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TRANSBOUNDARY AIR POLLUTION

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DRAFT 2006 REVIEW OF STRATEGIES AND POLICIES FOR AIR POLLUTION ABATEMENT

Note by the secretariat*

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* The present document was submitted late due to resources constraints.

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I. INTRODUCTION

Preface

1. The Convention on Long-range Transboundary Air Pollution, signed in Geneva in 1979, is a landmark international agreement. For more than 25 years it has been instrumental in reducing emissions contributing to transboundary air pollution in the UNECE region through coordinated efforts on research, monitoring and the development of emission reduction strategies on regional air pollution and its effects.

2. The 2006 summary review of strategies and policies for air pollution abatement is based on replies by Parties to the Convention to the 2006 questionnaire on strategies and policies as well as other information provided by Parties. The questionnaire asked Parties for information on their implementation of the protocols to the Convention as well as general policy information related to the integration of air pollution mitigation policies with economic, transport, energy, waste management, spatial planning and other policy frameworks. Each of the protocols includes reporting obligations by Parties. At its twenty-third session, the Executive Body decided that the questionnaire would represent the uniform reporting framework referred to in article 8.2 of the Protocol on Nitrogen Oxides, article 8.4 of the Protocol on Volatile Organic Compounds, article 5.1 of the 1994 Protocol on Sulphur, article 9.2 of the Protocol on Persistent Organic Pollutants, article 7. 2 of the Protocol on Heavy Metals and article 7.2 of the Gothenburg Protocol (ECE/EB.AIR/87, para. 70(b)).

3. The overall aim of the reviews of strategies and policies is:

(a) To assess the progress made by Parties and the region as a whole in implementing obligations under the Convention and its protocols and to further their implementation;

(b) To facilitate the exchange of information between Parties, which is foreseen in the Convention and its protocols; and

(c) To raise awareness about the problems of air pollution, as well as to make the contribution of the Convention and successful abatement strategies more visible.

4. As of 24 August 2006, 49 member countries of UNECE and the European Community were Party to the Convention. The review reflects the continued efforts made by Parties to comply with their obligations under international environmental agreements, and to contribute to a cleaner environment in the region.

Introduction

5. The 2006 review of strategies and policies for air pollution abatement is one of a series of such reviews prepared under the Convention on Long-range Transboundary Air Pollution. They aim to identify Parties' progress, aid information exchange as well as raise awareness about air pollution problems and the work of the Convention towards solving them. This review does not constitute a review and assessment of compliance by Parties with their substantive and reporting obligations under the protocols, as carried out by the Convention's Implementation Committee.

6. To provide background information, section II of the review summarizes briefly the work of the Convention and its subsidiary bodies. Section III is based on information provided by the EMEP Meteorological Synthesizing Centres-East and West (MSC-W and MSC-E) using data submitted by Parties and data submitted to the International Cooperative Programmes under the Convention's Working Group on Effects. It summarizes the trends in air pollution and effects in the region in recent years and identifies some of the consequences of the strategies and policies taken.

7. Parts IV and V of this review draw mainly on replies from Parties to a questionnaire on national strategies and policies. To address the aims described in the preface and to help Parties report on their obligations and to provide a basis for reviewing their actions, the Executive Body, at its twenty-third session, approved the 2006 draft questionnaire on strategies and policies for air pollution abatement (EB.AIR/2005/4, Adds.1 and 2). Similar to other strategies and policies questionnaires in recent years, the 2006 questionnaire was made up of two parts, one that covered the obligations of protocols, the other a general policy part. Replies relating to the protocol obligations are reflected in section IV, those to the general policy responses are in section V.

8. The questionnaire was made available to Parties on the Internet between 15 February and 31 May 2006. Twenty-four Parties responded to all or parts of the questionnaire. Information supplied by other means was collected up to 15 July 2006. Emission data used for this review were those up to 31 March 2006. As requested by the Executive Body, the Parties' replies to the 2006 questionnaire are available on the Convention's website.

9. [The review was approved for publication by the Executive Body at its twenty-fifth session in December 2006.]

II. CONVENTION ON LONG-RANGE TRANSBOUNDARY AIR POLLUTION

A. Recent progress and the status of the Convention and its protocols

10. With the accession of Albania to the Convention in December 2005, the Convention's Parties now number 50. Virtually the entire area of the UNECE region in Europe and North America is now covered by the Convention. While only two countries from Central Asia are Party to the Convention (Kazakhstan and Kyrgyzstan), the remaining three (Tajikistan, Turkmenistan, and Uzbekistan) are involved in work that can lead to accession. Capacity-building in Eastern Europe, Caucasus and Central Asia (EECCA) and in South-Eastern Europe (SEE) is increasingly important in the Convention's work, and some of the work is described in section D below. (Insert graphic box in final report: The UNECE region and the Parties to the Convention).

11. Already at the time of the last review of strategies and policies for air pollution abatement, the Convention had successfully negotiated and adopted eight legally binding protocols to control specific pollutants. With the entry into force of the 1998 Aarhus Protocol on Persistent Organic Pollutants, the 1998 Aarhus Protocol on Heavy Metals in 2003 and the 1999 Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone in 2005, all eight protocols to the Convention are now in force. Continued efforts by Parties to ratify or accede to the more recent protocols will further strengthen the endeavours to meet the targets set by the protocols. Overall targets for the region for most pollutants covered by the protocols are being met, though the successes of individual Parties vary.

12. Even so, most Parties to protocols are meeting their obligations and some are achieving much more than the set targets through effective national action. Only a few Parties have been identified by the Convention's Implementation Committee as failing to meet the requirements they have signed up to, and these are explaining to the Convention's Executive Body how they will accelerate action in order to meet obligations in the future.

13. Since the 2002 review was published, the Convention has continued to make advances in its work on air pollution control and abatement. With the fall in emissions of sulphur and nitrogen oxides we are beginning to see recovery of sensitive ecosystems in some areas. Further details are provided in section B of this chapter. The underpinning science also continues to develop and progress in the work of the Convention's Working Group on Effects and the Cooperative Programme on Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP) is outlined in the sections below.

14. The website for the Convention, (www.unece.org/env/lrtap) provides further information on the Convention's work.

B. The Convention's Executive Body and its main subsidiary bodies

15. The Executive Body (the meeting of the Parties) is the governing and decision-making body of the Convention. At its meetings, its three main subsidiary bodies and the Convention's Implementation Committee provide reports on their work. The Executive Body is responsible for adopting protocols, decisions, reports (such as this review) and agreeing its annual workplans as well as developing strategies for its future work.

16. Reflecting the Convention's science-based approach to emission control strategies, the Executive Body has two scientific subsidiary bodies, the Working Group on Effects and the EMEP Steering Body. The Working Group on Strategies and Review is the main negotiating body for the Convention and is responsible for reviewing protocols, identifying any need for amendment or revision and making recommendations for such changes.

17. The Implementation Committee consists of 9 elected members covering a cross-section of the geographical spread and expertise of the Convention. It draws the attention of the Executive Body to cases of non-compliance by Parties with their obligations under the protocols to the Convention and recommends action for encouraging compliance.

18. The work of the three main subsidiary bodies is described below with reference to recent structural changes and achievements. (Insert chart in final report: The organizational structure of the Convention).

1. Activities of EMEP

19. EMEP was established before the adoption of the Convention but its implementation and development, including reference to work on monitoring, modelling and emissions reporting, is described within the text of article 9 of the Convention. The programme is comprised of four main elements: (a) collection of emission data; (b) measurements of air and precipitation quality; (c) modelling of atmospheric transport and deposition of air pollution; and (d) integrated assessment modelling.

20. The work of EMEP continues to expand and involves increasing numbers of Parties. There are now 41 Parties to the EMEP Protocol, which provides funding for three EMEP Centres, and increasing numbers of Parties are establishing monitoring stations and reporting their emissions.

21. Parties to protocols are obliged to report their emissions of the associated pollutants; all Parties to the Convention are encouraged to report emissions and most do so. MSC-W holds a database of emission data that are publicly available. In recent years, EMEP's Task Force on Emission Inventories and Projections has developed a review procedure for improving the quality of reported data. Pilot reviews are already taking place and a regular review mechanism will be implemented soon.

22. Emission data are used by MSC-W and MSC-E to model the transport of pollutants between countries. Models developed by the centres cover all the pollutants of the protocols and they form the basis for developing strategies for abatement measures to protect human populations and sensitive ecosystems. Since 2002 the MSC-W and the MSC-E models have been reviewed and compared with other available models; they were judged state of the art and fit for application to the future work of the Convention.

23. EMEP has made progress too in its monitoring activities. The Executive Body has approved a monitoring strategy, developed by EMEP's Chemical Coordinating Centre and its Task Force on Measurements and Modelling, that describes three levels of commitment. The lowest level provides basic monitoring information on the major air pollutants; the second level requires more in-depth monitoring of a wider range of substances, while the third level is aimed at research and intensive monitoring campaigns.

24. A new area of work under EMEP is hemispheric transport of air pollution. This reflects the Executive Body's concern about the amount of pollution that is believed to move into and out of the UNECE region (see section D below). A new Task Force has been established under the EMEP Steering Body to coordinate scientific work in this area, to find out the extent of the problem and understand how it might be accounted for in the development of future strategies.

25. Key to the development of air pollution strategies for most of the major pollutants has been the use of integrated assessment models that use emissions data, transport models, abatement costs and effects to develop cost-optimized strategies that provide maximum benefits. EMEP's Task Force on Integrated Assessment Modelling directs and oversees this modelling work that has been the major driving force in developing the Oslo Protocol and the Gothenburg Protocol. Recently, the RAINS model, developed by EMEP's Centre for Integrated Assessment Modelling (CIAM), has also been peer reviewed. Parties were reassured that the model was considered effective for most pollutants whilst its effectiveness for others could be improved through Parties providing better data. The model is being used for the first review of the Gothenburg Protocol.

2. Activities of the Working Group on Effects

26. The Working Group on Effects was established to develop international cooperation in research and monitoring to provide information on the degree, geographic extent and trends of pollutant impacts. It manages six international cooperative programmes (ICPs) that study aquatic and terrestrial ecosystems and materials; these are each led by a Task Force and supported by a programme centre. A joint task force of the Executive Body and the World Health Organization (WHO) was set up to consider the health effects of air pollution.

27. The Working Group receives regular reports from its ICPs and the Task Force on Health. It also prepares major reports for the Executive Body. Its 2004 substantive report reviewed and assessed the status of air pollution effects and their recorded trends in the UNECE region. The report was based, in large part, on the long-term results of the monitoring and modelling work of the ICPs and the Task Force on Health.

28. The reports of the Task Force on Health attempt to identify relationships between concentrations of air pollutants and their effects using, for example, the analysis of data from epidemiological studies. In recent years the Task Force has reported on the effects of ozone (in particular agreeing on a new indicator for ozone health impacts), particulate matter (PM), persistent organic pollutants (POPs) and heavy metals.

29. Effects of pollution on buildings and materials have been studied by ICP Materials, which, through its monitoring programme, has derived dose-response functions to quantify the effects of multiple pollutants causing corrosion and soiling. The ICP has now extended its evaluation of effects to cultural heritage sites.

30. ICP Modelling and Mapping has been responsible for developing and maintaining up-to-date maps of critical loads that show the threshold of effects for acidification and eutrophication. These maps were the basis for setting targets for the Oslo Protocol and Gothenburg Protocol. The work has now been extended to dynamic modelling and deriving target loads from the models; many national focal centres have provided data on this since 2003. The programme has also developed critical loads of heavy metals and the Programme's Coordination Centre for Effects (CCE) and MSC-E have now mapped areas at risk from the deposition of cadmium, lead and mercury both for ecosystem and health effects. CCE together with CIAM have developed methods for linking emissions and critical load exceedances in integrated assessment models.

31. Monitoring by ICP Vegetation has shown the widespread effects of ozone on crops and other vegetation across Europe. Recently, a new "flux-based" approach was proposed for

assessing the risk of ozone-induced effects on crops and forest trees in integrated assessment models, though the previously used concentration-based approach is still being further developed for quantifying effects on (semi-) natural vegetation. Calculations by ICP Vegetation and MSC-W, using both approaches for wheat and for beech, showed critical ozone levels were widely exceeded across Europe. However, the two approaches showed different spatial patterns of predicted damage.

32. The Working Group on Effects' environmental monitoring networks provide long-term data series on important environmental effects, covering most of Europe and parts of North America. The extensive defoliation and intensive forest sites of ICP Forests have shown the continued damage to forests from a variety of causes, including air pollution. The numerous lakes and streams monitored by ICP Waters have shown trends in both damage and, more recently, recovery of aquatic systems in many parts of the region. Biomonitoring by ICP Vegetation and in-depth monitoring by ICP Integrated Monitoring provide detailed information on changes to biota that are responding to a variety of environmental factors including air pollution.

33. Site monitoring data from the programmes have been important for calculating ecosystem-specific critical loads and for validating critical loads and critical levels maps. Site-specific data are also important for developing complex dynamic models that are able to predict future changes in the environment resulting from air pollution control strategies. The Working Group's Joint Expert Group on Dynamic Modelling brings together experts from all programmes to share knowledge and to coordinate activities on dynamic modelling.

34. Identifying the effects of air pollution is not always an easy task. There are many confounding factors and, increasingly the Working Group and its programmes need to take account of changes in climate and impacts on biodiversity when evaluating the results of their work.

3. Activities of the Working Group on Strategies and Review

35. Through the 1990s, the Convention's Working Group Strategies focused most of its efforts on negotiating protocols for consideration by the Executive Body. In 1999, the Working Group was renamed the Working Group on Strategies and Review to recognize that much of its future work would be to prepare reviews of existing protocols and present the results to the Parties for their consideration and possible action. The Working Group continues to deal with other policy-related questions and recommends decisions on these to the Executive Body.

36. At the time of writing, the review of the Protocol on POPs had been completed, the review of the Protocol on Heavy Metals was in its final stages, and that for the Gothenburg Protocol was in progress. The Working Group was therefore heavily committed to its work on preparing reviews and making recommendations for possible revisions to all three instruments.

37. In 1999, the Executive Body established an Expert Group on POPs under the Working Group to prepare information in readiness for the review of, and possible addition of substances to, the Protocol after it had entered into force. A similar Expert Group on Heavy Metals met for the first time in 2003. With the entry into force of the two protocols, the Expert Groups were retitled Task Forces with new mandates to prepare the documentation for the formal review processes required by the protocols as well as making recommendations on possible future revisions. They were also charged with reviewing, in accordance with the Protocol requirements, any new substances proposed by Parties for addition to the protocols. The Task Force on POPs is currently reviewing a number of substances that are being considered for addition to the annexes to the Protocol.

38. The entry into force of the 1999 Gothenburg Protocol, in May 2005, heralded a new area for review. Some activities such as those carried out by the Expert Group on Ammonia Abatement and the Task Force on Integrated Assessment Modelling were well established and these bodies had been working on their contributions to the review process even before it had formally started. The Expert Group was responsible for developing a Framework Advisory Code of Good Agricultural Practice for Reducing Ammonia Emissions; this was needed before entry into force of the Protocol since each Party was obliged to publish a code within one year of entry into force of the Protocol.

39. Identifying the costs and benefits of abatement technologies has long been a focus of the Convention’s work. To develop work in this area, the Executive Body, in 2001, established the Expert Group on Techno-economic Issues. This Group has examined data on the costs and effectiveness of various techniques and technologies and has created a database of information to allow Parties to compare in-country cost estimates and derive cost-effective reduction strategies. In future, the Expert Group will also consider the impact of emerging technologies on air pollution abatement. Such technical information may play a significant role in any updates to the technical annexes to the protocols.

40. Even at the time of the adoption of the Gothenburg Protocol in 1999, some Parties were voicing their concerns about the effects of fine PM. While it was recognized that the Protocol would decrease PM indirectly through controls of sulphur, nitrogen oxides and ammonia, no specific measures were included to control PM emissions. Recent work by WHO and CIAM has indicated that there are significant health effects due to PM across Europe (see section III. B

below). The Executive Body therefore, in 2004, established an Expert Group on Particulate Matter under the Working Group. It was charged with looking into the possibilities for PM controls through understanding more of the problems and the available abatement measures. The Expert Group is preparing information that can be considered in the review of the Gothenburg Protocol.

C. Capacity-building activities

41. The Executive Body is placing increased emphasis on the implementation of the Convention and its protocols and has stressed the importance of capacity-building for Parties with economies in transition.

42. At the nineteenth session of the Executive Body, the delegation of Kazakhstan, at that time a new Party to the Convention, stressed the need for assistance to build capacity in countries with economies in transition. In response, the secretariat developed the project "Capacity-Building for Air Quality Management and the Application of Clean Coal Combustion Technologies in Central Asia" (CAPACT), which attracted funding from the United Nations Development Account. Kazakhstan was the focus for the project, but all five Central Asian States were to be involved in workshops and related activities. The three-year project started in 2004 and will run until 2007. It includes the development of a national implementation plan as well as the establishment of an EMEP monitoring site in Kazakhstan. There is a particular focus on monitoring and reporting of emissions, with the aim of assisting countries to accede to the Convention as well as to its EMEP and most recent protocols. The project is being carried out in cooperation with the United Nations Environment Programme (UNEP), which also has an interest in air pollution issues in Central Asia, with the aim of strengthening cooperation between European and Asian monitoring programmes. For further information on CAPACT see www.unece.org/ie/capact.

43. At recent sessions of the Executive Body, other Parties with economies in transition noted the value of the CAPACT project and expressed a desire for similar capacity-building support. To this end, Parties have donated to the Convention's Trust Fund to enable CAPACT workshops to be extended for participation of experts from all UNECE countries with economies in transition.

44. To support capacity-building further, the Executive Body at its twenty-third session in December 2005, agreed an action plan for countries of EECCA. The 12 countries are at various stages of implementing the Convention and its protocols: nine (Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, the Republic of Moldova, the Russian Federation and Ukraine) are already Parties to the Convention, three (Tajikistan, Turkmenistan and Uzbekistan)

have yet to accede; three are Parties to the EMEP Protocol, the 1985 Protocol on Sulphur and the 1988 Protocol on Nitrogen Oxides. The Republic of Moldova is Party to the Protocol on POPs and the Protocol on Heavy Metals. However, all have stressed the need for further capacity-building and the EECCA action plan is designed to address this.

45. The EECCA action plan aims, *inter alia*, to create awareness about air pollution and its effects on health and the environment, assure political commitment at the ministerial level to tackle air pollution problems, develop emission estimates and scenarios, set up monitoring stations and extend EMEP modelling to Central Asia and develop ecosystem sensitivity maps and health damage estimates. The plan aims to coordinate activities with the Convention's scientific centres and seeks to further develop funding mechanisms.

D. Future work under the Convention

46. The Convention has a heavy workload for the future with the reviews of the three most recent protocols prompting possible new areas of work. For the Gothenburg Protocol there has already been an expansion of interest in the health effects of PM and in the need to consider how hemispheric transport of air pollution might be addressed within a revised or amended protocol. In addition, many Parties are aware of the synergies between the causes and effects of climate change and those of air pollution. Greenhouse gases and major air pollutants come from many of the same sources and some gases contribute to both global warming and air pollution. There may also be a need to reconsider the effects of air pollution, which could be very different in a future changed climate.

47. At least for the next few years there will be a continued focus on adding new substances to the Protocol on POPs. Expert peer reviewers are evaluating proposed substances and making recommendations, through the Task Force on POPs, to the Executive Body for their addition to one or more of the annexes in the Protocol. The Task Force on POPs will continue to explore management options to control the use of some of these substances. An ad hoc group of legal experts has identified various options for amending the Protocol, and these will be considered by the Parties.

48. For the Protocol on Heavy Metals, no new substances have been proposed for addition to the annexes. However, the Protocol requires that the Parties encourage work on an effects-based approach for formulating future optimized control strategies and that, following the first review, they develop a workplan on further steps to reduce emissions to the atmosphere. The Working Group on Effects has reported that scientifically sound methods exist to form a satisfactory basis for an effects-based approach based on critical loads, but decisions have yet to be taken on how such work might be applied in the future.

49. The new work, as well as ongoing activities, will require continued support and encouragement of the scientific bodies of the Convention. The scientific and technical activities have always underpinned the decision making of the Convention and Parties are expected to continue to base their decisions upon sound science and the advice provided by the Convention's scientific community.

50. In addition to the scientific work, the policy focus of the Convention may also need to be extended. Ship and aircraft emissions contribute an increasing proportion of the pollution load in Europe and mechanisms for developing strategies for their control need to be developed. There are also problems when pollution is transported from non-UNECE countries. The Convention's work on hemispheric transport may provide scientific information on a broader scale, but political involvement of countries outside the region is likely to be a long-term challenge. At present the scientific links between the Convention and other regions of the world are growing; exchange of knowledge and information is increasing. But the challenge will remain how to link policy development in one part of the world with that in another. This will only be achieved through mutual agreement and a keen understanding of the needs of other regions in terms of their environmental management in general, and their air quality goals in particular.

III. TRENDS IN AIR POLLUTION EMISSIONS AND EFFECTS

A. Emission levels and trends

51. Under the Convention, the reporting of high-quality emission data is essential both for assessing the state of air pollution within the UNECE region, through the use of transport models, and for establishing the compliance of Parties with their protocol commitments. Parties submit data each year in accordance with the Convention's Emission Reporting Guidelines and using the EMEP/CORINAIR Atmospheric Emission Inventory Guidebook. For this review, emission data are those submitted by Parties in 2006 for their 2004 emissions. Emission totals for the major air pollutants were reported by approximately 75% of the Parties to the Convention.

52. Emissions of sulphur dioxide (SO_2) in Europe continued to show a clear downward trend. The total emission for all Parties to the Convention within the geographical scope of EMEP was estimated to be 14,896 Gg (SO_2) in 2004 representing s a decrease of 65% since 1990 (see figure: Emission trends of sulphur in the EMEP area 1980–2004, 2010). This implies that, over the whole EMEP area, the emission target for SO_2 set by the Gothenburg Protocol for 2010 was already reached in 2004. However, there are significant differences in the achievements of individual Parties. About half of the Parties to the Convention have already

reached their targets set by the Gothenburg Protocol, the other half still need to reduce their emissions.

53. For emissions of nitrogen oxides (NOx) the situation is not as satisfactory. Total emissions of all Parties within the EMEP area have fallen to 17,741Gg (NO2) in 2004, only 30% less than the 1990 levels (see figure: Emission trends of nitrogen oxides in the EMEP area 1980–2004, 2010). However, 40% of Parties to the Convention have reached their targets set by the Gothenburg Protocol for 2010, but, nevertheless, a further 15% decrease in the total emission from the EMEP region is needed to reach the overall 2010 target.

54. Estimated ammonia emissions in the EMEP region have fallen by 22% from the 1990 levels; in 2004 they totalled 6,774 Gg (NH_3). These figures imply that 65% of all Parties to the Convention have already reached the goal of the Gothenburg Protocol and that the total ammonia emission in the EMEP area is now close to the Protocol target set for 2010 (see figure: Emission trends of ammonia in the EMEP area 1990–2004, 2010).

55. For non-methane volatile organic compounds, emissions in 2004 were 15,247 Gg, a decrease of 38% from 1990 levels. The Protocol goals require a further 2% to 6% reduction by 2010, which implies that action is still required by many Parties.

56. For POPs, emissions of polychlorinated dibenzo(p)dioxins and dibenzofurans within the EMEP domain were estimated, for the Parties to the Convention, to be 11,211 g I-TEQ (PCDD/Fs) in 2004. This represents a decrease in PCDD/Fs emissions by 18% since 1990. Benzo[a]pyrene emissions in 2004 were estimated at 471 mg/year, a fall of 18% from 1990 levels.

57. Most official submissions of emission data for heavy metals continued to have significant uncertainties. Therefore, emission trends of lead, cadmium, and mercury for the period 1990–2004 were calculated from officially reported data and unofficial estimates. Between 1990 and 2004 total anthropogenic emissions in the EMEP region decreased for all three metals: for lead by about 84% (from 35.4 Gg/year to 5.6 Gg/year), for cadmium by about 47% (from 0.468 Gg/year to 0.248 Gg/year), and for mercury by about 44% (from 0.324 Gg/year to 0.182 Gg/year).

B. Trends in effects

58. Trends in effects demonstrate the effectiveness of the Convention in meeting its goal “to protect man and his environment against air pollution” (article 2 of the Convention). The work of

the effects programme has been described above. This section summarizes the status and trends of the effects still being observed.

59. For human health effects, the Task Force on Health has evaluated the impacts of current *ozone* levels, which cause tens of thousands premature deaths, significantly increase the need for medical attention and restrict the activity of many. Current predictions of ozone concentrations indicate that these effects will not change significantly in the next 10 years. For *fine particles* (commonly measured as particulate matter < 2.5 micrometres, $PM_{2.5}$), WHO and CIAM have calculated that current concentrations are reducing life expectancy across Europe by several months on average. In some regions this may be two years or more, while the most severe effects are on vulnerable groups – PM causes acute and chronic illnesses, in particular in children and adults with health problems. While current policies are expected to cut population exposure to PM over the next decade, widespread effects will remain.

60. A review by the Task Force on Health on the health risks of *POPs* highlighted known health risks and identified gaps in information necessary for risk assessment. For *heavy metals*, the Task Force assessed the health effects and concluded that emissions of cadmium, lead and mercury should be further reduced to diminish the risks of direct and indirect impacts, e.g. via food consumption.

61. Trends in the effects on materials identified by ICP Materials over the period 1987–1997 showed decreasing corrosion that follow the fall in concentrations of acidifying air pollutants. The corrosion of carbon steel and limestone in 1997 was reduced by 60% over the 10-year period, that of zinc by about 40%. In 1997–2003 the corrosion rate of carbon steel continued to fall, but the rates for zinc and limestone increased slightly.

62. Effects on forests have been assessed through crown condition observations at 6000 ICP Forests “extensive monitoring sites”. Since 1986 an overall increase in defoliation was observed. More than 24% of the trees assessed in 2004 were classified as “damaged” though the damage was unlikely to be solely from air pollution. Recently, some recovery has been observed but this has high spatial and temporal variation. Dynamic modelling at 35 of these sites showed, for sensitive soils, a marked increase in acidity during the last century and only partial recovery after 1990.

63. Freshwaters in Europe and North America are responding positively to decreasing emissions of sulphur and nitrogen. Acidification is falling though accumulated sulphur in catchment soils over the past century may delay the recovery of many lakes and streams. Also decreases in nitrate concentrations in waters are only modest. ICP Waters has reported biological recovery of fish and invertebrates at some locations where chemical recovery was sufficient.

Both steady-state and dynamic model predictions indicate that surface water chemistry will continue to improve in the future.

64. Soils at several ICP Integrated Monitoring sites in Europe are recovering from high sulphur deposition in the past by currently releasing more sulphate than they receive. The trends of sulphate concentrations over 1993–2003 showed decreasing trends in deposition for more than half of the studied sites; the generally decreasing trends in runoff and soil water were a response to decreasing deposition. Similar correlations were not observed for nitrogen, probably due to catchment-specific nitrogen retention processes. However, the ICP has found that nitrogen leaching into the groundwater or surface waters is strongly related to atmospheric nitrogen inputs, in particular at nitrogen-enriched sites. At sites with low nitrogen status, the mean annual temperature mainly determined the amount of leaching and this may be affected by a changing climate.

65. Since 1994, ICP has monitored ozone damage to sensitive plant species at its vegetation at sites across Europe and the United States. Studies on damage to the foliage of agricultural and horticultural crops, and on biomass reductions in white clover showed no trends, possibly reflecting the large year-to-year variation in ozone concentrations.

66. The ICP Vegetation survey on concentrations of nitrogen and selected metals in naturally growing mosses throughout Europe shows an east-to-west decrease in metal concentrations in mosses, related in particular to industrial emissions. Long-range transboundary transport appears to account for elevated concentrations in areas without local emission sources. A general temporal decline was found for arsenic, cadmium, lead and vanadium. Nitrogen concentration in mosses in Switzerland has shown a clear increase in recent decades.

67. Critical loads maps can be used with deposition estimates to identify areas of potential damage in the past, present and future. The recently updated critical loads data collated by ICP Modelling and Mapping comprises 1.4 million data points that can be gridded to match the resolution of deposition maps to give exceedance maps that provide a Europe-wide perspective of potential damage from acidification and eutrophication. The new ecosystem-specific deposition values of EMEP are mapped on a 50 km × 50 km grid. Using the earlier critical load data and the previous 150 km × 150 km grid cell average deposition, the calculated area in Europe where ecosystem critical loads for acidity were exceeded was 3.9% and 2.3%, for 2000 and 2010 respectively. With the new data, the areas exceeded are estimated to be 11.0% and 8.2% (See figure: Exceedances of critical loads for acidification). For eutrophication, the earlier values were calculated to be 26.0% and 24.6% for 2000 and 2010 and the current calculations show an increase to 35.1% and 34.7%. The new calculations highlight that we are still far from the goal of achieving critical loads.

IV. IMPLEMENTATION OF AND PROGRESS IN NATIONAL STRATEGIES AND POLICIES FOR THE 1985 PROTOCOL ON SULPHUR

68. This section summarizes the extent of implementation and progress for national strategies and policies for the seven substantive protocols to the Convention based on information provided by the Parties, in particular their responses to the 2006 questionnaire.

69. Parties to the Convention have generally developed action plans or long-term programmes to implement their national strategies. These programmes can be made up of a host of regulations, decrees or directives. Some Parties have constitutional laws in place and many (in particular European Community (EC) Member States and applicant countries) refer to EC directives. EC directives are a set of provisions set out by the Economic Council of the European Union. Parties meeting these provisions often draw attention to this rather than provide detailed information. Some Parties set emission reduction targets based on Protocol obligations or domestic policy, whilst others set goals and requirements for achieving national air quality standards. Air quality standards or target levels are regulatory measures that frequently serve as a reference for other standards (e.g. fuel quality, control technology) designed to achieve a desired level of air quality. Target loads or deposition standards, often established after consideration of critical loads, play a similar role by providing a basis for other policy measures. A mix of instruments is used in most cases, though the different types of measures should be complementary. Parties' responses generally referred to their framework for regulation and cited the appropriate directives, policies and/or regulations. (See website for complete replies.)

70. There is a series of requirements to apply the best available techniques, which are economically feasible, through national emission standards to new mobile and certain stationary sources, and to apply pollution control measures to certain existing sources. The best available techniques, and the extent to which they are economically feasible, are a matter of judgement. In some countries, these concepts are explicitly stated in environmental legislation, whereas others stipulate their use in the permits and licences for undertaking potentially polluting activities. Emission standards for the control of air pollutants either set maximum permissible quantities for specific sources and for specified pollutants, or require specific technological controls to be applied. Emission standards can be set industry by industry, plant by plant or on the basis of national emission standards for specific pollutants. These requirements are discussed below. More detailed definitions are provided in the protocols to the Convention and their annexes.

A. The 1985 Protocol on the Reduction of Sulphur Emissions or Their Transboundary Fluxes by At Least 30 Per Cent

Twenty-two Parties (as of 22 June 2006)

Austria, Belarus, Belgium, Bulgaria, Canada, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Italy, Liechtenstein, Luxembourg, the Netherlands, Norway, the Russian Federation, Slovakia, Sweden, Switzerland, Ukraine

1. Overview

71. This first pollutant-related protocol to the Convention entered into force in 1987 and contains a clear target for Parties to reduce by the year 1993 (at the latest) their sulphur emissions or their transboundary fluxes by at least 30% from their 1980 levels.

72. This Protocol has been successfully implemented, with its 21 Parties exceeding the 30% reduction figure. All Parties have achieved reductions in sulphur emissions of over 50%, and 11 Parties have exceeded 60%.

2. Progress in implementing the first Protocol on Sulphur

73. While the 1994 Oslo Protocol on Further Reductions in Sulphur emissions in many ways supersedes the 1985 Helsinki Protocol, some Parties to the Helsinki protocol have not yet ratified the Oslo Protocol (*Belarus, Estonia, Russian Federation, and Ukraine*).

74. Parties to both the Helsinki and the Oslo Protocol reported in more detail their current and future sulphur reduction strategies under the Oslo Protocol. Nonetheless, a number of Parties did report briefly on their achievements in complying with the Helsinki Protocol.

75. *Canada's* approach to tackling sulphur emissions has been, and continues to be, both at the federal level and at the level of provinces/territories. Its first comprehensive acid deposition programme, the 1985 Eastern Canada Acid Rain Programme, was in effect from 1985 through 1999 and required emission reductions in the seven eastern provinces and in the Sulphur Oxide Management Area (SOMA). The *Czech Republic* reported a drop in SO_2 levels of 87.9% between 1990 and 2004. *Denmark* reported the following four measures to reduce SO_2 emissions: levying a sulphur tax, limit values for the sulphur content of fossil fuels, limit values for emissions from large combustion plants and a quota system for large combustion plants. Sulphur emissions fell 80% from 1980 to 1994 in *Finland,* due largely to the implementation of

its Air Pollution Control Act, targeting the sulphur content of oil products, SO_2 emissions from new and major old coal-fired power plants and sulphur emissions from major industrial installations. *Germany* reported a drop in sulphur emissions between 1980 and 1990 of 70% in the old West *Germany*, while, since reunification, the emissions of the entire country have decreased from 7,514 kilotonnes in 1980 to 2,945 kilotonnes in 1993 (a 60% drop) and further decreased to 638 kilotonnes in 2000. This reduction was achieved by fitting all large combustion plants with flue gas desulphurization technology and reducing the sulphur content of fuels or, in the cases where flue gas treatment technology was not appropriate, using low-sulphur fuels. *Hungary* reported a 53% reduction in sulphur emissions between 1980 and 1993.

76. *The Netherlands* reported a drop in sulphur emissions of 65% between the years 1980 and 1993, and a continued downward trend thereafter. It attributed this trend to the adoption, in 1979, of a comprehensive strategy with national emission ceilings, followed by the setting of air quality standards in 1986, passing of legislation for combustion plants in 1987 and the definition of critical deposition loads in 1989/90 in environmental policy plans and its Acidification Abatement Plan. The *Russian Federation* reported that sulphur dioxide emissions in the European Territory of *Russia* (ETR) decreased by 73.1% in 2004 compared to 1980 levels. The *United Kingdom* reduced its emissions by 36% between 1980 and 1999. Emissions in 2004 totalled 833 kilotonnes, signifying a further 73% drop from 1999 levels (3,117 kilotonnes). In 2004, *Ukraine* began implementing a programme aimed at improving thermal power stations by 2010 in order to reduce both sulphur and nitrogen emissions.