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## Economic Commission for Europe

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

### Working Group on Strategies and Review

#### Forty-ninth session

Geneva, 12–16 September 2011

Item 3 (b) of the provisional agenda

**Options for revising the annexes to the Gothenburg Protocol to  
Abate Acidification, Eutrophication and Ground-level Ozone:  
technical annexes**

### Techno-economic issues

#### Report by the co-Chairs of the Expert Group on Techno-economic Issues

#### I. Introductory remarks

1. The present report presents progress in the work of the Expert Group on Techno-economic Issues, including the results of its nineteenth meeting, held on 6 May 2011 in Rome, hosted by the Italian National Agency for New Technologies, Energy and Sustainable Economic Development, in accordance with item 1.5 of the 2011 workplan for the implementation of the Convention on Long-range Transboundary Air Pollution (ECE/EB.AIR/106/Add.2). It also presents the results of the work of the subgroup on emerging technologies in large combustion plants (EmTech 50–500), which held its second meeting on 5 May 2011.<sup>1</sup>

#### A. Attendance

2. Experts from the following Parties to the Convention attended the meeting of the Expert Group: Belgium, Finland, France, Italy, Netherlands, Poland, Russian Federation and Sweden. The participation of experts from the Russian Federation was financially

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<sup>1</sup> Presentations delivered at the meeting are available on the website of the Expert Group:  
[http://www.citepa.org/forums/egtei/egtei\\_meetings.htm#Steeringgroup18](http://www.citepa.org/forums/egtei/egtei_meetings.htm#Steeringgroup18).

supported by France. In addition, experts from the oil companies' European association for environment, health and safety in refining and distribution (CONCAWE), EURELECTRIC, the European Confederation of Iron and Steel Industries (EUROFER), the European Association of Internal Combustion Engine Manufacturers (EUROMOT), the Standing Committee of the European Glass Industries (CPIV), the Karlsruhe Institute of Technology/French-German Institute for Environmental Research (KIT-DFIU), the Interprofessional Technical Centre for Studies on Atmospheric Pollution (CITEPA) and the French Environment and Energy Management Agency (ADEME), as well as the co-Chair of the International Cooperative Programme on Effects of Air Pollution on Materials, including Historic and Cultural Monuments (ICP Materials; a subsidiary body of the Convention's Working Group on Effects), also attended the meeting. Simultaneous English-Russian interpretation was provided during the meeting to facilitate the active participation of the Russian-speaking experts.

## **B. Organization of work**

3. Mr. T. Pignatelli (Italy) and Mr. J.-G. Bartaire (France) co-chaired the meeting.
4. The meeting was broadcasted "live" on the web, in streaming video.

## **II. Objectives and main discussion points of the meeting**

5. The Expert Group addressed the outcome of the discussions at the forty-eighth session of the Working Group on Strategies and Review, held in Geneva in April 2011, in relation to the ongoing revision of the Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (Gothenburg Protocol), and analysed its implications for the activities of the Expert Group.

6. The Expert Group discussed the following main issues in accordance with item 1.5 of the 2011 workplan for implementation of the Convention:

(a) The cooperation between the Expert Group and the Coordinating Group on the promotion of actions towards implementation of the Convention in Eastern Europe, the Caucasus and Central Asia (Coordinating Group for Eastern Europe, the Caucasus and Central Asia) led by the Russian Federation;

(b) The work carried out by the Expert Group technical secretariat on costs associated with the options proposed in the revised annexes to the Gothenburg Protocol for submission to the Working Group on Strategies and Review; and

(c) Further work to update the Expert Group's methodology on large combustion plants (LCPs).

7. The issue of black carbon was raised during the meeting. The Expert Group had already carried out relevant work on wood combustion in the domestic sector, and wood combustion was identified as one of the largest sources of black carbon emissions. The Expert Group recognized the importance of continuing the work on black carbon, to the extent possible, within the resources available and in cooperation with other technical bodies of the Convention working on this issue.

8. The Expert Group also discussed its workplan for 2012 and beyond.

### **III. Progress in the work of the Expert Group**

#### **A. Cooperation with the Coordinating Group for Eastern Europe, the Caucasus and Central Asia (workplan item 1.5 (f))**

9. The co-Chairs informed the Expert Group that the work programme for technical cooperation with the Russian Federation had been consolidated. They had presented the activities of the Expert Group at a meeting in February 2011, at the Ministry of Natural Resources and Environment of the Russian Federation, focusing on the developed methodology for cost analysis in some industrial sectors. Senior officials from the Ministry for Natural Resources and Environment, representatives from the Ministry of Energy and experts from the various industrial sectors had attended the meeting.

10. Following that meeting, the first step of the cooperation with the Expert Group was defined. A pilot project study, for the analysis of costs of implemented abatement technologies, on a selected power plant, was to be carried out through the methodology developed by CITEPA (providing the technical secretariat of the Expert Group). Further steps of the cooperation should include: a series of technical seminars with technical experts and officials; further development of assessment projects concerning costs of implementation of abatement technologies; extension of the cost assessment analysis to the implementation of the Gothenburg Protocol in the countries in Eastern Europe, the Caucasus and Central Asia; cost assessment guidelines or handbooks in the Russian language; and training seminars for regional experts on techno-economic issues/methodologies.

11. The Expert Group co-Chairs had also participated in the first meeting of the Coordinating Group for Eastern Europe, Caucasus and Central Asia, held in March 2011. The Chair of the Coordinating Group presented the outcome of that meeting, with regard to the revision of the Gothenburg Protocol. He highlighted the needs of countries in the subregion for longer transition periods in existing installations, both with respect to the application of best available technologies (BAT) and compliance with emission limit values (ELVs), flexibility on the base year, and a transition period for reporting. A higher coherence with the EMEP/EEA<sup>2</sup> Air Pollutant Emission Inventory Guidebook (Russian version) was needed in the methodologies for emission reporting, in the Eastern Europe, Caucasus and Central Asia region.

#### **B. Estimation of costs of reduction techniques associated with options proposed by the Expert Group in the draft revised annexes to the Gothenburg Protocol (workplan item 1.5 (b))**

12. A representative of CITEPA presented the cost data collected for LCPs, glass production, steel production, cement production, stationary engines and solvent use, covered by annexes IV, V, VII and VI of the Gothenburg Protocol. The Expert Group had provided the data collected for the first three activities and solvent uses as informal documents at the forty-eighth session of Working Group on Strategies and Review. For the other activities and the refinery sector, data would be presented at the forty-ninth session of the Working Group as additional information, since a final check on the data was still necessary. Work was being carried out in close cooperation with EUROMOT for stationary

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<sup>2</sup> The Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP) and the European Environment Agency (EEA).

engines, with CEMBUREAU for cement, with CPIV for glass, with EUROFER for iron and steel and with VGB and EURELECTRIC for LCPs. The new BREFs documents<sup>3</sup> were being used.

13. A representative of CONCAWE presented an update of the cost analysis for the refinery sector. The scope of the work was confined to sulphur oxide (SO<sub>x</sub>) and nitrogen oxide (NO<sub>x</sub>) abatement measures for: combustion systems, Fluid Catalytic Cracking Units (FCCUs) and Claus Units. Costs were derived from the 2006 “refinery sulphur survey”, based upon a survey sample equivalent to more than two thirds of European Union refinery throughput in 2006 and comprising detailed data from:

(a) More than 400 combustion plant stacks, including quantity and sulphur content of fuels fired;

(b) 33 FCCUs, including design and actual throughput of fresh feed, sulphur in fresh feed, sulphur emitted to the air; and

(c) 56 Sulphur Recovery Units (SRUs), including design and actual throughput, quantity of sulphur recovered and quantity emitted to the air (hence, recovery efficiency).

14. Examples of costs were given for the SRUs, the FCCUs and the combustion plant stacks. The related presentation, with explanations, would be made available at the forty-ninth session of the Working Group.

### **C. Methodology for large combustion plants (workplan item 1.5 (d))**

15. The Italian co-Chair presented the results of the methodology developed by Italy to compare the ELVs, as proposed by the Expert Group in the draft technical annexes, with the official emission scenarios developed by the Centre for Integrated Assessment Modelling (CIAM) through the Greenhouse Gas and Air Pollution Interactions and Synergies (GAINS) model for the purposes of the revision of the Gothenburg Protocol. The analysis was limited to power plants and was also aimed at estimating the efforts needed — in terms of emission reductions, technology upgrade and related costs — to achieve compliance with the ELVs. A semi-automatic Excel macro had been developed, after close consultations with CIAM, to carry out the task. For particulate matter (total suspended particulates) the methodology had worked quite well, and a combination of technologies had always been found to match the three ELV options, providing the expected estimations. However, for SO<sub>x</sub> and NO<sub>x</sub>, the comparison between the GAINS output and the ELVs in some cases had failed, which might have been due to the fact that: (a) the proposed ELV was much too ambitious; (b) the average emission factor in GAINS was too high to match the ELVs; and/or (c) the comparison was meaningless in those cases. Calculations were available for Italy, France, the United Kingdom of Great Britain and Northern Ireland, Spain and the Netherlands. Advice from national experts was further expected. An expert noted that the results of the study had arrived too late with respect to the status of the discussion among the European Union member States. However, it could still be useful to provide further elements of evaluation for the countries in Eastern Europe, the Caucasus and Central Asia.

16. A representative of CITEPA presented the methodology for the assessment of costs for LCPs and refinery plants and the potential areas for improvement, which were linked to

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<sup>3</sup> Reference documents on BAT produced by the European Integrated Pollution Prevention and Control (IPPC) Bureau.

the reference installations, unabated emission factors, the reduction techniques considered, lifetimes, cost functions and operating costs. The following work was planned:

- (a) Development of cost functions on the basis of collected information for installation larger than 500 MWth;
- (b) Extension to 50 to 500 MWth range installations;
- (c) Updating of operating costs if necessary; and
- (d) A first meeting in the beginning of October 2011, to discuss the preliminary results and define the following steps.

May 2012 was indicated as the deadline for the updating work. The participants were invited to solicit their administrations and/or associations to nominate ad hoc experts for this task before June 2011.

#### **D. Improving the representation of large combustion plants and the steel industry sector in the GAINS model (workplan item 1.5 (c))**

17. The French co-Chair of the Expert Group presented the state of progress of the work aimed at improving the representation of power plants in the GAINS model. Following initial discussion between the Expert Group and CIAM, in June 2010 an assessment had been made on plants, fuels and cost parameterizations and emission factors. Some national case studies were still in progress (e.g., France, Germany, United Kingdom and Italy) in the framework of EURELECTRIC activities. The results of the surveys and next steps would be discussed with CIAM experts in June 2011. It was expected that the situation could differ from country to country. The huge time and human resources requested from CIAM for the activities on the revision of the Gothenburg Protocol had influenced the time schedule of that work. However, the time frame of the joint activity with CIAM was independent from the time frame for the Gothenburg Protocol revision, being the quality assessment and improvement of data, an institutional task for the Expert Group.

18. A representative of EUROFER presented the progress made in efforts to achieve better representation of the iron and steel production sector in the GAINS model. EUROFER had succeeded in collecting some new data. Currently, the work focused on emissions and reduction techniques. A structure similar to the one adopted in the BREF document was envisaged. The BREF document would be the basis for the assessment of reduction techniques.

#### **E. Work on emerging technologies in large combustion plants lower than 500 MWth (workplan item 1.5 (g))**

19. A subgroup had been formed within the Expert Group to collect and validate information and data for emerging technologies relevant for LCPs lower than 500 MWth. The Chair of the subgroup (EmTech 50–500) said it would continue the work on emerging technologies for LCPs larger than 500 MWth completed by a previous subgroup in 2008 (LCP 2030 subgroup). The current work covered combustion plants from 50 MWth to 500 MWth, with a time horizon of 2030. Those were not strictly fixed boundaries, since up-scaling from smaller plants and downscaling from larger plants could be relevant. It had been agreed not to take into consideration peak load plants. All kinds of combustion plants would be covered, with the exception of plants not causing significant air emissions (e.g., fuel cells). Natural gas, hard coal and biomass were considered as priority fuels in the data collection. The work focused on the following air pollutants: dust, NO<sub>x</sub> and SO<sub>2</sub>. The definition of “emerging technology” was the same as in the work carried out by the

previous subgroup on larger capacity plants. Five kinds of emerging technologies would be considered: improvement of existing abatement techniques; improvement of existing technologies; abatement techniques/technologies applied in other domains (emerging application); new (emerging in the narrow sense) abatement techniques; and new abatement technologies.

20 The expected outcomes of that work were the identification of general trends with relevance for air emissions; identification of candidate emerging techniques/technologies and applications; and data on environmental performance, costs and penetration rates. The results of the work would be made available as a technical basis for updating, in the future, the calculation parameters in the GAINS model used by CIAM in the integrated assessment modelling analysis, as well as for the upcoming revision of the LCP BREF.

21. A literature review was being carried out by KIT-DFIU (Germany). A kick-off meeting had been held on 2 February 2011 in Paris and a second meeting had been held on 5 May 2011 in Rome,<sup>4</sup> back to back with the Expert Group meeting.

22. Among the technologies presented and discussed at the two meetings were the following:

(a) Lignite pre-drying: a powerful technique to increase thermal efficiency and therefore overall plant efficiency. Research results and demonstration plant results in Niederaussem, Germany, tended to show that the penetration rate for that technique might increase from 2015 onwards ;

(b) A significant trend towards solid fuel gasification, especially biomass gasification, was developing in Europe to ensure a more efficient use of biogenic solid fuels and biogenic wastes for the production of electricity and heat. An overview of pilot plants, some of them being close to 50 MWth, and gasification methods had been presented;

(c) Upgrading of biogas for injection in the natural gas grid had been discussed as a driver for clean technologies.

23. Furthermore, representatives of industry presented the following:

(a) Recent technological developments regarding turbines and integrated gasification combined cycles (IGCC), allowing for the use of dry-low NO<sub>x</sub> systems, gas turbine combined cycles (GTCC) and a large range of fuels; and

(b) Current research programmes on flameless combustion. Such technology had already been implemented in some industrial furnaces, but faced particular challenges with respect to boilers. It was therefore considered promising in terms of industrial implementation before 2030, although it was still at an early stage of research. Up-scaling was considered possible by having several installations in parallel.

24. A third meeting was scheduled for the 22 June 2011 in Paris to provide and discuss additional available information. A fourth meeting to discuss and review the collected data would be held in the first half of October 2011, tentatively in Paris. A draft report would be issued following that meeting. The draft report would be presented and discussed at a final meeting on 21 November 2011 in Warsaw. A final report was expected by the beginning of 2012.

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<sup>4</sup> All presentations made at the meetings are available at:  
[http://www.citepa.org/forums/egtei/egtei\\_LCP50-500MW.htm](http://www.citepa.org/forums/egtei/egtei_LCP50-500MW.htm).

#### **IV. Next meeting**

25. The Expert Group welcomed the official invitation from Poland and decided to hold its twentieth meeting in Warsaw on 21 and 22 November 2011.

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