United Nations ECE/EB.AIR/GE.1/2020/5–ECE/EB.AIR/WG.1/2020/16

Economic and Social Council

Distr.: General
2 July 2020

Original: English

Economic Commission for Europe

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

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

Working Group on Effects

Sixth joint session
Geneva, 14–18 September 2020
Item 12 (c) of the provisional agenda
Progress in activities of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe in 2020 and future work: integrated assessment modelling

Integrated assessment modelling

Report by the Co-Chairs of the Task Force on Integrated Assessment Modelling

Summary

The present report describes the results of the forty-ninth meeting of the Task Force on Integrated Assessment Modelling under the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (online, 20 to 22 April 2020).

Based on presentations of scenarios during the meeting, the Task Force concluded that, for most countries, emissions in the current decade would become much lower than the emission targets set in the amended Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (Gothenburg Protocol), assuming that the emission limit values in the Protocol's annexes, as well as stated climate policies, were fully implemented.[1] This suggests that any future revision of emission targets can easily be more ambitious than the targets contained in the amended Gothenburg Protocol. Additional reductions will occur when the use of fossil fuels is further reduced. The exception is ammonia, where the conclusion is that more measures will be needed to reach existing targets. Due to limited reduction of ammonia emissions, nitrogen depositions will remain higher than critical loads in 50 per cent of ecosystems. In 2030, the fine particulate matter ($PM_{2.5}$) concentrations as modelled with the

[1] The Task Force did not look into the question of whether the 2020 emission reduction obligations would be met in 2020. This depends on the final emission reporting by the Parties, which will become available in 2022.

Greenhouse Gas and Air Pollution Interactions and Synergies model exceed the current World Health Organization guideline value for $PM_{2.5}$ in wide areas of northern Italy and parts of Poland due to the high share of secondary ammonium-nitrate aerosols and primary emissions from solid fuel domestic heating. Health risks and crop damage due to ozone will also remain a problem, with increasing emissions of nitrogen oxides (NO_x) and methane in the northern hemisphere. Around Europe, NO_x emissions from ships will exceed NO_x emissions on land before 2030. Trade-offs between policy areas call for an integrated approach comprised of air quality management, climate and energy policy, as well as agriculture and food.

During the reporting period, the Task Force carried out activities assigned in the 2020–2021 workplan for implementation of the Convention on Long-range Transboundary Air Pollution (ECE/EB.AIR/144/Add.2) and in line with the revised mandate of the Task Force (Executive Body decision 2019/7).

I. Introduction

1. The present report describes the results of the forty-ninth meeting of the Task Force on Integrated Assessment Modelling under the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP) (online, 20–22 April 2020). It includes the main findings from the meeting and recommendations for future work. The full report on, and the presentations made during, the meeting are available online.[2]

2. Around 100 experts participated, representing the following Parties to the Convention on Long-range Transboundary Air Pollution: Canada; Croatia; Cyprus; European Union; Finland; France; Germany; Ireland; Italy; Netherlands; Norway; Poland; Portugal; Serbia; Slovakia; Spain; Sweden; Switzerland; and United Kingdom of Great Britain and Northern Ireland. Other bodies represented were the EMEP Centre for Integrated Assessment Modelling, the Task Force on Techno-economic Issues, the Task Force on Hemispheric Transport of Air Pollution, the Task Force on Emission Inventories and Projections, the Task Force on Reactive Nitrogen, the International Cooperative Programme on Effects of Air Pollution on Natural Vegetation and Crops (ICP Vegetation), the Meteorological Synthesizing Centre-West, the European Commission Joint Research Centre, the European Environment Agency, the World Health Organization (WHO), the World Meteorological Organization Global Atmosphere Watch Urban Research Meteorology and Environment, the European Environmental Bureau and the Oil Companies' European Association for Environment, Health and Safety in Refining and Distribution.

3. Mr. Rob Maas (Netherlands) and Mr. Stefan Åström (Sweden) chaired the meeting.

II. Objectives of the meeting

4. Mr. Maas and Mr. Åström summarized the recent activities under the Task Force, including the Task Force contribution to the fortieth anniversary of the Convention. The purpose of the forty-ninth Task Force meeting was to: assess the current status of integrated assessment models; learn from national and local assessments; and prepare for the review of the Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (Gothenburg Protocol).

5. The Chair of the Executive Body of the Convention presented the latest developments within the Convention and other air pollution policy arenas, and highlighted Executive Body decision 2019/4 on the review of the Gothenburg Protocol, as amended in 2012.[3] Bodies under the Convention were requested to develop a work schedule to identify gaps in the current Protocol and options for further steps, if needed. She said that an assessment was needed of the policy consequences of reporting condensables emissions. She recalled the celebration of the fortieth anniversary of the Convention in December 2019 and Executive Body decision 2019/5 on the establishment of the forum for international cooperation on air pollution.

III. Updates on European integrated assessments

6. The Task Force took note of the presentation by the head of the Centre for Integrated Assessment Modelling on the Greenhouse Gas and Air Pollution Interactions and Synergies (GAINS) model analysis of European air quality futures. With new regulations agreed after the revision of the European Union National Emission Ceilings Directive,[4] and the new energy and climate measures, in many countries an overachievement was expected for the emission ceilings for sulphur dioxide, nitrogen oxides (NO_x), $PM_{2.5}$ and non-methane volatile

[2] See www.iiasa.ac.at/TFIAM/past-meetings.html.

[3] Available at www.unece.org/env/lrtap/executivebody/eb_decision.html.

[4] Directive (EU) 2016/2284 of the European Parliament and of the Council of 14 December 2016 on the reduction of national emissions of certain atmospheric pollutants, amending Directive 2003/35/EC and repealing Directive 2001/81/EC, *Official Journal of the European Union*, L 344 (2016), pp. 1–31.

organic compounds by 2030. However, for ammonia, current policy was not sufficient to meet the European emission reduction targets. To meet the 2030 targets, additional measures would be needed, with a total cost of around €0.5 billion per year. In wide areas of northern Italy and Poland, $PM_{2.5}$ concentrations as calculated with the GAINS model would remain higher than the current WHO air quality guideline values for $PM_{2.5}$ (10µg/m^3 in ambient air). That exceedance was due to high secondary inorganic aerosols (related to ammonia emissions) and domestic solid fuel burning. With current policies, 50 per cent of ecosystems would remain at risk due to nitrogen deposition. There again, ammonia was the main culprit. For NO_x, shipping emissions in the seas around the European continent were still increasing and would exceed European Union emissions on land. Abatement measures for shipping were cost-effective.

7. The Task Force took note of work planned under the Forum for Air Quality Modelling in Europe and the topics for possible cooperation with the Task Force and the Expert Panel on Clean Air in Cities: source apportionment approaches; guidelines for local air quality plans; and modelling intercomparison activities. New results of the impacts of local climate actions under the "Covenant of Mayors for Climate and Energy" on air quality would be published in the near future and would address trade-offs between local climate measures and air quality. An integrated approach, including energy and traffic policies, was recommended.

8. The Task Force took note of an overview of new insights into health impact assessments and valuation by Mr. Michael Holland (United Kingdom of Great Britain and Northern Ireland). Additional health endpoints could include stroke, dementia and diabetes. The monetary valuations used previously appeared likely to underestimate damage. A review undertaken for the second European Commission Clean Air Outlook had concluded that the new findings could lead to a significant increase in damage costs of air pollution. However, the review had also found no consistency in the response functions adopted by different European authors. The paper, which would be published in the summer of 2020, recommended that, for future European analysis, current concentration response functions be retained to provide a consistent baseline until further detailed review was undertake.

9. The Task Force took note of ongoing work to quantify the damage costs per ton of pollutant, as presented by experts from France and the United Kingdom of Great Britain and Northern Ireland. A European Environment Agency report on the externalities of industrial facilities in the European Union 28 was expected in December 2020.

10. The Task Force was briefed by the new Chair of ICP Vegetation on activities and achievements of ICP Vegetation that could be used for the review of the Gothenburg Protocol. Ozone damage to crops was still significant. In 2010, more than 7 per cent of the global wheat yield had been lost due to ozone damage. With current ozone trends, the yield loss would be 6.5 per cent in 2030. Reductions of ozone precursors in United Nations Economic Commission for Europe (ECE) countries were partly nullified by increasing emissions of methane and of nitrogen oxides in the northern hemisphere.

11. The Task Force took note of the results of the French APollO research project on the economic impacts of ozone on crops and forests. Results showed a downward trend when aggregated over France and the European Union 28, but a more disaggregated view indicated increases in ozone damage in certain regions, depending on the crop species. Up to 2030, impacts in terms of yield losses and economic damage remained significant. International strategies to reduce ozone precursor emissions were considered to be more appropriate than adaptation strategies by the sector.

12. The Task Force took note of a presentation by the head of the Centre for Integrated Assessment Modelling on a global assessment of air quality. Policy interventions had been instrumental in decoupling energy-related air pollution from economic growth in the past, and further interventions would determine future air quality. At the global scale, even full implementation and enforcement of current policies were unlikely to reduce current average $PM_{2.5}$ exposure in the next 20 years. Improvements in North America, Europe and East Asia would be compensated by further deterioration in South Asia, Africa and the Middle East. Theoretically, a portfolio of ambitious policy interventions could bring concentrations below the WHO air quality guideline values in most parts of the world, except in areas where natural

sources (for example, soil dust) were dominant. Such a portfolio needed to be integrated into multiple policy domains: environmental policies focusing on pollution controls; energy and climate policies; policies to transform the agricultural production system; and policies to modify human food consumption patterns. None of those policy areas alone could deliver clean air. Those policy interventions would require fundamental transformations, but were technically achievable in the future. Political will could emerge from a solid understanding of the full range of benefits, including their contributions to the achievement of the Sustainable Development Goals. Lowering emissions from agricultural activities and meat production would be critical in achieving clean air worldwide.

13. The Task Force took note of results of an Energy Space Time Integrated Model Optimizer scenario with low carbon dioxide (CO_2) emissions in Europe based on renewable energy and an optimal interconnection of the European energy network, presented by University College London (United Kingdom of Great Britain and Northern Ireland). Energy systems with a high share of heat pumps with heat storage could meet heat demand without emissions, even in the case of weather extreme events. A high interconnection capacity among the European countries could reduce storage needs by at least 30 per cent and eliminate the consumption of polluting energy sources (as biomass and natural gas). The Energy Space Time Integrated Model Optimizer could provide additional energy scenarios as input to integrated assessment models.

14. The Task Force took note of a cost-benefit assessment of ammonia emission abatement options, presented by the Cyprus Institute. More ambitious reduction commitments for ammonia emissions could be applied by European Union countries at relatively low costs. The exceedance of economic benefits over farmers' abatement costs might indicate a need to transfer part of the societal benefit of reduced ammonia emissions back to the farmers in the form of investment support for abatement measures. A better integration of agricultural and air quality policies could further lead to reduced air pollution and health impacts in Europe.

IV. Updates on national integrated assessments

15. The Task Force took note of a recently launched project – funded by the National Institute for Health Research of the United Kingdom of Great Britain and Northern Ireland – assessing the public health benefits of air pollutant emission reductions from agriculture. The project aimed to quantify the impact of actions to achieve greenhouse gas reductions in the agriculture sector and improved diets for human health and well-being.

16. The Task Force took note of an assessment of health impacts in the Netherlands due to European air quality policy over the past few decades. By comparing a scenario with actually reported emissions to a world avoided scenario, which assumed that no air quality policies had been adopted from 1980 onwards, the avoided health damage in the Netherlands would correspond to about 66,000 avoided attributable deaths per year, and an increase in average life expectancy of about 6 years.

17. The Task Force took note of the air quality effects of the 2050 carbon neutrality road map for Portugal. The strategy would reduce NO_x-emissions significantly, even without additional air pollution abatement measures. There were indications that it was not possible to achieve significant reductions in industrial process emissions, such as cement, paper and glass. Biomass burning also made it difficult to comply with $PM_{2.5}$ national emissions ceilings. Ammonia emissions would not be influenced by the road map.

18. The Task Force took note of the suggestions from the representative of Imperial College London, United Kingdom of Great Britain and Northern Ireland, on health-oriented policy indicators for $PM_{2.5}$. In order to avoid a policy focus on hot spots solely, as with a limit value, alternatives could aim at a combination of two targets:

(a) Reducing the average exposure based on population-weighted mean concentrations, as an indicator of overall exposure and health benefit; and

(b) Reducing the exposure locally where the WHO guideline value was exceeded, using the population-weighted mean exceedance as a second indicator. Those twin indicators

had proved to be informative and relatively robust in comparing policy scenarios. However, there were still modelling challenges, uncertainties in emissions and issues of scale to be overcome. For a legally binding target there needed to be a robust protocol for monitoring progress and compliance, which raised the issue of how measurements and modelling could best complement each other.

19. The Task Force took note of the results of the Spanish National Air Pollution Control Programme for air quality and health. Meeting the volatile organic compound (VOC)-emission ceiling would remain a challenge. In spite of a decrease in the number of non-compliant zones, ozone concentrations would remain too high over some areas, even with additional measures to reduce VOC emissions in Spain. The envisaged reduction of NO_x emissions will reduce health risks from NO_2 exposure and, for most of the country, from ozone exposure. Nevertheless, due to the titration effect, the health risks from ozone exposure could increase over cities such as Madrid or Barcelona.

20. The Task Force took note of experiences with the development of national emission reduction scenarios for Serbia using the GAINS model, in preparation for negotiation on the process of accession to the European Union, and supported and funded by the Environment Accession Project Phase 3. Results obtained to date represented a good basis for further calculations and defining the negotiating position in relation to the European Union National Emission Ceilings Directive. This capacity-building project had raised awareness of the considerable emission reduction potential in Serbia.

21. The Task Force took note of the assessments of local air quality plans in Poland and the impacts of European Union emissions reductions. Local emission reduction strategies had proved to be insufficient to meet air quality targets for particulate matter. Optimizing transboundary impacts required bilateral cooperation and information exchange. The impacts of ammonia reductions had not yet been considered.

22. The Task Force took note of the preliminary results of Swedish integrated assessment studies. Damage due to shipping emissions on the Baltic Sea to health and ecosystems on land seemed to be equal to the damage on the Baltic Sea itself. Another project indicated that more abatement measures became cost-efficient when transboundary health benefits were included. If all countries only looked at the benefits at the national level, the European result would be suboptimal compared to a cooperative approach.

V. Progress of the Task Force workplan

A. Expert Panel on Clean Air in Cities

23. The Task Force endorsed the report of the first meeting of the Expert Panel on Clean Air in Cities (Bratislava, 27 November 2019), as presented by its Co-Chair Mr. Guus Velders (Netherlands) (see annex I below). The Task Force recommended increasing efforts to involve more experts from cities, both from inside and outside the ECE region, as clean air in cities was a universal issue.

24. Significant local sources in the most polluted cities were traffic and residential heating. The import of pollution from surrounding areas and countries was also significant. WHO air quality guideline values could not be achieved unless sources outside the city were also addressed, emphasizing the need for multiscale modelling. Cities were net exporters of pollution. Advanced approaches combining local and regional models were becoming available and offered possibilities for formulating effective measures and policies. A variety of models existed, some were complex, requiring expert use, while others were less complex that are openly available. Both types of model had roles to play in effective air quality management: there was a need to better define how the findings of complex modelling could be integrated into local decision-making. Estimation of local exceedances of air quality limit values required other model characteristics (and measurement strategies) than estimation of the average exposure of the population in a city and the associated health impacts. There was limited data availability for the costs, air quality benefits and co-benefits of local measures, particularly those involving behavioural change (for example, modal shift in transport).

Further work should be undertaken to fill that gap to improve the efficiency of future air quality action planning.

25. The Expert Panel would shortly move into the next phase of initiating expert discussion and examination of current and emerging solutions to improve air quality in cities, including aspects that needed to be strengthened; for example, emission inventories, air quality monitoring, modelling health impacts, quantifying air quality management options and public engagement. The success of the Expert Panel would depend on it coming up with concrete recommendations and guidance for cities that must include a regional context. Within the wider Task Force framework, it would start to define a work programme in cooperation with other international groups such as the World Meteorological Organization Global Atmosphere Watch Urban Research Meteorology and Environment, WHO, the Climate and Clean Air Coalition and the C40 Cities Climate Leadership Group.

26. The Task Force recommended focusing on cost-effective measures to reduce average population exposure, but also looking at the cost-effectiveness of measures to protect highly exposed groups.

27. The Task Force took note of progress under the World Meteorological Organization Global Atmosphere Watch Urban Research Meteorology and Environment. Analysis with a combination of complex regional and urban scale models supported by observations revealed that $PM_{2.5}$ levels within a city could be due to local contributions (30–60 per cent) and up to 70–80 per cent due to long-range transport. In addition, those relative contributions varied spatially within the urban area. That heterogeneity, coupled with the daily movement of people, could affect real life population exposure to air pollutants.

28. The Task Force took note of the impacts of a (near) zero greenhouse gas scenario for local air quality, as presented by University College London, United Kingdom of Great Britain and Northern Ireland. Renewable energy, apart from biomass burning, would have low air pollution emissions. The reduction of particulate matter concentrations would also depend on ammonia emission reductions in agriculture. Most energy demands in stationary sectors and land transport could be electrified, with consequent low city emissions except for particulate matter from vehicle tyres. Electrofuels (electrolytic hydrogen, ammonia) were required for fuelling ships and energy storage; synthetic kerosene (for example, from waste biomass or biocrops) was required for aircraft. New emissions could arise from those processes. One complex issue would be the impacts of biomass sourcing and processing.

B. Updating control costs and assessment of the costs of inaction

29. With respect to the update of GAINS control cost data, the Task Force on Techno-economic Issues continued to regularly update cost data and was currently focusing on the costs of reducing emissions from the aluminium and cement industry, shipping emissions and methane emissions from municipal waste and gas distribution networks, which were planned to be available by the end of 2020.

30. The Task Force took note of the current status of the report on the costs of inaction (forthcoming). The report was sponsored by Norway. Estimates showed that the costs of implementing the amended Gothenburg Protocol's emission reduction measures would be equivalent to less than 0.01 per cent of gross domestic product (GDP) for the European Union. Given that the costs of health care and lost workdays due to air pollution were estimated at 2.5–7 per cent of GDP per year in Western Europe and at or above 10 per cent of GDP per year for 10 countries in the pan-European region, additional policy measures could be highly cost-effective. The costs of additional abatement (the costs of taking action) were significantly lower than those of inaction.

C. Ammonia assessment report

31. The Task Force took note of the draft ammonia assessment report (forthcoming).[5] The goal of the report was to raise more policy attention regarding ammonia abatement. The report described the damage done by ammonia to public health and biodiversity. Abatement costs were around ten times lower than those of inaction. Meat and milk prices would be 40–50 per cent higher if the damage were included in their true price. Suggestions were made that uncertainties in emissions and in damage estimates should be emphasized, and that the proposal to use European Union Common Agricultural Policy investment support schemes to meet the ammonia emission reduction commitments and maintain the competitiveness of European agriculture should be included. Experts were invited to send further suggestions before 15 May 2020.

D. Preparation of the review of the amended Gothenburg Protocol

32. The Task Force discussed the questions that the Task Force and the Centre for Integrated Assessment Modelling could answer in support of the review of the amended Gothenburg Protocol. Questions were derived from the list of questions adopted by the Working Group on Strategies and Review in May 2019:

(a) What would emissions and environmental impacts be in 2030 and beyond following a full implementation of the annexes to the amended Gothenburg Protocol? How far away would we be from environmental targets? What would be the remaining costs of inaction? What could be gained if eastern Parties were to sign up to the technical annexes on emission limit values? To what extent could adjustments of obligations reduce the gains of the Gothenburg Protocol?;

(b) What would be the potential for further emission reductions in 2030? What would be the remaining low-cost options for further emission control? What could be done at local scale? What would require international action? What would be the socioeconomically efficient emission reduction in the European ECE region in 2030, where marginal costs equals to the marginal benefits? What would the optimal strategy look like when black carbon and organic carbon aerosols were included (including condensables)?;

(c) Which problems were insufficiently covered by the Gothenburg Protocol – for example, ammonia and biodiversity, short-lived climate forcers, shipping emissions, ozone precursors (including methane) outside European ECE, impacts of air pollution on the marine environment?

33. The Task Force expected that the analysis of past trends in air quality and effects would be taken up by other bodies; for example, the Task Force on Measurement and Modelling and the Working Group on Effects (including the development of metrics for health impacts, and the combined impacts of climate change, ozone damage and nitrogen on biodiversity). Improvement of emission inventories was the core business of the Task Force on Emission Inventories and Projections. Identification of bottlenecks in implementation and benefits of flexibilities remained the responsibility of the Working Group on Strategies and Review.

34. It was unclear whether the Task Force and the Centre for Integrated Assessment Modelling work on the review of the amended Gothenburg Protocol as described in paragraph 32 above, was to be extended and supplemented with in-depth analyses by other bodies of the Convention (such as the various ICPs) on future impacts on ecosystems and health. Guidance from the Working Group on Strategies and Review was required.

[5] Available at https://iiasa.ac.at/web/home/research/researchPrograms/air/policy/Assessment_Report_on_Ammonia_20200410.pdf.

E. Update of the 2020–2021 workplan

35. An update of deliverables of the 2020–2021 workplan was included in annex II to the present document.

36. The fiftieth session of the Task Force would take place in April 2021. One suggested topic for discussion was what lessons could be learned from the current coronavirus disease (COVID-19) pandemic with respect to behavioural change measures to reduce emissions, and how those measures affected emission scenarios.

37. The second meeting of the Expert Panel on Clean Air in Cities would take place on 29 September 2020 in Olso (or on-line).

38. Envisaged work for the next decade included: the linkages between geographical scales; the continuation of work within the Expert Panel;[6] and the extension of the geographical scope of integrated assessment modelling outside the European ECE region. Modelling efforts would remain focused on improving estimates of the damage of air pollution to human health and ecosystems, the cost data and the cost-effectiveness of abatement measures and the costs of inaction.[7]

39. Future improvements of integrated analyses would also include: ground-level ozone-nitrogen-climate-biodiversity interaction; integrated nitrogen management, including nitrogen impacts on health; the climate change co-benefits of air pollution policies and measures; the impact of climate policies on air pollution;[8] and the interactions between air quality and other Sustainable Development Goals.

40. Several participants suggested improving estimates of health risks based on the actual exposure of the population and including where people were during the day, as well as indoor air pollution. Indoor air quality could be worse than outdoor air quality due to internal pollution sources such as smoking, cooking, solid fuel burning and volatile compounds from materials and solvents use. Experts were invited to present available knowledge at future meetings of the Task Force or the Expert Panel.

41. Several participants suggested that there was a need for more than one (online) meeting per year and that a virtual forum could facilitate interactions between national integrated assessment modellers to exchange experiences, consult each other (for example, on missing sources) and improve the modelling of (projected) transboundary pollution. Experts from Germany, Serbia, Sweden and the United Kingdom of Great Britain and Northern Ireland offered to develop a preliminary plan for such a forum. One topic to address would be how to interpret exceedance of the WHO air quality guideline values.

[6] See Executive Body decision 2018/5 on the Long-term strategy for the Convention on Long-range Transboundary Air Pollution for 2020−2030 and beyond, annex, para. 65. Available at www.unece.org/env/lrtap/executivebody/eb_decision.html.

[7] ibid., para. 69.

[8] ibid., para. 79 (d).

Annex I

Expert Panel on Clean Air in Cities

Report of the first meeting of the Expert Panel on Clean Air in Cities (Bratislava, 27 November 2019)

1. Around 80 participants – including 20 from national Governments, 10 from cities, 30 from the scientific community and 15 from non-governmental organizations (NGOs), as well as others from industry, the European Commission and the World Bank Group – participated in a workshop that was held in Bratislava, on 27 November 2019, back-to-back with the second European Union Clean Air Forum (Bratislava, 28 and 29 November 2019). Mr. Rob Maas (Netherlands) chaired the first meeting of the expert panel.

2. Despite emission reductions since the 1980s, air pollution was still a leading cause of health damage in European countries. Significant local sources in the most polluted cities were traffic and residential heating. The import of pollution from surrounding areas and countries was also significant. World Health Organization (WHO) guideline values could not be achieved unless those sources were also addressed, emphasizing the need for multiscale modelling. Cities were net exporters of pollution.

3. Advanced approaches combining local models and regional models that took into account chemical and meteorological processes on various scales were becoming available and offered possibilities for more robust analysis for formulating effective measures and policies. A variety of models were presented dealing with that issue, some complex requiring expert use, and some less complex were openly available. Both types of model had roles to play in effective air quality management. There was a need to better define how the findings of complex modelling could be integrated into local decision-making. Estimation of local exceedances of air quality limit values required other model characteristics (and measurement strategies) than estimation of the average exposure of the population in a city (or neighbourhood) and the associated health impacts.

4. There was limited data availability for the costs, air quality benefits and co-benefits of local measures, particularly those involving behavioural change (for example, modal shift in transport). Further work should be undertaken to fill that gap to improve efficiency of future air quality action planning.

5. Introductory presentations by the Chair, the European Urban Partnership on Air Quality and the European Environment Agency showed the need for cooperation across spatial scales in order to meet the WHO air quality guideline values in cities. While there were, of course, important local sources, the exposure of the urban population to particulate matter ($PM_{2.5}$) was significantly influenced by sources outside cities. The regional background could easily be of a similar order of magnitude to the local contribution to $PM_{2.5}$ concentration, requiring a multilevel response to improve air quality in many cities. Secondary PM concentrations, which formed a large part of the $PM_{2.5}$ concentrations, were influenced by emissions of ammonia, nitrogen oxides and sulfur dioxide from ten to several hundreds of km away from the city. At the same time, cities were net exporters of air pollution. Emission reductions in a city would also improve air quality outside the city, by reducing air pollutant concentrations in the surrounding background. Reducing local exceedances of legal air quality limits in general was an effective way to improve air quality for persons at the highest risk, but could also trigger measures that would not reduce emissions, such as an alternative distribution of traffic and pollution across the city that could even increase the average population exposure and associated health risks.

6. Several presenters stressed that current statutory air quality limit values were not “safe levels”. Substantial health impacts occurred below the current air quality limit values in the European Union. That raised the question of what effective multilevel policy strategies could be designed to maximize health benefits. There were still few examples of successful cooperation across spatial scales.

7. There were doubts whether even the strictest feasible emission standards for cars, installations or farms would be sufficient to meet WHO guideline values. While the call for systemic changes in the transport, energy and food system increased, there were still few successful examples of such an integrated approach across policy domains. In some cases, energy, transport or agricultural problems were even tackled at the expense of air quality.

8. Mr. Mike Holland (United Kingdom of Great Britain and Northern Ireland) discussed assessment of the costs and benefits of action, and identified a lack of data on behavioural and infrastructural measures and the reasons for that lack. That acted as a barrier to the development of efficient local air quality management plans. Several institutions expressed interest in further discussion in that area. The quantification of damage costs per kg emitted (to assess the costs of inaction or the benefits of measures) was growing across Europe, though it was noted that there were examples of bad practices.

9. Representatives of the World Meteorological Organization, the European Commission Joint Research Centre and the Centre for Integrated Assessment Modelling at the International Institute for Applied Systems Analysis presented methodologies for attributing local air quality to local, national and international sources and calculating the effectiveness of policy measures at different scales. For assessing future air quality, results were presented showing the importance of taking account of interactions with climate change, and reductions of greenhouse gas emissions. Models ranged in complexity from those requiring extensive modelling experience to web-based tools (for example, SHERPA City). With sufficient data it would be possible to define an optimal multilevel policy strategy, as was shown for studies in Asia in the context of the Pollution Management and Environmental Health programme of the World Bank Group. Germany and the Netherlands presented a modelling framework for nationwide assessments of local exceedances of limit values and average population exposure, including both national and local measures. That facilitated a coordinated approach between the two levels of government. In the Netherlands, almost all exceedances of limit values had disappeared. The policy for the next 10 years was to gain health improvement by further reducing the average exposure of the population in cities. In the discussion, the need for more use of validated low-cost sensors to support modelling was identified.

10. In a panel discussion, it was concluded that local policies should be based on robust knowledge of the contribution of both local and external sources. Existing efforts to produce such source apportionments should be compared and made available to cities from up-to-date databases. One possible option could be to have all available models run certain policy scenarios and produce an ensemble output. The next challenge was to nest fine-scale local models in the more complex large-scale regional and global models that took into account chemical and meteorological processes to the extent required. At the same time, gaps in availability of local level data were highlighted in the discussion. While the models and results were typically made publicly available, researchers often faced difficulties in getting access to emission inventory inputs, or to experience on effects and costs of “non-standard” interventions.

11. Policy strategies should include both the effects of international and national measures on the city level and the impacts of additional local policies. The assessment of local (and national) policies should include transboundary impacts to surrounding regions and countries. In designing policies, attention should be paid to constraints from other policy domains such as: the nitrogen limits in groundwater; the deposition constraints that resulted from nature protection agreements; and the reduction obligations for greenhouse gases.

12. Mr. Roald Wolters (Netherlands) Mr. Guus Velders (Netherlands) closed the meeting, concluding that further interaction with local experts, authorities and NGOs was needed to disseminate available results from large-scale models and to learn from local assessment tools in order to define best practices and policy actions. They acknowledged the challenge to engage more cities in the progress of the Expert Panel. They announced that they would coordinate the organization of the meeting of the Expert Panel on Clean Air in Cities next year.

13. All presentations were uploaded to the Task Force web page.[1]

[1] See www.iiasa.ac.at/TFIAM/past-meetings.html.

Annex II

Workplan items 2020-2021

Decided at the thirty-ninth session of the Executive Body (see ECE/EB.AIR/144/Add.2)

Workplan item	*Activity*	*Outcome*	*Lead body(ies)*	*Resources*
1.1.1.2	Harmonize PM inventory emissions and modelling, accounting for condensables	Expert workshop(s) on condensables (2020-2021, as needed) Reporting to EMEP Steering Body	MSC-W and other relevant bodies, notably CEIP, TFMM, TFEIP, TFIAM, TFTEI	Nordic Council of Ministers / other sources
1.1.3.1	IAM-Framework for the review of the amended Gothenburg Protocol Assessment of extent to which long-term targets will be met (in 2020–2030–2050)	Position paper for the review (2020) Data and scenario analyses (2021)	TFIAM and CIAM	In-kind + EMEP mandatory contribution
1.1.3.2	Assessing observed trends in air pollution at the various scales Linkages between global and regional air pollution	Note to the review of the Gothenburg Protocol (2020)	TFMM, TFHTAP, TFIAM, MSC-W	In-kind
1.1.3.3	Ammonia: Contribute to improve understanding of expected benefit of ammonia mitigation	Ammonia assessment report in 2020	TFIAM with support from TFMM, TFRN and national experts	In-kind
1.1.4.1	EPCAC road map	Position paper on multiscale interactions (2020) Two annual meeting of EPCAC (2020 and 2021)	TFIAM with nominated experts	In-kind
1.1.4.4	Investigations on global scenarios and assessment of global sectoral mitigation measures	Report (2021)	TFIAM and TFHTAP	In-kind
2.1.3	Discuss control strategies to recommend for use by the TFHTAP of air pollution in future scenarios	Development of policy questions + recommendations on priority sectors	WGSR, TFIAM,TFHTAP	

Workplan item	*Activity*	*Outcome*	*Lead body(ies)*	*Resources*
2.1.6	Undertake a review of the control costs currently used with a view to improving – on an ongoing basis – the cost-effectiveness analyses produced by the GAINS model	Review of control costs currently used and update	TFTEI, TFIAM	Funding needed
2.1.7	Produce a report for policymakers that clearly sets out the costs of controls versus the costs of inaction	Report for policymakers	TFTEI, TFIAM	Financial contribution from Norway
2.2.1	Development of guidance in relation to prioritizing reductions of particulate matter from sources that are also significant sources of black carbon	Draft guidance document submitted for adoption by the Executive Body at its 40th session	TFTEI, TFIAM	Currently the project EUABCA will contribute, but more in-kind is welcome

Abbreviations: CEIP, Centre on Emission Inventories and Projections; EMEP, Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe; EPCAC, Expert Panel on Clean Air in Cities; EUA-BCA, European Union Black Carbon Action; GAINS, Greenhouse Gas and Air Pollution Interactions and Synergies; IAM, Integrated Assessment Management; MSC-W, Meteorological Synthesizing Centre-West; PM, particulate matter; TFEIP, Task Force on Emission Inventories and Projections; TFHTAP, Task Force on Hemispheric Transport of Air Pollution, TFIAM, Task Force on Integrated Assessment Modelling; TFMM, Task Force on Measurement and Modelling; TFRN, Task Force on Reactive Nitrogen; TFTEI, Task Force on Techno-economic Issues, WGSR, Working Group on Strategies and Review.