AIR CONVENTION
(CONVENTION ON LONG-RANGE TRANSBOUNDARY AIR POLLUTION)

Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP)

TASK FORCE ON INTEGRATED ASSESSMENT MODELLING (TFIAM)
51st session, 6 - 8 April 2022
Online meeting

Informal chairs report

I.   INTRODUCTION

1.   This report describes the results of the 51st session of TFIAM, held online from the 6th to the 8th of April 2022. The presentations made during the meeting and the reports presented are available at:
http://www.iiasa.ac.at/web/home/research/researchPrograms/air/policy/past_meetings.html.

2.   144 experts registered, and at most 95 participated simultaneously, representing the following Parties to the Convention: Austria, Belarus, Belgium, Canada, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, European Union, Finland, France, Georgia, Germany, Hungary, Ireland, the Netherlands, Norway, Italy, Poland, Portugal, Russia, Serbia, Spain, Sweden, Switzerland, the United Kingdom of Great Britain and Northern Ireland, and the United States. Other bodies of the Convention represented were EMEP Centre for Integrated Assessment Modelling (CIAM), the Meteorological Synthesizing Centre-West (MSC-West), the Task Force on Techno-Economic Issues (TFTEI), the Task Force on Hemispheric Transport of Air Pollution (TFHTAP), the Task Force on Emission Inventories and Projections (TFEIP), the Task Force on Reactive Nitrogen (TFRN), the World Health Organization/Task Force on Health (TF-Health), and the Integrative Collaborative Program (ICP) on Vegetation. In addition, a representative from South Korea participated and the organisations Arctic Monitoring and Assessment Programme (AMAP), Joint Research Centre of the European Commission (JRC), WMO Global Atmospheric Watch Urban Research Meteorology and Environment (WMO/GURME), the European Environment Bureau (EEB), World Resource Institute (WRI), the International Cryosphere Climate Initiative (ICCI), and CONCAWE were represented.

3.   Mr. R. Maas (Netherlands) and Mr. S. Åström (Sweden) chaired the meeting.

II.   NEWS FROM THE CONVENTION AND OBJECTIVES OF THE MEETING

4.   Mr. Maas and Mr. Åström summarized the recent activities under the Task Force and defined the purposes of the 51st TFIAM meeting: to assess the current status of integrated assessment models and its projections, to learn from national and local

assessments and to prepare input for the review of the Gothenburg Protocol. The current work plan of the Task Force for 2022-2023 is included in Annex 1.

III. REVIEW OF THE GOTHENBURG PROTOCOL

5. TFIAM took note of the presentation by Tiziano Pignatelli and Nadine Allemand (TFTEI) on their work supporting the review of the Technical Annexes to AGP and its associated guidance documents. Amongst other updates, TFTEI observe the availability of emission factors as informative to a potential technical annex on small (<50 kWht) combustion sources. But the issue of whether the annexes include condensables or not is still not answered satisfactorily. TFTEI conclude that there is a technical possibility to state new emission limit values for the sectors concerned in the Technical Annexes

6. TFIAM took note of the ongoing GAINS scenario development work within the Center for Integrated Assessment Modelling (CIAM). Zbigniew Klimont (CIAM) reported on progress in development and implementation of emission scenarios and their preliminary impact assessment, in response to the questions for the Gothenburg Protocol review. The current legislation scenario (CLE) indicates continued reductions of air pollutants' emissions for all Parties with exception of ammonia which emissions are estimated to decline only slightly or continue increasing in the next decades. This has implications for long term objectives of the Gothenburg Protocol, including the widespread exceedance of critical loads for eutrophication and no alignment with the WHO guidelines for PM2.5 limit values for majority of population in the region. Additional CIAM scenarios (MFR and 'Low') identified further mitigation potential, varying across the Parties, which would allow to significantly increase the level of ecosystem protection and reduce exposure to PM2.5. The analysis of urban pollution levels and contributing sources in the West Balkan and EECCA countries shows that effective solutions would need to include local and regional policies addressing multiple source sectors.

7. The CLE and MFR scenarios include the current energy and climate policies (with significantly more ambitions in the EU than other regions). In addition, a 'low' scenario has been developed which also includes ambitious climate policy, compatible with Paris targets, for all regions and a significant transformation in the agricultural sector. This leads to a strong reduction of food waste and livestock numbers, especially cattle and pigs, resulting in additional mitigation of ammonia and methane, i.e., additional 20-40% reduction compared to MFR. The number of UNECE citizens, excluding North America, experiencing annual average PM2.5 concentrations above the new WHO guideline ($5\mu g/m^3$) could decrease from 590 million in the 2050 baseline to 380 million in the MFR scenario, and around 300 million in the 'Low' scenario. Preliminary estimates of the exceedance of critical loads of acidification in the EU show a reduction from more than 2% of the nature area in the CLE scenario for 2050 to 1% with MFR and below 1% in the 'low' scenario. Exceedance of critical loads for eutrophication remains a challenge across large parts of the ecosystems declining from 65% in CLE to 50% in MFR in 2050, and even in the 'Low' scenario 30% of the nature area remains unprotected in the EU.

8. **TFIAM concluded** that there is scope for more improvement of air quality in the UNECE region than with the emission reduction obligations in the Amended Gothenburg Protocol. TFIAM recommended to make country data available to

national experts for further scrutiny and to analyse national abatement options. More attention to the spatial distribution and further reduction of NO$_x$-emissions from shipping was also suggested. In view of the current uncertainties on future developments in energy and agriculture, TFIAM also recommended to further work on sensitivity analysis.

9. David Simpson (MSC-West) introduced the discussion on condensable fraction of particulate matter with a short explanation of the issue and its importance to better estimate PM2.5 exposure of people.

10. TFIAM took note of the presentation by Jeroen Kuenen (Netherlands) who gave a detailed overview of the developments of the Ref2 database, a consistent set of emissions of condensables from residential wood combustion in Europe. The current version of REF2 also includes updates of activity data, installed technology as well as emission factors for the most relevant emission sources. Work is still ongoing, and results preliminary, but the current conclusions are that the emission factors found in literature are still variable, and that assumptions on 'real life' combustion behaviour will have a large effect on emissions. The comparison with country data shows a diverse picture, relating to differences in activity data as well as emission factors used. Real life use of wood stoves forms a significant source of uncertainty. There has been progress, but more research is needed.

11. TFIAM took note of the presentation by Zbigniew Klimont (CIAM) who reported on progress in implementation of the condensable particulate matter (PM) fraction in the GAINS model. Compared to the current GAINS model estimates of PM2.5, the preliminary assessment of impact of including condensable PM (using the draft 'typical' emission factors developed by TNO/Jeroen Kuenen) indicates small to moderate impact on total regional PM2.5, but high impact on emissions of some countries, notably those reporting only emission of filterable PM. CIAM also stressed the importance of simultaneous improvement and harmonization of data about fuelwood use, structure of combustion installations in residential sector, and spatial distribution of emissions.

12. TFIAM took note of the presentation by David Simpson (MSC-West) on the use of Ref2 data as input to EMEPs emission dispersion modelling. With the EMEP model, three types of datasets have been calculated, covering the uncertainty margins in real life emission factors. He illustrated the potential effect on modelled atmospheric concentrations of PM2.5 of including condensables. Calculations based on different Ref2 emission factors are promising, but the model still leads to concentrations that are lower than the measurements, and none of the modelled concentration trends are as steep as the trends that monitoring stations show. Probably other assumptions are needed about the volatility of condensables. But also, further scrutiny of the data on the actual residential small-scale combustion installations and its real-life use, is needed.

13. **TFIAM concluded** that a preliminary database of consistent emission factors including condensable PM and updated fuelwood use is available. Using this database will increase PM-exposure in countries that only report filterable PM-emissions. Further analysis of the implications in relation to emission reduction obligations will have to follow.

14. TFIAM took note of the presentation by Claudio Belis (EC-JRC) who showed scenario calculations on the health impacts of PM2.5 and ozone exposure in the

UNECE region, based on the global emission developments. The results confirm the importance of non-UNECE emissions of methane for the formation of ozone levels in the UNECE. The emission reductions of ozone-precursors within the UNECE as foreseen in the baseline scenario are counteracted by the increased methane emissions in the rest of world. The UNECE regions possibility to reduce ozone damages on its own is becoming less and less possible. For the western Balkan, the results show large improvements within-WB and exported from WB if WB would implement ambitious climate and air pollution policies.

15. **TFIAM concluded** that (in addition to NO_x/NMVOC control within the UNECE) global methane emission reduction is needed to reduce ground level ozone in UNECE.

16. TFIAM took note of the presentation by Roman Perez Velasco (WHO) who gave an overview of the 2021 WHO global air quality guidelines. There have been numerous updates on air quality guideline (AQG) values. For estimating the health impacts in integrated assessment models the reduction of annual average PM2.5 concentrations in ambient air from 10 to 5 µg/m^3 and the reduction of the NO_2 guideline level from 40 to 10 µg/m^3. The evidence-base remains too small to quantify health impacts below these levels, although they cannot be excluded. Also different risk ratios for specific types of particles (e.g. for organic and inorganic aerosols) cannot be quantified yet.

17. **TFIAM concluded** that sensitivity analysis of the health impacts would be recommendable to increase the robustness of policy advice based on model assessments.

18. TFIAM took note of the presentation by Guus Velders (Netherlands) on developments within the Expert Panel on Clean Air in Cities. TFIAM learned about the recent results of the EPCAC 3 that took place in September 2021. Focus-areas were amongst others: methods for modelling the source apportionment of local concentrations, experiences with multi-level policy making, modelling and monitoring requirements for multiscale governance, as well as lessons drawn from the COVID19 lockdown measures. The fourth EPCAC meeting will be organized in autumn 2022.

19. TFIAM took note of the presentation by Bruce Denby (MSC-West) on the development of the urban EMEP model and its application in support of the revision of EU Ambient Air Quality Directive and the review of the Gothenburg Protocol. The model showed a good fit with local measurements. The baseline scenario for 2050 showed that while in the EU around 50% of the population will be exposed to levels above the WHO-guideline level for PM2.5, 85% of the population of the West Balkan and more than 90% of the population of the EECCA region will be exposed to levels higher than the WHO-guideline.

20. TFIAM took note of the presentation by Gregor Kiesewetter (CIAM) on recent developments of modelling contributions to city level pollution with the GAINS model. This is done in the context of the general update of atmospheric transfer coefficients and extension of the domain in GAINS. For around 300 cities (175 non-EU), preliminary results for sector and source specific contributions to ambient PM2.5 have been derived. For the West Balkan cities, he showed the significant contribution of local residential heating and of remote (often transboundary) power plants. Current

legislation will improve the situation, but high concentrations (of sometimes more than 20 µg/m³ PM2.5) are expected to remain.

21. TFIAM took note of the presentation by Rita van Dingenen (EC-JRC) on recent work on nitrogen pollution, air quality and health. The study finds that ammonia abatement in most world regions has a higher benefit/cost ratio than NO_x abatement. A study on long term NH_3 emission trends consistent with the IPCC SSP-RCP scenario narratives used in climate research, showed a large NH_3 emission reduction potential remaining in several SSP-RCP scenarios, with corresponding improvements in PM2.5 exposure in Eastern Asia, Europe, and North America.

22. **TFIAM concluded** that most of the questions of the Gothenburg Protocol review Group could be answered, though in some cases preliminary.

IV.   OTHER ELEMENTS OF THE TFIAM WORK PLAN 2022-2023

23. TFIAM noted the presentation by Stefan Åström (Sweden) on current work supporting the development of a guidance document on non-technical and structural measures, to be finalised in 2023. Several participants expressed their interest to contribute to the inventory of good practices to stimulate behavioural change.

24. TFIAM took note of the presentation by Alison Davies (Task Force on international cooperation on air pollution - TFICAP). The first physical meeting of TFICAP is planned for October 2022, more information will follow. The global Forum for international cooperation on air pollution will meet in Gothenburg, Sweden on the 16th of March 2023, back-to-back with the Saltsjöbaden VII workshop. Several participants expressed their interest in further co-operation with TFICAP.

25. TFIAM took note on the overview by Stefan Åström of the TFIAM 2022-2023 work plan items and their status, as well as the current thinking towards the update of the IAM/Economic research strategy as part of the updated strategy for EMEP and WGE for 2020-2030 and beyond, in line with the Long-term strategy for the Convention on Long-range Transboundary Air Pollution. Given that the work plan period has just started, none of the items is yet finalised. The TFIAM participants were invited to inform the co-chairs on their activities in relation to the work plan and their suggestions for research strategies for the coming years.

V.   OTHER RESULTS OF ASSESSMENT MODELLING

26. TFIAM took note of the presentation by Andrew Kelly (Ireland) on effects on emissions from early introduction of electric vehicles and on effects on emissions from work-from-anywhere practices. The results show that early introduction of electric vehicles would have large effects on cumulative CO_2 emissions by 2030. Also, work-from-anywhere will have air quality effects, but not large, and it is important to recognize that at least in Ireland, commuting is only representing some ~25% of total personal vehicle transport demand.

27. TFIAM took note of the presentation by Carlo Trozzi (Italy) on the regional air quality plan of the Campania Region in Italy. The region currently often has PM10 and ozone concentrations higher than air quality limit values, which requires the development of an air quality plan. Based on emission inventories, air quality

modelling and emission and emission abatement scenarios, future emissions and concentrations have been analysed. The strategic environmental assessment has been completed and the plan was adopted by Regional Council.

28. TFIAM took note of the presentation by Stefan Reis (United Kingdom) of the [AMPHoRA project](#). Through a range of agricultural management and dietary scenarios – developed with stakeholder engagement – the analysis includes the impacts of NH_3 emission changes on PM2.5 concentrations, population exposure, costs and benefits due to reduced air pollution, and changed diets.

29. TFIAM took note of the presentation by Paul Ruyssenaars (Netherlands) on the possibility for the Netherlands to comply with the 2021 WHO air quality guidelines or interim targets. For NO_2 the scenario calculations show promising results for 2030, but for PM2.5 the situation will be more difficult. The WHO interim target 4 is within reach by 2030. Analysis of more options is ongoing to see if climate policies and nitrogen policies can help the Netherlands to reach the AQGs.

30. TFIAM took note of the presentation by Mark Barrett (United Kingdom) on a zero-greenhouse gas emission scenario for the United Kingdom. Even for the islands constituting the United Kingdom, extended electricity grids to continental Europe are expected to be more cost efficient than storage solution. Also interesting is the seasonal shift in energy demand for households from heating demands in winter to cooling demands in summer.

31. TFIAM took note on the work by Matteo Paolo Costa (Italy) on developments of a new air quality integrated assessment model for Italy. The predicted effect of a reduction in road traffic emissions, was compared with a brute force CTM simulation model. Relative biases appear over port cities which suggests that the simplified model lacks accuracy in reproducing the large NO_x emissions that are released in coastal regions and ports. **TFIAM concluded** that the spatial distribution of shipping emissions required further attention and that further mitigation options for shipping exist.

32. TFIAM took note of UKIAM modelling of a range of scenarios up to 2050 presented by Helen ApSimon (United Kingdom). This has been used to inform the setting of targets for reducing PM2.5 in England both to reduce population exposure and to set an upper limit on concentrations. Scenarios modelled incorporated electrification of road transport and covered different levels of ambition for abatement and effects of "net zero" energy projections, plus sensitivity studies to various uncertainties (for example with respect to domestic wood-burning). Targets have been produced for public consultation as a 35% reduction in population exposure, and a limit value 10 µg/m^3, both to be achieved by 2040. The monetised benefits are substantial, and there is convergence between average exposure in more deprived and less deprived areas.

33. TFIAM took note of the presentation by José-Luis Santiago (Spain) on multiscale modelling for analysis of measures to reduce NO_2 concentrations. Based on the Spanish National Air Pollution Control Programme, the modelling compared the year 2016 situation with future years. In 2030, for larger regions, there is no expected exceedance of annual average NO_2 concentrations, not for 10*10 km regions either. But to ensure compliance, the modelling of the same scenarios was done on street level resolution to confirm the coarser resolution results. The results for the three street level sites modelled showed that for two of the three cases should hot spots (4

and 12 % of the area) be experiencing NO_2 concentrations above 40 µg/m3. But on average each area analysed should have annual concentrations below 40µg/m3.

VI CONCLUSIONS

34. **TFIAM concluded** that most of the questions of the Gothenburg Protocol review Group could be answered, though in some cases preliminary.

35. **TFIAM concluded** that current emission reduction obligations will be insufficient to meet long term targets of the Gothenburg Protocol to protect health and ecosystems in 2030 or 2050.However, there is scope for more improvement of air quality in the UNECE region than with the emission reduction obligations in the Amended Gothenburg Protocol. Changes in the energy and agricultural systems play an important role in future emission reductions. More attention to the spatial distribution and further reduction of NO_x-emissions from shipping was also suggested.

36. **TFIAM recommended** to make country data available to national experts for further scrutiny and to analyse national abatement options.

37. **TFIAM also recommended**, in view of the current uncertainties on future developments in energy and agriculture, to further work on sensitivity analysis.

38. **TFIAM concluded** that sensitivity analysis of the health impacts would be recommendable to increase the robustness of policy advice based on model assessments.

39. **TFIAM concluded** that a preliminary database of consistent emission factors including condensable PM and updated fuelwood use is available. Using this database will increase PM-exposure in countries that only report filterable PM-emissions. Further analysis of the implications in relation to emission reduction obligations will have to follow.

40. **TFIAM concluded** that (in addition to NO_x/NMVOC control within the UNECE) global methane emission reduction is needed to reduce ground level ozone in UNECE.

Annex 1: 2022-2023 Workplan items

Decided at the 41st Executive Body of the Air Convention

WP item	Activity	Outcome	Lead Body(ies)	Resources
1.1.1.27	Consolidate existing evidence on health outcomes of exposure to air pollution	A report on methods for health risk/impact assessment of air pollution and cost-benefit analysis (update to HRAPIE project) An overview on air pollution and COVID-19 (optional, pending resources)	Task Force on Health in collaboration with other groups, for example, TFIAM Task Force on Health	Expected to be covered by recommended contribution; further funding needed
1.1.3.1	Scenario assessment relevant for the Gothenburg Protocol review and potential revision using multiscale GAINS and EMEP/uEMEP and including an extension of the GAINS domain (EECCA/West Balkans/Turkey)	Data and scenario analyses (2022−2023)	CIAM, TFIAM and MSC-W	Covered by the EMEP budget
1.1.3.2	Scenario development for the (potential) revision of the Gothenburg Protocol, including cost-effectiveness analysis of specific measures and assessment of the implication of improved modelling, among others, inclusion of condensables and marine deposition targets	Scenario analyses (2023)	TFIAM and CIAM	Covered by the EMEP budget
1.1.3.3	Assessing observed trends in air pollution at the various scales	Contribution to the review of the Gothenburg Protocol (2022)	TFMM, TFHTAP, TFIAM and MSC-W	Covered by the EMEP budget

WP item	Activity	Outcome	Lead Body(ies)	Resources
	Linkages between global and regional air pollution			
1.1.3.5	Perform an evaluation of the impact of potential methane mitigation measures on regional ozone	Report and workshop organized in 2023	TFMM, TFHTAP, MSC-W, TFIAM and CIAM	Covered by the EMEP budget
1.1.4.1	EPCAC activities	Activity report (2022) Two annual meetings of EPCAC (2022 and 2023)	TFIAM with nominated experts	Covered by in-kind contributions from participating countries
1.1.4.2	Development and design of global emission scenarios with a regional and sectoral breakdown to explore the mitigation potential in comparison to the baseline with a data set for use in Convention modelling tools	Report (2022–2023)	TFIAM and TFHTAP	
1.3.1	Cooperation with HELCOM and OSPAR; marine environment protection	Evaluation of atmospheric load of heavy metals and POPs to the Baltic and North Seas Reports (2022-2023) Evaluation of the impact of air pollution on marine environment Evaluation of the impact of chemicals of emerging concern in the Baltic Sea Developments to include marine ecosystem protection in future emission	MSC-E, WGE, MSC-W, TFIAM AMP (Ad hoc Group on Marine Protection including CCE and ICP Waters)	Covered by HELCOM and OSPAR funding Further funding needed

WP item	Activity	Outcome	Lead Body(ies)	Resources
		reduction strategies		
2.1.2	Review of the sufficiency and effectiveness of the Gothenburg Protocol as amended	(a) Input provided to support the review; (b) Consideration of the main findings and conclusions of the review of the amended Gothenburg Protocol; final report on the review submitted to the Executive Body; (c) Session on barriers to ratification and implementation.[1]	WGSR, TFIAM, TFTEI, TFRN and scientific bodies WGSR WGSR, EECCA Coordinating Group	2.1.2
2.1.5	Demonstrate the costs of inaction on air pollution to encourage ratification of the key Protocols to the Convention, in particular the Gothenburg Protocol.	Report for policymakers on the costs of inaction on air pollution submitted to the Executive Body	TFIAM, TFTEI	Funding provided by Norway
2.1.6	Promotion of multiscale modelling for formulating effective measures and policies	Policy brief on multilevel governance	TFIAM	Funding needed
2.1.7	Discuss the implications of future global and regional emissions scenarios	(a) Based on scientific work in point 1.1.4.3, identify priority emission sectors and regions outside the Convention that have a significant potential to have	WGSR, TFHTAP, TFIAM, CIAM	

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[1]   In case it is feasible to organize an in-person event in 2022.

WP item	Activity	Outcome	Lead Body(ies)	Resources
		an impact on the achievement of the Convention's goals; (b) Make recommendations to the EB.	WGSR	
2.2.3	Development of a Guidance document on non-technical and structural measures	Draft guidance document submitted for adoption by the Executive Body at its forty-third session	TFIAM, TFRN, TFTEI	In-kind contributions by participating countries
2.2.4	Promotion of guidance documents, including those recently adopted	Explore opportunities to promote guidance documents, including those recently adopted within and outside ECE	TFRN, TFTEI, TFIAM	