



Nordic Council
of Ministers

Air Pollution Management in a World under Pressure



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Preface

International collaboration on air pollution has been key to the successful control of air pollution for over 40 years. Negotiations and agreements within the UNECE Air Convention have contributed to a dramatic reduction in emissions and associated impacts. Openness, transparency and a close collaboration between science and policy have been fundamental for success.

One ingredient in the strategic discussion on identifying future challenges and steps in air pollution management over the last 20 years has been the Saltsjöbaden Workshops. Held under the Chatham House Rule, over the years these have formed a 'marketplace' for informal discussions between policymakers, scientists, experts and other stakeholders. The seventh workshop, held in Gothenburg from 13 to 15 March 2023, was no exception.

The workshop was organized like the previous ones: first, a plenary session to set the scene of the workshop, followed by parallel discussions in working groups leading to conclusions and recommendations. And finally, the outcomes were presented and discussed at a general session where a set of general conclusions and recommendations were agreed.

Prior to the workshop, an Advisory Board was established for the overall planning of the workshop, in particular for the selection of topics, engagement of two to three topic chairs, and for the final preparations of the conclusions and recommendations. As a preamble to the actual physical event in March 2023, the workshop welcomed professionals new to international air pollution science and policy to an early career negotiation training exercise.

This year we were particularly happy to organize the first meeting with the **Forum for International Cooperation on Air Pollution (FICAP)** as a back-to-back event with Saltsjöbaden VII. This new forum aims to form a platform for extending the collaboration to regions outside the UNECE.

All in all, the gathering of 180 policymakers, scientists and experts from 35 countries and 20 international organizations resulted in a set of conclusions and recommendations that we hope will help to set the agenda for the coming years.

In this report we have compiled the most important outcomes from the meeting in a series of recommendations. They are the result of discussions in six working groups, and were presented and agreed in a plenary session. The final version of the text was approved by the chairs of the different working groups.

The workshop was organized by the Swedish Environmental Protection Agency, IVL Swedish Environmental Research Institute and the Swedish Presidency of the European Council in collaboration with many international organizations including

the UNECE Air Convention and other regional conventions, the European Commission, Nordic Council of Ministers, WHO, UNEP, CCAC, AMAP and others. We, the representatives of the organizers of Saltsjöbaden and FICAP, are grateful to all those involved in the planning and execution of the workshop, particularly the Advisory Board, those leading the working groups, giving presentations, and taking active part in the discussions. We are also grateful to those who have sponsored the meeting: the Swedish Environmental Agency, the Government Offices of Sweden, the Nordic Council of Ministers, the Department for Environment Food & Rural Affairs (Defra) UK, the City of Gothenburg and the UNEP.

Additional information on the workshop can be found [here](#), where the full report will also be available. Reports from previous workshops can be downloaded at this site. For further information, please contact any of the below.

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Background

Past Saltsjöbaden Workshops

The first workshop was held at Saltsjöbaden outside Stockholm in April 2000. The aim was to discuss and outline further initiatives within the UNECE Air Convention and the EU, following the recent ratification of Gothenburg Protocol and the protocols on heavy metals and POPs. The idea behind the workshop and the format was to discuss, under informal conditions, how science and policy should be developed in order to support further negotiations and actions on transboundary air pollution. The workshop became a starting point for the continued work both within the Convention and the European Commission, not the least the outline of the CAFE programme.

All subsequent workshops have taken place in Gothenburg, although they have been called 'Saltsjöbaden Workshops' because they have all followed the concept originally developed for the first workshop.

All workshops have, as mentioned above, ended in a set of strategic recommendations with respect to the further development of international air quality science and policy. The most significant recommendations from earlier meetings were:

- 2000:
The workshop pointed in particular to the increased importance of health effects for future international collaboration, in particular the increased role of the Air Convention Task Force for Health (TFH);
- 2004:
The intercontinental and hemispheric dimension of air pollution received increased attention and, as consequence of the workshop, the Air Convention set up a task force on Hemispheric Transport of Air Pollution (TFHTAP);
- 2007:
A key recommendation from the workshop was to initiate integrated activities on nitrogen under the Air Convention (TFRN). The workshop also brought up the importance of atmospheric pollutants for the climate, and the issue of short-lived climate pollutants (SLCP);

- 2009:
The workshop took a broad approach to the linkages between air pollution and climate change, in particular SLCP. The outcome was brought to the UNFCCC community, in particular to the COP 15 in Copenhagen 2009;
- 2013:
The workshop raised the issues of outreach to various stakeholders, including the public, as well as the issue of implementation of signed protocols.
- 2018:
The workshop expanded the collaboration horizon both outwards and inwards. The recommendations urged the international community to engage more in transregional cooperation, which subsequently led to the inauguration of the Global Forum for International Cooperation on Air Pollution (FICAP) and the corresponding Air Convention Task Force for International Cooperation on Air Pollution. Furthermore, the workshop also stressed the importance of engaging with city air quality planners and policymakers, a recommendation that spawned the Air Convention Expert Panel on Clean Air in Cities (EPCAC).
Of specific policy interest was that the workshop stressed the importance of some sort of flexibility for parties in the Eastern region of the Air Convention in their process of ratifying Air Convention protocols. Flexibility here meaning stepwise ratification of protocols rather than ratifying all parts at once.

For the first time, Saltsjöbaden VI arranged an early career workshop, aimed at facilitating the understanding of scientists and policymakers new to the field of transboundary air pollution. At this workshop, an air quality negotiation simulation exercise was held for new and early career researchers and professionals, to learn about the nature of international negotiations and the different perspectives that play a role and to gain experience in finding creative solutions that can bridge contrasting stakes of various parties. At Saltsjöbaden VI it was recommended that such early career workshops continue to be held, where possible, in order to encourage other young professionals to participate in air quality science and policy work, particularly under the Air Convention. Subsequently, this workshop was held during the 40th anniversary of the Air Convention as well as during Saltsjöbaden VII.

Several recommendations are repeated at each workshop, firstly because of difficulties in fulfilling them, and secondly because they need to be repeated in order to not be forgotten. Such recommendations include:

- Better communication to the public
- Better communication to finance ministries
- Closer cooperation with the UN FCCC
- Stable funding of effects work

The first three workshops were organized within the framework of the Mistra ASTA research programme and the following mainly with support from the Swedish Environment Protection Agency. The Nordic Council of Ministers has supported all workshops. Other organizations, such as the European Commission and the UNECE, have supported some of the workshops.

The Saltsjöbaden VII Workshop

The world is under pressure. In recent times we have seen increased threats to nature, health and welfare, and society as a whole. Climate change, the Covid 19 pandemic and the Russian military invasion of Ukraine and conflicts in other parts of the world are examples of high-concern threats. Air pollution should be added to the list of pressures. With more than 7 million premature deaths annually and far more people suffering from poor air quality, air pollution is also a global threat. In addition, the numbers are increasing and the assumption that there are safe levels of air pollution is losing credibility. There are also risks for rollbacks of already achieved improvements.

However, important initiatives to improve the air pollution situations around the world are under way. The World Health Organization published in September 2021 new and stricter air quality guidelines. A review of the Gothenburg Protocol under the Air Convention was finalized in 2022. UNEP recently published its report on the global status of air pollution, highlighting the need for common actions. Initiatives are being taken to control methane emissions. Further, the linkages between climate change / biodiversity and air pollution are receiving increased attention, opening for synergies in control strategies. Finally, the newly inaugurated International Forum for International Cooperation on Air Pollution (FICAP) is opening new venues for international cooperation on air pollution policies and science. Correspondingly, the workshop was arranged around six main discussions, all with the over-arching objective of clarifying if and how international science and policy cooperation can accelerate the transition to a world with less air pollution.

Parallel discussion 1: Attain good air quality in airsheds at risk

The first discussion addressed three themes of concern for hotspot areas of air pollution. The implementation and interpretation of WHO's new air quality guidelines was one such theme, coupled with the matter of how to increase air quality monitoring using low-cost sensors in areas with limited financial resources. A second theme was related to emission sources, as regard both sustainable residential heating and mobility challenges. The third theme was the future of sustainable cities with clean air and discussing how to support such a movement and how to increase the use of air quality co-benefits from initiatives targeting biodiversity, climate change, etc.

Parallel discussion 2: Achieve policy-relevant understanding of air pollution effects on health

The second discussion focused on how to increase the uptake of scientific developments in our knowledge of the health effects of air pollution. The three main themes addressed how to estimate the health impacts of air pollution, how to improve communication of health impacts so that early action is promoted, and finally, which policy measures, legal actions and structural and behavioural changes are effective in reducing the health effects of air pollution.

Parallel discussion 3: Fulfil Air Convention objectives

The third discussion investigated international cooperation within the UNECE region and on the Air Convention. The themes of the discussion were related to issues such as: how to improve implementation of the Amended Gothenburg Protocol, how to increase policy cooperation with related policy areas such as biodiversity (UNCBD) and climate change (UNFCCC), how to address imported pollution from areas outside the UNECE, and how to encourage further ratification of the existing protocols.

Parallel discussion 4: Transform nitrogen waste into nitro-resources and flourishing ecosystems

The discussion on nitrogen focused on the effects of future macro-level changes of e.g. global population, diet and mobility. It also discussed effects of the recent spikes in the price of nitrogen fertilizers. Other themes related to further developments of nitrogen budget techniques and emerging technologies to use ammonia as an energy carrier that might increase emissions of nitrogen compounds if not governed correctly.

Parallel discussion 5: Integrate policies and research on air pollution, climate change and biodiversity

The fifth discussion looked at the integrated areas of climate change, air pollution and biodiversity. The themes of the discussions were related to Arctic warming, global methane policy initiatives, actions in the agricultural sector, as well as how to increase scientific and policy cooperation with the Convention on Biodiversity.

Parallel discussion 6: Accomplish significant air quality improvements through international cooperation

The final parallel discussion was focused on how the Air Convention initiatives can better cooperate with regional initiatives in other parts of the world. This included identifying common barriers and opportunities for reduced air pollution, as well as how to improve cooperation between neighbouring countries with respect to emission reduction and information sharing.

Recommendations from Saltsjöbaden VII

The text below presents the most pressing and actionable recommendations from the parallel discussions. The recommendations specify the intended recipient(s) most suitable to take on the recommendations for actions. Since this was the 7th Saltsjöbaden workshop, we could build on previous experience and discuss new ways of thinking, to improve the uptake of the recommendations. The recommendations are organized in three groups. We first present an overarching recommendation, followed by a set of cross-cutting recommendations. Finally, we present specific recommendations from each parallel discussion. Some of the topic-specific recommendations have been moved to become part of the cross-cutting recommendations. Except for the overarching recommendation, the recommendations are not ordered with respect to importance. The recipient organizations for the recommendations are in most cases only mentioned using their initials. For explanation see the list of abbreviations at the end of the report. The order the organizations listed does not indicate any priority.

Over-arching recommendation

Consider setting a global target for air quality control

A global environmental agreement for air pollution does not exist. Common environmental targets, however, have proven to provide good motivation for ambitious cooperation both internationally and within countries. Such global targets have been inspirational for the United Nations Framework Convention on Climate Change (limit global temperature increase to well below 2 degrees Celsius), and the United Nations Convention on Biological Diversity (protect 30 per cent of Earth's lands, oceans, coastal areas and inland waters). In a similar way, a target for air pollution could be formed as a reduction of XX per cent between a base year and the target year. A suggestion presented at the workshop was that a 50 per cent improvement in health effects should be achieved by 2035. Such a target needs, however, to be further assessed and elaborated before presented at top-level meetings in key organizations. Future discussions also need to include possible targets for other air pollution effects.

Recipients: Air Convention Executive Body (EB), UNEP General Assembly, WHO General Assembly. Air Convention TFIAM & FICAP

Cross-cutting recommendations

Of the recommendations from the parallel discussions, four themes can be presented under common headings. These themes include various aspects of methane emission management, nitrogen management, integration of international environmental policies and efforts to communicate more effectively.

Increase action on methane as a tropospheric ozone precursor and as a key co-beneficial air pollution and climate change compound

For several of the Saltsjöbaden discussion groups, methane stands out as a problem that requires more attention from the air pollution science and policy communities. It is established that methane emissions at a hemispheric scale strongly affect the UN/ECE's ability to reach regional targets for ground-level ozone concentrations. It is also established that much of the methane is co-emitted with ammonia emissions from agriculture. And particularly for the non-agricultural sources, there is an abundance of very cost-effective methane measures, some that also reduce emissions of fine particulate matter. Given that methane is a short-lived climate pollutant and air pollutant precursor, science and policy responses are needed to address the recommendations that follow.

- **Set binding methane targets and increase ambition on ammonia in environmental agreements**
Recipients: Air Convention EB, EMEP, WGE, WGSF and corresponding bodies under the European Commission
- **Give high priority to the understanding of the methane/ozone problem and the development of international and national strategies for methane emission reductions to reduce ozone problems**
Recipients: Air Convention EB, WGSF, TFIAM and parties to the Air Convention
- **Urgently prepare national positions on how to tackle emission reductions of methane as an ozone precursor**
Recipients: parties to the Air Convention
- **Expand the mandate of TFRN to include agricultural methane emissions**
Recipients: parties to the Air Convention
- **Mobilize resources, including financial resources, to support knowledge transfer to regions outside the UN/ECE on the importance of global-scale methane mitigation for air pollution abatement**
Recipients: Air Convention FICAP

- **Assess the effects on short-term climate change from air pollution mitigation in the decision-support material delivered to the Air Convention and the European Commission**

Mitigation of methane and conventional air pollutants are affecting climate in the short term. This effect should be included in the assessments of Air Convention and EU control strategies.

Recipients: Air Convention EB, EMEP, WGE and WGSR. Corresponding bodies under the European Commission

Increase engagement in actions that lead to sharper and faster reduction of UN/ECE ammonia emissions

Although regulated in the Air Convention Gothenburg protocol since 1999, ammonia emissions in the UN/ECE have not decreased as fast as the other pollutants regulated in the protocol. Correspondingly, the ecosystem effects related to ammonia are not progressing at the same rate as ecosystem effects related to other pollutants. Further, the atmospheric behaviour of ammonia is changing, implying longer time in gas phase and shorter distances travelled. In addition, at least two parallel trends are ongoing, which both motivates increased attention to ammonia. The world market prices of nitrogen fertilizers have increased three-fold over just a few years, and new climate-friendly technological innovations are at risk of increasing ammonia emissions. Correspondingly, several discussion groups provided recommendations related to nitrogen in general and ammonia in particular.

- **Develop and apply nitrogen reuse policies within the agricultural/food sector**
Recipients: EB, TFRN, TFIAM, EU, World Bank
- **Promote a change in the EU Industrial Emissions Directive so that the livestock unit threshold for reporting/action on ammonia emissions is maximum 100 LSU**
Recipients: Air Convention EB, EU member states
- **Collect more detailed farm-level data on land use, economy, and emissions to overcome barriers to the implementation of known measures for agriculture**
Recipients: Air Convention EB, TFEIP and TFIAM
- **Assess environmental risks and consequences for increased nitrogen emissions if ammonia is used as an energy carrier**
Recipients: UNECE, EU, IMO, Air Convention EMEP, TFHTAP and TFRN

Continue efforts to, and specify how, the Air Convention can become more active and build better synergies with other international environmental agreements

Several discussion groups identified specific international environmental agreements that should be approached with information on how their priorities and targets are affected by air pollution. On the flip side, to fulfil its objectives and to put it higher on the political agenda, the Air Convention needs to establish/intensify linkages and synergies with the very same international environmental agreements. The EU Zero Pollution Action can serve as a model for making policy linkages. More specifically:

- **Engage through the planned UNEP Science Policy Panel on chemicals, waste and pollution**
Recipients: Air Convention EB, EMEP, WGE and WGSR
- **Ensure that European CAP includes cross-compliance with the EU Habitat directive with respect to nitrogen air pollution impacts**
Recipients: EU member states
- **Support and contribute to the UNFCCC process for development of guidelines for SLCF emission inventories**
Recipients: Air Convention TFEIP
- **Initiate and promote a special UNFCCC report on "Air Pollution and Climate" to support the current UNFCCC process, and for the benefit of policies under the Air Convention**
Recipients: Air Convention EMEP and WGE, WMO, UNFCCC

Strengthen communication activities and develop tailor-made activities

Communication and outreach also emerged as a common theme in several discussion groups. There were discussions on engaging new communities (journalists, medical specialists, other ministries than the environmental, and other international and non-governmental organizations). There were also discussions on more modern forms of communication such as e-courses and other forms of direct knowledge sharing. In this context, the importance of stricter adherence to advice from communication experts was flagged as a key issue. These efforts can help air pollution scientists and policymakers to better reach other professional communities and civil society for enhancing focus on air quality, liveable cities, nature engagement, international cooperation, links to climate agenda etc. There is a need to engage across the usual silos (energy, transportation, health, education, urban planning) through a multi-level governance approach. For this, communication efforts need more innovation. More specifically, the discussion groups have inter alia identified the following:

- **Concentrate communication to policymakers, civil society, and the public on the findings where there is overall scientific consensus**

Despite ongoing scientific developments, there are no doubts about serious health and ecosystem effects from air pollution. And for health effects, no safe levels can be observed. This should always be emphasized.

Recipients: TFH, assisted by all parties to the Air Convention, including stakeholders such as NGOs. In addition: the air pollution scientific community, all levels of governments, including local (city) governments. However, responsibility lies with all organizations endowed with communication departments, journalists, academia and NGOs etc.

- **Unfold the complexity in the communication of air pollution health effects and simplify the messages**

Adapt and simplify key messages to different target groups and enhance credibility by explaining why academic results can differ. Communication improvements should include the understanding of local or one's own contribution to poor air quality, the need for action, ways to mitigate exposure, links to environmental justice, efficiency of policy process, and personal experiences of those affected by pollution. Moreover, the availability of appealing communication tools, such as infographics, are needed to 'make the invisible killer visible'.

Recipients: All levels of government, including local (city) governments, TFH. But responsibility lies with all organizations endowed with communication departments, journalists, academia and NGOs etc.

- **Develop practical guidelines/roadmaps on air quality monitoring and management adapted to low- and middle-income countries**

Recipients: Air Convention FICAP, TFH, EB, TFMM

- **Communicate to stakeholders inside and outside the Air Convention that the future development of agricultural policy is of central importance for achieving not only air pollution objectives, but also climate change and biodiversity objectives**

Recipient: Air Convention EB

Inter-regional cooperation will also be dependent on successful communication efforts. Three main recommendations stand out:

- **Use FICAP to work with UNEP to streamline online resources**

These should include air quality guidance documents as well as tools and knowledge from the scientific community. It is important to identify user needs and make resources user-friendly. Further, materials must be translated into several languages.

Recipients: Air Convention FICAP in coordination with UNEP

- **Package easy to understand, positive messaging or campaign that AQ has improved but additional progress is possible and must be achieved**
Work on ways to provide better communication and the right narrative to the public. Engage the younger generation, journalists, medical specialists, NGOs and the private sector. Events such as the International Day for Clean Air and Blue Skies^[1] should be used.
Recipients: Air Convention FICAP, international air pollution funding organizations
- **Identify champions at the local and national levels, to provide expertise for global south-to-south and north-to-south capacity-building and exchange of experience**
Recipients: Air Convention FICAP, international air pollution research and funding organizations

Recommendations from the parallel discussions

Attain good air quality in airsheds at risk

#1 Create air quality roadmaps for low-income countries

Equity should be improved significantly regarding exposure to poor air quality. The new WHO guidelines are mostly achievable for high-income countries. And even in high-income countries, air pollution levels are typically highest in the poorest neighbourhoods. In some low-income countries action should not be prevented due to the absence of data, where there are no-regret solutions. Priorities should be given to governance structure and mechanisms. Low-cost sensors may be a complementary tool for generating data.

Recipients: Air Convention EB, FICAP and TFH, National air pollution decision-makers

#2 Develop guidance documents on how to access finance and overcome implementation barriers for clean residential heating solutions

There is a need for affordable, accessible, decarbonized-ready residential heating solutions, notably in low-income households to achieve maximum climate and air quality benefits. Finance is generally the most important factor for replacing old heating systems with new.

Recipients: Development partners, i.e., IGOs and IFIs, Air Convention FICAP and TFTEI

1. <https://www.un.org/en/observances/clean-air-day>

Achieve policy-relevant understanding of air pollution effects on health

#3 Improve scientific rigour in the application and advancement of methods for environmental health studies and burden of disease estimations

Currently the proportion of low-quality studies and meta-analyses is high, but these methodological problems might go undetected unless thoroughly reviewed. The issue of low-quality published studies and evidence/systematic reviews needs therefore to be resolved through promoting good-quality science. The scientific community needs to promote high-quality studies and discourage publications which do not add to the weight of evidence. It is critically important to rigorously adhere to methods in designing, conducting and reporting of research and systematic reviews.

Another problem is the long-term delays in updating air pollution health data. To avoid this problem, a mechanism for rolling reviews of research on air pollution and health, and updates of health quantification methods, should be established and funded. Burden of disease estimation should also ensure usage of the most appropriate exposure-response function for that specific estimation.

Recipients: ISEE, ERS, et al. to develop guidance and communicate to editors of relevant scientific journals. WHO to lead regular reviews, with appropriate funding provided.

Fulfil Air Convention objectives

#4 Increase efforts to use the Gothenburg Protocol as an instrument for cleaner air

The Gothenburg Protocol Review clearly shows the progress in reducing air pollution in the UNECE region. However, not all Convention objectives are being met. For PM, the attainment of WHO AQ Guidelines everywhere will be a major challenge, which necessitates non-technical and structural measures. Actions to promote air pollution should inter alia aim to include: investments in abatement and long-term assistance programmes, improvements of emission inventories and projections, dedicated national air policy development including awareness raising in relation to gains for health and environment benefits, as well as co-benefits such as industrial competitiveness, and inclusion of air pollution into bi-/multilateral cooperation agreements.

Recipients: Air Convention parties, and non-parties

#5 Continue clarification efforts with respect to abatement and implementation barriers; develop a staged commitment approach

Barriers (political, financial/economic, institutional, regulatory, capacity, technical) to ratification continue to exist in establishing emission reduction commitments and implementing the large number of requirements of the Technical Annexes. Focus should include abatement and implementation, and a phased/staged commitment approach – understanding that countries are at different stages of implementation and that a “one-size-fits-all” approach does not work – should be explored in future discussions.

Recipients: Air Convention EB, Ratifying and non-ratifying parties to the Air Convention protocols

Transform nitrogen waste into nitro-resources and flourishing ecosystems

#6 Integrate changes in production and consumption of agricultural products, and in bioenergy use into future scenarios and negotiation support to the Air Convention

Among the options, the most appealing strategies to achieve the 50 per cent reduction in N waste (losses) by 2030 include a combination of technical actions in agriculture, change to dietary patterns to reduce meat and dairy intake (and overall protein) combined with food waste reduction. Correspondingly, such scenarios should be presented to decision-makers during forthcoming negotiations.

Recipients: Air Convention MSC-West, TFMM, CIAM, TFRN and Parties to the Air Convention

#7 Strengthen key indicators of damage to terrestrial biodiversity across the UNECE region to set critical loads and levels for nitrogen deposition and ammonia concentrations

Increasing ammonia concentrations in ambient air across Europe, emission reductions of nitrogen oxides, as well as increased pressure on biodiversity motivates further development and disaggregation key indicators to support the Air Convention objectives.

Recipients: Air Convention EB, and parties to the Air Convention

Integrate policies and research on air pollution, climate change and biodiversity

#8 Prioritize the protection and maintenance of nature types and areas still in good condition over restoring areas after damage has already occurred

Restoration of damaged ecosystems is not always possible. 'Rewilding' does not necessarily lead to the return of biodiversity equivalent to pre-damage levels. Measures to restore damaged ecosystems are often extremely expensive and there can be long time delays between initiation of restoration efforts and observations of positive impacts. Monitoring, modelling and mapping tools are available within the Air Convention to understand which emission sources are especially important for ecosystems at risk, and these sources should be prioritized for mitigation measures.

Recipients: Air Convention EB and WGE

#9 Increase the number of indicators used to show the impacts of air pollution on vegetation (crops and ecosystems)

The indicators currently used to describe air pollution effects are not fully in line with knowledge developed in recent scientific developments. Aspects currently lacking, and which need to be represented by appropriate indicators, include the contribution of methane to ozone impacts, the influence of nitrogen and ozone exposure on carbon sequestration in soils and biodiversity, as well as nitrogen use efficiency of agricultural and forest areas.

Recipients: Air Convention EB and WGE

Accomplish significant air quality improvements through international cooperation

#10 Streamline online resources

There are today a multitude of resources available on the internet. There is, however, a need for some sort of hub or common starting point for users. International cooperation on air pollution would benefit from a streamlining of online resources including air quality guidance documents, tools, scientific knowledge and available expertise. Further, the resources should be made user-friendly and translated to more languages.

Recipient: Air Convention FICAP, UNEP

#11 Develop frameworks for international cooperation within and between regional cooperation networks

There is a strong interest in regional cooperation between the UN/ECE region and regions on other continents. Many stakeholders express interest in learning from the experience of the Air Convention, including knowledge of failures and successes, as well as sector- or source-specific knowledge. International cooperation on air pollution could thus be expediated through the development of methodologies or frameworks for tailored regional cooperation on topics of concern. Sectoral approaches and best practices for integrating co-benefits with climate change when applicable are examples of topics that could be addressed. Improvements in data collection, exchange and quality assurance are important items on an agenda. Many air pollution problems are of a common nature, and are often transboundary within regions. Establishing standards and collaboration on air pollution control and legislation within certain sectors are areas that might benefit of intraregional collaboration. Topics of interest are forest fires, agricultural burning, residential cooking and heating, energy and motor vehicle standards. The framework should also consider arrangement of periodic webinars and utilization of other international and regional organizations and existing conferences. An important step could be to engage new communities (journalists, medical specialists, energy-, transportation-, & agriculture ministries and other international organizations).

Recipients: Air Convention EB and FICAP, UNEP/CCAC, other international organizations

Group session reports

Attain good air quality in airsheds at risk

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Introduction

Air pollution is the world's greatest environmental health threat. Worldwide, seven million people die prematurely every year due to air pollution, with 90 per cent of them in low- and middle-income countries. In 2021, air pollution was responsible for \$8.1 trillion in healthcare costs, or 6.1 per cent of global GDP. Globally and locally, air pollution and climate change are inextricably linked. Reducing the use of fossil fuels is therefore not only a priority for improving air quality, it is also a priority action for climate change mitigation.

The objective of this session was to discuss and submit recommendations on how to develop air quality governance methodologies in airsheds at risk.

We looked into the need to improve air quality and the new WHO guidelines, data availability and low-cost solutions to bridge economic barriers. Further, we discussed policy areas closely linked to air protection, including residential heating and transport. Finally, we looked at future planning of cities where air quality could be a tool to drive change.

The session explored examples and experiences from around the world, with speakers from low-, middle-, and high-income countries.

Air quality and WHO guidelines and exposure to air pollution

Air quality levels differs depending on location. Typically, air quality levels are higher in cities, but there are also airsheds at risk that cover larger areas.

On a very small scale, there may be hot spots in street canyons within a city. However, there are also larger areas where topography, volcanic activity, wind-blown dust, climate conditions such as inversion, lack of wind, dry seasons, etc, lead to high air pollution levels. Additionally, lack of regulation or enforcement of regulations can lead to a deterioration of air quality in a particular area. Therefore, airsheds may be at risk because of local and transboundary pollutant emissions, local meteorology and geography, as well as governance and management issues.

The presentations pointed at how to assess air quality levels in our cities by modelling and if we should consider freshly emitted particles to be more hazardous than long-range transported particles.

Data availability and low-cost solutions

Air quality monitoring can be very costly. Air quality models are generally of high standard: they struggle with uncertainties but give a good picture of source distribution etc. Knowledge of both levels of pollution and emission sources is essential for governance and management of air pollution.

Low-cost sensor technology has developed rapidly, and low-cost sensors are deployed widely by civil society around the world, supporting citizen movements for clean air. But are the quality and the development of low-cost sensors at a level to be a basis for policy measures? There are still issues of quality and consistency in monitoring with low-cost sensor.

The presentations pointed to consider if monitoring in poorer resource environments requires a new approach and highlighted the benefits and potential of developing experience of monitoring with low-cost sensors. This would enhance understanding of air quality to support evidence-based policy making and air quality management in low-resource circumstances.

Sustainable residential heating

The use of fossil and biomass fuels is a major source of air pollution. Climate and air quality policies, energy shortage and prices can put pressure on our effort to ensure a sustainable transition of household heating – sustainable in terms of both emissions and energy poverty. Due to the poor quality of available appliances and fuels, marginalized communities are often the source of air pollution from residential heating, and suffer the worst health impacts.

The session focused on the further need to assess economic and technical barriers to sustainable household heating, among other collective district heating solutions, and need for effective policy mechanisms to overcome these. In addition, the session focused on the need to address how policies can ensure co-benefit – especially climate agenda and air quality co-benefits.

Sustainable mobility

Globalisation has increased transport demands. Over the past decades, passenger and freight transport worldwide increased more rapidly than the world's GDP. More and more people are moving to cities, where jobs, education, cultural life and other activities are more easily found. This also applies to families with children, who in recent years have more often taken root in the cities instead of moving out. The movement towards cities presents several challenges with, among other things, pressure on parks and green areas for physical activity, playing and socializing as well as increasing congestion, noise, CO₂ emissions and air pollution due to increased mobility.

Climate change, noise and poor air quality in cities has led to increased focus on greening the cities and greening the car fleet.

In developed and developing countries alike we continuously see an expansion of the car fleet. In developed countries, more households have two cars, which leads to a demand for more and larger roads to accommodate them. Even if all vehicles were pure electric vehicles, there would still be noise problems and emissions from tyres and brakes. In developing countries, car ownership is increasing rapidly, often in contexts of low fuel standards and partial enforcement of vehicle standards, placing significant pressure on air quality.

The presentation touched upon the second lives of cars in developed countries and how to maintain low emissions through the lifetime of a car. Urban development and healthy air quality should be rethought in the context of expanding sustainable mobility e-vehicle usage.

Envisioning the future to support a movement toward sustainable cities

Cities with many greens areas and parks may give citizens the opportunity to escape from air pollution, traffic noise, and enhance their physical activity, which increases positive health effects.

Air quality regulations can provide a more holistic approach towards sustainable cities and be woven into other policy areas for integrated solutions, conservation and biodiversity protection, etc.

The presentations focused on a need to envisage a sustainable mobility future in terms of prioritizing public transport, cycling and walking, in balance with space-demanding private vehicle ownership. The exercise of envisaging change itself promotes more creative and sustainable public policymaking.

Conclusions and recommendations

Air quality exposure and management

Equity should be improved significantly regarding exposure to poor air quality. The new WHO guidelines are mostly achievable for high-income countries. And even in high-income countries, air pollution levels are typically highest in the poorest neighbourhoods. In some low-income countries action should not be prevented due to the absence of data, where there are no-regret solutions. Priorities should be given to governance structure and mechanisms. Low-cost sensors may be a complementary tool for generating data.

More inclusive, transparent and participatory approaches to air quality monitoring such as through affordable and sustainable low-cost sensor networks can complement reference stations while promoting citizen engagement in air quality action.

- Developed countries need to pay attention to more exposed groups, to ensure equity in air-quality-related health outcomes.
- More broadly there is a need to support countries that lack effective air quality governance structures by providing a road map that constructs an air quality management system.
- Develop practical guidelines/roadmaps on air quality monitoring and management adapted to low- and middle-income countries.

Recipients: FICAP, Taskforce on Health, EB, decision-makers

Residential heating solutions

There is a need for affordable, accessible, decarbonized-ready residential heating solutions, notably in low-income households to achieve maximum climate and air quality benefits. Develop guidance documents on how to access finance and overcome implementation barriers for clean residential heating solution.

- Financing mechanisms: Guidance on accessing financing and overcoming implementation barriers should be developed.

Recipients: Development partners i.e. INGOs and IFIs, FICAP, TFTEI

Mobility and green liveable cities

To improve air quality in cities there is a need for innovative solutions and policies that reduce emissions from various sources. This can include sustainable mobility options and active modes of transport, implementation of clean energy sources for industries and enforcement of regulations on emissions.

- Promoting effective behaviour change requires a fundamentally different approach to technical solutions among different user groups for improved air quality and more liveable cities.
- Envisioning change should be promoted for reaching out to policymakers and civil society for co-creating more liveable cities.
- There is a need to engage across the usual silos (energy, transportation, health, education, urban planning) through a multi-level governance approach.

Recipients: New Urban Agenda partners (local authorities, civil society, local communities, youth, the scientific community)

Achieve policy-relevant understanding of air pollution effects on health

Chairs

Mike Holland, Ecometric Research and Consultancy, United Kingdom

Dorota Jarosinska, World Health Organization

Leo Stockfelt, Gothenburg University, and Sahlgrenska University Hospital, Sweden

Introduction

Ambient air pollution is the single largest environmental health risk, estimated to be associated with several million deaths globally each year, mostly through exposure to fine particles $<2.5\mu\text{m}$ ($\text{PM}_{2.5}$). There are, however, differences in the size of the estimated health effects between different reports, depending on differences in methodology and assumptions. These differences risk inducing an impression of uncertainty about the health effects of air pollution, despite the overall strong scientific agreement that exists, and inhibit clear risk communication to the public and promotion of science-based policy recommendations. Effective and appropriate risk communication that promotes action is also difficult regarding environmental health risks where the risk to the individual is usually low even when the effect on the population is large. More efforts are thus needed to continuously improve the way the developed scientific knowledge is communicated and understood in different parts of the world, and how it can be used by policymakers and be understood by civil society. Additionally, changes in policies and recommendations do not always translate into action that promotes real-world changes in population exposure. Thus there is a need to come to a larger agreement on:

1. How to best estimate the health effects of air pollution and the resultant societal costs
2. How we improve the communication of health effects so as to promote action
3. How the health effect of air pollution can be decreased through policy measures, structural change, behavioural changes and other actions, and
4. How reductions in air pollution can move forward in a rapidly changing world.

Notes from the discussions

This workshop discussed these issues in four consecutive sessions.

The first part covered how the health impact of air pollution can be, and currently is, estimated. An introduction by the session chairs was followed by presentations by Bertil Forsberg, Zorana J. Anderssen and Pierpaolo Mudu, and an intense discussion in plenum. The second part of the session discussed how communication of health impacts can be improved to promote faster action on air pollution. Alberto Gonzalez Ortiz, Anne Stauffer (pre-recorded) and Roman Perez Velazco presented before the general discussion ensued. Following this, the third part of the session included presentations by Mike Holland, Ugo Taddei and Mikael Skou Anderssen, and a discussion on how we can reduce the health effects of air pollution through legislation, policy measures and structural or behavioural changes. In the fourth and final part Francesco Forastiere and Ebba Malmqvist started the discussion on "ways forward" with reflections and summaries of the day, before a final wrap-up session where the entire group of participants gave suggestions on conclusions and recommendations for the future.

The presentations and plenary discussions are here grouped around the following key words/topics:

- Science
- Tools
- Communications
- Policy
- Environmental justice

Science

Discussion of aspects for advancing the science on air pollution and health discussed during the session covered the following:

- The need to target research on policy relevant questions including:
 - Multi-pollutant models;
 - Links between air pollution and other stressors, such as traffic noise;
 - Consideration of both short-term and long-term effects.
- The need to rigorously adhere to research protocols and to ensure good-quality peer review. Particular deficiencies were noted regarding a number of recently published systematic reviews. This problem needs to be acted on by journal editors.

- The need for authors of epidemiological and other studies to recognize that results will be used in health impact assessment to inform policy development, and hence the need to consider the science-policy interface in the conclusions of published work.
- Regarding Health Impact Assessment (HIA) of air pollution (quantification of effects, often to inform policy development), clarity is needed on the selection of counterfactual concentrations, concentration response-functions (CRFs, for which the most appropriate CRF based on type of exposure, quality, population etc. for the specific HIA should be selected, rather than just a meta-estimate), incidence data and other inputs. This will demonstrate that inputs are correctly aligned: there is for example sometimes inconsistent application of data on incidence or prevalence with response functions. This will also help to reduce confusion regarding variability in estimates and provide clearer policy-relevant messages. Care should be taken in selecting the first number presented since that is usually the information propagated in the media.
- The steps involved in developing disease needs to be studied further, for example from the initiation of atherosclerosis and hypertension through to cardiovascular and other diseases and mortality.
- 'Umbrella reviews', such as those being carried out at the present time for WHO through HRAPIE2 (Health Response to Air Pollution in Europe) and EMAPEC (Estimating Morbidity from Air Pollution and its Economic Costs), should be carried out more regularly. In the ten years since the original HRAPIE study was concluded, the science of impact quantification has advanced considerably with respect to the range of impacts covered and the response functions used. Consistent sources of funding for this work need to be agreed.
- Linked to this review work there is a need for guidance on how to perform and communicate burden of disease and impact assessment work (including guidance on what not to do). This work could perhaps be best done by model developers.

Methodological differences and complexities must not be allowed to obscure the fact that there is scientific consensus on the health effects of air pollution. Whilst there is variability in estimates of harm between sources, there is very good agreement that air pollution imposes a substantial health burden, on the pollutants involved and on the lack of thresholds for impact.

In addition, the need to be more open to citizen science was highlighted, to explore and better understand its potential, and to engage with stakeholders to address its limitations at an early stage.

Tools

Tools are already available for quantifying the health impacts of air pollution. These include WHO's AirQ+ software (a new version of which was released on the day of the workshop in several languages) which allows quantification of the health impacts of air pollution, providing valuable decision-making support, including for countries where expertise is limited. Use of these tools should be promoted to ensure their wide uptake, by environmental and public health experts and for clean air advocacy.

Continued capacity building is necessary, including getting public health institutions on board. The tools available online seem likely to be particularly useful in the EECC countries and for FICAP.

Communication

A range of topics related to communication on air pollution and health were discussed during the session, reflecting the complexity of communication, and priorities for improving it. Emphasis was placed on the engagement of scientists either individually or through academic associations with other parties, such as local and national authorities including public health institutions and medical societies, and civil society, as well as the need to promote dissemination of new knowledge, available tools, and best practice examples of plans for addressing air pollution. Related to this, a strategy for better and more frequent engagement with journalists was recommended.

Communications within the community of those working in the field could be improved. For example, a portal for reviews of research work, including those in the pipeline, could be established. This would apply also to ensuring that the main messages on air pollution and health are coherent. Authors of scientific papers should include policy recommendations in their conclusions, this in turn requiring that they develop a good understanding of the direction of policy in their region. Training researchers on risk communication would be beneficial, particularly in the areas affected by the worst levels of air pollution.

While the details may vary, there are common messages that should be voiced unanimously and regularly, including that:

- Air pollutants (PM, NO₂, O₃) are known to be bad for health, as reflected by an extensive academic literature that has been exposed to critical review.
- Air pollution affects real people. (this message could be reinforced using personal testimonies)
- These pollutants are each linked to a wide range of health impacts including mortality and chronic illness including heart and respiratory disease, dementia, stroke and type 2 diabetes.
- Safe exposure limits (thresholds) have not been identified, with effects found

to be associated to what we even now consider to be low concentrations.

- Impacts of these pollutants on health are substantial.

Whilst further materials need to be developed, good communication materials are already available (such as HEAT) and should be used more widely with information tailored to the needs of different groups. Checks are needed to ensure that material intended to improve literacy on air pollution and health is pitched at an appropriate level for the intended audience, and to not discourage physical activity. Increased dissemination would benefit from translation of key texts, particularly those developed nationally, to a broader range of languages. This is particularly the case for infographics that provide clear illustration of the burden of air pollution on health, including diagrams that show:

- The ways that air pollution affects health, both in terms of effects and the way that these effects develop with pollutant exposure
- The need to control emissions even in areas where pollution levels are considered 'low' by reference to historic conditions
- The benefits from existing and possible air pollution policy
- The outputs of cost-benefit studies that demonstrate that action to reduce air pollution and protect health is 'worth it'.

In addition, the value of communication 'beyond numbers', especially the importance of personal testimonies, the power of pictures, as well the use of positive examples and opportunities (the wider health benefits of reducing air pollution beyond estimates of mortality) was emphasized. Needs for further communication and advocacy were identified, with the involvement of civil society. This included the work on improving literacy on air pollution and health, better understanding of the mechanisms of air pollution effects on health, as well as simpler messaging of the estimates.

Further key messages concern the need to communicate the need for, and benefits of, policy on air pollution. There was a strong feeling that communication should promote positive messages, for example in relation to the benefits of action. Even the large estimates of health impact that often appear in the press can be turned to a positive – knowing that air pollution has a substantial impact on mortality provides evidence to support actions that we know will benefit health.

The group considered it to be important to ensure that effective communication on air pollution and health is available to all. It is important to strengthen interactions and cooperation between different parts of the UN/ECE region (and worldwide), in order to ensure equitable distribution of knowledge and of reliable information; featuring health in FICAP is recommended.

Environmental justice

Environmental justice is an important aspect of the policy work on air pollution and health that requires action and improvement. Past analysis has tended to treat all people as equally at risk from air pollution and has not accounted for links between health and deprivation or considered variability in the risks faced by specific vulnerable groups such as young children or those with existing illness. Past work on impacts has focused on impacts most common in the elderly, such as death, type 2 diabetes and heart failure. More recognition needs to be given to impacts at the start of life, through pregnancy and into childhood. The effect of different policies, for example, control of emissions locally vs regionally, and the role of air quality limits compared to exposure reduction targets, needs to be evaluated in policy development.

Proper enforcement of legislation is required. Where that fails, litigation has been used successfully against governmental bodies in many areas of environment and health. There is still not enough recognition given in policy appraisal to the fact that those who are most disadvantaged are at the highest risk of harm from air pollution and other environmental risks.

Policy

More science-policy debate is needed at different levels to maximize the health benefits of action to control pollution, for example, to better understand:

- Local contributions to air pollution for local action
- Variation in vulnerability across the population linked to chronic health conditions and deprivation
- The full range of available policy levers, such as the use of pricing as a tool (e.g., Euro Vignette) and
- The policy implications of the links between air pollution and other stressors, e.g., to transport and then to climate, traffic noise, etc.

This final point highlights the importance of understanding the interactions between policies. Research has demonstrated strong co-benefits between policies to reduce air pollution and those focused on health, inequality, climate, transport and other areas. Recognizing and using these links improves the efficiency of the overall basket of measures being introduced and by doing so will enable health and ecological benefits, as reflected in the sustainable development goals, to be achieved more quickly. Inefficiency costs lives.

It was noted that policy tends to be developed on an incremental basis, considering current conditions and how they can be adjusted to bring down pollution levels. An alternative approach would be to define an alternative baseline, where at some

point in the future we want to cover air quality, climate, mobility, equality, etc., and consider what society would look like to achieve this goal. This may bring in a number of efficiency benefits, for example, building in greener infrastructure and behavioural change. It could also shift responsibility for health effects of pollution away from affected individuals.

Further action is also needed to ensure availability of policy relevant reviews/updates of the scientific work. This requires formulation and establishment of clear responsibilities in terms of planning, science reviews, etc. WHO has been identified as the appropriate body for such reviews; however, this is conditional on securing sustainable resources to support that work.

The WHO Air Quality Guidelines (AQGs) demonstrate high confidence in observations that impacts occur even at what were previously considered very low concentrations. However, it must be recognized that they do not represent thresholds for effects, and hence that benefits of reducing air pollution will continue even below the WHO AQGs. Some in the group expressed a preference for policy based on limit values rather than exposure reduction targets, as the former are easier to measure and were felt more appropriate for reducing inequalities. However, this view was not shared by all present and others considered that the two could work in harmony. Care is, however, needed in the precise design of exposure reduction targets.

Whilst it is acknowledged that further research and debate will be informative it is also necessary to recognize the human cost of delays to action. Reducing health impacts of air pollution for the current population, young and old, requires that action is taken urgently.

Conclusions and recommendations

Concentrate communication to policymakers, civil society, and the public on the findings where there is overall scientific consensus

Despite ongoing scientific developments, there are no doubts about serious health effects and no safe levels, and this overall consensus and the main effects should be emphasized rather than uncertainties about details. Clear messaging improves the possibility for decision-makers to act.

Recipients: TFH, assisted by all parties to the Air Convention, including stakeholders such as NGOs. In addition: the air pollution scientific community, all levels of governments, including local (city) governments. However, responsibility lies with all organizations endowed with communication departments, journalists, academia and NGOs etc.

Unfold the complexity in the communication of air pollution health effects and simplify the messages

Adapt and simplify key messages to different target groups and enhance credibility by explaining why academic results differ. The scientific community and stakeholders should work together on how the main message should be refined. Communication improvements should include the understanding of local or one's own contribution to poor air quality, the need for action, ways to mitigate exposure, links to environmental justice, efficiency of policy process, and personal experiences of those affected by pollution. Moreover, the availability of appealing communication tools, such as infographics, are needed to 'make the invisible killer visible'.

Recipients: All levels of government, including local (city) governments, TFH. But responsibility lies with all organizations endowed with communication departments, journalists, academia and NGOs etc.

Improve scientific rigour in the application and advancement of methods for environmental health studies and burden of disease estimations

Currently the proportion of low-quality studies and meta-analyses is high, but these methodological problems might go undetected unless thoroughly reviewed. The issue of low-quality published studies and evidence/systematic reviews needs therefore to be resolved through promoting good-quality science. The scientific community needs to promote high-quality studies and discourage publications which do not add to the weight of evidence. It is critically important to rigorously adhere to methods in designing, conducting and reporting of research and systematic reviews.

Another problem is the long-term delays in updating air pollution health data. To avoid this problem, a mechanism for rolling reviews of research on air pollution and health, and updates of health quantification methods, should be established and funded. Burden of disease estimation should also ensure usage of the most appropriate exposure-response function for that specific estimation.

Recipients: ISEE, ERS, et al. to develop guidance and communicate to editors of relevant scientific journals. WHO to lead regular reviews, with appropriate funding provided.

Fulfil Air Convention objectives

Chairs

Dominique Pritula, Environment & Climate Change Canada

Till Spranger, The Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection, Germany

Introduction

The Gothenburg Protocol Review, which compiles and evaluates the state of play of international air pollution science and policy from a UNECE perspective, is complete. Starting from the review conclusions, this session focused on which actions are needed to reduce emissions further to levels that approach the Convention's long-term objectives. Discussions included:

- how to improve or streamline the functioning of the amended Gothenburg Protocol, e.g. regarding the role and detail of technical Annexes and Guidance Documents;
- how to cooperate with neighbouring issues/policy areas such as biodiversity, nitrogen management and climate change;
- how to address that emissions outside the Convention's territorial scope increasingly affect air pollution levels in the UNECE area and vice versa, particularly with respect to methane as an ozone precursor,
- how to encourage further participation of non-parties to the Protocols,
- whether shifting from a focus on ratification to implementation could yield increased abatement measures, and
- whether and which alternative/additional instruments are needed besides the existing Protocols.

Notes and conclusions from the discussions

A. Gothenburg Protocol – where we are and where we can go

Potential future emission scenarios:

- Baseline: Current knowledge of our policy and the reduction of emissions (it was before the Ukraine war, a lot has changed since then);
- MFR: Maximum technical feasible reduction
- Low scenario: visionary scenario, it includes Climate Paris goals, technology and behavioural change

While emissions of SO₂, NO_x, PM and NMVOC have been greatly reduced in the UNECE region, the effects of air pollution are still large. There are still a lot of opportunities (technological innovation and behavioural change) to attain additional emission reductions.

Based on the questionnaire results of EECCA countries and the thematic session held at the 42nd EB, there is no one-size solution that fits all. There are other systems in place (e.g., Canada and the US, who have different sections/flexibilities in the Amended Gothenburg Protocol (AGP)) that could work for EECCA/WB/Türkiye. We need to think how we can make it easier to ratify the AGP for the parties.

B. Future role of the Gothenburg Protocol

Focus on the Balkans

North Macedonia ratified the Gothenburg Protocol; Montenegro also ratified but was not ready to commit to the reduction targets.

Drivers that facilitate its implementation include: the will to accede to the EU, Athens agreement on energy community, Paris agreement, air pollution and public awareness, foreign investments and industry, organic agriculture to reduce NH₃ (small household farms).

Internal pressures to address air pollution include: public protests have pressured a government to improve air quality; governments responded with a national strategy for air quality in different Western Balkan countries. However not all necessary measures have been implemented. Despite these developments, Western Balkan countries are still not able to ratify the AGP; they need support from other parties.

A possible staged/phased commitments approach to amending the AGP was discussed. This would allow the Protocol to be ratified and then the commitments would be built in and improved over the years.

C. Linkages and synergies with other policy areas

The long-term strategy, the AGP Review and other documents stress that fighting air pollution needs to use synergies with different policies/synergies such as climate change, energy, industrial, etc. Three synergy areas were identified as most important.

Science Policy Panel

An SPP on chemicals, waste and pollution was launched one year ago as a global scientific panel focussing on pollution. The scope, focus, workplan of the panel are still under development. Some supporters of the panel want to include air pollution

as an explicit focus, while some countries don't want to share data on air pollution. The Air Convention has generated scientific data, and has successfully combined policy and science. But this panel has the opportunity to provide data on air pollution on a global scale, and address gaps in connecting with biodiversity and climate change. The SSP can help increase awareness, political will, and can provide additional opportunities for scientific data of the Convention to be shared more broadly. It also creates the opportunity to increase the understanding of financial support and global assessment of air pollution which could stimulate control measures outside the Convention.

EU Net-zero Strategy

The 2021 European Green Deal contains a number of pillars and targets. It is a concrete roadmap containing a zero-pollution ambition for a toxic-free environment. It covers a number of broad areas (air, water, soil) with the intent to reduce pollutants affecting these areas to a level no longer considered harmful for health and ecosystems. Within the Zero Pollution Action Plan there are specific sections and targets related to air pollution. The plan will improve communication and awareness raising. One example of successful interaction between policies is the potential effect of animal welfare improvements on the reduction of animal stock and therefore ammonia emission reductions.

Lessons learned: quantified targets help successful policy outcomes and a lot of groundwork and time is required in order to engage communities outside the Air Convention.

Methane

Methane is a valuable gas for energy production, but also a potent greenhouse gas which remains in the atmosphere for up to ten years. Cost-effective measures should be taken to reduce its use. While needs of global methane emissions are dealt with in other sessions, the purpose of the discussion in this session is to determine what the Convention can do to reduce emissions.

The Convention has drafted guidance documents (sources, reduction techniques, and future developments) on how to reduce methane emissions. These documents are planned to be adopted to at the EB in December 2023. There is a lot of work globally to address methane, but there are no binding commitments. Voluntary examples (such as the methane pledge) might not be enough, despite information on BAT being readily available. This is why methane should be part of the Protocol. We need to take the next step and make sure there are binding commitments to ensure future reductions.

Even if this Convention takes action, the question remains: how will we tackle methane emissions in non-UNECE regions. Key discussion points raised:

- We can only commit our own countries; we can promote and encourage countries in non-UNECE regions. For future negotiations we need to do our homework first to be credible when communicating with other countries.
- There is a lack of domestic authority to implement necessary measures to achieve a reduction of methane (e.g. in agriculture).
- Where agriculture causes a large share of GHG emissions, strict domestic measures would move the production to other countries, which might not have up-to-date reduction technologies. It is important to tackle the problem of methane together.

D. Options to achieve long-term objectives of the Convention

Several options were discussed.

Maintain status quo: focus on commitments of 2020 and beyond, and increase ratification. We will lose the momentum of the convention. This is not in line with the recommendation of the review report.

Develop options over time: talk more about the options. This will slow down the momentum that we build, the conclusions will become less visible and relevant with time, which might cause further delay.

Launch revisions: address technical annexes and their importance and function. This will take several years of negotiations. This keeps the momentum, it is in line with the review report, it is decisive, commitment to improve air quality, explore different options and could even explore options to go beyond the protocol.

Transform nitrogen waste into nitro-resource and flourishing ecosystems

Chairs

Filip Moldan, IVL Swedish Environmental Research Institute

Mark Sutton, UK Centre for Ecology & Hydrology

Introduction

Nitrogen compounds contribute substantially to air pollution, including impacts on both ecosystems and human health. This session discussed the latest evidence on the multiplicity of nitrogen effects and how a systems-approach focusing on reducing expensive wasted nitrogen resources could help accelerate action. The discussion focussed on air pollution control priorities while considering the context of nitrogen co-benefits for climate change, biodiversity loss, water quality and circular economy development. One of the key messages emerging is that action on nitrogen offers win-wins across all of these policy areas.

The most important development of the current legislation is the Gothenburg Protocol Review which has been completed by the end of 2022 ([link](#)), together with the Colombo Declaration ([link](#)) with two accompanying UNEP resolutions ([UNEP/EA.4/Res.14](#) and [UNEP/EA.5/Res.2](#)). The latter resolution gives attention to the need for National Nitrogen Action plans. These activities have also helped prepare the way for the Kunming-Montreal Global Biodiversity Framework (GBF) adopted by the UN CBD which in Target 7 aims at "reducing excess nutrients lost to the environment by at least half including through more efficient nutrient cycling" by the year 2030 ([link](#)) (Official doc: CBD/COP/DEC/15/4 (new link <https://www.cbd.int/decisions/cop/?m=cop-15>)).

Questions raised in the working group discussion included:

- Is the N pollution decreasing as fast as we have expected and is there an adverse "alkaline air" effect on vegetation? What are our best arguments that N pollution must be reduced?
- What are the links between (or conflicts) with respect to goals (e.g. 2030) of the policies aiming at air pollution, climate, and biodiversity protection (c.f. Introduction)? To what extent is the ambition of these processes harmonized?
- How do we achieve maximum and fastest progress? What are the tools (Such as N-budgets, NUE, N-footprint etc.) best suited to achieve the change?

- What are the most likely drivers of change? How much is the recent tripling of nitrogen price accelerating investment in circular technologies to recover nitrogen in agriculture, wastewater and the wider food system?
- How will population growth, changes in dietary preferences, future mobility and energy production affect nitrogen pollution? Which emerging technologies could lead to an increase in ammonia emissions and therefore need to be focused on?

Conclusions and recommendations

Develop and apply nitrogen reuse policies within the agricultural/food sector

Regulatory barriers need to be assessed, so as to enable circular use of reactive nitrogen, so that organic residues can be used to produce N fertilizer and other N products. This is here termed 'white nitrogen', including 'white ammonia', to distinguish from currently developing narratives for brown (using fossil fuels), blue (using fossil fuels but fitted with carbon capture and storage techniques), and green Ammonia (using renewably produced electricity and water), all of which refer to new reactive nitrogen production. The proposed EU RENURE (REcycle N from manuRE) agreement to allow N recovered from organic residues to be classified as inorganic N in relation to the nitrates directive provides an opportunity to enable wider use of emerging technologies.

The tripling of fertilizer prices in 2021–2022 is motivating the case for investing in N recovery and reuse technologies, which however are often capital-intensive. To stimulate recovery of the EUR 60 billion/year wasted N resource in the EU (at 2022 prices of EUR3/kg N) there is a need for investment in green financing for N recovery options ('Nitro-Finance').

Recipient: Air Convention EB, TFRN and TFIAM, EU, World Bank

Assess environmental risks and consequences for increased nitrogen emissions if ammonia is used as an energy carrier

The emergence of NH₃ as a future fuel and energy carrier provides major risks for new sources of NH₃, NO_x and N₂O pollution. There is a need for UNECE parties, EU member states and the IMO to cooperate in assessing the risks and opportunities associated with this development and in furthering the development of solutions.

While the increases in NH₃ concentrations across Europe are consistent with reducing SO₂ and NO_x emissions, the measured concentrations of SO_x and NO_y have not decreased as fast as implied by the emission inventories. There is a need for the TFEIP, EMEP and others to assess whether there are discrepancies in the reported data. There is also a need to strengthen key indicators of damage to terrestrial biodiversity across the UNECE region to set critical loads and levels for N deposition and NH₃ concentrations.

Recipients: UNECE, EU, IMO, Air Convention EMEP, TFHTAP and TFRN

Integrate changes in production and consumption of agricultural products, and in bioenergy use into future scenarios and negotiation support to the Air Convention

Among the options, the most appealing strategies to achieve the 50 per cent reduction in N waste (losses) by 2030 include a combination of technical actions in agriculture, change to dietary patterns to reduce meat and dairy intake (and overall protein) combined with food waste reduction. Correspondingly, such scenarios should be presented to decision-makers during forthcoming negotiations.

Recipients: Air Convention MSC-West, TFMM, CIAM, TFRN and parties to the Air Convention

Collect more detailed farm-level data on land use, economy, and emissions to overcome barriers to the implementation of known measures for agriculture

Recipients: Air Convention EB, TFEIP and TFIAM

Promote a change in the EU Industrial Emissions Directive so that the livestock unit threshold for reporting/action on ammonia emissions is maximum 100 LSU

High-density NH₃ monitoring needs to be a requirement for future UNECE and EU agreements. Addressing the NH₃ in the monitoring systems in the air quality regulations is urgently needed in light of NH₃ being one of the primary threats to biodiversity. There is an urgent need to map the exceedance of the NH₃ critical level across the UNECE region especially given the high sensitivity of vegetation to NH₃ and the currently increasing NH₃ concentrations as a result of reduced SO₂ and NO_x emissions.

Earlier LSU limits focused on pigs and poultry whilst excluding cattle. The higher the LSU limit value, the larger the amount of ammonia emissions that will remain outside the Industrial Emissions Directive.

Recipients: Air Convention EB, EU member states

Ensure that European CAP includes cross-compliance with the EU Habitat Directive with respect to nitrogen air pollution impacts.

There is an opportunity for EU civil society to challenge governments on the grounds of exceedance of critical loads and critical levels of nitrogen at Natura 2000 sites, as has been done in the Netherlands where it was supported by the decision of the European Court of Justice.

Credit should be given where voluntary programmes have achieved significant progress in reducing N pollution. Action is needed by public agencies to ensure that achievements are documented and made publicly available.

There is a need for public environmental agencies to monitor and enforce implementation and use of the measures to reduce N emissions at a farm level. Self-declaration was concluded to be often insufficient.

Recipients: EU member states

Strengthen research to quantify impacts of NH₃ and NO₂ on sensitive vegetation in the context of reducing SO₂ concentrations, to allow revision of critical levels and to improve understanding of the adverse impacts of 'alkaline air'

Increasing ammonia concentrations in ambient air across Europe, emission reductions of nitrogen oxides, as well as increased pressure on biodiversity motivate further action on measures to reduce ammonia emissions and the development and disaggregation of key indicators to support the Air Convention objectives. An 'alkaline air' effect of gaseous NH₃ may explain why this is more damaging to sensitive vegetation than wet-deposited ammonium or nitrate and may explain the fast recovery following NH₃ abatement.

There is a need to further quantify the alkaline air impacts of ammonia on sensitive vegetation relative to the nutrient nitrogen effects of ammonia. Over the past 20 years, parties have failed to invest sufficiently in research into NO₂ effects on vegetation. Until further research is conducted, limited earlier evidence suggests that the current NO₂ critical level is not sufficiently precautionary to protect the most sensitive vegetation.

Recipients: Air Convention EB and parties to the Air Convention

High-density NH₃ monitoring needs to be a requirement for future UNECE and EU agreements

Establishing comprehensive NH₃ measurements in the monitoring systems in the air quality regulations is urgently needed in light of NH₃ being one of the primary threats to biodiversity. The need is for monthly values (for trend assessment) at multiple sites, given the high degree of spatial variability.

Recipients: Air Convention EB, Parties to the Air Convention, EMEP

There is an urgent need to map the exceedance of the NH₃ critical level across the UNECE region

This is necessary because of the high sensitivity of vegetation to NH₃ and the currently increasing NH₃ concentrations as a result of reduced SO₂ and NO_x emissions.

While the increases in NH₃ concentrations across Europe are consistent with reducing SO₂ and NO_x emissions, the measured concentrations of SO_x and NO_y have not decreased as fast as implied by the emission inventories. There is a need for TFEIP EMEP and other to assess whether there are discrepancies in the reported data. There is also a need to strengthen key indicators of damage to terrestrial biodiversity across the UNECE region.

Recipients: Air Convention WGE, CCE

Integrate policies and research on air pollution, climate change and biodiversity

Chairs

Jesper Bak, Aarhus University, Denmark

Tim Butler, Institute for Advanced Sustainability Studies, Germany

Isaura Rabago, Research Centre for Energy, Environment and Technology, Spain

Introduction

Climate change, air pollution and threats to biodiversity are not separate problems but are rather linked through cause and effect at many levels. Similarly, policy solutions for tackling these problems must also be linked, taking account of the myriad interactions between these domains in both human and natural systems. Over the next decade, the mitigation of near-term climate warming will require substantial reductions in methane, a powerful short-lived greenhouse gas which is also an ozone precursor. Methane contributes significantly to ground-level ozone and its associated impacts on human health, ecosystems and reduced crop yields. Black carbon, a form of particulate matter which is emitted from combustion also has a warming effect, especially in the Arctic. Over 100 countries representing about half of global anthropogenic emissions have pledged to reduce global methane emissions by 30% between 2020 and 2030. The measures required to achieve this reduction are well-known and cost-effective, but methane concentrations in the atmosphere continue to rise, and are projected to continue to rise with current legislation. Projections indicate that methane emissions from livestock will remain difficult to mitigate. As well as being a substantial methane emitter, the livestock sector is also a large source of ammonia, a precursor to secondary particulate matter (with well-known and considerable effects on health), and a major driver of lost biodiversity through eutrophication. Rising global demand for cheap meat fuels climate change, air pollution, and the destruction of ecosystems; however, efforts to tackle emissions from livestock have met with powerful resistance from the agricultural lobby. Navigating the demands of farmers and consumers while preserving ecosystems, reducing air pollution, and mitigating near-term climate change is one of the major challenges facing environmental policymakers today.

Conclusions and recommendations

Links between air pollution and climate change

In the spirit of the multi-pollutant, multi-effect approach of the Gothenburg Protocol, the effects of air pollution mitigation on climate forcing should be considered during health and ecosystem impact assessments, and in the development of emission mitigation policies

Air pollution controls in the past decades have been focused primarily on the need to reduce acidification and protect human health. Progress towards achievement of these objectives has resulted in large reductions in emissions of SO₂. The corresponding decrease in the atmospheric loading of sulphate aerosol and its associated cooling effect has resulted in more warming of the climate system than would have occurred without air pollution control. Current levels of anthropogenic sulphate aerosol are still responsible for a significant amount of cooling, which partially offsets the warming due to the elevated level of CO₂ from human activities. Protection of ecosystems and human health calls for further reductions in SO₂ emissions, which will further reduce this cooling effect, leading to additional warming and its associated impacts on health and biodiversity. Clean air objectives can also be reached through reduced emissions of black carbon and methane (an ozone precursor), which have so far not been reduced by nearly as much as SO₂ emissions. Since both methane and black carbon lead to warming, reduced emissions will lead to cooling of the climate, minimizing the trade-off between air pollution and climate targets.

Recipient: Air Convention EB

The Air Convention should support the current UNFCCC process for development of guidelines for SLCF inventories

Effective policies for the reduction of SLCFs require good emission inventories. Presently the inventories used in the IPCC projections and in the CLRTAP are deviating, in some cases by quite large amounts. The UNFCCC has started a process for the development of guidelines to produce national SLCF inventories. There is significant expertise and experience in CLRTAP in the production of air pollutant inventories which could help to inform this process. CLRTAP would itself also directly benefit from improved air pollutant emissions for non-UNECE countries, through the use of these inventories in the modelling of hemispheric transport of air pollution and subsequent improved understanding of the impacts of non-UNECE sources on air pollution in the UNECE.

Recipient: Air Convention EMEP

The Air Convention and UNFCCC should author a special report on the links between climate change and air pollution in the AR7 cycle

The links between climate change and air pollution could be presented more prominently than they are in the IPCC sixth assessment report. Whereas in the Summary for Policymakers from Working Group 1 of AR5, the radiative forcing of emitted compounds is shown in terms of the resulting atmospheric drivers, in AR6 these links between emissions and drivers are not shown so clearly in the WG1 Summary for Policymakers. This makes it more difficult to communicate the value and effectiveness of targeted reductions in air pollutants which also warm the climate. Also, it is indicated that there is low confidence in the direction of change for the impacts of climate change on air pollution in Europe (IPCC AR6, Chap 12, Table 12.7), creating an impression that these impacts are not well known. However elsewhere in AR6 it is in fact quite well documented that a 'climate penalty' is linked to ozone in Europe during heatwaves (as also highlighted in IPCC AR6, Chap 6), while admittedly more uncertainties remain with regards to the effect on PM. Also, the benefits for air pollution vary considerably between different net-zero scenarios. A special report would help to raise awareness of air pollution as both a driver and an impact of climate change.

Recipient: Air Convention EMEP and WGE

Impacts of air pollution and climate change on biodiversity

Prioritize the protection and maintenance of nature types and areas in good condition over restoration after damage has occurred

Restoration of damaged ecosystems is not always possible. 'Rewilding' does not necessarily lead to the return of biodiversity equivalent to pre-damage levels. Measures to restore damaged ecosystems are often extremely expensive and there can be long time delays between initiation of restoration efforts and observations of positive impacts. Monitoring, modelling and mapping tools are available within the Air Convention to understand which emission sources are especially important for ecosystems at risk, and these sources should be prioritized for mitigation measures.

Recipients: Air Convention EMEP and WGE

Widen the range of indicators to show the impacts of air pollution on vegetation (crops and ecosystems)

- Contribution of methane to ozone impacts
- Contribution of ozone deposition to nitrogen use efficiency
- Influence of N and O₃ load on C sequestration and biodiversity

The level of knowledge of the detrimental effects of air pollution on biodiversity is already sufficient to justify emissions mitigation. Nevertheless, some knowledge gaps do remain in both the range of species tested and in the responses that could

directly and indirectly lead to changes in ecosystem composition and functioning. A better quantification of the contribution of methane to the ozone damage to vegetation would strengthen arguments for methane emissions mitigation. A better understanding of the effects of ozone damage on reductions in nitrogen use efficiency would similarly strengthen arguments for additional mitigation of ozone precursors including methane and is especially timely given recent rises in the price of fertilizer. A better understanding of the effects of eutrophication and ozone deposition on carbon sequestration by ecosystems would help to inform estimates of the effectiveness of the large-scale reforestation and BECCS projects which are required to meet ambitious climate targets.

Recipient: Air Convention WGE

Mitigation of methane emissions

Recommend that parties adopt and contribute to implementation of the Global Methane Pledge and recommend best available technology and best practices by sector

Many parties have already signed on to the GMP. The voluntary mitigation targets included in the GMP are based on well understood measures, can be differentiated per country and region based on mitigation potential, and can be implemented in a stepwise manner. Implementation of the voluntary GMP forms a basis for more ambitious and legally binding mitigation efforts.

Recipient: Air Convention WGSR

Consider revisions to the GP that include binding methane targets and increased ambition on ammonia

Cost-effective technical measures for mitigating methane emissions from the fossil fuel sector have been known for at least 15 years. Many fossil fuel companies have joined OGMP 2.0 and voluntarily committed to improve monitoring, reporting and control of methane emissions within this framework. Unfortunately, there has been very little progress on reducing emissions to date. By enshrining the emission reductions available through these measures in legally binding instruments such as the Gothenburg Protocol, rapid progress on the implementation of these measures can be expected.

Mitigation of methane emissions from the agricultural sector is more difficult. Technical measures tend to be less cost effective than those available for other sectors. Some degree of structural or behavioural change may be required for mitigation of agricultural methane. Almost all agricultural methane in the UNECE region is due to livestock, specifically beef and dairy cattle, which also emit significant amounts of ammonia. While mitigation of ammonia emissions is worthwhile in its own right, any legally binding measures targeted at reducing methane from the agriculture sector should also be accompanied by increased ambition for mitigation of ammonia to avoid any potential trade-offs.

Recipient: Air Convention WGSR

Methane mitigation outside of the UNECE region

Mobilize resources, including financial resources, to FICAP to support knowledge transfer

The UNECE region is responsible for a relatively small share of global methane emissions. To minimize the impacts of ozone within the UNECE region, methane mitigation efforts must include regions outside the UNECE, where there is a significant mitigation potential. CLRTAP can help other regions to mitigate their methane emissions through knowledge transfer. The mitigation of methane emissions from the waste sector in particular is an area in which CLRTAP can help.

Different parts of the world have different cultures of communication and cooperation. Knowledge transfer is rarely a simple process of providing information, rather it requires an iterative process aimed at developing a common understanding. This process takes time and requires resources to ensure that the process is sustained. FICAP has the potential to be an effective vehicle for this kind of knowledge transfer. CLRTAP should ensure that FICAP has the resources required for this activity. Mitigation of non-UNECE methane emissions through knowledge transfer through FICAP may potentially be more cost effective for parties than direct mitigation of methane emissions within the UNECE.

Recipients: Air Convention EB, FICAP

Methane mitigation from the UNECE agricultural sector

Communicate to stakeholders inside and outside CLRTAP that the future development of agricultural policy is of central importance for achieving air pollution, climate change and biodiversity objectives

Participants in the session were less able to achieve consensus on how methane and ammonia emissions from the agriculture sector in the UNECE should be mitigated. Opinions were broadly split between two opposing visions for the future of the sector. On the one hand, there is significant (if expensive) technical potential for simultaneous mitigation of methane and ammonia through increased centralization and intensification of cattle farming. On the other hand, there is the possibility of a more fundamental transformation of the food system away from industrial livestock farming towards an emphasis on smaller farms as environmental stewards and a return to older traditional farming methods and regenerative agriculture. Mitigation of methane and ammonia under the second scenario is simply achieved by a large reduction in livestock numbers. This necessitates fundamental change in diets towards plant-based alternatives or perhaps an emerging technology such as cellular agriculture. There are also land-use issues where land is needed for forestation and biofuels, reclamation of peatland, and other climate measures.

Discussions on the preferred method for organizing food production and reforming agriculture are significantly beyond the scope of CLRTAP. However, CLRTAP has a

role to play in highlighting the importance of the agriculture sector, in particular livestock, as an emission source with a significant impact on air pollution, climate change and biodiversity.

Recipient: Air Convention EB

Lobby to set the LSU threshold under the EU IED for agricultural emissions to 100 LSU at most

While a potential transformation of the agricultural sector would potentially take decades to design and implement, there are known measures available now which can reduce methane and ammonia emissions from larger industrial livestock farms. To the extent that such industrial farms exist, their emissions should be regulated under the EU Industrial Emissions Directive. In the recent review of the IED, the European agriculture lobby successfully argued that the threshold for classifying a livestock farm as an industrial facility should be set at 350 LSU (livestock units). Setting this threshold to no more than 100 LSU for intensive farms would cover significantly more facilities and yield correspondingly larger reductions in emissions of methane and ammonia.

Recipient: Parties to the Air Convention

Encourage the collection of more detailed farm-level data including land use data, economic data and emissions data

There is enough data and information about the European agriculture sector available in aggregate to address methane emissions from large farms with >100 LSU through legally binding policies. However, access to detailed farm-level data is often difficult, making it hard to counter the arguments of the agricultural lobby. Better collection of data from all types of farms will help to learn about the specific challenges of different groups of farmers, to overcome barriers to the implementation of known measures for agriculture, and to enable development and use of novel policy and governance structures that are flexible enough to reflect the wide heterogeneity in individual farmers' conditions. The collection of farm-level data does not have to cover all farms in Europe; it is sufficient to collect enough farm-level data to identify a typology for groups of farms facing similar challenges that can be targeted with tailor-made policy solutions.

Recipient: Air Convention WGSR and TFIAM

Consider expanding the mandate of the TFRN to include agricultural methane emissions

If agricultural methane emissions are to receive more attention under CLRTAP, the convention could consider expanding the mandate of the TFRN to include these emissions since they are so closely related to the ammonia emissions from this sector. Taking a sector-based approach to agricultural emissions mitigation will avoid splitting the work on this sector into different organisational 'silos'.

Recipients: Air Convention WGSR and TFRN

Accomplish significant air quality improvements through international cooperation

Chairs

Beatriz Cardenas, World Resource Institute

Kimber Scavo, United States State Department

Young Sunwoo, Konkuk University, South Korea

Introduction

Air pollution does not stop at national borders and can impact regions in different ways. Key to ensuring clean air globally is to leverage the expertise in existing international bodies that address air pollution, and to provide a framework for these bodies, countries, and other international organizations to share information, address airsheds that cross administrative boundaries, improve science and technical cooperation, and support countries in taking action to improve air quality.

The goal of this session was to discuss the best approach for international cooperation that will achieve the greatest air quality benefit. The session focused on technical capacity, gaps in achieving air quality improvement, sector-based approaches, regional air quality frameworks, and the key issues facing cities and countries.

Notes from the discussions

The group identified potential gaps countries have experienced, what specific projects would be helpful and what areas lack resources. There was an emphasis on infrastructure for integrated air pollution and climate change policies throughout the session.

Gaps and needs in air quality management

Needs and technical gaps in capacity need to be identified by countries and organizations working bilaterally with countries so that international organizations and existing global and regional cooperation bodies can help facilitate capacity-building in these areas.

Sector-specific solutions and best practice in local initiatives

Tackling air pollution to protect health and the environment also requires coordinated policy action across different sectors. There are best practices and guidance documents available that address reducing emissions from sectors such as residential fuel burning, transportation, energy, agriculture, and other industrial sources. A cooperation network is needed to help facilitate progress in reducing

emissions of multiple pollutants in key sectors to improve public health, protect our ecosystems and increase quality of life.

Regional Initiatives and helping countries help their neighbours

With renewed global attention on the importance of tackling air pollution, existing international organizations addressing air pollution could come together regionally to help build more successful international cooperation on air quality around the world and to support and promote initiatives for continued action on air quality. Key to ensuring clean air globally is to leverage the expertise in existing regional bodies that take a regional cooperation approach to dealing with air pollution. A combination of both bottom-up and top-down approaches were discussed and deemed necessary, as well as a focus on integrated solutions that address air pollution, climate change and biodiversity.

Conclusions including needs and gaps

- Emission reductions and tailor-made solutions to the various air pollution problems are needed. Countries still require support for implementation. Regional webinars on specific issues would be helpful.
- Basic air quality management strategies are still needed in some countries. Action must be informed by methodology, and enforcement of policies is needed. There are technical gaps in air quality regulations and legislation. Some countries need emissions testing of mobile sources, monitoring equipment and support including a long-term monitoring strategy, regulation efficiency and in-house emission inventory support.
- Regional cooperation is required, to help harmonize policies for imported vehicles.
- The global knowledge platform online hub (with solution section and link with the pollution dashboard – envisioned in UNEA 3/8 resolution) must be created.
- An extremely helpful network would be for cooperation on sectoral approaches in energy production, waste, agricultural burning, methane emissions, cooking and heating, transportation and wildfires.
- Waste management was identified as needing a public-private partnership.
- Funding and resources are required in general and for communities to do innovative projects (e.g. fermenting invasive species to make bioethanol which is then used for cooking).
- There should be incentives for transition to renewable energy, as part of an air quality management strategy.
- The air pollution community must continue to work on overcoming the language barrier by stressing communication, translation and interpretation.
- Local, national and regional cooperation and expertise are needed especially

on-the-ground expertise in cities. PM-10, VOCs and hazardous air pollutants have not been resolved in many cities.

- These requirements have substantial regional differences that must be recognized, considered and applied. Therefore, cooperation where there are similar issues within regions is needed in an established cooperation framework, network and/or platform.

Additional recommendations

Set up a convener to mobilize action for air quality at the regional level

Recipients: Air Convention FICAP, UNEP, CCAC

Streamline online resources including air quality guidance documents, tools and knowledge from the scientific community

This must be done after user needs have been identified. Also, materials must be translated into other languages.

Recipients: Air Convention FICAP, CCAC, UNEP

Develop methodologies or frameworks for better regional cooperation and understanding within regions with similar issues, synergizing existing efforts and avoiding duplication

Address sectoral approaches and best practices, integrating co-benefits with climate change when applicable (e.g., transition to renewable energy while also retrofitting when necessary). Set up periodic webinars and/or meetings based on specific themes and utilize other international and regional organizations and existing conferences.

Recipients: UNECE, UNEP, Air Convention FICAP, other international organisations

Package easy-to-understand, positive messaging, or campaign that air quality has improved but additional progress is possible and must be achieved

Develop ways to provide better communication and the right narrative to the general public. Engage the younger generation, journalists, medical specialists, NGOs and the private sector, and use events such as International Day for Clean Air.

Recipients: UNEP, CCAC, WHO, Air Convention FICAP, international organizations

Mobilize funding for bottom-up initiatives, including city-driven efforts and small investments needed for specific projects

Build a coalition of the willing to fund specific work on air pollution.

Recipients: Air Convention FICAP, CCAC

Identify champions at the local and national levels, to provide expertise for global south-to-south and north-to-south capacity-building and exchange of experience

Recipients: Air Convention FICAP, CCAC, countries, international organizations

Report from the early career workshop

The early career workshop gathered 16 early career air pollution scientists and policymakers. For two days, the participants learned more about the history and context of the Air Convention and negotiated a way to find an agreement for how to reduce pollution over selected European countries by 35%. The negotiation workshop is based on the same decision-support material that was used during the negotiations of the first Gothenburg Protocol, and was developed by Markus Amann and Rob Maas. The organizers thank them both for the opportunity to re-use their workshop material. After the workshop, the participants could draw a couple of conclusions of relevance for negotiations of transboundary pollution agreements.

First of all, the participants recognized that 'thinking outside the box' is key to finding solutions that can unlock fixed positions amongst negotiators. Second, it was recognized that the typical setup of a negotiation room hampers effective negotiations, at least for the early parts of the negotiations. To more easily see each other during negotiations probably makes it easier to find ways forward. Third, it is important that negotiators remember the final and common objective of the negotiations. One should not get lost in detailed numbers. Fourth and lastly, it is important to clarify when additional help or input is needed to bring the negotiations forward. Available expertise should be used as much as possible, and tasks can be delegated amongst negotiators to more quickly bring negotiations to a conclusion.

Report from FICAP

Meeting

The inaugural Forum for International Cooperation on Air Pollution (FICAP) was held in Gothenburg, Sweden on 16 March 2023. FICAP, co-chaired by the UK and Sweden, brought together 178 air quality experts to collaborate on the reduction of air pollution through common policy solutions.

The meeting was comprised of two panel-led sessions, with hybrid audience participation both online and in person. FICAP followed on from the 7th annual Saltsjöbaden International Science-Policy Workshop, part of the official meeting programme of the Swedish EU Presidency.

Opening remarks

The Forum was formally opened by the United Kingdom Minister for Environmental Quality and Resilience, Rebecca Pow. In her opening speech, Minister Pow urged a multi-sectoral, multi-generational approach reaching across national borders, in order to fully address the global impact of pollution.

Session 1: Pathways to air pollution action in a regional context

Panellists:

- Peringe Grennfelt, Swedish Environmental Research Institute (IVL)
- Laurence Rouil, Chair of the Steering Body of the European Monitoring and Evaluation Programme (EMEP)
- Isaura Rabago, Chair of the Working Group on Effects (WGE)
- Sangmin Nam, Economic and Social Commission for Asia and the Pacific (ESCAP)
- Beatriz Cárdenas, World Resource Institute (WRI), Latin America
- George Mwaniki, World Resource Institute (WRI), Africa
- Markus Amann, Consultant for the World Bank, formerly at the International Institute for Applied Systems Analysis, (IIASA)

This session mapped the key steps and building blocks for establishing regional cooperation on air pollution, shared lessons learned, and discussed what kind of cooperation may be most useful in different regions.

The first three panellists, using the UNECE air convention as an example, pointed to the importance of transparency and close cooperation between scientists and policymakers as key success factors for the formation and development of the air convention in the UNECE region. Science is used to alert policymakers of the situation, supports implementation of measures, and monitors the success of measures. However, science is not part of the policy decision-making process. Bridging concepts like 'critical loads' and 'integrated assessment modelling' have been important tools for the effect-based approach of the air convention. To have the science network within the convention was deemed particularly important.

The panel also discussed similarities and differences with initiatives in other regions and focused on the key subjects for regions to cooperate on.

A more decentralized approach was taken for the Asia-Pacific region (UNESCAP) than for the UNECE region, under the 2022 Regional Air Pollution Action Plan. The need to act now is strongly felt. The science-policy linkage was noted as very important, and cooperation to strengthen this link is required.

In Latin America, focus is on health effects in cities and megacities, and what solutions could come from collective engagement. Shortening the path from the initial science evidence to policy action is a priority, in addition to building a strong cohesive narrative to influence non-experts, the public and decision-makers.

For Africa, cooperation on using research not only as a dataset but also as a means for capacity building was highlighted, along with ways of encouraging African nations to continue progress at a reasonable pace using in particular trade and supply chains to phase out high-polluting practises. Also, the possibility of 'leapfrogging' transitional arrangements of other regions, and using newer technological developments for finding solutions was highlighted as a benefit.

Panellists also shared recent practical experiences of air pollution management and possibilities for the work of the Forum. For most countries and communities, self-interest to treat local issues is often paramount. However, harnessing collective energy has the economies of scale to help all communities to achieve better air quality. Long-range aspects of air pollution should be better communicated to help encourage higher ambition and use of multilateral governance to achieve win-win outcomes.

It was highlighted that using the experience of the UNECE region and the domestic legislative and governance architecture of air quality management of certain countries can be useful for other regions to investigate and utilise already existing methods for their own development. This was highlighted as something the Forum could facilitate between the UNECE region and other regions. Particular attention

could be given to the levels of government involved in decision-making on air pollution management and how local, regional, long-range and international pollution can be managed effectively.

Side event: Emissions Inventories and Air Quality Management Report

Presenters:

- Chris Dore, Task Force on Emission Inventories and Projections (TFEIP)
- Carolin Sanz Noriega, UNECE Air Convention Secretariat
- Tom Grylls, Clean Air Fund (CAF)
- Soraya Smaoun, United Nations Environment Programme (UNEP)

The Forum heard from the UNECE secretariat and TFEIP on the newly launched UNECE Inventory E-Learning Course and the role of emission inventories in supporting international cooperation on air pollution. The e-learning course can be completed here: <https://unccelearn.org/course/view.php?id=166&page=overview>.

CAF and UNEP presented the key findings from their joint 'Strengthening Air Quality Guidance Management' report, which can be viewed here: <https://www.cleanairfund.org/resource/strengthening-air-quality-management-guidance/>

UNEP and CAF are eager to collaborate on implementing the recommendations from this report, which include enhancing coordination and online curation of guidance materials. They warmly invite interested parties to actively engage and reach out for collective action.

Session 2: 'No-regret' actions for improving air quality

Panellists:

- Valerie Hickey, Director, World Bank
- Pam Pearson, International Cryosphere Climate Initiative (ICCI)
- Zbigniew Klimont, Institute for Applied Systems Analysis (IIASA)
- Aleksander Macura, RES foundation
- Bill Parish, Deputy Director, UK Government
- Alice Kaudia, Climate and Clean Air Coalition, Africa
- Noe Megrelishvili, Vice chair of the Executive Body to the Air Convention, Georgia

Panellists were tasked with the hypothetical question: "From a developing country perspective, what would you push a fictitious decision-maker to do, to solve air pollution issues?" Firstly, the panel spoke from the IG/NGO perspective, where the World Bank, ICCI and IIASA discussed the measures that should be prioritized and financed worldwide. With regards to funding, it was agreed that any measures must be sustainable for countries to manage in the long term, and not isolated to individual projects.

Key priorities discussed included agricultural waste-burning mitigation, the second-hand car market in developing countries, the power sector and trade-offs when moving away from fossil fuels, cleaner domestic cooking fuels, nitrogen challenges, and improvements in waste management.

Panellists also referenced the Climate and Clean Air Conference in May 2023 (Bangkok) which will include the launch of the "Clean Air and Climate Solutions for ASEAN" study promoting a bundle of 15 'priority measures' across sectors which could be described as no-regret and are also applicable to regions beyond ASEAN. Details on the conference can be found here:

<https://www.unep.org/events/conference/climate-and-clean-air-conference-2023>

Secondly, the panel spoke from a regional perspective to assess what is achievable at a local level, and the relative associated trade-offs. Perspectives were shared from Serbia (West Balkans), the UK (Western Europe), Kenya (Sub Saharan Africa) and Georgia (The Caucasus).

Across the West Balkans, the issue of residential burning was highlighted, and the panel suggested possible measures such as prohibiting residential use of certain heaters and stoves. In this instance, the need for effective public communication and join-up with an international partner were noted. From the Western Europe perspective, panellists spoke of the similar importance of moving towards behavioural changes for the next level of measures. E.g. tackling food waste, livestock farming intensity, dietary changes, agricultural land management and green energy implementation. Also noted was the challenge of making climate change, sustainable development, and air pollution aims work together, and better understanding the co-benefits and trade-offs.

From the African perspective, the CCAC Africa Integrated Assessment was referenced, which identified certain ways to 'leapfrog' development trajectories in relation to air pollution. However, it was noted that solutions are needed quickly to keep up with current levels of urbanization. It was noted that the experiences of other developing countries are useful to help reduce the acceleration of air pollution related issues.

Across the Caucasus region, the significance of the Batumi Action for Cleaner Air (BACA), an instrument where governments can make voluntary commitments, was highlighted. It was recognized to have provided a positive pressure to act also through public/NGO/active citizen participation. Further, it was recommended that

action should be strengthened through improvements in data and monitoring to show progress to date, and to compare this with alternative no-action scenario modelling.

Conclusions and next steps

Discussions at the Forum showed a clear wish and ambition from different regions to increase cooperation on air pollution management. This is reflected in recent actions taken in many regions. However more can be done to make sure regions do not need to reinvent processes, and knowledge can be pooled to help all regions make further progress.

Communication was identified as an area that needs improving, so that the long-range aspects of air pollution, both within a country and across regions, are understood and that governance is organized at the right levels to effectively tackle locally generated air pollution and to cooperate more broadly on its impacts and effects.

Forum participants cite the plethora of forthcoming actions and publications which will form a blueprint of the measures that hold co-benefits with climate change mitigation, can be financed potentially through development organizations, and are widely deployable across regions. Technology and technical skills made available for countries to share, and a platform for mutual learning is desirable for all regions to utilize and benefit from.

In addition, the meeting showed that a multitude of actors, organizations and communities have identified air pollution as a key priority area. Many organizations support initiatives and are taking global responsibility in different areas. There is a high degree of energy between countries, communities and organizations to facilitate action on air pollution. They recognize the role of effective air quality management in improving human health, mitigating climate change, and reducing and reversing biodiversity loss.

Because the Forum sits under the UNECE Convention on Long-Range Transboundary Air Pollution (Air Convention), the Forum is well positioned to support and contribute to ongoing efforts, bringing the knowledge, experience, and technical assistance of the 44 years' experience of the Convention to the wider global community through these existing initiatives, rather than duplicating them. As well as through bespoke work with countries and regions if requested.

Drawing on the conclusions from the Forum, co-chairs have agreed a programme of next steps to include:

- In cooperation with the UNECE Air Convention secretariat and Convention Task Force chairs, list topics where the Air Convention has experiences to share through the Forum, and list relevant experts for the different areas.

This can be a basis for conducting targeted regional webinars where there is mutual interest.

- Together with development agency partners, organize, link-ups from regions and countries interested in utilizing the UNECE Air Convention experience to help set up local arrangements and understand domestic air pollution management by parties within the UNECE region for national or sub-national use.
- Continue to develop the Forum's web presence and understand what information and data would be useful to collate and communicate to a wide set of countries.
- Plan for the 2nd Task Force meeting under the Air Convention (steering group of the Forum) to take place in autumn 2023.
- Work with other regional organizations to understand the needs and interests of regions and what further collaboration and cooperation could be achieved

Abbreviations

AMAP	Arctic Monitoring and Assessment Programme, a working group under the Arctic Council
AR5, AR6	IPCC Assessment Reports No
BACA	Batumi Action for Cleaner Air
BAT	Best Available Technology
CAF	Clean Air Fund
CAP	EU Common Agricultural Policy
CCAC	The Climate and Clean Air Coalition to Reduce Short-Lived Climate Pollutants
CIAM	Centre for Integrated Assessment Modelling under the UNECE Air Convention
CLRTAP	Convention on Long-Range Transboundary Air Pollution. In this report we use the term "Air Convention"
EB	Executive Body of the UNECE Air Convention
EEA	European Environment Agency
EECCA	Eastern Europe, Caucasus and Central Asia
EMEP (SB)	European Monitoring and Evaluation Programme (Steering Body) under the UNECE Air Convention
ERS	European Respiratory Society
EPCAC	Air Convention Expert Panel on Clean Air in Cities
EU	European Union
EU IED	EU Industrial Emissions Directive
FICAP	Forum for International Cooperation on Air Pollution

GMP	Global Methane Pledge
GP	Gothenburg Protocol under the UNECE Air Convention
IIASA	International Institute for Applied Systems Analysis
IFIs	International Financial Institutions
IGOs	Intergovernmental Organizations
IMO	International Maritime Organization
INGOs	International Non-Governmental Organizations
INMS	Integrated Nitrogen Management System
IPCC	Intergovernmental Panel on Climate Change
LSU	Live-Stock Unit
MFR	Maximum Feasible Reduction
MSC-West	Meteorological Synthesizing West under EMEP
NGOs	Non-Governmental Organisations
NUE	Nitrogen Use Efficiency
OGMP 2.0	The Oil and Gas Methane Partnership 2.0
PM	Particulate Matter
RENURE	Recovered Nitrogen from Manure
SLCP	Short-Lived Climate Pollutants
TFEIP	Task Force on Emission Inventories and Projections (UNECE Air Convention)
TFH	Task Force on Health under WGE
TFIAM	Task Force on Integrated Assessment Modelling under the UNECE Air Convention
TFHTAP	Task Force on Hemispheric Transport of Air Pollution under the UNECE Air Convention

TFMM	Task Force on Measurement and Modelling under the UNECE Air Convention
TFRN	Task Force on Reactive Nitrogen under WGSR
TFTEI	Task Force on Techno-Economic Issues
UNCBD	United Nations Convention on Biological Diversity
UNECE	United Nations Economic Commission for Europe
UNECE Air Convention	The UNECE Convention on Long-Range Transboundary Air Pollution, sometimes named CLRTAP
UNEP	United Nations Environmental Programme
UN ESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNFCCC	United Nations Framework Convention on Climate Change
WGE	Working Group on Effects under the UNECE Air Convention
WGSR	Working Group on Strategies and Review under the UNECE Air Convention
WHO	World Health Organization
WRI	World Resource Institute
WMO	World Meteorological Organization

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