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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 (EMEP)

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Working Group on Strategies and Review

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INTEGRATED ASSESSMENT MODELLING*

Report of the Task Force by the Chair of
the Task Force on Integrated Assessment Modelling in collaboration with the secretariat

1. This report describes progress in integrated assessment modelling and assessment of model inputs in view of the entry into force and upcoming review of the Gothenburg Protocol. It includes the results of the thirty-second meeting of the Task Force on Integrated Assessment

* This document was submitted on the above date because of processing delays.

Modelling, held in Rome on 17–19 May 2006. The presentations made during the meeting and the reports presented can be accessed at www.unece.org/env/tfiam.

2. Fifty-five experts from the following Parties to the Convention attended the meeting of the Task Force: Austria, Belgium, the Czech Republic, Denmark, Finland, France, Germany, Ireland, Italy, the Netherlands, Norway, Portugal, Serbia and Montenegro, Spain, Sweden, Switzerland and the United Kingdom. Also present were representatives of the Centre for Integrated Assessment Modelling (CIAM) of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP), the EMEP Meteorological Synthesizing Centre - West (MSC-W), the Expert Group on Particulate Matter, the Task Force on Emission Inventories and Projections, the Expert Group on Techno-economic Issues, the European Commission and its Joint Research Centre (JRC), the Oil Companies' European Organization for Environment, Health and Safety in Refining and Distribution (CONCAWE), the Union of the Electricity Industry (EURELECTRIC) and the European Environmental Bureau (EEB). A member of the UNECE secretariat also attended.

3. Mr. R. Maas (Netherlands) chaired the meeting, which was hosted by the Italian National Agency for New Technologies, Energy and the Environment (ENEA).

I. OBJECTIVES AND INTRODUCTORY REMARKS

4. Mr. Maas noted that the meeting's purpose was to (a) assess the data needed for the review of the 1999 Gothenburg Protocol, (b) assess progress in integrated modelling and scenario development, and (c) learn from experiences by national integrated modelling groups.

5. Mr. M. Johansson (UNECE secretariat) outlined the conclusions from the twenty-third session of the Executive Body and the meeting of the Heads of Delegation to the Working Group on Strategies and Review. He emphasized the coordination of activities and the preparation of documents supporting the review of the Gothenburg Protocol.

6. Mr. E. Dame (European Commission) described the new unit on energy and environment, which is responsible for integrating energy and environment policies, delivering projections and scenarios, carrying out cost-benefit analyses related to legislative proposals and communications, and overseeing the implementation and revision of the European Union's National Emission Ceilings (NEC) Directive. The baseline scenario for the revision will be finalized in September 2006. The Commission planned to submit a revised directive proposal in mid-2007. He confirmed the Commission's willingness to fund the update of the *EMEP/CORINAIR Emission Inventory Guidebook*. The Task Force noted the need for collaboration given that the

Gothenburg Protocol review and the revision of the NEC Directive made use to a large extent of the same input data and model systems.

II. REQUIREMENTS FOR THE REVIEW OF THE GOTHENBURG PROTOCOL

7. Mr. R. Ballaman (Switzerland), Chair of the Working Group on Strategies and Review, presented the timetable and requirements for inputs for the review of the Gothenburg Protocol to evaluate its sufficiency and effectiveness. The Working Group would prepare the main review document, which would draw from reports of bodies under the Convention. The Task Force had been requested to provide a report on the methodological changes and recent relevant scientific findings and present it in an integrated assessment framework. The Task Force noted that its report would provide the required information for the main review document (as described in ECE/EB.AIR/WG.5/2006/1/Rev.1) on the sufficiency and effectiveness of the Gothenburg Protocol.

8. Mr. H. Gregor (Germany), Chair of the Working Group on Effects, indicated that the Working Group on Effects would deliver required input for the review report through updates to the 2004 substantive report by the Group's annual joint reports and technical documentation. The evaluation of monitored changes in ecosystems would have to be part of the review of an effects-based protocol. Data on dynamic modelling could be used to evaluate the risks of continued exceedances of critical loads. New information might become available on the damage to materials and cultural heritage. For ozone (O₃) a flux-based method for crops and trees was available for use in integrated assessment modelling, but for (semi-) natural vegetation this approach was not yet operational.

9. Mr. Gregor stressed that the Working Group had underlined the importance of having emission reduction strategies that were effects-based, and that the long-term objective was to achieve critical loads. The International Cooperative Programme (ICP) on Modelling and Mapping had recommended application of the gap closure method to achieve non-exceedance of critical loads on acidification and eutrophication, and had suggested including structural changes and future technical improvements in the analyses of maximum feasible abatement strategies. It had further noted that closing the gap to a deposition based on a maximum technically feasible reductions scenario should be considered as an interim goal only. The Task Force noted the importance of having strategies that were effects-based, and that the long-term objective was to achieve critical loads and levels.

10. Mr. Maas presented two background documents, which he had prepared for the meeting (see www.unece.org/env/tfiam/tfiam32.htm). The first document, "Preliminary policy

consequences of the most important methodological changes between 1999 and 2006”, described major methodological changes between 1999 and 2006 in integrated assessment modelling and concluded that, while the efforts under the Gothenburg Protocol could be considered to be “no-regret”, the Protocol had proved less effective than originally expected in protecting ecosystems and health. The Task Force noted that ship emissions were increasing and had become a major source of pollution. Awareness of the links between air pollution policy and other policies (e.g. on agriculture and climate change) had increased. The Task Force agreed to follow the outlined list of major methodological changes and decided to amend the first background document by adding methodological changes in the calculation of impact indicators: the change in expressing O₃ exposure (the sum of daily 8-hour means over 35 parts per billion (ppb), SOMO35, instead of accumulated O₃ concentrations over a threshold of 60 ppb, AOT60) and the insights from dynamic modelling and O₃ flux modelling.

11. The second background document, “Review of the Gothenburg Protocol: draft technical report of the Task Force on Integrated Assessment Modelling”, outlined the major issues to be discussed by the Task Force following the structure of the main review document. Issues related to particulate matter (PM) would be placed in a separate chapter. New insights on material damage and on the costs and benefits should be considered. The need for an overview of the applicability of the available modelling tools, including the reviews of the EMEP and RAINS models, was expressed. There was a request to pay special attention to policy development within the European Union. It was noted that the negotiated ceilings were not fully in accordance with the mathematically optimized ceilings. The Task Force decided to ask the Working Group on Strategies and Review for guidance on whether and how to quantitatively address the cost-effectiveness. A group for drafting the technical report might convene later in 2006. The Task Force agreed that it was important to emphasize the sufficiency and effectiveness of the Protocol, but that its technical report could also take a broad view on issues covered by integrated assessment modelling.

12. Mr. M. Amann (CIAM) presented the improvements made in the RAINS model since the Gothenburg Protocol was negotiated. The Task Force noted that the improvements included, *inter alia*, results from the EMEP Eulerian model, ecosystem-specific deposition rates in 50 km × 50 km grids, a new indicator for health effects of O₃ (SOMO35), description of long-term health effects of PM, differentiation of urban and rural exposure, new critical load data with an interface to dynamic modelling, and inclusion of emissions and atmospheric transport of primary PM. Measures aimed at emission reduction of greenhouse gases, which are incorporated in the GAINS model, could influence abatement potential and costs. The Task Force suggested that the review of the Gothenburg Protocol be made with the revised RAINS model. Development of the GAINS model would continue for future use.

13. Ms. H. Fagerli (MSC-W) presented the draft outline of the EMEP report in 2006 for the review of the Gothenburg Protocol. The Task Force noted that the planned report would provide useful information and that the relevant bodies under the Convention should be consulted to ensure that all items of the report were appropriately covered.

14. Ms. K. Rypdal (Norway), Chair of the Task Force on Emission Inventories and Projections, presented the latest findings on emission data quality. The main conclusions were that (a) uncertainties were very small for sulphur dioxide (SO₂) and relatively small for nitrogen oxides (NO_x), (b) for non-methane volatile organic compounds some sources and activities were missing, (c) for ammonia the methods were sufficient, but data on management practices were lacking, and (d) for PM data were incomplete and, in particular, emission factors were uncertain. New emission reporting guidelines, which will emphasize uncertainty management, were being prepared. The Task Force took note of the focus on improving the quality of on emission data and encouraged the Parties to use the opportunity to discuss methodological improvements in informative inventory reports.

15. Mr. T. Pignatelli (Italy), Co-Chair of the Expert Group on Techno-economic Issues, presented the priorities of the Expert Group. The Task Force welcomed the Working Group's workplan for reviewing the emission limit values in the Gothenburg Protocol annexes using current information on best available techniques.

16. Ms. M. Wichmann (Germany), Co-Chair of the Expert Group on Particulate Matter, presented the recent activities of the Group. The Expert Group had noted that the coarse fraction of PM, with a diameter of 2.5–10 µm, might have more visible impacts on respiratory morbidity than fine particulate matter (PM_{2.5}). The Expert Group had recognized the difficulty of distinguishing between the effects of PM_{2.5}, coarse PM (PM₁₀), primary PM and secondary organic aerosols.

17. The Task Force adopted the revised draft outline of the second background document. It agreed to submit the outline to the EMEP Steering Body and the Working Group on Strategies and Review.

III. DEVELOPMENTS IN INTEGRATED ASSESSMENT MODELLING

18. Mr. M. Amann (CIAM) presented the status of the RAINS model and scenario developments. The model had been expanded with information on greenhouse gases into the GAINS model, which allowed estimation of the potential for and costs of structural changes. The first results from the GAINS model for Europe suggested that there were potential co-benefits to

reducing greenhouse gases and air pollutants simultaneously. The Task Force took note of the fact that the GAINS model would be operational by the end of 2006 and that it would offer different optimization targeting possibilities. The Task Force advised to have the countries to review their greenhouse gas options.

19. Mr. Amann presented the development of the baseline scenario for the revision of the European Union's NEC Directive and emphasized the importance of national activity and emission scenarios derived by the countries. The study had concluded that (a) there were inconsistencies between national projections for greenhouse gases (UNFCCC) and for the NEC Directive, (b) there were differences between energy projections derived by the EU Member States and by the PRIMES model (which matches imports and exports of energy between EU Member States), (c) current policies in place were likely to be insufficient to meet the climate change targets, and (d) air pollutant emissions and control costs were sensitive to efforts to meet the climate change targets. The Task Force noted the need for further analysis of the internal and external consistencies of the energy projections.

20. Ms. Rypdal presented the revised emission projections guidelines. The Task Force noted that some of the information required to support the development of the integrated model would not be part of the annual routine emission reporting. It further noted that the bilateral consultations between CIAM and the countries had proven efficient for gathering this information. The Task Force recommended not increasing the reporting requirements by requiring details that might not be used efficiently. It stressed the need for quantitative information on envisaged or applicable national abatement measures. The Task Force agreed to hold a joint workshop with the Task Force on Emission Inventories and Projections to improve national projections.

21. Mr. Amann described the modelling of agricultural emissions, which had incorporated changes in animal productivity and various policies affecting agricultural emissions. The Task Force noted the need for consistency between the ammonia emission projections and policies for agriculture, water quality and biodiversity.

22. Mr. S. Reis (United Kingdom) described the work on the EU integrated project Nitro-Europe, which studies the nitrogen cycle and its influence on the European greenhouse gas balance. The Task Force noted the long-term research programme and expressed a desire to receive updates when appropriate.

23. Ms. R. van Dingenen (JRC) presented a summary of integrated assessment modelling at the global scale, including long-term predictions. Initial results included scenario studies on future emissions of greenhouse gases and air pollutants and an estimate of global agricultural

losses due to O₃. The Task Force expressed appreciation for the extension of integrated modelling approach to the global scale.

24. Ms. A. Engleryd (Sweden) presented ongoing work by sustainable environment consultants (SENCO) on energy scenarios for Europe which took into account options for energy security and emission control. Critical assumptions included the inclusion of international shipping and aviation, international energy prices and the share of nuclear energy.

25. Mr. C. Ågren (EEB) presented a new study on health impacts from SO₂ and NO_x emissions from large point sources in Europe, where relative risk factors for PM_{2.5} were applied to secondary inorganic PM. The total health damage from secondary PM_{2.5} from these sources was valued at 57–170 billion euros per year. A relatively small number of plants with large emissions of SO₂ and NO_x were calculated to be responsible for significant impacts, and there was wide variation between plants regarding effects per unit of useful energy output. The full report is available at www.acidrain.org.

26. Mr. L. White (CONCAWE) presented the findings of the work aligning the revision of the European Union's Integrated Pollution Prevention and Control Directive with the effects-oriented approach. The study compared the effects-driven approach (similar abatement costs per reduced years of life lost) with the technology-driven one (similar abatement costs per ton of reduced pollutant) using PM_{2.5} as an example. The results suggested that the effects-oriented approach was aligned with the "polluter pays" principle and required best available technologies applied locally, whereas the technology-oriented approach did not seem an overall cost-effective way to reduce total health damage.

IV. NATIONAL INTEGRATED ASSESSMENT MODELLING ACTIVITIES

27. Ms. Rypdal presented a Nordic project linking climate change scenarios with air pollution scenarios and policies. The results indicated uncertainties in air pollution abatement costs due to unsettled future climate policies and the extent of emission trading in Europe.

28. Mr. J. Bollen (Netherlands) presented the cost-benefit analysis on local air pollution and global climate change. The study concluded that climate change policies should not be delayed, since their integration with air pollution strategies would bring net benefits, and suggested increasing research to reduce the uncertainties in climate change effects.

29. The Task Force noted that there were opportunities for cost savings in integrating air pollution policies and climate change policies, both locally and at larger scales.

30. Mr. R. Borge (Spain) described a model system applied to Spain to assess O₃ exposure scenarios. The model used detailed emission data testing O₃ impacts in the greater Madrid area in 2010. These results highlighted the benefits of spatially detailed national studies complementing Europe-wide models with relatively low grid resolution.

31. Ms. M. Volta (Italy) described a methodology for effectively controlling O₃. A case study in the Milan area had concluded that O₃ exposure could be reduced significantly with relatively low reduction costs. Future plans included uncertainty analyses and inclusion of PM.

32. Ms. H. ApSimon (United Kingdom) presented a study on attainment of urban air quality objectives and its links to transboundary air pollution. Many European cities were having difficulties in complying with European Union legislation on concentrations of PM and nitrogen dioxide (NO₂). Within the long-range transboundary context, little attention had been given to links between NO_x abatement and urban concentrations of NO₂, in which traffic emissions played a particularly important role. Some countries were also finding that imported NO_x from neighbouring countries and shipping might make a significant contribution. Integrated assessment modelling studies in the United Kingdom had been extended to address roadside concentrations as well as urban background levels and to investigate the effectiveness of both technological and local measures. These studies illustrated that improvements in NO₂ from reducing NO_x concentrations might be affected by trends in O₃ concentrations, and also by higher proportions of NO₂ in the NO_x emissions associated with the introduction of particulate traps.

33. Mr. J. Aben (Netherlands) presented a specific version of the RAINS model which had been implemented in the Netherlands with high spatial resolution. It was used to explore the effects of the proposed Euro5/6 vehicle emission standards on PM_{2.5} concentrations in urban streets in 2020. The results indicated that exceedances of PM_{2.5} thresholds would still occur with the baseline scenario, but would disappear when the Euro5/6 measures were introduced. The original RAINS model would underestimate exposure in highly polluted areas, but it also underestimated the effectiveness of European Union-wide abatement measures in these areas.

34. The Task Force noted that the national studies described in more detail the various parts of integrated modelling that were useful for checking and complementing large-scale assessments. Countries were encouraged to continue national modelling.

V. FURTHER WORK

35. The Task Force reconfirmed the workplan that had been discussed during its thirty-first meeting and decided to add the following items:

- (a) Update of national energy and emission scenarios (CIAM, Parties);
- (b) New calculation module for agricultural emissions (CIAM);
- (c) Update of baseline energy and emission scenarios for 2010, 2015 and 2020 (CIAM, Parties);
- (d) Report on provisional results from the GAINS model optimization (CIAM);
- (e) Improving the treatment of negative cost measures in the GAINS model (CIAM);
- (f) Joint workshop on projections, in collaboration with the Task Force on Emission Inventories and Projections, 30–31 October 2006, in Thessaloniki (Greece);
- (g) Joint workshop “Modelling of urban particulate matter and ozone”, in collaboration with the Task Force on Measurements and Modelling, in October at the International Institute for Applied Systems Analysis (IIASA) in Laxenburg (Austria) (to be confirmed);
- (h) Drafting group meeting on the Task Force’s technical report on the review of the Gothenburg Protocol, in November 2006 (Task Force, CIAM);
- (i) Training session on use of the GAINS model, late 2006 (CIAM);
- (j) Thirty-third meeting of the Task Force in May 2007 in Prague.