireland); University College London (United Kingdom of Great Britain and Northern Ireland); Icahn School of Medicine at Mount Sinai (United States of America); Spadaro Environmental Research Consultants (United States of America). Eight observers participated in the meeting. The Governments of Germany and Switzerland both provided financial support for the Task Force on Health activities and the meeting.

II. International policies and processes on air quality and health

3. A representative of the Convention Secretariat provided an update on recent developments under the Convention on Long-Range Transboundary Air Pollution. The Executive Body for the Convention at its forty-second session (Geneva, 12-16 December 2022) reviewed the implementation of the 2022-2023 workplan, and developed a list of official documents for the 9th Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP) Steering Body (SB)/Working Group on Effects (WGE) session. It further adopted decisions 2022/3 on the strategy for scientific bodies under the Convention on Long-Range Transboundary Air Pollution (CLRTAP)[2], 2022/4 on the conclusion of the review of the Gothenburg Protocol and the path forward, and the final report on the review contained in document "Report on the review of the Protocol to Abate Acidification, Eutrophication and Ground-level Ozone, as amended in 2012"[3]. The Executive Body also established a new ad hoc group of experts to address appropriate policy responses to review conclusions. In its 8th joint session[4], the SB to the EMEP and the WGE reviewed progress in activities in 2022 and elected new officers. Contributing to the review of the Gothenburg Protocol, the WGE noted the progress in implementation of the 2022–2023 workplan, emphasized the importance of the multi-pollutant approach, and encouraged the Task Force on Health (TFH) to further consider

[1] Available at www.unece.org/env/lrtap/executivebody/eb_decision.html.
[2] See https://unece.org/environment/documents/2022/10/working-documents/strategy-scientific-bodies-under-convention-long
[3] See https://unece.org/environment/documents/2022/09/working-documents/report-review-protocol-abate-acidification
[4] Meeting material available at https://unece.org/info/Environmental-Policy/Air-Pollution/events/360936

linkages to climate change mitigation and integrated assessment modelling. The Joint Meeting of the Extended Bureaux of the EMEP Steering Body and the WGE (Uppsala, 24–26 April 2023) updated on the 42nd EB session, discussed progress in the implementation of the 2022-2023 identified cross-cutting issues for the new 2024-2025 workplan: Contribution to ”Ex post analysis report”; Air pollution effects on biodiversity; Methane; Mercury and heavy metals; Ozone and non-methane VOCs; Impacts of shipping; Monitoring deposition activity, and Communication, dissemination of data and open data, outreach activities. Biodiversity and methane were selected as thematic sessions for the 9th EMP SB/WGE meeting. In addition, the representative presented two e-learning courses to enhance the understanding of the Convention and its protocols[5], and support countries in their efforts to report emission inventories[6].

4. A representative of the European Commission presented the ongoing revision of the European Union rules on air quality, which builds upon the mandate of the European Green Deal. The legislative proposal[7] aims to strengthen provisions on modelling, monitoring, and air quality plans for local authorities to achieve clean air, and seeks to align air quality standards more closely with the recommendations of the World Health Organization (WHO) Air Quality Guidelines (AQG). A comprehensive impact assessment of different policy options to achieve interim targets of the AQG has been conducted, considering achievability, mitigation costs, gross benefits, benefit vs cost, and health impacts. Outweighing the implementation costs by 2030, all three policy options considered for $PM_{2.5}$ would lead to significant health and environmental benefits. The proposal includes objectives for improvements in four domains: Environment & health (EU air quality standards and other metrics); Monitoring & assessment (refined monitoring and assessment regimes); Governance & enforcement (increasing effectiveness of air quality plans); and Information & communication (informing the public and appropriate organisations adequately and in good time through easily accessible media and communication channels). It is envisioned that the legislative proposal will achieve a series of health (e.g., reduced annual mortality and related morbidity), social (e.g., protection of sensitive populations and vulnerable groups), environmental (e.g., decreases in eutrophication and acidification) and economic (e.g., annual total gross benefits estimated at €42 bn in 2030, compared to measures that costs less than €6 bn annually) benefits.

5. A representative of WHO headquarters provided an update on WHO activities and emphasized their efforts in addressing global air pollution. Sharing the vision of clean air and energy access for healthier populations and universal health coverage, the WHO Strategic Approach for Air Quality, Energy Access and Health was introduced, which is organized along three key pillars: Knowledge, evidence and measuring progress; Institutional capacity building and technical support; and Leadership and coordination. An update of the WHO Ambient Air Quality Database, as well as air pollution-related Sustainable Development Goals (SDGs) 3.9.1 (Mortality from air pollution), SDG 7.1.2 (Access to clean energy), 11.6.2 (Air quality levels in cities) was presented. This was complemented by introducing a repository[8] of over 100 UN tools and guidance documents to support air quality management strategies and reporting criteria tools to support SDG monitoring, including the air quality management screening tool and the air quality management survey. The representative further highlighted the (soon to be published) epidemiological repository and the status of the review of national and global exposure assessments. A pilot workshop of the Air Pollution and Health Training toolkit (APHT) was conducted in Ghana in 2022. Regarding indoor air quality, several initiatives around household fuel combustion were presented, including the Clean Household Energy Solutions Toolkit (CHEST), a systematic review and meta-analysis of the health effects from liquid and gaseous fuels, global cost-benefit analysis for policy interventions on clean cooking, and Health & Energy Platform of Action. The presentation closed with a focus on energizing health and supporting electrification of health care facilities through energy needs assessments, techno-economic analyses, assessments of different electrification approaches, and support to different implementation phases.

[5] See https://unccelearn.org/course/view.php?id=150&page=overview
[6] See https://unccelearn.org/course/view.php?id=166&page=overview
[7] See https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2022%3A542%3AFIN
[8] See https://www.who.int/groups/sdg-11-6-2-working-group

6. An expert from Ecometrics Research and Consulting (EMRC) and vice-chair of the EMEP presented an overview of the 7th Saltsjöbaden workshop. The workshop serves as a platform for strategic discussions on identifying future challenges and steps in air pollution management under the CLRTAP, bringing together diverse stakeholders for informal exchanges. Ways forward for improved air quality were discussed in seven parallel working groups (WG). The expert reported on the session of WG 2 "Achieve Policy-relevant Understanding of Air Pollution Effects on Health" and its conclusions related to effective communication, up-to-date scientific analysis, addressing issues in peer review and scientific publications, and considering comprehensive approaches to control air pollution. In terms of communication, it was emphasized that targeted messaging on the health impacts of air pollution should reach various stakeholders, including policymakers and disadvantaged communities. The importance of staying abreast of scientific advancements and conducting regular reviews was emphasized to ensure accurate analysis. In addition, the representative highlighted the significance of exploring diverse strategies, such as environmental taxes and behavioural measures, while recognizing the interconnections between air pollution, climate change, diet, inequality, and mobility. Overall, active participation and collaboration among stakeholders were urged to effectively address the challenges of air pollution. The expert noted a lack of representation from Eastern European countries in the WG 2 discussion, highlighting the importance of broader participation in the future.

III. Sharing experiences from the Parties

7. A representative of the Kingdom of the Netherlands gave an overview of the Dutch approach to air quality, focusing on the clean air agreement and the feasibility of reaching the WHO AQG. He highlighted the collaboration between national, regional, and local governments in the clean air agreement, which aims to achieve a reduction in health impacts, and bring the 2005 WHO AQG within reach. The agreement involves various measures such as low emission zones and transportation policies. Regular communication and evaluation are integral parts of this collaboration. The representative outlined the methodology used for health impact assessments (HIA), which combines exposure to particles and gases and testing different scenarios. By calculating concentrations based on emissions and using health impact indicators, the study revealed a potential 47% improvement in health due to existing policies and the clean air agreement. In addition, different scenarios (maximum feasible reduction, low and WHO AQG) were examined to assess the achievability of targets in the WHO AQG by 2030, showing progress in reducing $PM_{2.5}$ levels but identifying challenges related to nitrogen emissions. The representative emphasized the need for an integrated approach, considering both air quality, climate and nitrogen policies to ensure positive outcomes.

8. A representative of Canada highlighted their efforts in air quality management, emphasizing the significant health burden posed by air pollution in Canada. The latest assessment estimated around 15,000 premature deaths per year in Canada, primarily attributed to $PM_{2.5}$ pollution. The Canadian Air Quality Management System (AQMS) is a collaborative endeavour involving the federal government, provinces, and territories, aiming to continuously improve air quality to protect human health and the environment, and keeping clean areas clean, with the Canadian Ambient Air Quality Standards (CAAQS) as the key driver. While the current CAAQS cover four ubiquitous air pollutants ($PM_{2.5}$, Ground-level O_3, SO_2 and NO_2), there is a need for consistent health guidance on other harmful pollutants, particularly in specific locations and for vulnerable populations. Health Canada is developing Health-Based Air Quality Objectives (HBAQOs) to provide recommendations solely based on health considerations, assisting governments and stakeholders in managing air quality and new developments. The process for selecting pollutants for HBAQOs development involves screening a wide range of priority pollutants, categorizing them based on available health data, emissions, and exposure information. After consultations with partners, a shortlist of five pollutants (PM_{10}, arsenic, carbon monoxide, benzene, and formaldehyde) was determined for initial objective development. The ongoing work focuses on developing health-based objectives for these pollutants, with progress already underway for arsenic and benzene. Prioritization of additional pollutants for HBAQO development will take place at regular intervals. This process will also inform research to address emerging and other data

poor pollutants. The representative emphasized the importance of engagement and consultation with stakeholders to ensure the relevance and usefulness of the guidance provided.

9. A representative of Serbia presented the National Air Quality Program [9] of the Republic of Serbia for the period 2022-2030 funded by the European Union. The program focuses on reducing emissions from sectors such as energy, industry, transportation, and agriculture, with the aim of achieving significant reductions in the emissions of several pollutants ($PM_{2.5}$, PM_{10}, SO_2, NOX, VOC, NH_3) by 2030. It acknowledges long-standing air quality issues, such as industrial pollution, household combustion, and traffic congestion. The program defines measures and activities aimed at helping municipal authorities in the development of air quality plans. Considering different emission scenarios (with existing measures, and with additional measures), potential health improvements could be demonstrated based on the impact pathway approach, showing a decrease in chronic mortality or a drop in asthma symptom days in children. The representative further emphasized the importance of collaboration and coordination between different sectors, highlighted the need for additional indicators and assessments related to children's respiratory health and indoor air pollution, and identified the importance of involving the health sector in the implementation process.

10. A representative of Ireland presented Ireland's first the Clean Air Strategy to reduce air pollution and meet the WHO AQG values by 2040. The current main air quality challenges in Ireland are domestic fuel use ($PM_{2.5}$) and transport emissions (NO_2), emphasizing the need for comprehensive monitoring networks to accurately identify and address air pollution sources. The recently launched Clean Air Strategy aims to improve air quality and align with climate change objectives. It involves various government departments working together, setting priorities, implementing measures, and monitoring progress. Public consultation and communication are essential aspects of the policy. Initiatives include grants for energy efficiency upgrades, expansion of renewable energy production, investment in sustainable public transport, phasing out of solid fuel for electricity, and targeted environmental research. The action plan emphasizes ongoing reviews, evidence-based decision-making, and initiatives that provide dual benefits for air quality and climate change. The representative underscored the importance of building regulations and sustainable infrastructure to support clean air initiatives, discussed the challenges of coordinating policies between different ministries, and highlighted the importance of cross-sector collaboration to address air pollution.

11. A representative of Estonia provided an overview of the air quality situation and related health impacts in the country. The primary sources of air pollution in Estonia are residential heating and traffic emissions. Residential heating contributes significantly to air pollution and has a major impact on public health. Traffic emissions, including both gases and dust, also contribute to the overall air pollution levels. Efforts are being made to promote cleaner residential heating practices and district heating systems, as well as address traffic-related emissions. Through the implementation of better emission control technologies and measures, Estonia has made progress in improving air quality. There are still localized hotspots of air pollution, particularly in urban areas such as the city centre of Tallinn. The levels of particulate matter ($PM_{2.5}$) and nitrogen dioxide (NO_2) occasionally exceed recommended limits during certain episodes. A health impact assessment using WHO Europe AirQ+ for premature deaths for the years 2010, 2020 and 2030 was implemented, showing a decrease in exposure to $PM_{2.5}$ from residential heating and traffic but an increase from other sources. Premature deaths decreased for local heating and traffic emissions but increased for traffic dust and other sources. The representative concluded that despite the air quality has improved over the years, it still has significant impact on health. Potential ways forward in Estonia include better emissions cleaning up technologies and connecting densely populated areas with district heating systems and more cleaner residential heating applications.

12. An expert from the German Environment Agency (Germany) addressed the issue of variations in estimates of premature deaths from different agencies and institutions, focusing on $PM_{2.5}$, and emphasized the need to better understand the reasons behind these differences.

[9] See https://www.ekologija.gov.rs/sites/default/files/2023-03/en_aq_programme_adopted_version.pdf

Different estimates from four agencies and institutions (European Environment Agency, Institute for Health Metrics and Evaluation, WHO and German Environment Agency) were presented, noting variations in input data and exposure data resolution, highlighting the impact of those variation in results. The expert concluded by emphasizing that environmental burden of disease estimates are not objective measures but highly depend on the aim of the study, which in turn affects the assumptions and input data, including exposure data and concentration–response functions. The importance of using these estimates as communication tools was underlined while being mindful of their limitations.

IV. Progress in research on air pollution and health

13. An expert from the Spanish Research Council (Spain) presented an overview of the Research Infrastructures Services Reinforcing Air Quality Monitoring Capacities in European Urban & Industrial AreaS (RI-URBANS) project. The project initiated in 2020 with 25 partners focuses on demonstrating the application of advanced air quality service tools in Europe. It aims to measure and harmonize air quality parameters, provide data for epidemiological studies, and develop new quality guidelines. Major challenges to abate particulate matter pollution in Europe were highlighted in three areas: policy, technology, and science. Policy challenges include bridging the gap between WHO AQG and EU AQ standards, reducing agricultural and urban ammonia and abating PM emissions from domestic and commercial sectors. Technology challenges focused on NOx, VOCs and NH_3 and UFP reduction from traffic, particularly shipping and airplanes. Scientific challenges involve understanding the impact of policies and assessing their effectiveness in abating secondary organic aerosols, which constitute a significant portion of particulate matter (PM). The project also highlights the need to harmonize and implement measurements of PM components, black carbon, and oxidative potential, as well as their correlation with mortality and morbidity data. By addressing these challenges, the project aims to contribute to improved air quality guidelines, effective mitigation strategies, and a better understanding of the complex relationship between air pollutants and health outcomes.

14. An expert from the University College London (United Kingdom of Great Britain and Northern Ireland) presented ongoing research on the links between HAP (HAP) and health and climate change. The importance of addressing HAPHAP was emphasized, particularly its significant impact on health, with up to 25% of deaths attributed to HAPHAP in some low- and middle-income countries. The lack of access to clean fuels was identified as a major contributor to this issue, affecting approximately 2.4 billion people worldwide. There is still a lack of studies quantifying global exposure to HAPHAP and its connection to health impacts and climate change. The research conducted focused on quantifying personal exposure to $PM_{2.5}$, specifically from solid fuel use for cooking and heating. The study extended the updated WHO HAP database and analysed data from 29 countries and expanded on previous research by including factors such as ambient air pollution and heating degree days in the modelling process. The results revealed higher exposure to HAP in rural areas compared to urban areas, highlighting the inequality in energy access and health. The study also estimated the health impacts of HAP, considering different fuel types, and found significant differences in exposure and mortality rates between cleaner (gas and electricity) and polluting (biomass, charcoal, coal) fuels. Shift from polluting to cleaner fuels can reduce the average $PM_{2.5}$ personal exposure by 53% and thereby, potentially, lower the death rate by 21%. The expert concluded by stressing the need for policy interventions but also interventions at building level and residence behaviour.

15. An expert from the Swiss Tropical and Public Health Institute (Switzerland) showcased health effects of airborne pollen, in light of air pollution and climate change influences. Pollen, whereas necessary for plant reproduction, can cause health complaints when released into the air by trees and grasses. The pollen season shows significant variability, and climate change has advanced the start and increased the intensity of pollen seasons. The spread of invasive species and increased plant productivity due to carbon dioxide (CO_2) levels further contribute to pollen exposure. The prevalence of pollen allergies has been increasing worldwide. Potential pathways for pollen-induced health effects, such as nasal congestion, systemic inflammation, and autonomic nervous system dysregulation.

There is evidence of pollen exposure affecting cardiovascular health and systemic inflammation, as well as associations between acute pollen exposure and severe health effects. The expert emphasized the need for further epidemiological studies to understand the relationship between pollen exposure and health outcomes, and outlined their research using spatial-temporal machine learning models to estimate pollen exposure and its impact on health. The studies showed a clear association between pollen exposure and symptoms in allergic individuals, without a clear threshold effect. The expert further highlighted the importance of considering pollen as an environmental health issue and the need to mitigate the impacts through climate change mitigation and strategic planning.

16. An expert from the Universitat Jaume I (Spain) presented the findings of a rapid expert consultation on selected air pollutants, with the aim to identify and discuss the latest available evidence on health effects of benzene, arsenic, cadmium, lead, nickel, and mercury. The main sources of these pollutants were identified as fossil fuel combustion, industrial emissions, E-waste recycling, energy production, mining and smelting, and tobacco smoke. The study revealed that concentrations of these pollutants varied across different regions, and outlined potential exposure pathways. The expert highlighted various critical health outcomes associated with these pollutants, including cancer, and renal effects. In terms of specific pollutants, the expert consultation identified the following new health effects evidence: For benzene, additional neurological, respiratory and development effects, as well as blood and bone marrow cancers were identified, occurring not only in occupational exposures but also in the general population, including children; Arsenic was found to be associated with a series of acute non-carcinogenic and chronic effects, along additional carcinogenic effects, with evidence of skin and urinary bladder cancers; Cadmium was linked to renal dysfunction, bone damage, cardiovascular diseases, pregnancy problems, and neurodevelopmental and central nervous system effects. Inconclusive evidence suggested additional carcinogenic effects in kidney, bladder, endometrial, breast and prostate; Lead exhibited a range of new health effects on the central nervous, cardiovascular, respiratory, haematological, renal, and musculoskeletal systems, as well as adverse reproductive and developmental health outcomes; Mercury exposure was associated with effects on the nervous system, cardiovascular and respiratory issues, developmental problems, and cognitive detriments; For Nickel, new health effects evidence suggests links to several acute and chronic effects, e.g. in the respiratory system, as well as additional carcinogenic effects through occupational exposure and in the general population. These findings stressed the importance of implementing air quality guidelines to mitigate the adverse health effects of these pollutants worldwide, and emphasized the need for monitoring new available evidence.

17. A representative of the United States of America gave an overview of their work on the health effects of lead and presented key findings from the U.S. Environmental Protection Agency (EPA) Draft Integrated Science Assessment (ISA) for Lead, focusing on causality determinations and health effects. The ISA is part of the National Ambient Air Quality Standards (NAAQS) Review process based on the U.S. Clean Air Act (1970), which evaluates air quality standards for various pollutants that are harmful for public health and the environment. The conclusions presented were preliminary and subject to further analysis. The assessment involved a comprehensive review of 278,000 studies (of which 2,800 were cited in the report), identifying a wealth of evidence linking lead exposure to diverse health effects across organ systems. The findings highlighted that lead can disrupt important physiological pathways, leading to health impacts such as cognitive effects in children, cardiovascular effects, and renal effects, among others. Causality determinations were based on a weight of evidence approach, considering factors like consistency, coherence of findings, biological plausibility, temporality, and strength and specificity of associations. The evidence supported a causal relationship between lead exposure and cognitive function decrements in children. Cardiovascular effects were also deemed causally linked to lead exposure, while renal effects saw a change from suggestive to causal determination. At-risk factors, including genetics, race/ethnicity, age, and stress, were found to modify lead-related health risks. Overall, the assessment emphasized the substantial body of evidence supporting the harmful health effects of lead exposure and the need for continued efforts to reduce lead contamination in various environmental media.

V. Tools – advancements, examples of application

18. A representative of the WHO Regional Office for Europe presented progress and developments of the AirQ+ software[10], which has been continuously developed since 1999, with a major update in 2016. AirQ+ is a user-friendly tool available in several languages designed for public health or environmental specialists that allows to estimate the magnitude of the most important and best recognized impacts of air pollution in a given population. AirQ+ can also serve as an educational resource to raise awareness about air pollution. The software's accessibility and adaptability have contributed to its popularity among users, with thousands of people accessing the website and utilizing the software globally. In the most recent update (version 2.2), all suggested default parameters were updated based on the 2021 AQG, the Life Table module was improved, Global Burden of Disease (GBD) functions were updated and the GEMM function became available. An online survey indicated a diverse user base, including individuals from academia, research institutes, and national authorities, covering 367 cities and areas in 110 countries and territories, with a growing interest in health impact assessment almost evenly distributed between the local, regional and national level. $PM_{2.5}$ and PM_{10} were in the majority of cases the pollutants of interest, followed by NO_2 and O_3. The software's flexibility in utilizing different data sources, its consistent updates and the continuous incorporation of user feedback to enhance functionality and usability have contributed to its effectiveness and relevance.

19. An expert from the Icahn School of Medicine at Mount Sinai (United States of America) gave a presentation on the progress in the development of health risk assessment tools, using AirQ and AirQ+ as examples. The significant role of air pollution as a major environmental determinant of health, causing a wide range of adverse health conditions and a substantial burden of disease, was highlighted. The study aimed to systematically review publications that applied AirQ and AirQ+ since their release (until Dec 2022) and conduct a critical appraisal to provide recommendations for good practice for future studies. In total, 236 full-text articles met the inclusion criteria for the extraction of their findings, to which 45 additional records were added from WHO's database. The analysis revealed that while many studies have utilized the software, there is a lack of transparency regarding data sources, data processing, and validation approaches. In addition, few studies have conducted uncertainty assessments, and justifications for methodological choices were often insufficient. It was suggested that registering health impact assessments and promoting collaboration among research groups could prevent duplication of work. Furthermore, the development of a web-based AirQ+ platform powered by AI tools was proposed to guide users in making informed choices and provide real-time data analysis and statistics.

20. An expert from Spadaro Environmental Research Consultants (United States of America) provided an update on the progress in the development of another health risk assessment tool: CLIMAQ-H, developed at the WHO European Centre for Environment and Health, as a decision aid software for investigating carbon mitigation pathways and their health and economic benefits. The tool aims to encourage data collection and knowledge transfer in the context of health impact assessment and economic evaluation, as it provides information on changes in air quality within a country and the spillover effects on neighbouring countries. CLIMAQ-H allows users to explore different emission reduction scenarios and their effects on air quality, health outcomes (mortality and morbidity), life expectancy, and disease incidences. It incorporates default data but also allows for additional input to improve calculations. The results can be used to inform stakeholders, decision-makers, and policymakers in formulating pragmatic and socially acceptable interventions to address climate change. Several case studies demonstrate the application of the CLIMAQ-H in different regions; Examples include calculating the health co-benefits of climate policies in various countries, such as Germany, North Macedonia, Pakistan, and Colombia. The studies emphasize the potential positive impact of climate policies on air quality and health outcomes, with the benefits reaching beyond national boundaries. CLIMAQ-H's serves as a valuable resource by providing valuable insights and evidence for informed decision-making and the development of effective climate change interventions. In the end, the expert

[10] See https://www.who.int/europe/tools-and-toolkits/airq---software-tool-for-health-risk-assessment-of-air-pollution

highlighted key components and the workflow of the CLIMAQ-H tool by providing insights into its application and functionalities.

VI. Health aspects of air pollution in the wider context of the Air Convention work

21. A representative from the International Institute for Applied Systems Analysis (Austria) provided insights into ongoing air quality and health impact calculations for the Gothenburg Protocol Review using GAINS. As one of the protocols under the CLRTAP, the amended Gothenburg Protocol established legally binding emissions reduction commitments for 2020 and beyond for the major air pollutants: SO_2, NOx, NH_3, VOCs, and $PM_{2.5}$. Key scenarios were analysed using modelling tools to assess the impacts of different measures. The baseline scenario aligned with EU objectives and showed promising results, while a maximum technically feasible reduction scenario and an alternative low scenario were also considered. The analysis highlighted the potential for mitigating air pollutants, particularly in Eastern Europe, Central Asia, and non-EU countries. Reductions in ambient $PM_{2.5}$ concentrations were projected, with the low scenario indicating significant improvements and potential health benefits for the majority of the European and Central Asian region by 2050. The expert discussed the scope for further mitigation in the UNECE region to reduce air pollution effects to human health by 50% to 2035. The trends and calculations from the analysis indicated that the target could be achieved, depending on factors such as population dynamics and demographic changes. The EU was already overachieving this target in the baseline scenario, while other regions, such as Eastern Europe and Central Asia, showed more ambitious goals. Including demographic factors, such as aging populations, influenced the ambition level and the achievement timeline. Different country groups demonstrated varying degrees of ambition. The study emphasized the potential for reducing anthropogenic $PM_{2.5}$ concentrations and highlighted the importance of considering factors like demographic changes and setting realistic targets to address air pollution's impact on human health.

22. An expert from the French National Institute for Industrial Environment and Risks (INERIS, France) and co-chair of the Task Force on Measurements and Modelling (TFMM) of CLRTAP gave an overview of surface ozone (O_3) air pollution, focusing on short and long-term mitigation, as well as past trends and future outlook. The expert emphasized the importance of considering both Nitrogen dioxide ($N0_2$) exposure and ozone together, as they are responsible for mortality and detrimental impacts on ecosystems in Europe. They are also very much interlinked from a chemical point of view and therefore strongly anticorrelated in space and time (both for short and long time scales). Data showing trends in O_3 levels observed across monitoring sites in Europe displayed variations depending on the metric and site typology. While O_3 annual mean concentrations increased significantly in certain areas, there was a decrease in O_3 peaks. There are several challenges of mitigating ozone levels, including, e.g., emission reduction measures may lead to increased O_3 concentrations in cities while reducing levels away from urban areas, year-to-year and daily variability of O_3 formation and its long-range transport. The expert further addressed the future impact of climate change on O_3 levels, emphasizing that heatwaves associated with climate change will lead to increased ozone concentrations in many regions of Europe. The expert concluded by stressing the need to consider the complexity of O_3 trends, the challenges of mitigation, and the expected penalty of climate change on O_3 levels.

23. A representative from the Asia Center for Air Pollution Research (Japan), invited as observer to the meeting, introduced the recent progress of Acid Deposition Monitoring Network in East Asia (EANET), highlighting the organization's activities. Following the United Nations Conference on Environment and Development in 1992, EANET was established in 2001 after a preparatory phase. To date, 13 countries in Northeast and Southeast Asia participate in EANET. The network’s main objectives are to create a common understanding of the state of acid deposition (air pollution) problems in East Asia; to provide useful inputs for decision-making at the local, national, and regional levels aimed at preventing, or reducing adverse impacts on the environment caused by acid deposition; and to contribute to cooperation on the issues related to acid deposition among the participating countries. EANET’s main activities are monitoring, data compilation, public awareness, and

collaboration with international organizations. They also engage in project activities, which were established in 2021 for more flexibility and allow for proposed projects to be implemented based on approval and external funding. EANET values collaborations with other regions and organizations, and plans to hold workshops and seminars to enhance scientific knowledge and methodology regarding the interrelationships between the atmosphere, environment, and human health.

24. An expert from the Imperial College London (United Kingdom of Great Britain and Northern Ireland) gave a presentation on the updates of the work on methods for impact assessments of air pollution, focusing on the Update of the Health Risks of Air Pollution in Europe (HRAPIE-2) project coordinated by the WHO European Centre for Environment and Health (ECEH) and Estimation of Morbidity from Air Pollution and its Economic Costs (EMAPEC). EMAPEC has the ultimate objective of establishing a methodology to estimate the economic costs of select morbidity outcomes in populations exposed to air pollution and test its application at various geographical scales. Focusing on the implementation of projects related to air pollution and its impacts, it aims to expand the health outcomes covered by concentration–response functions (CRFs) and update these for morbidity. The project involves collaboration between different partners and consists of five work packages (WP) such as the development of CRFs, under which an umbrella review of systematic reviews (SR) on long-term exposure to air pollution (exposure to $PM_{2.5}$, NO_2 and O_3) and morbidity outcomes is currently being conducted, assessment of background morbidity, economic assessment, and integrated assessment. The project is ongoing, and the results will provide valuable information for impact assessment in the future. Regarding the HRAPIE-2 project, the expert presented the rationale for this work, which included the new evidence providing CRFs; updated WHO AQGs informed by SRs; and ongoing work of several groups on CRFs. An update of CRFs had also been included in the 2022-2023 work plan of Task Force on Health. Since EMAPEC (described above) covered morbidity outcomes, it was possible for HRAPIE-2 to focus on mortality outcomes. The expert further highlighted future steps for the formulation of advice on CRFs resulting in the publication of the assessment of the evidence in a peer-reviewed journal and the development of the final report.

VII. Updates from WHO ECEH and workplan of the Task Force on Health

25. A representative of the WHO European Centre for Environment and Health (ECEH) presented an update of recent activities regarding air quality and health at the regional level. Consolidating existing evidence on health outcomes, WHO ECEH coordinated the HRAPIE-2 project and supported EMAPEC (described in 24 in more detail above), primarily focused on updating concentration–response functions for mortality and morbidity associated with air pollution. A rapid expert consultation on selected air pollutants was organized to assess existing evidence on benzene, arsenic, cadmium, lead, mercury and nickel (described in 16 in more detail). AirQ+ (described in 18 and 19 in more detail) and CLIMAQ-H (described in 20 in more detail), both tools for health (and economic) impact assessments, were updated. Fostering capacity building and supporting the implementation of WHO AQG, several trainings on air quality and health and science policy dialogues were organized, complemented by the publication of a resource package on protecting health through ambient air quality management for the WHO European Region [11]. For health messaging and risk communication, a report published in 2023 suggested that health messaging should be flexible and tailored to the local level, considering baseline concentrations, air pollution mixtures, cultural differences and health risk preferences. Good practices were identified, emphasizing the importance of providing detailed information of at-risk populations, symptoms that may be experienced, and personal actions to reduce exposure to air pollution[12]. The representative also discussed a forthcoming report on personal-level actions individuals can take, such as reducing time in polluted environments and considering face coverings and air cleaners. Dissemination and advocacy activities included presentations and

[11] See https://apps.who.int/iris/handle/10665/366687
[12] See https://apps.who.int/iris/handle/10665/365787

sharing resources to support the implementation of the WHO AQG to different audiences at various platforms. Contributing to the regional policy framework, background reports including different aspects of air quality (e.g., relationship with COVID-19) were developed in light of the upcoming 7th Ministerial Conference on Environmental Health in Budapest (5-7 July 2023).

26. A representative of the WHO European Centre for Environment and Health (ECEH) introduced the upcoming 7th Ministerial Conference on Environment and Health in Budapest, which is organized and coordinated by the WHO ECEH, focusing on the "triple environmental crisis" of climate change, environmental pollution, and biodiversity loss and land degradation and their impact on human health. The Ministerial Conference builds upon a process initiated over 30 years ago, recognizing the direct link between the environment and human health and well-being. It aims to accelerate action and collaboration, present good practices and share knowledge, launch and/or join the European Environment and Health Process (EHP) Partnerships, promote youth engagement and adopt a negotiated Ministerial Declaration. The Declaration will serve as a guiding document, outlining commitments and actions to protect and improve public health. An outlook of the Ministerial Declaration and its Annexes, featuring a Roadmap and EHP Partnerships, was presented, in which air pollution is mentioned in the preamble, and the CLRTAP and its Gothenburg Protocol in paragraph 10. The Ministerial Conference will include three days of sessions, addressing key issues and practical activities related to the environment and health. Parallel events will cover priority topics identified by Member States. Air quality and health is one thematic priority area, with a dedicated parallel session. The representative outlined in more detail the EHP partnerships, a new implementation mechanism, that will be launched to foster practical and flexible approaches to implementing commitments and attracting additional resources. The Ministerial Conference presents an opportunity for international collaboration, knowledge exchange, and the advancement of sustainable solutions. The representative invited those attending the Conference to actively participate and contribute to this vital initiative.

27. A representative of the WHO European Centre for Environment and Health (ECEH) provided an overview of the accomplishments of the Task Force on Health in relation to the workplan for 2022-2023, including contributions to the review of the Gothenburg Protocol (2022) (1.1.1.27), the work on a report on methods for health risk/impact assessment of air pollution and cost-benefit analysis (1.1.1.27), updating tools for quantification of health impacts of air pollution (1.1.1.28), developing and implementing of capacity-building curriculum to address different needs (1.2.3 and 1.3.5), formulating health messages on air pollution, including on personal-level interventions (1.3.6), and organizing a workshop on risk communication (1.3.6). Other optional tasks, such as an overview of air pollution and COVID-19 (1.1.1.27) and an assessment of health co-benefits and trade-offs between climate change and clean air agendas (1.1.1.28), were hindered due to resource limitations.

28. The representative also presented activities proposed under the 2024–2025 workplan, emphasizing that the Task Force should actively participate in their development, and outlining that the activities align with the WHO's frameworks and mandate. The workplan structure builds on the primary needs of the CLRTAP and its Parties, relating to five main areas: science; policy; compliance; capacity-building; communication; and outreach. Planned activities under the 2024–2025 workplan are:

i) Improving monitoring and modelling tools to assess air pollution and its effects in the UNECE Europe region

(a) Consolidate existing evidence on health outcomes of exposure to air pollution; a report on methods for health risk/impact assessment of air pollution and cost-benefit analysis (update to HRAPIE project); exploratory analysis of the recent developments on ozone and health (depending on availability of resources);

(b) Further develop methodologies for assessment of direct and indirect impacts of long-range transboundary air pollution on human health; update of tools for quantification of the health impacts of air pollution, including links to climate change mitigation; case studies of estimating health co-benefits and trade-offs between climate change and clean air agendas (optional, depending on availability of resources);

ii) Cooperation with Parties

(c) Capacity-building for the health impact assessment of air pollution at regional and subregional levels; development and implementation of the capacity-building curriculum to meet different needs;

iii) Cooperation with other projects and bodies (outreach activities)

(d) Promote health messages related to air pollution in Europe; formulation of health messages in air pollution; risk communication activities for different stakeholders (depending on availability of resources).

VIII. Workshop: “Communication on air pollution and health”

29. A representative of the WHO European Centre for Environment and Health (ECEH) gave an interactive workshop on communication on air pollution and health, covering the principles of effective communication and message structuring. The representative highlighted the importance of considering diverse target audiences, including the public, media, scientists, peers, and communication officers, and tailoring language and channels to reach specific populations and delivering timely messages. Communication serves the purpose of knowledge transfer and building a common understanding. Before communicating, it is crucial to determine the objective and the reason of conveying a message. Six principles for effective communication were introduced, including understandability, accessibility, actionability, credibility, relevance and timeliness. Risk communication refers to the exchange of real-time information, advice and opinions between experts and people facing threats to health and well-being and enables individuals to make informed decisions to protect themselves. It is is one of the core capacities that WHO Member States must fulfil as signatories to the International Health Regulations (2005). Meeting participants shared good practices and issues in risk communication, including challenges in communicating a change in understanding (using the example of mask-wearing during the COVID-19 pandemic) to highlight the need to adapt messages to the evolving scientific evidence. The relevance of distinguishing between evidence of no effect and no evidence of effect; while technical people understand the difference, the public may perceive these statements as similar. Public understanding and support are essential for enacting legislative changes and lifestyle adjustments. Other points raised included: challenges in communicating during emergencies, acknowledging the need to balance evidence-based messaging with limited evidence, and varying public perceptions; tailoring communication strategies, considering the context, emotions, concerns, and understanding of the target audience; aligning public perception with scientific understanding; developing a strategic communication plan to address air quality challenges, including setting objectives, identifying target audiences, determining strategies and communication channels, and crafting clear and tailored messages to drive behaviour change. Overall, the discussions emphasized the need for effective communication to bridge the gap between scientific understanding and public perception and ensuring that accurate information is conveyed to support actions for reducing air pollution and protecting public health.

30. Within the workshop, a representative of Denmark gave an intervention on using the concept of "nudging" as a means of influencing decision-making, discussing the dominance of System 1 thinking (intuition) over System 2 thinking (rationality), and the relevance of unconscious triggers. The representative used the example of wood burning and behavioral design, highlighting the importance of choosing the right default option (e.g. reducing wood stove usage through the introduction of district heating systems as the default option), providing information at the appropriate time (e.g. when individuals are buying or selling houses), implementing regulations and campaigns, and leveraging social norms and shaming techniques. By tackling the path of least resistance, behaviors can be shifted in a desirable direction, leading to large-scale behavioral changes.