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

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

Working Group on Effects

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Geneva, 13–16 September 2016
Item 5 (b) 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 2016 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-fifth meeting of Task Force on Integrated Assessment Modelling under the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (Lisbon, 23–25 May 2016). It provides an overview of recent changes in the Greenhouse Gas and Air Pollution Interactions and Synergies model and results of scenario analyses, as well as the

[*] The Executive Body to the Convention agreed that, as of 2015, the Working Group on Effects and the Steering Body to the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe should meet jointly, to achieve enhanced integration and cooperation between the Convention's two scientific subsidiary bodies (ECE/EB.AIR/122, para. 47 (b)).

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exchange of national and international experiences with integrated assessment modelling, in accordance with the Task Force mandate set out in the 2016–2017 workplan for the implementation of the Convention (ECE/EB.AIR/133/Add.1, items 1.1.2.1, 1.1.3.1–1.1.3.3 and 1.1.4.2) and the informal document submitted to the Executive Body for the Convention at its thirty-fourth session, "Basic and multi-year activities in the 2016–2017 period" (items 1.5.2, 1.5.4, 1.5.6–1.5.8).

Contents

I. Introduction

1. The present report provides a summary of the discussion at and the results from the forty-fifth 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), held in Lisbon from 23 to 25 May 2016. The presentations made during the meeting and the reports presented are available online.[1]

2. Attending the meeting were 33 experts representing the following Parties to the Convention on Long-range Transboundary Air Pollution: Denmark, Finland, France, Germany, Ireland, Italy, Netherlands, Portugal, Russian Federation, Spain, Sweden, Switzerland and the United Kingdom of Great Britain and Northern Ireland. A number of international and regional organizations and processes were also represented at the meeting, including: the Centre for Integrated Assessment Modelling; CONCAWE — a division of the European Petroleum Refiners Association; the European Environment Bureau/Air Pollution and Climate Secretariat; the European Topic Centre for Air Pollution and Climate Change Mitigation of the European Environment Agency; the International Cooperative Programme on Effects of Air Pollution on Natural Vegetation and Crops (ICP Vegetation); the Institute for Environment and Sustainability of the European Commission Joint Research Centre; the Task Force on Reactive Nitrogen and the Task Force on Techno-economic Issues.

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

4. Ms. Ana Teresa Perez, Director of the Environmental Protection Agency in Portugal, opened the meeting and welcomed its participants.

II. Objectives of the meeting and news from other bodies

5. Mr. Maas presented the latest developments within the Convention, and defined the goals of the forty-fifth Task Force meeting, which were to learn about recent European policy analysis and Centre for Integrated Assessment Modelling model developments, as well as hear Parties' experience of assessing co-benefits and trade-offs between climate change and air pollution.

6. Under the Convention the following activities and issues were highlighted:

(a) The Convention's 2016 scientific assessment report would be launched in Brussels on 31 May 2016. Air pollution remained an international problem and especially agricultural emissions would require more attention;[2]

(b) The Joint Task Force on the Health Aspects of Air Pollution had launched a new health impact assessment model (AIRQ+) and had started work on revising the World Health Organization (WHO) Air Quality Guideline values;

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

[2] Rob Maas and Peringe Grennfelt, eds., *Towards Cleaner Air: Scientific Assessment Report 2016* (Oslo, 2016). Available from http://www.unece.org/environmental-policy/conventions/envlrtapwelcome/publications.html.

(c) The Task Force on Emission Inventories and Projections had requested information from the Parties on whether they reported particulate matter (PM) emissions including condensables or not;

(d) The discontinuation of the national financing of the Coordination Centre for Effects created challenges. In the short term, it needed to be ensured that data collected in 2017 was made available to the Centre on Integrated Assessment Modelling in order to be able to include biodiversity changes in policy formulation. In the longer run, there was a need to develop a new focal point for assessing multiple stressors on biodiversity (including climate and land use changes) and to link the critical loads approach traditionally used within the Convention to assess ecosystem impacts with other concepts, such as the ecosystem services approach and the planetary boundaries approach.

III. Recent policy analysis with integrated assessment modelling

7. A representative of the Centre on Integrated Assessment Modelling presented how the Greenhouse Gas and Air Pollution Interactions and Synergies (GAINS) model had been used to estimate the impact of policy instruments on emissions. In hypothetical scenarios without decoupling of emissions from economic growth, acidification and human health impacts would have increased by a factor of 30 for acidification from 1990 levels and by a factor of 3 for PM-related human health impacts; ozone fluxes to forests would be reduced by some 30 per cent, and ozone-related human health impacts by some 70 per cent; and eutrophication impacts would increase by a factor of 3.

8. Recent GAINS model work included the analysis of the European Union Ecodesign Directive,[3] the Medium Combustion Plants Directive,[4] and the revised Non-Road Mobile Machinery Directive.[5] In comparison with the modelled cost-effective strategy that had been developed to support the European Union National Emission Ceilings Directive[6] proposal, the three Directives would achieve additional emission reductions. The turnover rate of the existing capital stock was a critical assumption in the calculations.

9. Other GAINS model work was related to estimating the source-apportionment of PM concentrations in large cities. New results for Asia showed similar results to Europe. Even in very large cities like Delhi, up to 60 per cent of total PM concentrations was caused by sources far outside of the cities. The GAINS model had also been applied for the WHO Global Burden of Diseases, Injuries, and Risk Factors Study. A critical assumption was the use of a non-linear exposure-response relationship. At higher concentration levels, changes would show less additional health impacts than the same changes at lower concentration levels. Additional information was available online.[7]

[3] Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products

[4] Directive (EU) 2015/2193 of the European Parliament and of the Council of 25 November 2015 on the limitation of emissions of certain pollutants into the air from medium combustion plants.

[5] Directive 97/68/EC of the European Parliament and of the Council of 16 December 1997 on the approximation of the laws of the Member States relating to measures against the emission of gaseous and particulate pollutants from internal combustion engines to be installed in non-road mobile machinery.

[6] Directive 2001/81/EC of the European Parliament and of the Council of 23 October 2001 on national emission ceilings for certain atmospheric pollutants.

[7] See www.iiasa.ac.at/web/home/research/researchPrograms/air/Program-Overview.en.html.

IV. Updates on European scientific research

10. A representative of the Task Force on Techno-economic Issues said that during the past year the Task Force had developed an emission abatement cost calculation tool for large point sources: the Emission Reduction Investment and Cost Calculation (ERICCa_LCP). The tool was available on the Task Force web page. [8] The Task Force had also produced guidance documents for emission reductions from mobile sources. Currently, the Task Force was developing guidelines for volatile organic compounds (VOC) measures and cost calculations (ERICCa_VOC). The Task Force also provided a clearing house on reduction techniques with the aim of providing information on best available techniques.

11. An expert from the Task Force on Reactive Nitrogen presented a proposal for the development of an International Nitrogen Management System project to develop joint management strategies for nitrogen, to be funded by the United Nations Environment Programme (UNEP) and implemented through the Global Environment Facility. The project was in a final review phase and would focus on improved data collection, regional demonstration projects, costs and effects of nitrogen policy measures, as well as improved nitrogen modelling.

12. A representative of ICP Vegetation reported on the application of a global ozone flux model developed by the EMEP Meteorological Synthesizing Centre-West, which had enabled analysis of the ozone impact on crop losses on a global level. The current estimate was that, globally, ozone exposure caused almost 10 per cent wheat production loss with an economic value of almost €25 billion per year. However, analysis also showed that in many parts of the world ozone only partially explained the difference between the optimal and the observed yield ("yield gap"). Over the past few years, ICP Vegetation had also published reviews of ozone impacts on biodiversity and had mapped Natura 2000 habitats at potential risk from ozone impacts. Currently it was involved in a number of analyses, inter alia, an international moss survey for the analysis of heavy metal accumulation and nitrogen concentrations.

13. A representative of the European Commission Joint Research Centre outlined developments with regard to the European Union Socio Economic Implications For Individual Responses to Air Pollution Policies (SEFIRA) project, which used interviews, focus group workshops and discrete choice analysis (16,000 questionnaires) to identify the acceptability of suggested air pollution abatement instruments. One interesting result was that citizens perceived that industry was still the main source of air pollution, followed by transport. The link with food and agriculture was hardly recognized. Transport behaviour was seen as the most important individual contribution to cleaner air. In terms of policy preferences, there were differences between countries, income levels, age groups and gender with regard to approaches that favoured behavioural change versus paying a price for polluting the air.

14. The Joint Research Centre representative also presented the newly developed interactive Screening for High Emission Reduction Potential on Air (SHERPA) tool, which had been developed by the Joint Research Centre and was available for download.[9] SHERPA aimed at providing information for air quality managers in regions and cities. It addressed issues such as:

[8] See tftei.citepa.org/en/.
[9] See aqm.jrc.ec.europa.eu/sherpa.aspx .

(a) "What can I influence in terms of control in my region?";

(b) "Which sectors or pollutants are most important?";

(c) "With whom should I coordinate action?";

(d) "How large are the impacts of actions?"

SHERPA included the air quality impacts of local and regional policies as well as policies implemented in a wider region or at the European scale. It used a simplified source-receptor model. The methodology was able to reproduce the country-to-grid source receptor relationships of the multi-scale model for air quality forecasting and simulation (CHIMERE) chemistry transport model. The Task Force took note of the presentation and advised making additional tests and checking how SHERPA behaved in comparison with the EMEP model.

V. National experiences: co-benefits and trade-offs of climate and air policies

15. Several experts presented national analyses of the impact of additional climate and energy policies on air pollution. Although there were differences in climate policy ambition levels between countries, the Task Force noted that in general those policies would offer a greater reduction in emissions of sulphur dioxide (SO_2) and nitrogen oxides (NO_x) than those included in the current national baseline scenarios in the GAINS model. In those cases where climate measures also included reductions of methane and nitrous oxide emissions from the agricultural sector, ammonia emissions could also decrease, because such policies would lead to a reduction in fertilizer use, cattle numbers and dietary change.

16. Speakers noted that the encouragement of domestic biomass burning as part of a climate policy would potentially increase residential emissions of particulate matter and persistent organic pollutants. In order to avoid that, such climate measures would need to be accompanied by stricter emission standards for small combustion sources. Efforts to influence "clean wood burning" behaviour (including the choice of wood quality and ignition techniques) would also be important to prevent an increase in emissions.

17. It was also observed that, while encouraging the use of diesel cars as part of climate policy had reduced carbon dioxide (CO_2) emissions as compared with petrol cars, on the other hand it had led to increased PM and NO_x emissions, thus contributing to adverse health impacts. Presently more and more cities were considering ways to discourage the use of diesel cars because of their health impacts.

18. Besides the costs and effects, societal acceptability and the need for new legal arrangements appeared to be important criteria in omitting certain policy measures from the whole basket of potential additional measures, speakers said. In one case, a multi-criteria analysis had been performed to explicitly take societal acceptability and the absence of a legal framework into account in the assessment of potential measures.

19. In several countries, the potential of local-scale measures to meet air quality limit values or to further reduce health risks had been assessed. In most cases, it had been found that local measures alone were insufficient, despite the fact that, compared with national or international assessment studies, more measures to influence local transport behaviour had been included, e.g., as part of a comprehensive approach to promote healthy life styles.

20. A representative from the European Topic Centre for Air Pollution and Climate Change Mitigation gave a presentation on emissions from domestic heating in Europe. Residential combustion of wood, coal and oil was a major contributor to exceedances of benzo(a)pyrene (BaP) and fine particulate matter ($PM_{2.5}$) target and limit values in Europe. Emissions of BaP showed an increase, which was strongly related to the increase in wood combustion (and the emissions of $PM_{2.5}$ from domestic wood combustion). Only 12 per cent of the European population lived in areas with concentrations of BaP lower than 0.12 nanograms per cubic meter (ng/m^3), corresponding to the WHO acceptable risk level of one cancer incidence in 100,000 inhabitants. Only 11 per cent of the European population lived in areas under the WHO guideline values of 10 $\mu g/m^3$. Domestic wood burning could cause 5–40 per cent of total $PM_{2.5}$ concentration during the heating season. Emissions from wood combustion were very dependent on a large number of behavioural factors, and caused a broad uncertainty range around generic emission factors.

21. An expert from Denmark said the country was aiming for a 100 per cent renewable electricity and heat system by 2050, and a transport system that was to a large extent dependent on renewable energy. There would be substantial co-benefits for air pollution. However, the connection to air pollution was not linear, since the transport system would still we be based on combustion. Air pollution was not a significant driver in the Danish energy plans. Energy security was the main driver.

22. An expert from Germany said the national climate and energy policy was driven by the 2011 decision to phase out nuclear power by 2022. An analysis of an energy transition scenario showed that a reduction of CO_2 emissions by 42 per cent from the 1990 level would have no impact on ammonia, non-methane VOCs and $PM_{2.5}$, but would reduce emissions of NO_x and SO_2 in addition to the baseline projections. Emission reduction of SO_2 was mainly caused by reduced coal use. $PM_{2.5}$ emissions from domestic heating had increased in Germany between 1997 and 2011 owing to an increased use of wood combustion. Nationally, the $PM_{2.5}$ emission from wood combustion was now larger than from vehicles.

23. In Spain, an expert said that recent integrated assessment modelling had focused on estimating $PM_{2.5}$ emissions and $PM_{2.5}$ concentrations in Spanish cities. Modelling was performed both on the city and street levels. Among other things, the results showed that traffic congestion in one specific part of the city could increase the NO_x emissions in that part by up to 65 per cent. Currently, city emission abatement strategies were assessed as part of the new Air Quality and Climate Plan for Madrid.

24. Air quality and climate research in Ireland focused on transport and domestic heating, an expert from Ireland said. Available data enabled the estimation of road transport activity distributions across all the roads of Ireland. A study on the potential for retrofit of air source heat pumps in the residential sector showed that residential sector emissions of NO_x and $PM_{2.5}$ could be substantially reduced with net costs savings, while greenhouse gases could be reduced by some 4 million tons under one defined scenario. An evaluated Irish non-Emissions Trading System of the European Union (non-ETS) climate scenario would decrease emissions of NO_x and SO_2 substantially, but would increase emissions of non-methane VOCs and $PM_{2.5}$ owing to the increased use of biomass recommended under that specific climate scenario.

25. An expert from Finland noted the impact of nearly zero energy buildings on emissions of air pollutants and greenhouse gasses in 2030 was expected to be low, as the current policy proposal focused on new buildings.

26. An expert from the Netherlands reported that the current climate and energy scenario for the country showed that by 2030 there would be a 20 per cent CO_2 emission reduction as compared with 2010, implying a 25 per cent reduction in SO_2, a 12 per cent reduction in NO_x and a 47 per cent decrease in $PM_{2.5}$. An illustrative scenario where 40 per cent of fossil use was replaced with wind energy would generate additional health benefits of the same order of magnitude as the proposed revised National Emission Ceilings Directive.

27. Portugal had calculated emission scenarios for both greenhouse gases and air pollution, an expert said. Between 2005 and 2030, a 30–40 per cent reduction of greenhouse gasses was projected. Assuming that all measures from the national air strategy entered into force, the requirements of the amended Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (Gothenburg Protocol) for 2020 would be met for all pollutants. Nevertheless, by 2020, some locations were expected to remain in non-compliance for the coarse particulate matter (PM_{10}) and nitrogen dioxide (NO_2) limit values. For ozone, the non-compliance was expected to be substantial.

28. An expert from France said the Government had developed an evaluation chain for decision support in the development of the national air pollutant emission reduction plan using a multi-criteria analysis approach. According to that study, currently, the exceedance of limit values for PM_{10}, $PM_{2.5}$, NO_2 and ozone was fairly widespread and more measures were needed. The French study also included measures that were not commonly included in integrated assessments, such as "knowledge improvement" measures and "incentive" measures. It examined the impact of each measure on emissions reduction, costs, benefit, societal acceptance, legal leverages and co-benefits for polycyclic aromatic hydrocarbons, heavy metals and greenhouse gasses. The study also identified the level of public aversion or support for certain measures on the basis of its attention in news media and expert consultation. Moreover, the study identified if new measures could be introduced within the existing legal framework or would require new legislation. The set of measures and their evaluation was intensively discussed with key stakeholders. The impacts on average annual concentrations could be presented measure by measure at a high spatial resolution.

29. The analysis of potential co-benefits between air pollution and greenhouse gas policy in Sweden by 2030 focused on transport, non-road mobile machinery and small-scale domestic wood combustion. The Swedish expert said that preliminary results showed the relative importance of large-scale infrastructure changes and of scrapping initiatives to reduce emissions from the oldest vehicles, machines and domestic heating units.

30. An expert from Switzerland said that, in order to assess the potential co-benefits between climate and air pollution policies, Switzerland had commissioned the International Institute for Applied System Analysis to develop scenarios using the Swiss GAINS model. The analysis showed the impact on air pollution from ambitious climate policies (with additional measures (WAM)) compared with the existing climate policies (with existing measures (WEM)), from ambitious air pollution scenarios (maximum technically feasible emission reductions (MTFR)) compared with existing air pollution scenarios (current legislation (CLE)), as well as the combination of WAM and MTFR (maximum control efforts (MCE) scenario). The results showed clear impacts of WAM climate policies on emissions of air pollution in Switzerland. Even ammonia emissions would decrease, as methane and nitrous oxide reductions would imply a reduction of fertilizer use and cattle densities. Cost-effective measures focusing on agriculture and small wood-burning devices would bring compliance with the WHO air quality guidelines for $PM_{2.5}$ into reach by 2030, assuming that transboundary contributions would be reduced significantly by the revised European Union National Emission Ceilings Directive.

VI. Other integrated assessment work

31. An expert from the United Kingdom said that measurements of real world emissions of Euro-6 emission standards cars in the United Kingdom emphasized the importance of addressing the high primary NO_2 emissions from the diesel vehicles as well as their wide range of exceedance of standards for NO_x. Just 2 of 39 Euro-6 diesel cars had achieved the standard of 80 milligrams (mg) per kilometre (km) of NO_x emissions, and the average could be significantly improved by removing the worst few cars. Data were publicly available online.[10] The United Kingdom Committee on the Medical Aspects of Air Pollutants had been reviewing the health impacts of exposure to NO_2. The resulting costs of exposure of the United Kingdom population to NO_2 were comparable with those attributed to $PM_{2.5}$.[11] Based on interim advice from the Committee, the Department for Environment, Food and Rural Affairs had updated its guidance on valuing changes in emissions of NO_x and concentrations of NO_2, with very much higher damage costs attached to traffic emissions in cities. Comparison of technical measures and behavioural changes in cities illustrated the need to consider wider co-benefits: improvements in physical fitness from active travel far outweighed the health impacts of exposure to air pollution and accident risks.

32. A representative of the Air Pollution and Climate Secretariat presented measures to reduce NO_x emissions from international shipping. A report would be published soon on the impacts of reducing emissions by introducing a Nitrogen Emission Control Area in the Baltic and the North Seas. The results showed a gradual decrease in NO_x emissions from international shipping after 2021. However, with economic instruments, for example a levy and fund system for the entire shipping fleet, emissions could be reduced more and quicker with a levy at the level of €2–€3/kg NO_x.

33. Results of joint integrated assessment activities by Sweden and the Russian Federation were presented. The results showed that baseline emissions of ammonia for the oblasts studied could increase by 12 per cent between 2005 and 2030, but that there was a relatively large reduction potential. Scenario results showed, inter alia, that the ammonia emission reduction strategy for the European part of the Russian Federation would have a relatively large impact on the region of Moscow owing to the regional proximity to high-emitting regions. A major source of uncertainty with respect to the black carbon emissions was the location and intensity of gas flaring.

34. A consultant from Ecometrics Research and Consulting updated the Task Force on progress in the monetization of health and ecosystem impacts. His company had been involved in health monetization studies for London,[12] the Balkans[13] and the Organization

[10] See www.emissionsanalytics.com.

[11] See Committee on the Medical Effects of Air Pollutants, *Long-term exposure to air pollution and chronic bronchitis* (Public Health England, 2016). Available from www.gov.uk/government/publications/comeap-long-term-exposure-to-air-pollution-and-chronic-bronchitis.

[12] See Royal College of Physicians, *Every breath we take: the lifelong impact of air pollution*, report of a working party (London, Royal College of Physicians, 2016). Available from www.rcplondon.ac.uk/projects/outputs/every-breath-we-take-lifelong-impact-air-pollution.

[13] See Health and Environment Alliance, "Coal's unpaid health bill in the Western Balkans", available from www.env-health.org/resources/projects/coal-s-unpaid-health-bill/coal-s-unpaid-health-bill-in-the/ (accessed on 1 July 2016).

for Economic Cooperation and Development (OECD).[14] Changes in damage estimates had occurred due to the direct health impacts from NO_2 exposure and because air pollution was associated with more types of diseases, including diabetes, obesity and dementia.

35. The Chair reported that the "Effects of climate change on air pollution impacts and response strategies for European ecosystems" (ÉCLAIRE) project had made it possible to improve the valuation of crop losses and reduced forest growth due to ozone exposure. Several methodologies were applied to value biodiversity losses due to excess nitrogen: e.g. the willingness to pay for biodiversity protection; the restoration costs to maintain favourable conditions for species in nature areas; or the emission mitigation costs to comply with the European Union Nature Directives[15] or the United Nations Convention on Biological Diversity. The GAINS model optimizations showed that an optimal strategy based on health impacts only would entail biodiversity co-benefits, but that the benefits of an additional biodiversity ambition would exceed the additional costs, even if the method with the lowest monetary value for biodiversity was used.

VII. Workplan

36. In some concluding remarks, the Chair noted that during the past year the Task Force had been involved in the coordination of the Convention's 2016 assessment report, which had now been finalized. The Task Force had also participated in the February 2016 workshop on hemispheric scenarios and policy strategies organized by the Task Force on Hemispheric Transport of Air Pollution and the Arctic Monitoring and Assessment Programme. The forty-sixth meeting of Task Force would be held in France in May 2017. In cooperation with the Joint Research Centre, the Task Force intended to organize a meeting in spring 2017 on the options for local-scale policies back to back with the meeting of the Forum for air quality modelling in Europe (FAIRMODE).

[14] See Organization for Economic Cooperation and Development, *CIRCLE: Costs on Inaction and Resource scarcity: Consequences for Long-term Economic growth 2014*, brochure available from www.oecd.org/env/indicators-modelling-outlooks/OECD_CIRCLE_web-2014.pdf.

[15] A group of several laws protecting nature and biodiversity. See http://ec.europa.eu/environment/nature/legislation/index_en.htm.