UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE

Strategies and Policies for **Air Pollution Abatement**

2010 review prepared under

The Convention on Long-range Transboundary Air Pollution

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EXECUTIVE SUMMARY

The Convention on Long-range Transboundary Air Pollution, signed in Geneva in 1979, is a landmark international agreement. For more than 30years 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.

The 2010 summary review of strategies and policies for air pollution abatement is based on replies by Parties to the Convention to the 2010 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.

The questionnaire on strategies and policies, circulated every two years, is intended to assist Parties in providing information as required under the seven substantive protocols to the Convention. In 2009, the Executive Body decided that the 2010 questionnaire would represent the uniform reporting framework referred to in article 8, paragraph 2, of the Nitrogen Oxides (NO_x) Protocol;[1] article 8, paragraph 4, of the Protocol on Volatile Organic Compounds (VOCs);[2] article 5, paragraph 1, of the 1994 Sulphur Protocol;[3] article 9, paragraph 2, of the Protocol on Persistent Organic Pollutants (POPs);[4] article 7, paragraph 2, of the Protocol on Heavy Metals;[5] and article 7, paragraph 2, of the 1998 Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (the Gothenburg Protocol).

1 1988 Sofia Protocol concerning the Control of Emissions of Nitrogen Oxides or Their Transboundary Fluxes.

2 1991 Geneva Protocol on Volatile Organic Compounds or Their Transboundary Fluxes.

3 1994 Oslo Protocol on Further Reduction of Sulphur Emissions.

4 1998 Aarhus Protocol on Persistent Organic Pollutants.

5 1998 Aarhus Protocol on Heavy Metals.

Since 2000, the information reported by Parties via the questionnaire has been summarized and published every four years.[6] 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.

As of 22 May 2010, 51 member countries of UNECE and the European Community were Party to the Convention. The 2010 Review reflects the continued efforts made by Parties to implement the Convention and its seven substantive protocols, with a focus on the three most recent protocols. It is based on replies to the 2010 questionnaire on strategies and policies for air pollution abatement received from 28 of the 51 Parties to the Convention.

A. The Convention

The Convention has been a major contributor to international policy on reducing transboundary air pollution and an essential framework for controlling and reducing the damage to human health and the environment caused by such pollution through research, monitoring, policy and legislative action. In

6 The 2000, 2002 and 2006 Reviews are available at http://www.unece.org/env/lrtap/conv/conclusi.htm. Parties' responses to the 2010 and the earlier on-line questionnaires are available at: http://apps.unece.org/ehlm/WebApt/Questionnaire/login.aspx. (Username: "guest", no password required).

the 30 years of its existence, the Convention has been extended by eight protocols, seven of which address specific pollutants and environmental problems such as acidification and eutrophication.

The 2010 Review presents progress to date in implementing the Convention and its seven substantive protocols, with a focus on the three most recent protocols. It is based on replies to the 2010 questionnaire on strategies and policies for air pollution abatement received from 28 of the 51 Parties to the Convention.

Concentrations of SO_2 in Europe continued to decrease, falling 70% from 1990 to 2008. Over the same period, other pollutants have also decreased: NO_x by 32%; VOCs by 45%; and NH_3 by 29%.

Effects, particularly acidification, have fallen in line with the decrease in emissions. This was especially notable in freshwaters in some regions. However, there remain concerns about nitrogen depositions, ozone concentrations and the effects of particulate matter (PM) on human health.

The Executive Body continues to place increased emphasis on the implementation of the Convention and its protocols, in particular in Parties with economies in transition. This objective is promoted through a dedicated action plan and several donor-funded projects coordinated by the secretariat. Furthermore, the obligations of the three most recent protocols have been revised and now include, inter alia, more flexibility, e.g., with respect to implementation timescales and to facilitate their ratification.

The Convention adopted a long-term strategy for 2010–2020, which takes stock of important scientific and policy developments regionally and globally relating to air pollution issues such as climate change and biodiversity and defines its future priorities, work programme and organizational structure accordingly. The vision for the next 10 years is based on the Convention's strong link between science and policy and its ability to negotiate strong regional agreements to improve the environment and protect human health.

B. Implementation of the protocols and progress on national strategies and policies

The Gothenburg Protocol aims to simultaneously address the three effects it describes through controlling and reducing the emissions of SO_2, NO_x, NH_3 and VOCs. Following negotiations to revise the obligations under this protocol, the amended protocol will also address PM and black carbon once it enters into force. Emissions from mobile sources were well controlled in the majority of responding countries. For existing stationary sources the level of emissions continued to vary significantly between countries. All Parties reported on their efforts with respect to introducing and implementing best available techniques (BAT). Specific non-technical measures reported by Parties included promoting renewable sources of energy, fuel switching and increased energy efficiency. The linkage with climate change was noted, with Parties reporting that efforts to reduce greenhouse gases also contributed to reducing air pollutants under this Protocol and vice versa. The majority of responding Parties had specific strategies in the agricultural sector to limit emissions from slurry and manure application and storage, including rules on the time of day and means of application and guidelines on livestock housing and management.

The Protocol on POPs sets out to eliminate any discharges, emissions and losses of POPs by banning or restricting their production and use. Originally the Protocol recognized a list of 16 POPs. After the entry into force of the 2009 amendments to the Protocol, it regulates altogether 23 hazardous substances. In addition, in 2010 further five substances were included into the Protocol. All responding Parties reported a ban on import, production and use of the substances originally included in the annex I to the Protocol. Progress was reported on the environmentally responsible elimination of remaining substances under annex I, including their safe transport. Countries that did not have the facilities to eliminate these substances safely exported them to appropriate facilities abroad. Responses from Parties indicated varying degrees of removal of substances originally listed in annex II for which uses were restricted under the 1998 Protocol.

The main objective of **the Protocol on Heavy Metals** is to control the human-induced emissions of cadmium, lead and mercury. Following negotiations to revise the obligations under this protocol, more stringent emission limit values were introduced and the scope of industrial activities to which they apply was extended. Significant reductions in lead were achieved by most Parties through the phasing out of leaded petrol. BAT was promoted in most responding countries and was integrated into permits for new stationary sources emitting heavy metals. The majority of responding Parties reported limit values for most stationary sources as being within those set in annex V to the Protocol.18.

The 1994 Sulphur Protocol provides for the control of the sulphur content of fuel, energy-efficiency measures, the promotion of renewable energy and the application of BAT. Most Parties to the Protocol indicated that they promoted energy efficiency mainly through subsidies, grants and tax breaks, e.g., in the transport and building sectors. The reported measures to promote renewable energy simultaneously targeted reductions in greenhouse gas emissions. Many Parties had set specific targets for their desired share of energy from renewable sources.

Although the 1994 Protocol superseded **the 1985 Sulphur Protocol,**[7] a few Parties did not accede to it and remain bound by the obligations of the latter. The most frequently cited measures to reduce SO_2 emissions related to limits and caps, including in relation to power generation and mobile sources, and economic measures such as taxes and fiscal incentives. All Parties had achieved at least the 30% reductions in SO_2 emissions required by this Protocol, with many having exceeded this amount.

The Protocol on VOCs requires Parties to control and reduce their emissions of VOCs in order to reduce their transboundary fluxes and the fluxes of the resulting secondary photochemical oxidant products so as to protect human health and the environment. Parties reported on a range of techniques and limits to reduce their emissions emitted from a diversity of sources. The European Union (EU) member States referred to their implementation of the relevant EU legislation.

The NO_x Protocol requires Parties to take effective measures to control and/or reduce their annual emissions of NO_x, to apply national emissions standards to sources and to introduce pollution control measures for major sources. The majority of Parties had reached their targets under this Protocol, while others reported significant reductions. Some of the reported measures to control NO_x emissions from major stationary sources included retrofitting low NO_x burners, retrofitting selective catalytic reduction units, using combined cycle or cogeneration configurations, modernizing fusion aggregates and introducing Emission Optimized Sintering (EOS) systems.

[7] 1985 Helsinki Protocol on the Reduction of Sulphur Emissions or their Transboundary Fluxes by at least 30 per cent.

C. General trends and priorities in combating air pollution

In most Parties the ministry of the environment was the lead authority in combating air pollution and air quality issues were integrated within broader environmental protection plans. A number of Parties reported on regular collaboration between the ministry of the environment and other ministries, while others felt that inter-ministerial collaboration needed further improvement. Several Parties reported that they applied a multi-pollutant management approach, and applied measures to simultaneously address air pollution and climate change. Parties reported on the use of economic measures such as taxes, grants, licensing and voluntary schemes to reduce emissions from industrial sources. In the transport sector, significant efforts were being made by Parties to promote cycling, to improve public transportation and to improve fuel quality. Parties indicated a clear trend towards increased use of renewable sources of energy and improved energy efficiency in buildings. In the agriculture sector, many Parties reported on measures such as alternative livestock feeding strategies, improved practices for manure storage and spreading, low-emission animal housing systems and the use of mineral fertilizers.

A number of Parties mentioned that their research activities were linked to those of EMEP and its task forces, while others emphasized research relating to both climate change and air pollution. Technology exchange, both at the national and the international levels, was reported by a number of countries. The active role of the public in defining policies related to air pollution was also reported by various Parties.

INTRODUCTION

A. Mandate and general objectives

1. The 2010 Review provides an overview of the activities undertaken in the framework of the 1979 Convention on Long-range Transboundary Air Pollution (the Convention) and presents progress in implementing the Convention and its protocols. It also summarizes the replies to the 2010 questionnaire on strategies and policies (ECE/EB.AIR/2009/12 and ECE/EB.AIR/2009/13) received from 28[8] of the 51 Parties to the Convention by 22 May 2010.

2. In 2009, the Executive Body approved the protocol-related and general policy questions of the 2010 questionnaire, invited the secretariat to make the questionnaire available online and requested the Parties to reply to it by the deadline of 31 March 2010.

3. The questionnaire on strategies and policies, circulated every two years, is intended to assist Parties in providing information as required under the seven substantive protocols to the Convention. In 2009, the Executive Body decided that the 2010 questionnaire would represent the uniform reporting framework referred to in article 8, paragraph 2, of the Nitrogen Oxides (NO_x) Protocol;[9] article 8, paragraph 4, of the Protocol on Volatile Organic Compounds (VOCs);[10] article 5, paragraph 1, of the 1994 Sulphur Protocol;[11] article 9, paragraph 2, of the Protocol on Persistent Organic Pollutants (POPs);[12] article 7, paragraph 2, of the Protocol on Heavy Metals;[13] and article 7, paragraph 2, of the 1998 Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (the Gothenburg Protocol).

4. Since 2000, the information reported by Parties via the questionnaire has been summarized and published every four years.[14]

5. The overall aim of the reviews is:

(a) To assess the progress made by Parties and the region as a whole in implementing the Convention and its protocols;

(b) To facilitate the exchange of information between Parties on the activities for air pollution abatement, as required by the Convention and its protocols; and

(c) To raise awareness of the problems of air pollution, as well as to make the Convention's contribution to successful abatement of pollution more visible, in particular with a view to promoting the ratification of the protocols by the countries in Eastern Europe, the Caucasus and Central Asia.

B. Main contents

6. The 2010 Review includes an executive summary and the following main chapters:

(a) Chapter I presents an overview of the Convention and its recent activities, including in particular the revision of the three most recent protocols and the capacity-building activities in Eastern Europe, the Caucasus and Central Asia. Future priorities under the Convention are also presented;

[8] Austria, Belarus, Bulgaria, Canada, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Germany, Hungary, Italy, Liechtenstein, Netherlands, Norway, Poland, Romania, Russian Federation, Slovakia, Slovenia, Spain, Sweden, Switzerland, United Kingdom of Great Britain and Northern Ireland, Ukraine, United States of America and European Union.

[9] 1988 Sofia Protocol concerning the Control of Emissions of Nitrogen Oxides or Their Transboundary Fluxes.

[10] 1991 Geneva Protocol on Volatile Organic Compounds or Their Transboundary Fluxes.

[11] 1994 Oslo Protocol on Further Reduction of Sulphur Emissions.

[12] 1998 Aarhus Protocol on Persistent Organic Pollutants.

[13] 1998 Aarhus Protocol on Heavy Metals.

[14] The 2000, 2002 and 2006 Reviews are available at http://www.unece.org/env/lrtap/conv/conclusi.htm. Parties' responses to the 2010 and the earlier on-line questionnaires are available at: http://apps.unece.org/ehlm/WebApt/Questionnaire/login.aspx. (Username: "guest", no password required).

(b) Chapter II outlines trends in air pollution emissions and effects in the region in recent years. It is based on information provided by the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP) Centre on Emission Inventories and Projections (CEIP), using data submitted by Parties in 2010 and data submitted to the International Cooperative Programmes under the Convention's Working Group on Effects;

(c) Chapter III of the review highlights progress made by responding Parties in meeting their obligations under the protocols, with a focus on the three most recent protocols;

(d) Chapter IV presents an overview of the national institutional and regulatory frameworks for air pollution abatement, as well as of policy measures and economic instruments for addressing the emissions from the main economic sectors.

7. To avoid overlaps in the information reported and to emphasize implementation of the Gothenburg Protocol, the strategies and policies to reduce emissions of sulphur dioxide (SO_2), NO_x, ammonia (NH_3) and VOCs reported by the Parties to the Gothenburg Protocol are summarized in the section dedicated to that Protocol. The sections on the 1985 and 1994 Sulphur Protocols, the Protocol on NO_x and the Protocol on VOCs only refer to the replies by those countries that are not yet Parties to the Gothenburg Protocol.

I. CONVENTION ON LONG-RANGE TRANSBOUNDARY AIR POLLUTION

A. Status of ratification of the Convention and its protocols

8. With 51 out of the 56 United Nations Economic Commission for Europe (UNECE) member countries being Parties to the Convention, the Convention covers virtually the entire area of the UNECE region in Europe and North America (see Figure 1: Parties to the Convention on Long-range Transboundary Air Pollution). While only two countries from Central Asia are currently Parties (Kazakhstan and Kyrgyzstan), the remaining three (Tajikistan, Turkmenistan, and Uzbekistan) are involved in work that can lead to accession. Capacity-building in Eastern Europe, the Caucasus and Central Asia and in South-Eastern Europe is increasingly important in the Convention's work, and some of that work is described in section C below.

9. The Convention successfully negotiated and adopted eight legally binding protocols to control specific pollutants, all of which have entered into force. Furthermore, the three most recent protocols have been revised and continued efforts by Parties to ratify or accede to the more recent and revised protocols will further strengthen endeavours to meet the targets set by the protocols (see Figure 2: Status of ratification of protocols as of November 2013). Overall targets for the region for most pollutants covered by the protocols are being met, though the successes of individual Parties vary.

B. Activities in the framework of the Convention

10. 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 decisions, reports (such as this review) and agreeing its annual workplans, as well as developing strategies for its future work. The sessions of the Executive Body provide a forum for Parties to adopt protocols and amendments to them.

11. 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.

12. The Implementation Committee consists of nine 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 Convention's protocols and recommends action for encouraging compliance.

13. The work of the three main subsidiary bodies is described below with reference to recent achievements (see Figure 3: Organizational structure of the Convention).

1. Working Group on Strategies and Review

14. Having first focused on negotiating protocols for consideration by the Executive Body, in 1999, the Working Group on Strategies 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.

15. The three most recent Protocols (the Protocols on POPs and Heavy Metals and the Gothenburg Protocol) require Parties to keep under review the sufficiency and effectiveness of their obligations. The reviews provide the basis for possible revisions and updates of these Protocols. Furthermore, to facilitate ratification by countries with economies in transition of the UNECE region, the Working Group explores options for building in more flexibility into the obligations of these three Protocols, for instance with respect to timescales for their implementation.

16. For the scientific and technical preparatory work, background documents and recommendations considered in the formal review and revision of the protocols, the Working Group relies on inputs from all the Convention bodies and programme centres. The Executive Body has established four technical groups (Task Forces on Heavy Metals, POPs and Reactive Nitrogen and the Expert Group on Techno-economic Issues) that assist the Working Group in the review and revision of the protocols, their technical annexes and the related guidance documents, as needed.

17. The Expert Group on Techno-economic Issues has been instrumental in informing the negotiations for updating the technical annexes to the Gothenburg Protocol and the guidance documents connected to it, including on cost-effective abatement techniques and technologies and the impact of emerging technologies on air pollution abatement. The Task Force on Reactive Nitrogen was established in 2007 to address the need for a more integrated approach to understand and control the emissions of nitrogen, taking into consideration the full cycle of reactive nitrogen. Furthermore, the Task Force carries out work for the revision of the measures for the control of ammonia in the Gothenburg Protocol and has taken on the work of the former Expert Group on Ammonia Abatement to regularly update the Guidance document on control techniques and the Framework advisory code on good agricultural practice. The Task Forces on Heavy Metals and on POPs are also charged with reviewing any new substances proposed by Parties for addition to the protocols.

18. The EMEP Task Force on Integrated Assessment Modelling and the Centre for Integrated Assessment Modelling (CIAM), in collaboration with the Working Group on Effects, have been charged with most of the preparatory work for the revision of the emission ceilings in the Gothenburg Protocol and proposing of new environmental and health targets. In addition, ad hoc expert groups have been set up for a limited period of time to accomplish specific tasks in connection with the Gothenburg Protocol review and revision, notably on PM and on black carbon. For the numerous questions of legal nature in relation to the legal instruments and their revision, the Working Group refers to an ad hoc group of legal experts.

19. The Working Group has completed the reviews of the Protocols on POPs, Heavy Metals and the Gothenburg Protocol based on which these Protocols have been amended.

2. Cooperative Programme on Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe

20. Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP) was established before the adoption of the Convention as a consequence of rising awareness in Europe, the United States and Canada of the environmental damage caused by deposition of acidifying pollutants. Its implementation and development is described in article 9 of the Convention. The main objective of the programme is to provide sound scientific support for the Convention mainly in atmospheric monitoring and modelling; emissions inventories and projections, and integrated assessment.

21. Five programme centres (the Chemical Coordinating Centre, the Meteorological Synthesizing Centre-West, the Meteorological Synthesizing Centre-East, CIAM and the Centre on Emission Inventories and Projections) and four task forces coordinate the work of

EMEP. The EMEP centres and task forces report to the EMEP Steering Body, which reviews their activities at its annual sessions.[15]

22. There are now 45 Parties to the 1984 Protocol on Long-term Financing of EMEP which provides funding for the work. The work of EMEP continues to expand as increasing numbers of Parties report data and establish monitoring stations. Parties to protocols are required to report emissions of the associated pollutants in accordance with the Convention's Guidelines for reporting emission data[16] and to submit their emission inventories to regular in-depth reviews, with a view to minimizing uncertainties related to data collection and reporting. Parties to the Convention that have not yet ratified protocols with reporting obligations are nevertheless encouraged to report on their emissions in line with the Guidelines and many of them do so.

23. The emissions database is available at http://www.ceip.at/. Emission data are used to model the transport of pollution across Europe and to quantify overall deposition of pollutants and country-to-country deposition matrices. The modelling results form the basis for developing and implementing abatement measures to protect human health and threatened ecosystems and are therefore key to the development of air pollution strategies and policies.

24. Integrated assessment models use emissions data, atmospheric air pollution transport models and effects in combination with available control techniques to develop cost-optimized strategies, which maximize benefits for the environment and human health. The effects of acidification, eutrophication, PM and ozone exposure are described with exceedances of critical loads for different ecosystems and human health indicators.

25. In 2009, EMEP developed a monitoring strategy for 2010–2019 to ensure sufficient ongoing long-term monitoring of concentrations and deposition fluxes in a way that is affordable for all Parties and that reflects the scientific development and emerging capabilities at the national levels.

26. An overall EMEP strategy for 2010–2019 was adopted in 2009. The strategy addresses acidification, the reactive nitrogen cycle, ozone formation, PM, heavy metals and POPs. The strategy takes into account relevant policy developments under the Convention and elsewhere, including in the EU. For example, one of the objectives of the negotiations that led to the revision of the Gothenburg Protocol was to address PM, which had been the subject of scientific investigations and a driving force of relevance to the work of EMEP for several years. In addition, climate variability and change have consequences for atmospheric composition which EMEP takes into account in its work with the aim of supporting development of policies that recognize the co-benefits of harmonized air pollution and climate change emission reduction strategies. Processes related to regionalization and globalization, an increasing emphasis on the intercontinental transport of air pollution and its contribution to pollution in various regions, as well as the extension of the EMEP domain to areas in the eastern part of the UNECE region, are included in the strategy. EMEP also cooperates with other Conventions and initiatives which offer opportunities to further extend its work in support of policy developments.

3. Working Group on Effects

27. 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. Since the early 1980s, the Working Group has provided a unique framework for comprehensive air pollution effects monitoring and research that is science-based and policy relevant. This research, based largely on observational evidence, has documented widespread causal effects of air pollution of a variety of receptors in Europe and North America.

28. The Working Group manages six international cooperative programmes (ICPs) that study aquatic and terrestrial ecosystems and materials.[17] Effects of pollution on buildings, materials and cultural heritage sites have been studied by ICP Materials. ICP Modelling and Mapping has been responsible for developing maps of critical loads that show the effects of acidification, eutrophication and heavy metals. Monitoring by ICP Vegetation has shown the widespread effects of ozone on crops and other vegetation across Europe. The extensive defoliation and intensive forest sites of ICP Forests have shown the continued damage to forests

[15] Details on the work of EMEP are available at http://www.emep.int/. For documents of the EMEP Steering Body see: http://www.unece.org/env/lrtap/emep/documents.htm.

[16] Guidelines for reporting emission data under the Convention on Long-range Transboundary Air Pollution (ECE/EB.AIR/97) and other reporting instructions are available at: http://www.ceip.at/reporting-instructions/.

[17] Additional information, including details on each of the ICPs, can be found at http://www.unece.org/env/lrtap/WorkingGroups/wge/welcome.html.

from air pollution. The lakes and streams monitored by ICP Waters have shown trends in both damage and recovery of aquatic systems in many parts of the region. ICP Integrated Monitoring has determined and predicted the state of ecosystems and their changes from a long-term perspective with respect to the impact of air pollutants, especially nitrogen, sulphur and metals. A joint Task Force on Health with the World Health Organization (WHO) considers the health effects of air pollution using, for example, the analysis of data from epidemiological studies.

29. The Working Group prepares an annual review of the activities and results of the ICPs, the Task Force on the Health and the Joint Expert Group on Dynamic Modelling. In addition, in 2008, it prepared a consolidated report on air pollution effects which summarizes current information.

C. Capacity-building activities

30. The Convention actively supports the increased participation of the countries in Eastern Europe, the Caucasus and Central Asia and South-Eastern Europe in the Convention's activities and promotes their accession to the protocols to tackle air pollution and its environmental and health impacts in these countries. It promotes as a priority the implementation and ratification of the three most recent protocols to the Convention and the EMEP Protocol. In 2005, the Executive Body adopted a dedicated action plan to promote efforts to this end. The action plan was revised in 2007 and its implementation is regularly reviewed by the Working Group on Strategies and Review.[18] Parties to the Convention have also been urged to contribute to a trust fund administered by the Convention secretariat for assisting the countries with economies in transition to implement the action plan.

31. The secretariat's initiatives to better understand and effectively target the needs of the countries in the subregion in question have indicated that the capacity-building activities should focus on establishing and improving the policy and legislative frameworks and technical capacities in these countries. To date, the secretariat has already coordinated a number of donor-funded projects aimed at the development of national action plans for the implementation of the protocols, taking into account specific legislative and environmental challenges. The module for the project implementation developed by the secretariat includes three phases: (a) a design phase, including a launching event and the development of a project proposal for potential donors and stakeholders; (b) an elaboration phase, involving the development of a national action plan; and (c) an implementation phase, focusing on enforcement of actions specified in the national action plan with the assistance of the secretariat and partner countries.

32. In April 2010, the secretariat organized a special session on the Convention's activities to facilitate the implementation and ratification of the three most recent protocols by countries in Eastern Europe, the Caucasus and Central Asia and South-Eastern Europe. Several capacity building projects were presented at this session:

(a) **The project to support to the implementation of the Gothenburg Protocol in the Republic of Moldova** was funded by the Czech Republic. It focused on the establishment of a high-quality national emission inventory and the improvement of the country's capacity for integrated assessment modelling. As part of the project implementation, a gap analysis of national air quality legislation was completed and the costs of the technical and economic measures related to the implementation of the Gothenburg Protocol were assessed. The Government is now in the process of completing its national action plan for the implementation and ratification of the Gothenburg Protocol and for submitting data to CIAM and the Chemical Coordinating Centre (CCE);

(b) **The Western Balkans Project**, financed by the Netherlands, aimed at assisting Albania, Bosnia and Herzegovina, Montenegro, Serbia and the former Yugoslav Republic of Macedonia in implementing and ratifying the Heavy Metals, POPs and Gothenburg Protocols.

(c) **The Joint Project of the Russian Federation, Belarus and Kazakhstan** aimed at assisting the countries in Eastern Europe, the Caucasus and Central Asia to ratify and implement the three most recent protocols to the Convention. Following the presentation of the project's design phase in April 2010, the financial contributions from Switzerland and the Russian Federation have allowed the project to proceed to the next phase involving the development of national implementation and ratification strategies.

33. At its twenty-eighth session in 2010, the Executive Body established a Coordinating Group. In line with its

[18] ECE/EB.AIR.WG.5/2009/13.

terms of reference, the Coordinating Group will review the current work on implementation of the Convention in countries of Eastern Europe, the Caucasus and Central Asia and assess the lessons learned; promote the implementation of the Convention and its mechanism on air quality management in these countries through information exchange and capacity-building; jointly assess with other relevant bodies of the Convention the costs and benefits of prospective accession to the latest protocols by the countries of this subregion; develop and maintain the information databases on scientific, technical and policy documentation related to the Convention in the Russian language; develop and implement joint projects aiming at accession to the latest protocols to the Convention; and elaborate joint recommendations on strategic issues of the Convention.

D. Future priorities under the Convention

34. The Executive Body of the Convention developed a long-term strategy for the Convention for 2010–2020. In view of the important scientific and policy developments regionally and globally over the past 10 years relating to air pollution issues, such as climate change and biodiversity, the Convention assessed its priorities in relation to these wider issues and will be deciding on its future work programmes and organizational structure accordingly. Moreover, the vision for the next 10 years is based on the Convention's strong link between science and policy and its ability to negotiate strong regional agreements to improve the environment and protect human health, which has led the way for a wider global approach for POPs and heavy metals.

35. A major strength of the Convention is its geographical coverage of most of the Northern Hemisphere. Increased ratification, implementation and compliance with existing protocols will continue to be a high priority in the Convention. In particular, the Executive Body reaffirmed that a more active participation of countries in Eastern Europe, the Caucasus and Central Asia and South-Eastern Europe was one of the key priorities, stressing the need for support directed to assist these countries in ratifying and implementing the three most recent protocols to the Convention.

36. PM, the linkages between air pollution and climate change, hemispheric transport of air pollution and reactive nitrogen in the environment are the newer challenges facing the Convention. The reduction of black carbon, as part of PM, is important due to its toxicological effects and contribution to climate change. In 2009, the Executive Body established the Ad Hoc Expert Group on Black Carbon to review the current state of black carbon research and explore future strategies for reducing the pollutant's emissions. The Group's work contributed to improved coordination of black and organic carbon-related activities, with the aim of improving public health in the UNECE region while achieving reductions that will also benefit the climate in the near term.

37. The Convention's work on hemispheric transport[19] may provide information on a broader scale, but political involvement of countries outside the region is likely to be a long-term challenge. In addition, the threat of eutrophication of sensitive ecosystems continues in large areas of the UNECE region despite the reductions in emissions in nitrogen-containing air pollutants. Links could be established between eutrophication, including the acidifying effects of nitrogen deposition, and changes in biodiversity in sensitive ecosystems dependent on nutrient-poor conditions.

38. Cooperation on air pollution can extend beyond the UNECE region. Other organizations such as WHO, the World Meteorological Organization, the United Nations Environment Programme (UNEP), the United Nations Framework Convention on Climate Change, the Stockholm Convention on Persistent Organic Pollutants and the Convention on Biological Diversity are now addressing issues of importance to air pollution and it will be important for the Convention to formulate additional ways of working with these bodies.

39. Science will remain an essential component of the Convention and the content and balance of the scientific programme will need to reflect its overall policy priorities. While the scientific links between the Convention and other regions of the world are growing, the challenge remains how to link policy development in one part of the world with that in another. This will only be achieved through keen understanding of the needs in other regions. The goal is for the Convention to be a leading regional framework, working with other bodies, in addressing the remaining and emerging transboundary air pollution challenges in the twenty-first century.

[19] The 2010 Hemispheric Transboundary Air Pollution Report is available at http://www.unece.org/fileadmin/DAM/env/lrtap/Publications/11-22136-Part-D.pdf.

II. Trends in air pollution emissions and effects

A. Emission levels and trends

40. Reporting of high-quality emission data is essential for assessing the state of air pollution within the UNECE region and for establishing the compliance of Parties with their protocol commitments. Parties submit data each year in accordance with the Guidelines for reporting emission data and the EMEP/EEA Air Pollutant Emission Inventory Guidebook (the Guidebook).[20] The data summarized in this report correspond to the latest available annual emissions submitted by Parties until 2010.[21] Emission totals for the major air pollutants were reported by approximately 84% of the Parties to the Convention.

41. Emissions of SO_2 in Europe continued to show a clear downward trend. The total emissions for all Convention Parties within the geographical scope of EMEP[22] was estimated to be 12,220 Gg (SO_2) in 2008, representing a decrease of 70% since 1990. SO_2 emissions reported by Parties with targets under the Gothenburg Protocol decreased by 77% (see Figure 4: Emission trends of sulphur in the EMEP area 1990-2008 and 2010). This implies that, over the whole EMEP area, the emission target for SO_2 for the Gothenburg Protocol for 2010 had already been reached in 2008. However, there are significant differences in the achievements of individual Parties.

42. For emissions of NO_x, the situation is not as satisfactory. Total emissions of all Parties within the EMEP area have fallen to 17,062 Gg (NO_x) in 2008, a 32% reduction from 1990 levels. NO_x emissions reported by Parties with targets under the Gothenburg Protocol decreased by 41% (see Figure 5: Emission trends of NOx in the EMEP area 1990-2008 and 2010). 65. Estimated ammonia emissions in the EMEP region decreased by 29% from 1990 levels, in 2008 they totalled 6,070 Gg. NH_3 emissions reported by Parties with targets under the Gothenburg Protocol decreased by 29% as well (see Figure 6: Emission trends of ammonia in the EMEP area 1990-2008 and 2010) 66.For non-methane volatile organic compounds (NMVOCs), emissions in 2008 were 13,775 Gg, a decrease of 45% from 1990 levels. NMVOC emissions reported by Parties with targets under the Gothenburg Protocol decreased by 53%. In the EMEP area as a whole, the Protocol emission target for NMVOCs for 2010 had been reached in 2008 (see Figure 7: Emission trends of NMVOCs in the EMEP area, 1990-2008 and 2010).

43. For POPs, emissions of polychlorinated dibenzo-(p) dioxins and dibenzofurans (PCDD/PCDF) within the EMEP domain were estimated to be 5,913 g I-TEQ in 2008. This represents a decrease in PCDD/PCDF emissions by 63% since 1990. In 2008, polycyclic aromatic hydrocarbon (PAH) emissions were estimated at 1,519 Mg (PAH), a fall of 59% from 1990 levels, and hexachlorbenzol (HCB) emissions were estimated at 14,356 Mg, a decrease of 31% from 1990 levels (see Figure 8: Emission trends of POPs in the EMEP area, 1990-2008).

44. Regarding emissions of lead, cadmium and mercury, between 1990 and 2008, total anthropogenic emissions in the EMEP region decreased for all three heavy metals, for lead by about 82% (from 34.9 Gg/year to 6.4 Gg/year), for cadmium by about 43% (from 0.484 Gg/year to 0.278 Gg/year) and for mercury by about 47% (from 0.331 Gg/year to 0.177 Gg/year) (see Figure 9: Emission trends of heavy metals in the EMEP area 1990-2008).

45. Officially reported estimates for acidifying pollutants NO_x, SO_x and NMVOCs for the United States and Canada indicate a decrease between 1990 and 2008 of their emissions of SO_x (50%), NO_x (35%) and NMVOCs (33%). NH_3 emissions in North America decreased only by 5% overall, with an increase of 12% for Canada and a 7% decrease for the United States (see Figure 10 a-10 f: Emission trends in North America 1990-2008).

46. In 2008 the EMEP grid was extended eastwards to include further parts of the Russian Federation and Kazakhstan, as well as Uzbekistan, Turkmenistan and Tajikistan. Due to the insufficiency of the officially reported data, emissions from the extended areas were only estimated and imply significant uncertainties. For 2008, SO2 emissions in the extended areas were estimated at 6,552 Gg; NOx emissions at 2,063 Gg; NH3 emissions at 1,413 Gg; and emissions of NMVOCs at 1,439 Gg. For gridded maps showing the total emissions within the geographical scope of EMEP in 2008 for sulphur, nitrogen oxides, ammonia, NMVOCs and PM see Figure 11 to Figure 15.

[20] The Guidebook developed by EMEP and the European Environment Agency (EEA) is available athttp://www.eea.europa.eu/publications/emep-eea-guidebook-2013.

[21] For Parties where no data were submitted the emissions were estimated.

[22] Emissions reported by the United States and Canada and estimated emissions for North Africa, the sea areas and the extended EMEP area are not included.

47. Main sources of emissions by sector for the EMEP area are presented for the "Western"[23] and "Eastern" part in Figure 16 to Figure 22. A number of emission categories were identified as being key[24] (for both Western and Eastern Europe) for more than one of the 13 pollutants assessed. 10 pollutants (all except NMVOC and NH3) are emitted mainly in combustion processes. 1A4bi 'Residential – Stationary plants' is one of the most important sources regarding the thirteen pollutants assessed: 1A4bi is a key source of all pollutants except NH3 and HCB in Eastern Europe and mostly ranks among the top 3 key categories. 1A2fi 'Stationary Combustion in Manufacturing Industries and Construction – Other' is among the key categories for 7 assessed pollutants (except NMVOC, NH3, CO-East, PCDD/PCDF-East, PAH and HCB). 1A1a 'Public Electricity and Heat Production' is the key source of SOx, NOx, PM, Cd, Hg, Pb and PCDD/PCDF-West and HCB-East. The significant share of NOx, NMVOC, SOx, CO and PM emissions reported in Eastern Europe in category 7A 'Other' indicates that emissions in other categories for Eastern Europe are possibly underestimated.

48. Reductions in emissions of SO_x, NO_x, ammonia and NMVOC between 1990 and 2008 are presented per country in Figure 23 and Figure 24.

B. Trends in effects

49. There are a number of health and environmental effects from air pollution (see Figure 25: Effects of pollutants covered by the Convention's protocols). The Working Group on Effect's six ICPs and the Task Force on Health identify the most endangered areas, ecosystems and other receptors by considering damage to human health, terrestrial and aquatic ecosystems and materials. They also track the status and trends of the effects still being observed. The effects-oriented work has initiated and supported the development of air pollutant emission reduction protocols under the Convention. In addition, the effects-oriented activities have considered aspirational targets to describe the potential status of the environment and human health. Aspirational targets were set up for the year 2050.

50. For human health effects, the current levels in the WHO Air Quality Guidelines[25] should be considered as the health-related targets for air quality. The data used for the following analysis relate to 2008 and cover 32 European countries. A small decrease of coarse PM (PM_{10}) levels has been observed in 2007–2008 compared with the period 2000–2006. However, about 90% of the urban population of Europe continues to live in cities where the WHO levels for annual mean PM_{10} are exceeded. Monitoring of fine PM ($PM_{2.5}$) is expanding and is conducted in about 500 locations. In Eastern Europe, the Caucasus and Central Asia monitoring of PM is still very limited. Research continues to demonstrate the effects of PM on mortality and cardiopulmonary disease in children, adults and the elderly.

51. The Task Force on Health has concluded that ozone was one of the air pollutants with the most important negative health impacts in Europe. It was associated with 21,000 annual premature deaths in 25 EU member States. New areas of research include the impacts on neurological effects (migraines and cognitive performance). Recent observations in both North America and Europe have shown that as concentrations of ozone increase (due to human activities or episodes of very hot weather), health effects become increasingly numerous and severe. Current policies would not be sufficient to reduce impacts significantly during the next decade.

52. For Heavy Metals, the Task Force assessed the health effects and concluded that further emissions of cadmium into the atmosphere or soil should be avoided, concentrations of mercury in fish should be reduced and emissions of lead into the atmosphere should be kept as low as possible.

53. Trends in the effects on materials identified by ICP Materials over the period 1987–1997 showed decreasing trends in corrosion of all trend materials (carbon steel, zinc and limestone). During 1997–2003 the corrosion rate of carbon steel continued to decrease, but the corrosion rate of zinc and limestone increased slightly. Additional actions are needed in order to meet the 2020 and 2050 targets for protecting infrastructure and cultural heritage, as there were no substantial changes in corrosion compared with the exposures in 2005–2006 and 2008–2009.

54. Effects on forests have been assessed through crown condition observations at 6,000 ICP Forests "extensive monitoring sites". As a result of air pollution control measures implemented under the Convention,

[23] Western European countries included = Austria, Belgium, Denmark, Finland,, France, Germany , Greece, Iceland, Ireland, Italy, Liechtenstein, Malta, Monaco, Netherlands, Norway, Portugal, Switzerland, Spain, Sweden. United Kingdom.

[24] A key category (KC) is one that is prioritised within national inventory systems because it has significant influence on a country's total inventory in terms of absolute level of emissions, the trend in emissions, or both. Key categories considered in this report are those which, when summed up in descending order of magnitude, cumulatively add up to 80% of the total level.

[25] WHO Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulphur dioxide — Global update 2005: Summary of risk assessment.

acidic deposition has decreased. Despite this success, critical loads for sulphur are still exceeded on a quarter of the monitoring plots studied and critical loads for nitrogen are exceeded on over 65% of the plots studied, particularly those in Central Europe. For 2010, ICP Forests calculated 10 years of deposition time trends for the mean of 150 forest monitoring plots. The decrease in sulphate inputs was confirmed, and 50% of the plots showed a decrease, but no trends could be detected on the rest of the plots. Soil acidification remained a possible threat to forest vegetation in parts of Europe. There were hardly any visible trends for nitrogen compounds.

55. Freshwaters in Europe and North America are responding positively to decreasing emissions of sulphur and nitrogen. However, the trend assessment on acidification in aquatic ecosystems up to 2004 by ICP Waters showed that acidification remained a problem in some parts of Europe, although its effects were decreasing in Western Europe. The biological recovery is slow and not widespread.

56. The work of ICP Waters has recently focused on mercury in aquatic ecosystems and the effects of nitrogen deposition on nutrient-poor aquatic ecosystems. It has shown considerable evidence that nitrogen enrichment through nitrogen deposition affected primary production in nutrient-poor boreal and Arctic lakes. The finding challenged the reigning paradigm of freshwater primary productivity being limited by phosphorus, suggesting that additional nitrogen did not affect the growth of algae and other organisms. Assessment of mercury in water, lake sediments and fish, has shown that mercury concentrations in fish were increasing in northern boreal lakes. Levels in fish in Europe and North America were frequently above thresholds advised for human consumption. The high and increasing mercury concentrations in fish were in contrast to the low concentrations in water and in lake sediment data, indicating reduced mercury deposition since the 1990s.

57. ICP Integrated Monitoring has calculated site-specific critical loads for acidification, showing evidence of decreasing lead concentrations in organic layers of soil and of decreasing cadmium. Mercury showed no sign of decrease. On the basis of the critical loads of acidification of aquatic ecosystems calculated at 16 Integrated Monitoring sites, only 4 sites (25%) can be considered protected from surface water acidification in 2010. Seven sites will be protected from surface water acidification in 2020 if sulphur deposition decreases as expected. ICP sites in Northern Europe also indicate recovery from acidification. The situation regarding nitrogen is quite different, with few decreasing trends in deposition and both decreasing and increasing trends in run-off/soil water.

58. ICP Vegetation recently reviewed evidence of widespread ozone damage to vegetation in Europe. At the local scale, there was evidence of higher ozone damage in years with higher ozone concentrations in regions where climatic conditions were conducive to high ozone fluxes. Current ambient ozone concentrations in the Mediterranean area induced negative impacts on the production and quality of many agricultural and horticultural crop species of economic importance. Despite the high ozone concentrations frequently experienced in Mediterranean areas, observed ozone impacts were often less severe than expected due to interactions with other environmental stresses such as drought. ICP Vegetation concluded that air pollution abatement strategies based on protecting only human health would not protect vegetation from adverse effects of ozone in Northern Europe.

III. Implementation of protocols and progress in national policies and strategies

A. The 1999 Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone

1. Overview

59. The 1999 Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (Gothenburg Protocol)[26] entered into force in May 2005 and has 25 Parties (as of November 2013).[27]

60. The Gothenburg Protocol is a multi-effect, multi-pollutant protocol that sets out to control and reduce emissions of sulphur (SO_2), nitrogen oxides (NO_x), ammonia (NH_3) and volatile organic compounds (VOCs) that

[26] The text of the Protocol is available at http://www.unece.org/env/lrtap/multi_h1.htm.

[27] Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Finland, France, Germany, Hungary, Latvia, Lithuania, Luxembourg, Netherlands, Norway, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, United Kingdom of Great Britain and Northern Ireland, United States of America and European Union. The updated status of ratifications is available at http://www.unece.org/env/lrtap/status/lrtap_s.htm.

contribute to acidification and eutrophication as well as to increasing levels of ground level ozone, all of which have adverse impacts on human health and the environment. The Protocol sets emission ceilings for each pollutant to be reached by 2010 and beyond, as well as limits for emission sources, both mobile and stationary. Furthermore, the Protocol aims to promote exchange of information and technology among Parties, public participation and adoption of strategies, policies, programmes and measures to reduce emissions and increase energy efficiency. It also encourages research, development, monitoring and cooperation to improve scientific understanding on the long-term effect of emissions and their impact on the hemispheric background concentrations of SO_2, NO_x, VOCs, ozone and particulate matter (PM). Once the Protocol is fully implemented, Europe's emissions should be cut significantly for SO_2 (63%), NO_x (41%), VOCs (40%) and ammonia (17%), compared to 1990.

61. The Gothenburg Protocol and its annexes were amended in 2012 to include national emission reduction commitments to be achieved in 2020 and beyond. Several of the Protocol's technical annexes were revised with updated sets of emission limit values for both key stationary sources and mobile sources, as well as with emission ceilings for fine particulate matter. The revised Protocol also introduced flexibilities to facilitate accession of new Parties, mainly countries in Southern and Eastern Europe, the Caucasus and Central Asia.

62. In support of the revision of the Protocol it was computed that the area in Europe with excessive levels of acidification would shrink from 42 million hectares in 2000 to 17 and 4 million hectares in 2020 under base line and maximum feasible emission reductions respectively (see Figure 26).[28] Excessive levels of eutrophication (Figure 27) were computed to fall from 200 million hectares in 2000 to 147 million hectares in 2020 under the base line scenario. Computation also showed that an application of maximum feasible end-of-pipe techniques would further lower the area at risk to 54 million hectares in 2020.

2. Strategies, policies and programmes for implementing the Gothenburg Protocol

63 Most Parties reported that they had specific national strategies for reducing air pollutants regulated under the Gothenburg Protocol, some of them setting national ceilings and standards. In other cases, for example in Romania, air pollution was regulated through environmental laws and decrees implemented jointly by a number of ministries. Several Parties noted also that they had implemented all relevant European Union (EU) directives and policies related to air pollution **or that the national legislation was being harmonized to comply with them, as in Croatia.**

64. Canada had set SO_2 emission reduction targets and caps, including federal regulations of national scope on the SO_2 content of fuels for the transportation sector and regional (provincial) regulations of stationary sources. Industries had introduced cost-effective ways to meet the caps (including modernization of their equipment and processes), thereby maximizing competitiveness and innovation. Canada and the United States reported on plans to negotiate an annex to the 1991 Canada-United States Air Quality Agreement that would specifically target PM.

65. Switzerland reported that it had revisited its policy on air pollution in 2009, since, of the main pollutants, only SO_2 targets had been achieved. Its new strategy was integrated across the different pollutants: NO_x, SO_2, VOCs, NH_3 and PM_{10}, and aimed to reach air quality standards and critical loads for acidity and nitrogen. It defined emission-reduction targets as well as measures and management options in road and non-road traffic, industry, combustion plants and agriculture.

66. Others highlighted financial incentives and taxes as an important element of their strategy to reduce pollutants. For example, Norway made use of economic incentives in order to reduce emissions of SO_2. In Sweden, measures taken to reduce SO_2 emissions included tax incentives for sulphur-free motor oil and disincentives (taxes on coal, peat and oil), and the application of a charge to combustion plants since 1992.

67. Parties also referred to their measures for promoting renewable sources of energy, fuel switching and increased energy efficiency to combat both climate change and air pollution. For Spain, research on and promotion of alternative sources of energy was an important element of its pollution-reduction strategy, involving biofuels in the transport sector, wind energy and a reduction in the use of nitrogenated fertilizers. The United Kingdom noted that, in line with the national air quality strategy, local authorities were required to report back on 198 national performance indicators, including emissions of NO_2. In the United States, national ambient air quality standards had been set for six pollutants, including SO_2, NO_x, ozone and PM. Furthermore, upon the establishment of a new ambient air quality standard, state and local governments would be required to implement plans and programmes to reduce these pollutants by specific deadlines.

[28] Source : Coordination Centre for Effects, 2011.

3. Progress in meeting emission limit values for stationary sources

68. Basic obligations set out in article 3 of the Gothenburg Protocol provide for the application of emission limit values (ELVs) specified in annexes IV, V and VI to the Protocol for each new and existing stationary source.

New stationary sources

69. In Bulgaria, Croatia, the Czech Republic, Denmark, Finland, Germany, the Netherlands, Romania, Slovakia, Slovenia and Spain limit values for SO_2 emissions from new stationary sources varied between 5 milligrams per cubic metre (mg/Nm^3) (for liquefied gas) to 850 mg/Nm^3 (for solid and liquid fuels in power plants of 50–100 megawatt thermal (MWth)), well within the limits set in annex IV to the Gothenburg Protocol. While Norway reported that two of its three new sources produced SO_2 emissions within the limits of the Gothenburg Protocol, the third and most recent plant required optimization of the process to reduce its SO_2 emissions. In Sweden, refineries did not have concentration ELVs, but rather bubble loads ELVs (in tons per year). Switzerland's maximum SO_2 emissions reached 1,700 mg/m^3 for heavy or medium fuel oil in stationary sources of between 50–300 MWth. This Party applied the same limits for both new and existing stationary sources.

70. Annex V to the Protocol sets limits for NO_x in new stationary sources varying from 50 NO_x mg/Nm^3 for onshore combustion sources of more than 50 MWth fuelled by natural gas, to 1,300 NO_2 mg/Nm^3 for boilers with solid fuels with less than 10% volatile compounds. With respect to this pollutant, Parties reported limit values for new stationary sources varying from 20–50 mg NO_2/Nm^3 to a maximum of 800 mg NO_2/Nm^3 for kilns used in cement production in Bulgaria, Slovakia and Spain. The Netherlands reported 1,270 mg NO_2/Nm^3 for compression ignition engines, >5 MWth using heavy fuel where the limit set in the Protocol is 600 mg NO_2/Nm^3. The highest value reported by Croatia was of 600 mg/Nm^3 for stationary compression ignition (diesel) engines (>5 MWth) with heavy fuel oil.

71. VOC limits for new stationary sources that store and distribute petrol (excluding ships) with throughput of 5,000 m^3 are set in the Protocol at 10 grams per cubic metre (g/Nm^3). Responding Parties reported a range from a low of 0.15 g/Nm^3 to a high of 35 g/Nm^3. All responding Parties noted that their VOC emissions from new stationary sources producing solvents (including adhesive coatings, varnishes and inks) were in line with the limits set in annex VI to the Protocol, with a few exceptions reported by Finland, Norway, Slovakia and Sweden. Limit values for VOC emissions for wood and plastic lamination, coating processes in the car industry, dry cleaning and extraction of vegetables and animal fats, as specified in the annex VI, were respected by all responding Parties (with only two values across all countries being slightly higher than the limits values), with Germany reporting more stringent values for most sources.

Existing stationary sources

72. For existing stationary sources, limits for emissions of SO_2 were significantly higher, reaching 3,650 mg/Nm3 for liquid fuels in plants of 300–500 MWth in Bulgaria and Romania, and 2,000 for solid fuels 50–100 MWth in Croatia, Denmark, Finland and Spain.

73. Similarly to new sources, maximum limits for existing sources were set for kilns used in cement production with limit values as high as 1,200 mg NO_2/Nm^3 in Bulgaria, Croatia, Cyprus and Spain, 1,300 mg NOx/Nm^3 in Slovenia and 1,500 mg NO_x/Nm^3 in Slovakia.

74. Most Parties considered the limit values specified in accordance with article 3.3 to be technically and economically feasible for existing stationary sources. However, the Czech Republic noted that the size and type of footwear would impact on the limit set of 25g VOC/pair with, for instance, army or mountaineering boots requiring extra adhesives.

Sulphur recovery for new and existing Claus plants and emissions from new and existing installations for titanium dioxide production

75. Annex IV to the Gothenburg Protocol sets limit values for sulphur recovery for Claus plants that produce more than 50 mg of SO_2 a day. These limits were respected (and exceeded) by Bulgaria, Germany, the Netherlands, Portugal, Slovakia, Slovenia, Sweden, Switzerland and the United Kingdom. For titanium dioxide (TiO_2) production, annex IV sets the limit of SO_2 discharges at no more than 10 kg of SO_2 equivalent per mg of TiO_2 produced for both new and existing installations. In this respect EU Directive 92/112/EC sets a limit of 10 kg/ton TiO_2 (total emission), which was reported as the limit applied in Bulgaria, Croatia, Slovakia and Slovenia. Finland had not set general emission limits for either Claus plants or TiO_2 production. Nevertheless, these plants were regulated through permits which required the application of best available techniques (BAT).

Sulphur content of gas oil

76. The SO_2 content of diesel for on-road vehicles was 0.001% in Austria, Cyprus, Denmark, Norway, Sweden and Switzerland. It was 0.05% in Finland, 0.005% in Germany, Hungary, Slovenia and Spain, and 0.1% in Slovakia. For other types of fuels (e.g., diesel for off-road vehicles, gas oil for inland navigation, for heating, etc.), the maximum limit set was 0.2% (for example in Cyprus). The SO_2 content of other types of fuels was 0.1% in Denmark, Finland, Hungary (since 2008), Slovakia and Spain, and 0.005% in Sweden. In Norway, since 2008 the maximum permitted SO_2 content in gas oils, other than auto-diesel, was 0.1%. In Croatia, the limit value for SO_2 content of gas oil was set at 0.2% and is due to go down to 0.1% as of June 2011.

4. Progress in meeting emission limit values for mobile sources

77. Annex VIII to the Protocol highlights ELVs for fuels and new mobile sources such as passenger cars and light-duty vehicles, heavy-duty vehicles, diesel engines for non-road mobile machines, mopeds, etc.

78. All responding Parties reported applying limit values for **new passenger cars and light duty vehicles** as set out in annex VIII to the Protocol for the period starting January 2006 and January 2007 (depending on the class). These limits were more stringent in Slovakia, Slovenia and Switzerland.

79. For **new heavy duty vehicles**, if the European steady-state cycle (ESC) and European load-response (ELR) test were used, the 2008 values set in the Gothenburg Protocol of 1.5g/kWh for carbon monoxide (CO), 0.46 g/kWh for hydrocarbons (HC), 2 g/kWh for NO_2 g/kWh, 0.02 for particulates and 0.5 for smoke were reported by most countries. Croatia, Cyprus, Denmark, Hungary and Spain reported a higher limit for NO_2, at 3.5 g/kWh which corresponds to the values of the EC Directive 2005/55/EC. The United States reported (in grams per break horsepower hour (g/bhp-hr)) 0.2 for NO_2, 0.14 for non-methane hydrocarbon (NMHC) and 0.01 for PM. On the other hand, if the European transient cycle (ETC) test was used (in application of Euro III, IV and V standards) and in line with annex VIII, table 3 to the Protocol, for new heavy duty vehicles, Croatia, Cyprus, Denmark, Hungary and Spain had complied with the 1 October 2006 values, while others reported on compliance with the values set for 1 October 2009.

80. Cyprus, Hungary, Slovakia and Slovenia reported that their most recent limit values for CO, hydrocarbons (HC), nitrogen and PM for new diesel engines for **non-road mobile machines** were within the limits of annex VIII. The Czech Republic, Denmark, Finland, Germany, Norway, Spain, Sweden and Switzerland reported more stringent values, in line with the EU Directive 97/68/EC and its amendment 2004/26/EC. The United States also reported values equal to or below those in the Protocol. Croatia reported limit values for pollutants from non-road machines corresponding to 1998 limits in the Protocol. The Netherlands however, reported ELVs for all pollutants above the limits set in the Protocol (from 2000) for engines above 37 kW (corresponding to the limits set from 1998 to 2000).

81. Cyprus, Finland, Slovenia and Spain reported limit values for **new motorcycles and 3- and 4-wheelers** (> 50 cm^3; > 45 km/h) equal to those identified in annex VIII to the Gothenburg Protocol while Croatia, the Czech Republic, Denmark, Germany, Hungary, the Netherlands, Norway, Slovakia and Sweden reported limits for new motorcycles that corresponded to the EU Directive 2002/51/EC, and were generally lower than those in the Protocol. Switzerland reported the same limits for two-stroke and four-stroke engines, corresponding to the lowest limits across all pollutants in the same EU Directive. The United States reported similar values to those in the Protocol for CO, but higher values for hydrocarbons emitted from off-highway motorcycles as of 2006.

82. The majority of responding Parties reported limits of 1 g/km and 1.2 g/km for CO and HC + NO_x respectively for **new mopeds** (≤ 50 cm3; ≤ 45 km/h), in line with EU Directives 1997/24/EC, 2002/25/EC and 2002/51/EC. On the other hand, Switzerland reported more stringent limits at 0.5 g/km for CO, 0.5 g/km for HC and 0.1 g/km for NO_2.

Fuels

83. All responding Parties reported that they complied with the limit values set out in annex VIII for different petrol types. For diesel fuel, the majority of Parties reported that they complied with limit values set out in annex VIII to the Protocol, except for SO_2 content for vehicles with positive ignition, which was lower in the following countries: Finland, Norway, Slovakia, Slovenia, Sweden and Switzerland, where it was 10 mg/kg instead of 50mg/kg.

84. Several EU member States noted that they had implemented Directive 94/63/EC on limiting VOC

emissions from petrol storage and distribution. All petrol stations in the Czech Republic and Finland were equipped with petrol vapour recuperation systems. Denmark promoted the application of vapour recovery systems via fiscal incentives for stations with a throughput of more than 500m^3/year.

5. Measures applied to products containing solvents

85. Most Parties reported that they implemented the EU "Deco Paint" Directive (2004/42/EC), according to which products containing solvents could only be placed on the market if they were below a maximum allowed VOC content and were clearly labelled with the subcategory of the product, the relevant VOC limit values in grams per litre and the maximum content of VOC contained in the product. Norway applied a harmonized, voluntary Nordic environmental labelling system, introduced in 1989, which provided consumers with more information on the products so that they could identify those that caused the least damage to the environment. Spain and the United Kingdom noted the use of the European Ecolabel, which includes VOC criteria for certain products, and is a voluntary instrument to encourage the development of greener products.

86. In Croatia, solvent production was the highest source of VOCs in 1990 (59.4% of total national emissions, in contrast to 15.8% for transport). To address the problem of solvents, a register had been set up of entities that used organic solvents or products containing VOCs and these were subject to ELVs by 31 December 2015. Plants not complying with ELVs of VOCs from vents/stacks, limit fugitive emission values or total ELVs were obliged to draw up an "Emission Reduction Programme". Switzerland noted that it had introduced a VOC tax on products containing solvents requiring clear labelling and that information campaigns had been carried out to make consumers more aware about VOCs and to promote products with lower VOC contents. Specialized private companies were responsible for collecting VOC waste and disposing of it adequately.

6. Application of best available techniques to mobile and stationary sources

87. In line with the obligations of the Gothenburg Protocol, responding Parties applied BAT to all pollutants and both to mobile and stationary sources. For example, since 2002, BAT have been applied in Bulgaria, using flue gas desulphurization in power generating plants. BAT were compulsory in Slovakia for both construction and upgrading of existing power facilities. The United Kingdom encouraged installation of flue gas desulphurization at many of its coal-fired power stations. Economic incentives were used in Finland, the Netherlands and Norway to promote adoption of BAT. For mobile sources, emissions in EU countries were being controlled under the EURO 1, 2, 3, 4, 5 and 6 standards. Issuance of permits was frequently tied to adoption of BAT.

88. Cyprus reported on techniques to reduce VOCs from petrol distribution, notably vapour recovery units for the storage and distribution of petrol, thermal incineration and closed circuit systems. Road tankers were also modified so that they could collect and maintain petrol vapour. The Netherlands reported on BAT it used for chemicals, printing and rubber/plastics. Norway reported that the main source of VOCs was the loading and storage of offshore crude oil. Consequently, permits allocated to offshore oil operators since 2001 required the use of appropriate technology, including VOC-reducing technology (absorption, condensation and adsorption technologies) on shuttle tankers and storage facilities. Since 2008, offshore oil operators had to ensure that VOC-reduction technology was applied to 95% of their loads. Slovakia reported on its use of BAT across different industries, including thermal incineration, catalytic incineration, adsorption for solvents and the organic chemical industry or controlled disposal of straw, composting of waste and combining manure with straw for the agriculture sector. Sweden mentioned a number of measures that could be considered "upstream", including substituting products containing VOCs with water-based systems and the development of new machinery in the dry-cleaning sector.

7. Progress in reducing emissions from agricultural sources

89. While emissions of NO_x, SO_2 and VOCs were addressed in earlier protocols to the Convention, the Gothenburg Protocol was the first one to address ammonia emissions from the agriculture sector (in its annex IX). Measures reported by Parties included publishing and disseminating an advisory code of good agricultural practice to control ammonia emissions, limiting ammonia emissions from the use of solid fertilizers based on urea, prohibiting the use of ammonium carbonate fertilizers, guidance on manure application, manure storage and animal housing.

Advisory code

90. Most Parties had a strategy to reduce ammonia emissions from agricultural sources. Germany reported that its guidelines on nitrogen management took an integrated approach which included assessing more specifically the amount of nutrients needed in order to ensure that the quantities applied were not excessive. Norway emphasized the importance of a well-established information system in order to disseminate advice on good agricultural practices. In this respect, the Norwegian Agricultural Extension Service played an important role in reaching and supporting rural farmers.

Manure

91. Many Parties reported strict guidelines for the spread (time of day, condition of soil, spreading process, etc.) and storage of manure. The main measures reported by Parties to limit ammonia emissions from solid manure application related to restrictions as to the season for the application, the condition of the soil (for instance, the ground should not be covered by snow or frozen) and the incorporation of manure into the soil approximately 24 hours after spreading it. For example, in Finland, spread of manure was controlled on warm, sunny and windy days. Croatia reported recommending the use of manure spreaders with smaller spraying angles and bigger drops. In Denmark, measures included improvements in manure handling, covering stores of solid manure, covering slurry containers, banning surface spreading, banning ammonia treatment of straw and limiting local ammonia volatilization from livestock in the vicinity of vulnerable natural habitats.. Germany also considered the time of day and the period in the growing season as additional factors in the application of manure. Restrictions on storage of manure were mentioned, notably by Cyprus, the Czech Republic, Finland and the United Kingdom. Romania reported that it provided direct payments to farmers who applied appropriate measures, such as taking into account the whole nitrogen cycle or using appropriate manure management techniques.

Nitrates

92. A number of Parties highlighted that nitrate application in certain ecologically vulnerable zones was subject to particular restrictions. For example, Finland and Slovenia specifically emphasized reductions in the release of nitrates from agricultural sources into water bodies, while Hungary reported on a governmental decree which contained a list of vulnerable zones where farmers had to respect specific requirements when spreading nitrates. The EU Nitrates Directive was also referred to.

Solid fertilizers based on urea

93. Measures applied for reducing ammonia emissions from solid fertilizers based on urea related to the temperature at which the urea was applied (e.g., Bulgaria, Germany), the speed at which it was applied (e.g., the Czech Republic) and use of urease inhibitors (e.g., Germany, Spain). However, not all responding Parties had specific measures related to urea, with many noting that only a small proportion of their fertilizers were based on urea (e.g., 5% of total solid fertilizers in Portugal).

Ammonium carbonate fertilizers

94. The Protocol specifies that within one year of its coming into force, fertilizers based on ammonium carbonate should be banned. Many Parties reported that they had prohibited the use of ammonium carbonate fertilizers. In contrast, they were not directly prohibited in Denmark, Finland, Hungary, Portugal, Sweden or the United Kingdom.

Slurry application and storage

95. Reported measures to reduce emissions from slurry application included injecting it or incorporating it directly into the ground, band-spreading, or limitations depending on slope inclination. For example, in Romania, the application of slurry on slopes greater than 12% was prohibited.

96. As of 2011 Denmark would have a legal obligation to inject liquid manure that is applied to bare-soiled farmland and grass fields. Norway launched a pilot project in 2008 to provide financial incentives to farmers in five districts that applied low-emission slurry application methods, such as direct ground injection, band-spreading/shallow injection methods, and incorporating slurry in soils within two hours of spreading.

97. Reported low-emission storage systems for slurry on large pig and poultry farms consisted in covering slurry stores, either with floating or rigid covers, which could reduce emissions by up to 90%. Croatia and Finland reported that slurry stores were filled from underneath to reduce emissions. Norway was also undertaking research to reduce emissions from slurry by transforming it into bioenergy to produce heat/electricity. Most responding Parties applied the above measures to both existing and new slurry stores.

Livestock housing

98. Measures applied to livestock housing systems which contributed to reducing emissions by 20% or more included the introduction of partly slatted flooring and (in Bulgaria) vacuum or flushing systems for pigs; drying and regular removal of manure from poultry farms; and phase feeding. In Cyprus, manure from poultry farms was removed through traditional deep-pit houses where the manure falls into a pit beneath the surface of the house and is collected using manure belts (Germany also reported using these). Optimal livestock feeding methods (including the amount of phosphate and nitrogen allowed), as outlined in the EU BAT reference (BREF) documents were highlighted as important by Cyprus, the Netherlands and Romania. Finland introduced manure cooling systems in pig farms but did not apply any ammonia abatement measures for poultry farms. Several Parties referred to the EU Integrated Pollution Prevention and Control (IPPC) Directive (96/61/EC) and Guidelines on intensive livestock farming.

B. The 1998 Aarhus Protocol on Persistent Organic Pollutants[29]

1. Overview

99. The 1998 Aarhus Protocol on Persistent Organic Pollutants (POPs) entered into force in October 2003 and has 33 Parties (as of November 2013).[30] Its ultimate objective is to eliminate any discharges, emissions and losses of POPs.

100. At the outset, the Protocol lists 16 hazardous substances: 11 pesticides; 2 industrial chemicals; and 3 by-products/contaminants. It bans the use and production of several of these substances outright (aldrin, chlordane, chlordecone, dieldrin, endrin, hexabromobiphenyl, mirex and toxaphene), while others are scheduled for elimination at a later stage (DDT, heptachlor, hexaclorobenzene and PCBs). The Protocol severely restricts the use of DDT, hexachlorocyclohexane (HCH) (including lindane) and PCBs. It also includes provisions for dealing with the wastes of products that will be banned and sets specific limit values for the incineration of municipal, hazardous and medical waste. Parties are obliged to reduce their emissions of dioxins, furans, hydrocarbons (PAHs) and hexachlorobenzene (HCB) below their levels in 1990 (or an alternative year between 1985 and 1995).

101. In December 2009, the Parties to the Protocol on POPs adopted decisions to amend the Protocol:[31] (a) to include seven new substances: hexachlorobutadiene, octabromodiphenyl ether, pentachlorobenzene, pentabromodiphenyl ether, perfluorooctane sulfonates, polychlorinated naphthalenes and short-chain chlorinated paraffins; (b) to update and upgrade the obligations for eliminating the production and use of a number of POPs regulated by the Protocol (DDT, heptachlor, hexachlorobenzene and PCBs) and for fixing ELVs from waste incineration; as well as (c) to update the guidance on BAT to control emissions of POPs in annex V and to turn parts of it (chapters III to V) into a guidance document.[32] The Parties also adopted an expedited procedure for the entry into force of the amendments to the Protocol. Parallel to this, with a view to facilitating the Protocol's ratification by countries with economies in transition, the Parties introduced flexibilities for these countries regarding the time frames for the application of ELVs and BAT. These amendments have not yet entered into force for the Parties that adopted them.

2. National strategies, policies and programmes for reducing or eliminating POPs

102. Several EU member States referred to EU Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) Regulation (2006/1907/EC) which aims to streamline and improve the EU legislative framework on chemicals by placing greater responsibility on industry to manage the potential risks of chemicals to health and the environment. Under the REACH Regulation all manufacturers and importers of chemicals must identify and manage risks linked to the substances they manufacture and market. Reference was also made to EU Regulation 850/2004 on POPs.

103. Some Parties, such as the Czech Republic, reported that the control of POPs was regulated under their national environmental strategy, while others had specific decrees or legislation addressing activities

[29] http://www.unece.org/env/lrtap/pops_h1.htm.

[30] Austria, Belgium, Bulgaria, Canada, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Iceland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Montenegro, Netherlands, Norway, Republic of Moldova, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, the former Yugoslav Republic of Macedonia, United Kingdom of Great Britain and Northern Ireland and European Union. Updated status of ratifications is available at http://www.unece.org/env/lrtap/status/lrtap_s.htm.

[31] ECE/EB.AIR/99/Add.1.

[32] Guidance document best available techniques for reducing emissions of persistent organic pollutants from major stationary sources (ECE/EB.AIR/2009/14).

releasing POPs, including in Denmark with regard to the emissions of PAH from wood burning stoves and boilers.

104. Emissions of POPs from waste incineration were seen as particularly problematic and subject to national legislation. Cyprus for instance, had developed an action plan to raise public awareness regarding emissions from uncontrolled combustion since most of its dioxin emissions resulted from uncontrolled burning of waste. Also, in Denmark, Air Pollution Control Guidelines regulated waste incineration plants which were the main sources for HCBs.

105. Belarus reported that it had developed technical documents on the treatment of equipment and waste containing PCBs and had set up a database of POPs (including PCBs, pesticides and areas contaminated by POPs). Canada reported on a number of federal policies and strategies related to toxic substances. In 2006 it had completed a categorization of 23,000 substances listed under the Domestic Substances List (DSL), with a view to developing a Chemical Management Plan to assess and manage the risks associated with the different substances.

106. Croatia and the Netherlands as well as Belarus and Ukraine, which are not yet Parties to the Protocol, referred to their implementation of the Stockholm Convention on Persistent Organic Pollutants which imposes a worldwide ban on the production and trade in a number of POPs. Ukraine, for example, reported that it had established an action plan to address the problems associated with emissions of dioxins and furans involving the assessment of emissions from stationary sources, tests to refine emission limits, monitoring emissions, the development of legislation and establishment of regulatory systems (promoting the introduction of BAT).

107. None of the responding Parties had made use of article 4 of the Protocol, which grants certain exemptions to the application of the obligations for example in the case of emergencies or if no suitable alternative product can be used.

3. Measures to eliminate annex I substances

108. All responding Parties had banned the import, production and use of the substances in annex I in compliance with the Protocol and EU Regulation 850/2004. However, some Parties (Denmark, Slovakia and Switzerland) and Ukraine reported restricted use of PCBs.

109. The Parties focused on describing the national measures to regulate PCB waste (reflecting the fact that most of the other substances were no longer in use). In Canada, national guidelines existed on decontamination of PCB transformers, use of PCB fuels in cement kilns and PCB incineration. Denmark required that PCBs be removed from capacitors before scrapping electrical or electronic products.

110. A number of countries used high temperature incineration to dispose of hazardous waste. The United Kingdom also reported that it used physico-chemical treatment and incineration with energy recovery. Some Parties had special facilities for the destruction of hazardous waste that were subject to prior authorizations and licences (usually valid for a period of five years). In Austria, destruction of annex I substances was also undertaken in specialized incineration plants and their residues (such as fly ash and bed ash) were exported for disposal according to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal.

111. Countries that did not have the necessary facilities exported their waste to be treated abroad. For example, Romania exported its PCBs for disposal in Belgium, France, Germany and the Netherlands. Equally, Slovenia exported such waste to Austria, France or Germany. Concurrently, the Netherlands operated a cleaning facility which imported PCBs for dismantling and decontamination. Some PCB-containing waste which the Netherlands could not effectively dispose of itself was exported to specialized plants abroad.

112. Some Parties reported on measures targeting specific products or activities found to generate high levels of POPs, such as the measures in Austria to limit the PAH content of clay pigeons. Norway was developing a new strategy for the safe treatment of creosote-treated wood after discovering, in 2005, that 99% of its total PAH emissions from products originated from this source.

Transboundary movement

113. The POPs Protocol requires Parties to ensure that the transboundary movement of substances listed in annex I is conducted in an environmentally sound manner. In this respect, the majority of responding Parties stated that they applied the obligations in the Basel Convention. Austria also reported that it had

ratified the Rotterdam Convention[33] and mentioned the relevance of the "Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade". The EU countries also referred to EU Regulation 1013/2006 on shipments of waste and to the EU legislation on POPs. Norway applied European Council Regulation 259/93 on the supervision and control of shipments of waste within, into and out of the European Union. The Netherlands specified that the transport of hazardous waste was subject to a permit and all transport was to be registered with the National Registry Office.

4. Measures to restrict annex II substances

114. Parties indicated varying degrees of removal of the annex II substances, with Bulgaria and the Netherlands reporting complete bans on all of them. In Austria, production and use of all four substances was banned, although products already in use that contained PCBs could be used. In Finland, HCH and lindane were banned while DDT could be used to produce dicofol until January 2014 in a closed-system and PCBs followed EU Regulation 850/2004. Lindane was banned in Germany for use as an active ingredient in plant protection products. Italy reported bans on DDT, HCH and lindane, while applying EU Directive 96/59/EC on the disposal of PCBs. In Liechtenstein and Switzerland both DDT and HCH (mixed isomers) were banned while lindane was permitted in dressings and pharmaceuticals for public health and veterinary topical insecticide, and PCBs were exceptionally allowed in existing installations with a total PCB content of less than 1 kg. DDT was banned in the United Kingdom, while release of lindane into surface water was controlled under the Environment Permitting Regulations, the Food and Environmental Protection Act and the Control of Pesticides Regulations. PCBs were regulated in the United Kingdom with the aim of phasing them out. Use of DDT, HCH and lindane was prohibited in Ukraine, while PCBs were allowed in electrical and electronic equipment (until the year 2025).

5. Best available techniques for reducing POPs from new and existing sources

115. In most responding Parties, BAT was explicitly required in permits for new stationary sources. Liechtenstein and Switzerland reported having set limit values based on BAT. Denmark reported the use of BAT according to the EU IPPC Directive and EU BREFs as minimum standards when issuing licences. Italy reported on a number of guidelines for BAT in different sectors of activity (such as waste incineration, combustion plants and mineral oil and gas refineries), all of which were based on EU BREFs. The Netherlands also used the BREFs to set standards for BAT.

6. Emission limit values for new and existing stationary sources

116. For dioxins and furans, most Parties reported that they complied with ELVs set in annex IV for both new and existing stationary sources of municipal solid waste, medical solid waste and hazardous waste. Reference was also made to the application of EU Directive 2000/76/EC. Canada reported values of 0.08 (nanogram toxicity equivalent per cubic meter) ng TE/m^3 for all three sources of waste.

C. The 1998 Aarhus Protocol on Heavy Metals[34]

1. Overview and main obligations

117. The Protocol on Heavy Metals was adopted on 24 June 1998 in Aarhus (Denmark) and is ratified by 33 Parties (as of November 2013).[35]

118. The objective of the Protocol on Heavy Metals is to control the emissions of cadmium, lead and mercury caused by anthropogenic activities that are subject to long-range transboundary atmospheric transport and are likely to have significant adverse effects on human health or the environment. The main sources identified under this Protocol are industrial sources (iron and steel industry and non-ferrous metal industry), combustion processes (power generation and road transport) and waste incineration. The Protocol sets out specific limits with deadlines for each metal and for each Party. It promotes the use of BAT, the application of product control measures and maintenance of emissions inventories.

[33] The 2004 Rotterdam Convention on the prior informed consent procedure for certain hazardous chemicals and pesticides in international trade.

[34] http://www.unece.org/env/lrtap/hm_h1.htm.

[35] Austria, Belgium, Bulgaria, Canada, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Latvia, Liechtenstein, Lithuania, Luxembourg, Monaco, Montenegro, Netherlands, Norway, Republic of Moldova, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, the former Yugoslav Republic of Macedonia, United Kingdom of Great Britain and Northern Ireland, United States of America and European Union. Updated status of ratifications is available at the Convention website at http://www.unece.org/env/lrtap/status/lrtap_s.htm.

119. Following negotiations to revise the obligations under this protocol, the Protocol was amended in 2012 introducing more stringent emission limit values and widening the scope of industrial activities to which they applied. The amendments also introduced flexibilities to facilitate accession of new Parties, notably countries in Eastern Europe, the Caucasus and Central Asia.

2. National strategies, policies and programmes to reduce emissions of heavy metals

120. Most Parties reported on significant reductions in lead emissions achieved through the phasing out of leaded petrol and improvements in transport management. Recycling of batteries and other materials containing heavy metals was being actively promoted by Parties such as the Czech Republic and Denmark. EU countries referred to the EU directives concerning heavy metals.[36]

121. Some Parties had set targets for the reduction of emissions from heavy metals. For example, Bulgaria's National Environmental Strategy and Action Plan for the period 2000–2006 set the following 2010 targets for heavy metals (from 1990 levels): a 60% reduction in lead, a 58% reduction in cadmium and a 56% reduction in mercury. In most cases reductions were being achieved on a product-by-product basis. For example, in the United States, measures at both the state and federal levels limited the amount of mercury in batteries, mercury in paint was banned and a number of chlor-alkali production facilities had been closed.

122. Some Parties had implemented bans outright, including, in the case of Denmark, a ban on the import and sale of products containing lead, the import, sale and production of goods containing cadmium and the import, sale and export of products containing mercury. Measures reported by some Parties (notably the Czech Republic, the Netherlands and the United Kingdom) included legal, economic and voluntary instruments, strategic planning, research and development, international cooperation, education and public awareness activities.

3. Best available techniques for new and existing sources

123. Annex III to the Protocol outlines a range of BAT, such as off-gas cleaning with scrubbers and filters or substitution of raw materials, which are intended to provide Parties with guidance for options to reduce emissions from the three heavy metals targeted. A large number of Parties reported that they issued integrated permits based on BAT for new stationary sources emitting heavy metals. In contrast, in Romania, permits did not specify the use of any single technique or technology, but took into consideration the technical characteristics of the installation, its geographical location and local environmental conditions. Canada had countrywide standards which helped to identify BAT for different sources. In Finland ELVs were set on a case-by-case basis in permits, but varied between 10-30 mg/m^3 for dust/particulate emissions. Permits required that plants be equipped with electrostatic precipitators and fabric filters or scrubbers to clean the waste gases.

124. BAT applied to stationary sources in the Czech Republic included wet scrubbers, electrostatic separators and fabric filters, while in Croatia the most commonly used technology was fabric filters. In Hungary primary technologies and end-of-pipe technologies (e.g., scrubbers and filters) were used to reduce emissions of heavy metals. In the Netherlands BAT included high pressure wet scrubbers, activated carbon injection, electrostatic precipitators, fabric filters and wet scrubbers, with the last three also being reported as the most common measures in Liechtenstein and Switzerland. Slovenia's measures involved introducing superior fuels (particularly natural gas), mixing coal with fuels with lower emissions of heavy metals, electrostatic dust filters, wet desulphurization of flue gases and filter bags.

4. Limit values applied to new stationary sources

125. The vast majority of Parties reported limit values for most stationary sources that were within the limits set in annex V to the Protocol. In some cases values reported were lower, as, for example, in Denmark for PM and lead, respectively, in the cement and glass industries. Equally, most ELVs in Germany and the Netherlands were below those set in annex V, as were many of Slovenia's.

126. Specifically for municipal waste incineration, Austria, Croatia, Denmark, Estonia, Finland, the Netherlands, Slovakia and Slovenia all reported slightly lower (0.05mg/m^3 instead of 0.08 mg/m^3 as set in annex V to the Protocol) thresholds for mercury emissions. Germany and Sweden reported even lower ELVs (0.03 mg/m^3) for mercury emissions from municipal waste incineration. However, both Liechtenstein and Switzerland reported emission limits for mercury from both hazardous and municipal waste incineration above those set in annex V.

[36] For example, Directives 2006/66/EC, 2007/51/EC, 2000/53/EC, 2002/95/ EC, 2002/96/ EC, 2002/95/EC and EC REACH (1907/2006).

127. In Croatia, Finland and Slovenia the ELVs set for the combustion of solid and liquid fuels for sources with thermal inputs above 100 Mwth was lower than that set in annex V. Liechtenstein reported PM emissions of 10 mg/m^3 for combustion plants of solid and liquid fuels of over 50 MWth, in contrast with the limit in annex V of 50 mg/m^3. Its PM ELVs in the cement industry were also below those set in annex V. Sweden reported lower ELVs for PM from the combustion of liquid and solid fuels. Most of Switzerland's ELVs for PM were below those in annex V. Except for PM emissions from the combustion of solid fuels and liquid fuels in plants of between 50–500 MWth, where limits were higher than those in annex V, Estonia's ELVs were in line with annex V.

128. The United States noted that regulations for chlor-alkali production, municipal waste combustors, primary zinc smelting, secondary copper smelting, secondary lead smelting, combustion of fossil fuels in utility boilers >25 megawatts, combustion of fossil fuels in utility boilers >3 megawatts, primary iron and steel production and electric arc furnaces were as or more stringent than those in the Protocol. The average mercury limit across all five types of incinerators in the United States was reported to be about half of the ELVs in the Protocol.

5. Lead in petrol

129. Leaded petrol was no longer sold in all responding countries and the lead content of unleaded petrol was restricted to less than 0.005 grams per litre (g/l) in most of the responding Parties and Ukraine. The EU member States also noted that they were bound by the relevant EU legislation.[37] In Norway, petrol with a lead content of a maximum of 0.15 g/l was allowed for historic vehicles, but the sales were limited to 0.5% of total yearly petrol sales. In the United Kingdom, a limited quantity of leaded petrol was available on a permit basis for historic vehicles with the total amount limited to less than 0.025% of total petrol sales.

130. Romania reported that qualitative monitoring of petrol and diesel fuel was achieved through sampling and analysis performed by laboratories, product certification bodies or third-party inspection bodies accredited at the ministerial level. In Slovakia, the Environmental Inspectorate regularly tested fuel quality, including its lead content. In Sweden, spot checks were carried out at depots and filling stations to check on quality.

[37] Directive 98/70/EC, relating to the quality of petrol and diesel fuels and Directive 2003/17/EC amending Directive 98/70/EC.

6. Mercury in batteries

131. Various legislative measures had been applied by responding Parties to limit the mercury content in batteries. Reference was also made to the implementation of EU Directive 2006/66/EC on batteries and accumulators. Mercury content allowed in alkaline batteries in most responding countries was 0.0005% by mass.

D. The 1994 Protocol on Further Reduction of Sulphur Emissions[38]

1. Overview and main obligations

132. The 1994 Oslo Protocol on Further Reduction of Sulphur Emissions (the 1994 Sulphur Protocol) entered into force in August 1998 and has been ratified by 29 Parties.[39] This second Sulphur Protocol was prompted by concerns over the transboundary emissions of sulphur that continued to cause widespread damage to ecosystems and historical monuments and had harmful health effects.

133. The 1994 Sulphur Protocol was the first effects-based instrument under the Convention and used critical loads to set country-specific emission ceilings. It requires Parties to take the most effective measures to reduce their SO_2 emissions, to increase energy efficiency and the use of renewable energy and to reduce the SO_2 content of particular fuels. It promotes the use of fuel with a low SO_2 content and the application of BAT. Annex II to the Protocol sets out specific and time-limited emissions ceilings for Parties and its annex V specifies emission levels for major stationary combustion sources and gas oil.

2. National strategies, policies and programmes

134. Parties that had ratified the Gothenburg Protocol referred to their implementation of that Protocol (see the summary of their replies in sect. A above). The present section summarizes information provided by Canada, Italy and Liechtenstein that are not yet Parties to the

[38] http://www.unece.org/env/lrtap/fsulf_h1.htm.

[39] Austria, Belgium, Bulgaria, Canada, Croatia, Cyprus, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Liechtenstein, Lithuania, Luxembourg, Monaco, Netherlands, Norway, Slovakia, Slovenia, Spain, Sweden, Switzerland, the former Yugoslav Republic of Macedonia, United Kingdom of Great Britain and Northern Ireland and European Union. Updated status of ratifications is available at: http://www.unece.org/env/lrtap/status/lrtap_s.htm.

Gothenburg Protocol, as well as by Ukraine (not a Party to either one of the Protocols).

135. Canada reported that the Canada-United States Air Quality Agreement, focused on reducing acidification, recognized the transboundary nature of SO_2 emissions. Canada also promoted the Canada-Wide Acid Rain Strategy for Post-2000. Furthermore, in 2006, Canada had begun developing a nationwide regulatory framework for reducing air emissions. A Sulphur Oxide Management Area (SOMA) was designated in the south-east of the country. Within this zone, and since 1991, Canada had respected an SO_2 emissions cap of 1.75 Mt/year.

136. Italy applied a mix of command and control measures and economic instruments to control SO_2 emissions. Its programmes and measures included air quality limits and target values, warning levels, emission limits for combustion plants and industrial installations and fuel quality standards. Measures also included the promotion of renewable energies, energy saving and the combined use of SO_2 with sulphur-free fuels in combustion plants.

137. Through its national legislation Liechtenstein regulated emissions from stationary sources, set emission standards for pollutants, including SO_2 and promoted renewable energy notably, solar, wood and biomass.

138. Ukraine's energy strategy for the period until 2030 and beyond promoted cleaner fuel and energy to reduce SO_2 emissions. Accordingly, power plants were being reconstructed and modernized. The country was planning to introduce systems of chemical bonding of sulphur during the reconstruction of existing thermal power plants with a moderate level of efficiency (50–70%) and the use of boilers with circulating fluidized beds between 2010 and 2017.

3. Most effective measures for reducing sulphur emissions for new and existing sources

139. Many of the measures undertaken to improve energy efficiency and the use of renewable sources of energy were closely tied to efforts to reduce anthropogenic sources of climate change. Parties reported on a range of such measures, including energy pricing, subsidies, certification and labelling schemes and information campaigns. (More on specific measures in different countries can be found under the section on energy in part three of the 2010 Review (ECE/EB.AIR/2010/8/Add.2)).

4. National standards for the sulphur content of gas oil

140. Canada reported on regulations which limited the SO_2 content of diesel for on-road, off-road, rail and marine vehicles and in gasoline. The SO_2 content of diesel for on-road vehicles was 0.001% in Ukraine, 0.005% in Italy and Liechtenstein, and 0.0015% in Canada (as compared to annex V which sets the limit at 0.05%). Italy and Liechtenstein distinguished the "other categories" of fuels with different limit values for diesel for off-road vehicles, for gas oil for inland navigation and for heating.

E. 1991 Geneva Protocol concerning the Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes[40]

1. Overview and main obligations

141. The Protocol concerning the Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes entered into force in 1997 and has been ratified by 24 Parties (as of November 2013).[41] The Protocol requires Parties to control and reduce their emissions of volatile organic compounds (VOCs) in order to reduce their transboundary fluxes and the fluxes of the resulting secondary photochemical oxidant products so as to protect human health and the environment. Parties must opt for one of the following three options for emission-reduction targets set out in the Protocol:

(a) A 30% reduction in VOC emissions by 1999 using a year between 1984 and 1990 as a basis. (This option was chosen by Austria, Belgium, Estonia, Finland, France, Germany, the Netherlands, Portugal, Spain, Sweden and the United Kingdom with 1988 as a base year; by Denmark with 1985; by Liechtenstein, Switzerland and the United States with 1984 as a base; and by the Czech Republic, Italy, Luxembourg, Monaco and Slovakia with 1990 as a base year);

[40] http://www.unece.org/env/lrtap/vola_h1.htm.

[41] Austria, Belgium, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Italy, Liechtenstein, Lithuania, Luxembourg, Monaco, Netherlands, Norway, Slovakia, Spain, Sweden, Switzerland, the former Yugoslav Republic of Macedonia and the United Kingdom of Great Britain and Northern Ireland. The updated status of ratifications is available at http://www.unece.org/env/lrtap/status/lrtap_s.htm.

(b) The same reduction as above within a Tropospheric Ozone Management Area (TOMA) specified in annex I to the Protocol and ensuring that by 1999 total national emissions do not exceed 1988 levels. Annex I specifies TOMAs in Norway (base year 1989) and Canada (base year 1988);

(c) For countries where VOC emissions in 1988 did not exceed certain specified levels, Parties could opt for a stabilization at that level of emission by 1999 (this option was chosen by Bulgaria, Greece and Hungary).

2. National programmes, policies and strategies

142. This section summarizes measures taken by Austria, Estonia, Italy and Liechtenstein and Canada[42] to implement the VOCs Protocol. (Measures by Parties to the 1999 Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (Gothenburg Protocol) are reported under section III. A. on the Gothenburg Protocol).

143. Austria reported that its VOC emissions had dropped by over 50% between 1988 and 2008. It referred notably to domestic regulations in the industrial sector, including its Industrial Code, the Clean Air Act for Steam-boilers and its Solvent Ordinance for operations relating to paints and lacquers. Canada outlined its programmes under the solvents, petroleum, organics, chemical, food, iron and steel industries, as well as those for its small-scale combustion sources, waste and agriculture.

144. Estonia, where VOC emissions had halved between 1990 and 2008, reported on its efforts in the transport sector to increase the share of public transportation and to prioritize electricity-based and railway transport. Italy reported that its measures in the transport sector included urban traffic plans and incentives to renew the existing fleet of cars and motorcycles. Measures taken in Liechtenstein had led to a 58% reduction in VOC emissions between 1985 and 2008. It reported in particular that its Energy Efficiency Act provided subsidies for the use of renewable energy such as solar energy, wood and biomass.

Stationary sources

145. Most Parties found it difficult to respond to the question related to the national or international emission standards applied to control and reduce VOC emissions from stationary sources. In many cases countries noted that it was site-specific, subsector-specific or based on best available techniques (BAT), but that no set figure could be applied across an entire sector such as the food industry. The Parties also referred to standards set in European Union (EU) Directives 1999/13/EC, 1994/63/EC, 2004/42/EC and EU BAT reference (BREF) documents.

146. Austria reported that it applied stricter standards than those in the Protocol for the production of iron and steel and of non-ferrous metals, as well as for foundries and some categories of steam-boilers. It also reported that local/regional air quality concerns could lead to more stringent limit values being applied in the issuing of licences. In Italy, new stationary plants required a permit issued by a competent authority that specified limits at least as stringent as those for existing plants. Subsidies for renewable energy were mentioned by Liechtenstein.

Mobile sources

147. Both Estonia and Italy reported on the application of relevant EU directives for passenger cars, light duty and heavy-duty vehicles (EURO standards).

F. 1998 Sofia Protocol concerning the Control of Emissions of Nitrogen Oxides or their Transboundary Fluxes[43]

1. Overview and main obligations

148. The Protocol concerning the Control of Emissions of Nitrogen Oxides or their Transboundary Fluxes entered into force in 1991 and has been ratified by 35 Parties (as of November 2013).[44] The Protocol requires that Parties take effective measures to control and/or reduce their annual emissions of nitrogen oxides (NO_x) or their transboundary fluxes so that by 31 December 1994 (at the latest) they do not exceed 1987 emissions (1978 for the United States). Parties to the Protocol are also required within two years of entry into force of

[42] Not a Party to the VOCs Protocol.

[43] http://www.unece.org/env/lrtap/nitr_h1.htm.

[44] Albania, Austria, Belarus, Belgium, Bulgaria, Canada, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Liechtenstein, Lithuania, Luxembourg, Netherlands, Norway, Poland, Russian Federation, Slovakia, Slovenia, Spain, Sweden, Switzerland, the former Yugoslav Republic of Macedonia, Ukraine, United Kingdom of Great Britain and Northern Ireland, United States of America and European Union. Updated status of ratifications is available at http://www.unece.org/env/lrtap/status/lrtap_s.htm.

the Protocol to apply national emissions standards to major new or modified stationary sources and/or source categories and to new mobile sources based on BAT and to introduce pollution control measures for major existing stationary sources.

2. National programmes, policies and strategies

149. This section reflects replies from Austria, Belarus, Canada, Estonia, Italy, Liechtenstein, the Russian Federation and Ukraine. Information on measures to reduce NO_x by Parties to the Gothenburg Protocol is included in the section on the Gothenburg Protocol.

150. In Belarus, between 1987 and 1994, NO_x emissions decreased by 22.8% and, by 2000, by 49%. Emission-reduction measures in Belarus included the promotion of new technologies for fuel combustion with minimal emissions (exhaust gas recirculation, multistage combustion, control of combustion using a gas analyser, conducting local monitoring) and environmental certification of vehicles. In the Russian Federation, while total emissions of NO_x increased by 2.4% between 1987 and 2008, total emissions from stationary sources during the same period dropped by 53% (an increase of 64.4% from mobile sources was responsible for offsetting this drop). Reduction strategies highlighted by the Russian Federation focused on mobile sources, including a 2001 federal programme to reduce emissions from vehicles, and on energy, including the 2003 Energy Strategy, which emphasized energy efficiency and new technologies. Ukraine's energy strategy covered the period up until 2030, and aimed at providing cleaner fuel and energy in order to reduce NO_x emissions, through measures such as improving energy efficiency, fuel switching, new combustion technologies, modification of combustion processes and flue gas treatment.

151. Austria managed its NO_x emissions from stationary sources through licences containing emission limit values and measures, including on BAT. Its emissions from stationary sources and from residential combustion had dropped by slightly less than one third between 1987 and 2008. Estonia reduced its NO_x emissions between 1990 and 2008 by 53.3% (50.31% reduction in stationary fuel combustion and 56.5% from mobile sources). Italy implemented a series of command and control measures to reduce NO_x emissions, such as taxing large combustion plants and setting ceilings. It also promoted energy efficiency (for example issuing green certificates) and sustainable mobility. The measures taken to date had enabled Liechtenstein to reduce its NO_x emissions since 1985 by 24% by 2008. The country provided incentives in the form of subsidies for the use of renewable energy, including solar energy, wood and biomass.

152. For Canada, measures cited to reduce nitrogen included caps and emission standards for particulate matter (PM) and ozone, since reductions in these would also reduce NO_x emissions. The Government was also working with stakeholders to develop a regulatory approach for managing emissions of NO_x and other air pollutants from industry and other key sectors. Measures taken in Canada were anticipated to reduce annual NO_x emissions by 39% by 2010 from 1990 levels in the region of Canada defined in the annex to the Protocol as the Pollutant Emission Management Area.

3. Stationary sources

153. For the responding Parties, emission limit values reported for major stationary sources varied from 35–80 milligrams per cubic metre (mg/Nm^3) for combustion turbines with natural gas, to 500–1500 mg/Nm^3 for the production of glass in Austria; 150 mg/m^3 for boiler plants > 100 MW and boiler plants of 50–100 MW with natural gas, to 600 mg/Nm^3 for boilers with solid fuel in Belarus; 50 mg/Nm^3 for gas turbines operating with natural gas to 600 mg/Nm^3 for boilers with solid fuel built before 2006 in Italy; 50 mg/m^3 for gas turbines operating with natural gas to 800 mg/Nm^3 for kilns in cement production in Liechtenstein and Ukraine; and 125mg/m^3 for gas-powered boilers of 80–299 MW to 300 mg/Nm^3 for coal stations of over 300 MW in the Russian Federation.

154. Some of the reported measures to control NO_x emissions from major stationary sources with a thermal input of at least 100 megawatt thermal (MWth) included retrofitting low NO_x burners (most frequently cited measure), retrofitting selective catalytic reduction units, using combined cycle or cogeneration configurations, modernization of fusion aggregates and introducing Emission Optimized Sintering (EOS) systems.

4. Mobile sources

155. The reported national NO_x emission standards for newly registered mobile sources included: 0.08 g/km for passenger cars (petrol) in Austria, Belarus, Estonia, Italy and Liechtenstein, and 0.5 g/km for passenger vehicles in Ukraine; 7 g/kWh for heavy duty vehicles in Ukraine; and 7.5–11 (hydrocarbons (HC)+NO_x) g/kWh for shipping in Liechtenstein and Estonia.

156. All Parties had made unleaded fuel sufficiently available. Furthermore, Estonia and Italy had completely banned leaded fuel for on road vehicles. Others such as Canada reported that for vehicles designed for leaded petrol, such as farm machinery, leaded gasoline was limited to 30 mg/l (and 26 mg/l for imported leaded gasoline).

G. 1985 Helsinki Protocol on the Reduction of Sulphur Emissions or their Transboundary Fluxes by at least 30 per cent[45]

1. Overview and main obligations

157. The Protocol on the Reduction of Sulphur Emissions or their Transboundary Fluxes by at least 30 per cent was adopted in Helsinki in 1985 and entered into force two years later. It has been ratified by 25 Parties (as of November 2013).[46] This first pollutant-related Protocol to the Convention requires Parties to reduce their national annual SO_2 emissions or their transboundary fluxes by at least 30% from 1980 levels, by no later than 1993. This Protocol was complemented and in many ways superseded by the 1994 Oslo Protocol on Further Reduction of Sulphur Emissions. However, some of its Parties (Albania, Belarus, Estonia, the Russian Federation and Ukraine) have not ratified the later Protocol.

2. National programmes, policies and strategies

158. This section summarizes replies from Canada, Estonia, Liechtenstein and the Russian Federation. (The sulphur reduction measures by Parties to the 1994 Sulphur Protocol and to the Gothenburg Protocol are reported under the sections on these Protocols).

159. The 1985 Sulphur Protocol has led to significant reductions in SO_2 emissions across Europe, with its 21 Parties surpassing the 30% reduction target. All Parties to the Protocol have achieved reductions in sulphur emissions of over 50% and 11 Parties have achieved reductions of at least 60%. Estonia reported a reduction of 74% between 1990–2008, while Liechtenstein reported a drop of over 63% between 1985 and 2008. The European territory of the Russian Federation saw a drop in SO_2 emissions of 80.4% between 1980 and 2008. In Belarus, SO_2 emissions decreased by 48.4% between 1980 and 1993 (and by 89% by 2008).

160. The most frequently cited measures to reduce SO_2 emissions related to limits and caps, and economic measures. Another frequently cited measure related to technological improvements such as pollution control equipment in Canada. The Russian Federation reported on a federal law passed in 1991 which promoted the use of BAT in the field of air protection and on a more recent (2008) decree to control emissions from cars, airplanes and various fuels.

IV. Strategies and policies for controlling long-range transboundary air pollution

161. This section describes national strategies and policies for controlling long-range transboundary air pollution in the United Nations Economic Commission for Europe (UNECE) region, highlighting institutional, regulatory and strategic frameworks in place and the application of non-technical measures and economic instruments by industry and by the transport, energy and agricultural sectors for air pollution abatement. It also summarizes information on research, development, monitoring, exchange of technology and public awareness related to air pollution. The information is based on replies by Parties to the general policy questions of the 2010 questionnaire on strategies and policies (ECE/EB.AIR/2009/13).

A. National institutional, regulatory and strategic framework for air pollution abatement

1. Division of responsibility for measures to combat air pollution

162. For most Parties, the Ministry of the Environment was the lead authority in matters of air pollution. However, in many cases Parties also reported on close

[45] http://www.unece.org/env/lrtap/sulf_h1.htm.

[46] Albania, Austria, Belarus, Belgium, Bulgaria, Canada, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Italy, Liechtenstein, Lithuania, Luxembourg, Netherlands, Norway, Russian Federation, Slovakia, Sweden, Switzerland, The FYR of Macedonia and Ukraine. Updated status of ratifications is available at http://www.unece.org/env/lrtap/status/lrtap_s.htm.

collaboration with other ministries, such as those of transport or energy. In Belarus, the remit for air protection was essentially shared between the Ministry of the Environment and the Ministry of Health.

163. In terms of hierarchical division of responsibility, most Parties noted the significant role of national authorities in policymaking and in monitoring, while local and municipal authorities were responsible for implementation and for informing the public. The Russian Federation reported on the distinction between the three levels of decision-making: federal, state and local. While the federal level was notably responsible for setting a unified air pollution policy and regulatory approach and establishing procedures, the state authorities were responsible for the adoption of laws and the development of regional programmes and interventions, among others. This Party also reported on the existence of specific federal bodies operating in fields of relevance to air protection that were responsible for issuing permits for emissions and in assessing emissions from different sources or for monitoring of air pollution.

164. Changes in Croatia had led to the creation of four new directorates, one of which was in charge of "atmosphere and waste management" with responsibilities for, notably: drafting regulations on pollutant limit values in ambient air; monitoring and analysis of the status of air quality at the national, regional and local levels; preparing background documents with regard to air pollution assessment; classification of the state territory into zones and agglomerations according to air pollution levels; and adopting and monitoring implementation of measures for air pollution reduction in zones and agglomerations in which limit and tolerance levels were exceeded. The Croatian Environment Agency, on the other hand, maintained information related to air quality.

165. The EU member States reported on a number of policies on air pollution, including directives and decisions (for example Directives 2008/50/EC and 2004/107/EC on air quality standards) which member States had to transpose into their legislation, as well as regulations which applied directly to them.

2. Ambient air quality and deposition standards

166. Many Parties noted that they applied the limits in the EU Directive for ambient air quality (2008/50/EC), which contained limits for SO_2, NO_x, PM (PM_{10}/$PM_{2.5}$) and lead. They referred, for example, to the limit of 350 micrograms per cubic metre (µg/m[3]) for SO_2, not to be exceeded more than 24 times a calendar year for an hour, and a limit for lead set at 0.5 µg/m[3] per calendar year. All but one responding Party also implemented the limit set for arsenic (6 ng/m[3]/calendar year).

3. Multi-pollutant management approach

167. Several Parties reported that they applied a multi-pollutant approach, in line with the relevant EU regulations. Such an approach was applied to energy saving in particular in Hungary, and in livestock farming and traffic in the Netherlands. Reference was made to the EU National Emission Ceilings Directive (NEC Directive 2001/81/EC) that set ceilings for SO_2, NO_x, VOCs and ammonia (NH_3).

4. Integrating climate change and air pollution policies

168. Many Parties highlighted the benefits of measures to combat air pollution for achieving climate change targets and vice versa. Yet, in many cases they also identified the need for closer integration between the two areas. For example, in Cyprus, air pollution and climate change were addressed by two separate ministries. Denmark also reported that to date policies on climate change and air pollution had been approached independently from each other and that different air pollutants tended to be targeted separately. The Netherlands noted that efforts to tackle climate change and air pollution in an integrated manner should be further improved, although it also reported on progress made in this direction, including by means of a research programme called the "Dutch Policy Research Programme on Air and Climate". The Russian Federation highlighted that, while there was some integration between both areas, it remained weak. Spain noted that air pollution and climate change policies were integrated only in certain sectors, such as transport and energy. Equally, Sweden's environment policy had separate goals for climate change and air pollution, although implementation mechanisms sought synergies.

169. On the other hand, some Parties reported on increased cross-fertilization between the policies targeting air pollution and climate change. For example, Belarus reported on regulations that since 2008 covered both air pollutants and carbon dioxide (CO_2) (from fossil fuel combustion). The Czech Republic was combining its efforts on air pollution and climate change mitigation

under its National Programme to Abate Climate Change Impacts, due to be adopted in the middle of 2010. Poland's efforts to promote renewable energy contributed to both climate change and air pollution reduction objectives. A number of measures in Slovenia, such as taxes on fossil fuels and the policy on waste management, achieved both air pollution and climate change objectives. The United Kingdom noted that its document "Air Pollution: Action in a Changing Climate", identified specific examples and opportunities to carry out synergistic improvements in air quality and reductions in climate change.

170. Promotion of synergies between climate change and air pollution measures was also a priority in the EU. An assessment of the EU Climate Action and Renewable Energy package showed the potential of reducing the cost of air pollution control by €8–€11 billion, and reduced SO_2 and NO_2 emissions by 10%–14%.

B. Sector-specific policies and measures for addressing air pollution

171. A number of Parties mentioned that they applied EU Directive 2008/1/EC concerning integrated pollution prevention and control (IPPC Directive) which promotes an integrated approach to pollution prevention. In Denmark, the "Eco-innovation 2010–2011" Action Plan promoted an integrated approach to environmental challenges, including air pollution, water and waste. The majority of responding Parties noted that air quality issues were integrated within broader environmental protection plans. Germany, Hungary, Romania and the United Kingdom stressed that air pollution concerns were taken into account in the activities of the various economic sectors, including industry, energy, transport, agriculture and in land use planning. The Czech Republic noted that its policies on air pollution took into consideration the wider ecosystems, as well as human health. Its State Environmental Policy (2004–2010) provided a framework for strengthening and improving cooperation with other sectors within the context of sustainable development.

172. A number of Parties mentioned environmental impact assessments as being an important basis for issuing permits, and for setting plans and programmes. In Norway, permits that were issued to facilities also regulated waste management more broadly. Consequently, they played a role not only in minimizing emissions into the air but also in reducing contamination of soil and water. Equally, Croatia's new Environmental Protection Act required companies to obtain an integrated environmental protection permit prior to starting construction and operations (as well as prior to any significant change in operation or reconstruction of the installation). Portugal reported on its Polis Programme, created in 2000 to improve the overall quality of life in cities, which actively considers measures to improve urban air quality.

1. Industry

173. Parties reported on measures such as taxes, grants, licensing and voluntary schemes to control and reduce emissions from industry. The Belarusian National Action Plan on Rational Use of Natural Resources and Environment for 2006–2010 included the introduction of automatic monitoring systems for pollutants and emission sources on the edge of buffer zones and the implementation of environmental management systems. Belarus also reported using basic economic mechanisms including licensing and taxes. A 10% tax relief was granted to companies with certified environmental management systems. In the Czech Republic, a system of charges applied to polluters, according to the operator's size, and the revenue generated entered the State environmental fund for use in environmental projects. Norway had established a grant scheme totalling NOK 1.8 billion (approximately €227 million) per year for research and development (R&D) and innovation in environmental technologies (notably renewable energy, energy efficiency and carbon capture and storage).

174. Cyprus reported on the use of incentives such as cash grants to reduce industrial pollution and to promote renewable energy, while Slovenia's public Environmental Fund provided soft loans to companies for activities related to environmental protection, including air pollution prevention and control. Slovenia also provided subsidies for measures to improve energy efficiency and to support the use of renewable energy. Denmark noted that the licences granted to operators in the industrial sector outlined their obligations and guidelines related to efficient use of energy and raw material, optimizing the production processes, avoiding waste and promoting recycling, etc. It also reported that it ran a "help desk" for companies under its Eco-Innovations scheme to provide advice and support to businesses wishing to apply eco-efficient technologies. Further efforts in R&D were reported by the Netherlands, which promoted research and innovation in small

businesses through a grants scheme called "Small Businesses Innovation Research", with a total budget of €2.45 million. Poland reported that its main priority was the restructuring of many industries, notably mining, cement and chemical industries, and the promotion of energy efficiency, innovation and BAT. Romania noted efforts to manage energy demand by monitoring energy consumption while raising awareness among industry operators about available options to reduce energy consumption.

175. The Russian Federation reported on specific subsectors such as the chemical and petrochemical industry, where the strategy included applying charges for negative environmental impacts, setting emission limits and promoting incentives to introduce BAT. A number of Parties mentioned the EU Emissions Trading Scheme for CO_2 emissions, which has been operational since 2005. The scheme covers over 11,500 energy-intensive installations, including combustion plants, oil refineries, coke ovens, iron and steel plants, and factories making cement, glass, lime, brick, ceramics, pulp and paper across the EU, accounting for about half of Europe's CO_2 emissions.

2. Transport

176. Measures by Parties to reduce emissions from the transport sector included reducing the use of cars through promotion of cycling and public transportation, elimination of old polluting cars, promotion of cleaner cars, improved fuels and R&D. For example, cycling was promoted in Germany (under its 2002 National Cycling Plan) and in Italy and Poland (notably through public campaigns). Furthermore, Italy had set up a Fund for Sustainable Mobility (of €90 million/year for the period 2007–2009) to reduce emissions by promoting better public transportation, notably through underground railways, trams and trains. Croatia reported on the creation of bicycle lanes, improvements in the quality of public transport and intelligent traffic regulation.

177. Poland was promoting public transport through, among others, integrated train, bus and tram tickets and expanding parking areas near train stations. Portugal was also prioritizing improvements to the public transport system, notably by expanding the Lisbon and Oporto subway network, improving the national railway service and enlarging the fleet of vehicles powered by natural gas in public transport in Lisbon and Oporto. Romania was modernizing its rolling stock fleet to promote rail transport. The Russian Federation reported on its efforts to modernize the national transport system. Slovenia mentioned the existence of "Park and Ride" systems to encourage drivers to minimize the distance driven in their cars and to switch to public transport. Sweden reported that in some local municipalities buses were free of charge for either all citizens or certain groups, and either for all connections or just during certain hours.

178. Nearly all responding Parties reported on financial support schemes to promote the renewal of the car fleet (for cars older than 15 years generally). For example, in the Netherlands, owners of old cars received between €750 and €1,000 for trading them in for newer, more eco-friendly cars. As a result, around 80,000 old, polluting cars and delivery vans were expected to be traded in for newer and less polluting vehicles. Belarus succeeded in switching more than 4,000 vehicles to compressed and liquefied gas and renewed its bus stock. It also introduced higher import taxes for vehicles older than 14 years, with a resulting rise in the importation of newer and cleaner vehicles. In contrast many Parties imposed extra taxes on cars that either had more polluting engines (larger engines) or diesel cars without a filter.

179. In parallel, many Parties reported on incentives and subsidies to promote hybrid or electric cars. For example, in Cyprus grants worth a total of €2.3 million had been awarded for the purchase of hybrid, electric and dual propulsion vehicles. In the Czech Republic, these cars were dispensed from paying the road-traffic tax. Fiscal measures helped to increase the number of hybrid cars sold in the Netherlands, practically doubling their number from 3,700 vehicles in 2007 to 6,000 vehicles by the first half of 2008. The Portuguese Government provided a subsidy of €5,000 to the first 5,000 individuals that acquired an electric vehicle.

180. Various Parties reported on emission-reduction measures targeting fuels, including incentives to promote cleaner fuels (such as biofuels or compressed natural gas). In Slovakia, part of the bus fleet was being replaced with vehicles powered by natural gas. Similarly, Slovenia had included in Ljubljana's bus fleet 20 buses (out of 200) operating on pure biodiesel. In Sweden, all large petrol stations were required to have a biofuel pump and the installation was supported financially by the State.

181. Both Sweden and the United Kingdom reported on a congestion charge applied in their respective capital cities. In central Stockholm the scheme, in place since 2007, had brought down traffic by approximately 20%. In London the congestion charge came into effect

in 2003 and the average volume of traffic entering the centre of the city had subsequently fallen by 21%.

182. Some Parties reported ongoing efforts in R&D to improve the transport sector's environmental impact. The Netherlands published several tenders for innovative developments, notably one to reduce the amount of kilometres necessary for transporting agricultural products, such as food and flowers/plants. One approach trialled in the United Kingdom by the Highways Agency was to look at the effectiveness of a barrier coated with titanium dioxide designed to remove NO_x from the air.

183. The Russian Federation reported also on its air and maritime transport policies. In the field of air transport, it implemented improved environmental standards for aircraft engines (in line with those of the International Civil Aviation Organization) and was seeking to set high standards in civil shipbuilding in order for its industry to become more competitive globally. It also set specific measures for ships to reduce their emissions of SO_2, NO_2 and VOCs. With respect to on-road vehicles, the Russian Federation reported on the application of vehicle taxes.

3. Energy

Energy efficiency

184. Parties placed much emphasis on promoting energy efficiency, which not only contributed to reducing air pollution but also reduced anthropogenic sources of greenhouse gases responsible for climate change.

185. In its 2006–2010 energy policy, Belarus, among others, promoted the use of alternative and renewable energy, the implementation of combined schemes of power generation, the use of technological measures to suppress the formation of NO_x, the modernization of boilers, the development of small power stations and emission controls. Canada promoted energy efficiency through regulations, incentives and non-financial assistance for voluntary action, information and outreach activities. Measures under Croatia's Energy Efficiency Master Plan (2008–2016) included the use of biodegradable municipal wastes to fuel district heating plants, credits for renewable energy projects, and the promotion of energy efficiency in buildings. Cyprus's energy policy focused on energy pricing, sector-specific energy-efficiency programmes and renewable energy. Combined heat and electricity generation was promoted in the Czech Republic, Finland and Germany.

186. Italy was using "green" and "white" certificates to promote energy savings and renewable energy respectively. In Slovakia, measures to increase energy efficiency included regular inspections of boilers, heating systems and air-conditioning systems and the labelling of appliances according to their level of energy consumption. In Slovenia, the most important energy efficiency measures were: (i) fiscal measures, such as favourable taxation for biofuels for transport; (ii) market measures, such as the use of certification for energy in buildings and for identifying the origin of electricity; (iii) standard-setting, particularly in the building industry; (iv) financial support, such as subsidies for the domestic and professional use of renewable energy; and (v) information, promotion and demonstration activities.

187. Several Parties reported on the application of a mandatory energy-efficiency labelling scheme for appliances such as electric refrigerators, freezers, washing machines, electric tumble driers, dishwashers, household light bulbs, etc., in line with EC Directive 2005/32/EC.

188. Most responding Parties reported on measures to improve energy efficiency in buildings, labelled and classified according to their estimated consumption in primary energy (in line with EU Directive 2002/91/EC). For example, Austria reported on the use of subsidies to promote energy efficiency in buildings and the use of renewable energy. In the Netherlands, as of 2017, new non-residential buildings would have to be 50% more energy efficient compared with 2005. Italy supported energy-efficient buildings through fiscal deductions of up to 55% and municipalities could reduce ownership tax to below 4% if renewable energy systems were installed. Equally, in the Netherlands, since 1 July 2009 improvements in the energy efficiency of buildings were eligible for tax deductions and several subsidies existed to support energy improvements to private buildings. Liechtenstein promoted energy efficiency in buildings through its Building Act, which notably subsidized installations using renewable energy such as solar energy, wood and biomass. The United Kingdom was funding demonstration projects in low-carbon buildings through a £131 million (approximately €157 million) "Low Carbon Buildings Programme".

189. Innovative schemes were reported by a handful of Parties. These included, for example, Portugal's InovGrid Programme, which used cutting edge technology and expertise to support the installation of smart systems for energy metering in about 10% of households, or

Sweden's "Get energy-smart" campaign to promote different ways to save and recycle energy via a touring demonstration house.

Renewable energy

190. Renewable energy sources were a major feature of all responding Parties' approaches to reduce emissions from the energy sector and were generally supported by grants or subsidies. For example, in Bulgaria, renewable energy represented 8.67% of total energy consumption in 2004, and 11.49% one year later. Croatia aimed for its share of electricity from renewable sources to reach 5.8% of total electricity consumption in 2010 compared to 0.8% in 2004. A major objective of Cyprus's policy to reduce emissions was to increase the contribution of renewable energy to the energy balance of the island up to 12% by the end of 2010. In the Czech Republic, renewable energy contributed 4.8% of the domestic energy consumption in 2008, essentially hydropower, but also biomass, biogas and solar energy (which had increased significantly (from 0.54 GWh in 2006 to 12.9 GWh in 2008). Furthermore, the Czech Republic reported that the Government subsidized up to 85% of the total eligible expenditures of a renewable energy project. Denmark's energy strategy aimed at increasing the share of renewable energy to 20% by 2011. To reach this target the Government subsidised onshore and offshore wind power and set up a special fund of DKK 25 million (approximately €3.3 million) per year over four years to promote the installation of solar photovoltaic cells, wave power, fuel cells running on renewable fuels and other renewable energy sources.

191. In Finland, about 30 % of electricity produced was from renewable sources, mainly hydropower and biomass. Hungary increased its use of renewable energy sources, particularly that of biomass. Poland's "Strategy for the development of renewable energy", adopted in 2001, aimed to increase the share of renewable sources of energy (particularly hydropower and biofuels) to at least 15% by 2020 through low interest loans and subsidies. Portugal was committed to securing 31% of its share of energy from renewable sources by 2020, with individual sources (such as wind and biomass) each having a specific target. To support these efforts it created an "Innovation Support Fund" in 2008 with a total of €76.8 million.

192. Romania reported on the use of a trading scheme whereby mandatory quotas of green certificates from renewable energy sources were allocated and could be traded. In Slovenia, the use of biofuels and other renewable fuels were promoted for motor vehicles, with the aim for them to reach 5% of all transport fuels by 2010 and 7.5% by 2015. More ambitiously, Slovenia's National Energy Programme expected that by 2010 the share of renewable energy would increase up to 12% of total primary energy supply, and the share of electricity based on renewable energy was expected to reach 33.6% of final electricity consumption.

193. Spain's 1999 Renewable Energy Promotion Plan committed to achieving 12% of primary energy use from renewables by 2010. Its Renewable Energy Plan for 2005–2010 foresaw that by 2010, 30% of electric production would come from renewable energy and approximately 6% of transport fuels would be biofuels. Switzerland's programme SwissEnergy was launched in 2000 with the objective of improving energy efficiency and the use of renewable energy (mainly biomass, wind generation and passive solar systems) to help meet the target set out in the Kyoto Protocol to the United Nations Framework Convention on Climate Change. The United Kingdom reported on its "Renewables Obligation" which required licensed electricity suppliers to source a specified and increasing proportion of their electricity from renewable sources or pay a penalty. As a result, the proportion of electricity from renewable sources rose from 1.8% in 2002 to 5.4% in 2008. The United Kingdom also reported on the anticipated economic impact of its investment in offshore wind energy, which it estimated as being worth up to £75 billion (approximately €90 billion) by 2020, and providing up to 70,000 jobs.

4. Agriculture

194. Measures reported by Parties to address emissions from agriculture included alternative livestock feeding strategies, improved practices for manure storage and spreading, low-emission animal housing systems and the use of mineral fertilizers.

195. For several Parties, biogas presented an opportunity to reduce emissions from agricultural waste while at the same time improving energy efficiency. Cyprus reported that it already had eight biogas plants with a total capacity of 4.4 MW (out of a total estimated national potential of 12 MW). The Czech Republic and Norway reported on similar schemes. In Denmark, the biogas scheme, under the Rural Development Programme, was expected to be awarded DKK 100 million (approximately €13 million) annually from 2010–2012. The United Kingdom reported on a £10 million (approximately €12 million) project, called the Anaerobic Digestion Demonstration Programme, which supported demonstration projects on anaerobic digestion (using agricultural waste).

196. Various economic instruments were used by Parties in the agriculture sector, such as subsidies, tax incentives, fees, low interest loans etc. For example, tax benefits were granted in the Netherlands for farms that used techniques leading to low emissions of ammonia and greenhouse gases; Norway imposed fees on pesticides; and both Romania and Spain provided incentives to renew agricultural machinery.

197. Many Parties promoted organic farming through various financial schemes. In Cyprus, under the Rural Development Programme 2007–2013, cash grants were provided for organic farming. The Czech Republic and Denmark reported using subsidies to promote organic farming. A sharp rise in the proportion of organic farming was seen in Slovenia thanks to financial support from the State, with the share of organic farming to total farming area increasing from 0.5 % in 1999 to 6.1% in 2008. Switzerland provided direct payments for organic farming. Some Parties reported on activities related to awareness-raising and information dissemination on organic food in order to stimulate demand. The United Kingdom reported on a scheme called the Organic Conversion Information Service, which targeted farmers and provided them with free advice on the process and implications of switching to organic farming. The EU had an EU-wide organic agriculture policy[47] which contributed to the protection of natural resources, biodiversity and animal welfare, as well as to rural development.

C. Research, development and monitoring

198. Many Parties mentioned that their research activities were linked to those of the Convention's Cooperative Programme on Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP) and its task forces. The Czech Republic reported that in 2010 it would participate in a case study on heavy metals which would analyse factors affecting the quality of the assessment of heavy metal pollution levels.

199. Slovakia reported on its Enviroportal, an environmental information system accessible online which provided verified information on the environment and served as an important decision-support tool. The Netherlands reported on a number of research programmes related to air pollution, notably a policy research programme on fine PM to deal with uncertainties concerning this pollutant and the European Platform on Mobility Management. This Party also noted that over 90% of its research related to air pollution was of an international nature. Switzerland reported that it had various institutes undertaking research related to air pollution (including the Swiss Federal Institute for Forest, Snow and Landscape Research; the Institute for Applied Plant Biology; the Agricultural Research Station; and the Research Group for Environmental Monitoring).

200. A number of Parties highlighted the importance of their air quality monitoring stations. For example, Hungary had 59 air quality monitoring stations across the country which measured levels of SO_2, NO_x, carbon monoxide (CO), PM, non-methane VOCs (NMVOCs) and ozone (at some stations). Similarly, Romania reported that its National Air Quality Monitoring Network had 142 automatic measuring stations across the country which measured air concentrations of SO_2, NO_2, CO, benzene and ozone, and PM. The Russian Federation reported that it had monitored air quality through 699 stations in 248 cities in 2008. Switzerland also reported that it had 96 stations to monitor air pollution across the country, 16 at the national level and 80 at the cantonal level.

201. The EU had a number of innovative programmes, such as the Competitiveness and Innovation Framework Programme's Entrepreneurship and Innovation Programme (CIP EIP),[48] which provided direct financial support for new and innovative technologies.

D. Exchange of technology and public awareness

202. Exchange of technology was reported by a number of Parties both at the national and international levels. For example, nationally, conferences, working groups and workshops were organized in Croatia, the Czech Republic, Hungary and Slovakia. International cooperation and sharing of experts were reported by Germany, Italy, Poland, Romania, Slovenia and Sweden. In the EU, regular workshops were organized (by the European Commission) to facilitate exchange of information on the development and implementation of air quality programmes. The EU candidate countries were invited to participate in assistance and support programmes which helped them to comply with EU legislation. Several Parties referred to their participation in the information exchange process set up by the European Commission under the IPPC Directive.

[47] http://ec.europa.eu/agriculture/organic/eu-policy_en.

[48] See http://www.ec.europa.eu/cip/eip/index_en.htm.

203. With respect to air pollution legislation and policies, all responding Parties reported that they conducted public consultations prior to passing new laws or amending existing ones. In Cyprus and Romania the public was invited to participate in the preparation or revision of plans related to air pollution through open public hearings. Germany sent drafts of legislation specifically to selected experts and published them on the Internet. In Poland and the United Kingdom the public was invited to comment on any new Government proposal within a period varying from 21 days to 12 weeks. National and regional authorities, private entities and non-governmental organizations held workshops, seminars or conferences to raise public awareness about new policies and/or to improve the application of existing ones in Portugal. In the Russian Federation the authorities had to review the results of environmental monitoring reports undertaken by non-governmental organizations and public associations.

204. The Czech Republic, the Netherlands, Portugal and Spain reported that they applied the UNECE Aarhus Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters, which establishes the right for the public to participate in decisions related to the environment. Furthermore, in the Netherlands, the Environmental Information Act contained new obligations for private enterprises to supply citizens with information about factors relating to their operations that might have an effect on the environment.

205. In most countries, information about air quality and pollution was communicated to the public via websites. In serious cases, some Parties (e.g., Cyprus, Italy and the Netherlands) reported that the public were further informed via the press and media. The Russian Federation reported on the use of interviews with leading experts to keep the public informed.

ANNEX

FIGURE 1 **Parties to the Convention on Long-range Transboundary Air Pollution**

51 Parties, as of November 2013

Albania, Armenia, Austria, Azerbaijan, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria, Canada, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Georgia, Germany, Greece, Hungary, Iceland, Ireland, Italy, Kazakhstan, Kyrgyzstan, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Monaco, Montenegro, Netherlands, Norway, Poland, Portugal, Republic of Moldova, Romania, Russian Federation, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, the former Yugoslav Republic of Macedonia, Turkey, Ukraine, United Kingdom, United States and European Community

FIGURE 2 **Status of ratification of protocols as of November 2013 [a/]**

Protocol	Open for signature	Entry into force	Number of signature	Number ofo ratifications
Acidification, Eutrophication and Ground-level Ozone	1999	2005	31	25 [b/]
Persistent Organic Pollutants	1998	2003	36	33 [c/]
Heavy Metals	1998	2003	35	33 [d/]
Further Reduction of Sulphur Emissions	1994	1998	28	29 [e/]
Volatile Organic Compounds	1991	1997	23	24 [f/]
Nitrogen Oxides	1988	1991	25	35 [g/]
Reduction in Sulphur Emissions	1985	1987	19	25 [h/]
European Monitoring and Evaluation Programme (EMEP)	1984	1988	22	45 [i/]

[a/] Updated status can be found at http://www.unece.org/env/lrtap/status/lrtap_s.htm.

[b/] Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Finland, France, Germany, Hungary, Latvia, Lithuania, Luxembourg, Netherlands, Norway, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, United Kingdom, United States and European Community.

[c/] Austria, Belgium, Bulgaria, Canada, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Iceland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Montenegro, Netherlands, Norway, Republic of Moldova, Romania, Serbia, , Slovakia, Slovenia, Spain, Sweden, Switzerland, the former Yugoslav Republic of Macedonia, United Kingdom and European Community.

[d/] Austria, Belgium, Bulgaria, Canada, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Latvia, Liechtenstein, Lithuania, Luxembourg, Monaco, Montenegro, Netherlands, Norway, Republic of Moldova, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, the former Yugoslav Republic of Macedonia, United Kingdom, United States and European Community.

[e/] Austria, Belgium, Bulgaria, Canada, Croatia, Cyprus, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Liechtenstein, Lithuania, Luxembourg, Monaco, Netherlands, Norway, Slovakia, Slovenia, Spain, Sweden, Switzerland, the former Yugoslav Republic of Macedonia, United Kingdom and European Community.

[f/] Austria, Belgium, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Italy, Liechtenstein, Lithuania, Luxembourg, Monaco, Netherlands, Norway, Slovakia, Spain, Sweden, Switzerland, the former Yugoslav Republic of Macedonia, and United Kingdom.

[g/] Albania, Austria, Belarus, Belgium, Bulgaria, Canada, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Liechtenstein, Lithuania, Luxembourg, Netherlands, Norway, Poland, Russian Federation, Slovakia, Slovenia, Spain, Sweden, Switzerland, the former Yugoslav Republic of Macedonia, Ukraine, United Kingdom, United States and European Community.

[h/] Albania, Austria, Belarus, Belgium, Bulgaria, Canada, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Italy, Liechtenstein, Lithuania, Luxembourg, Netherlands, Norway, Russian Federation, Slovakia, Sweden, Switzerland, the former Yugoslav Republic of Macedonia, and Ukraine.

[i/] Albania, Austria, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria, Canada, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Georgia, Germany, Greece, Hungary, Ireland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Monaco, Montenegro, Netherlands, Norway, Poland, Portugal, Romania, Russian Federation, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, the former Yugoslav Republic of Macedonia, Turkey, Ukraine, United Kingdom, United States and European Community.

FIGURE 3 **Organizational structure of the Convention**

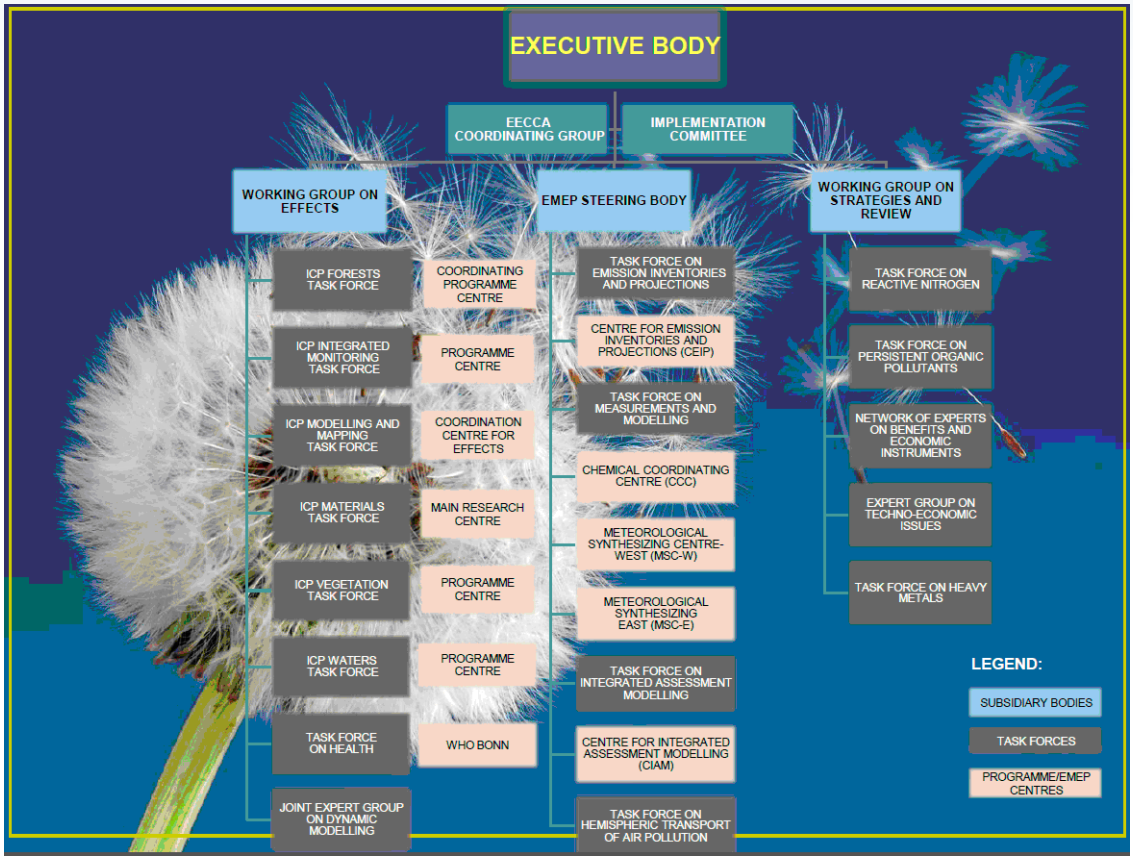

FIGURE 4 **Emission trends of sulphur in the EMEP area 1990-2008 and 2010**

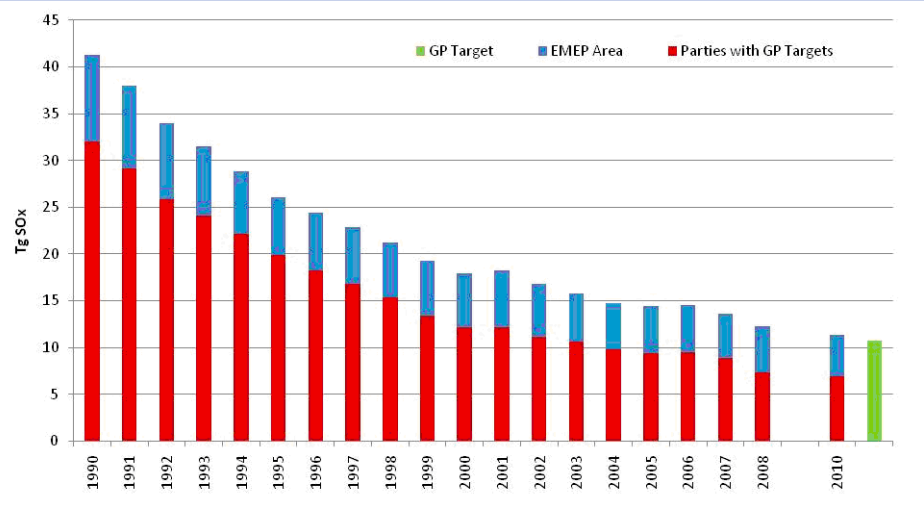

FIGURE 5 **Emission trends of NOx in the EMEP area 1990-2008 and 2010**

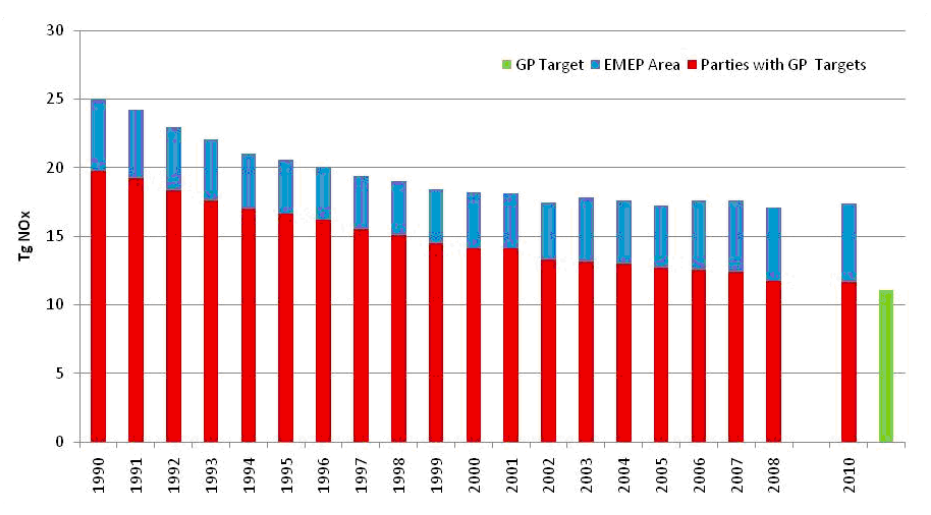

FIGURE 6 **Emission trends of ammonia in the EMEP area 1990-2008 and 2010**

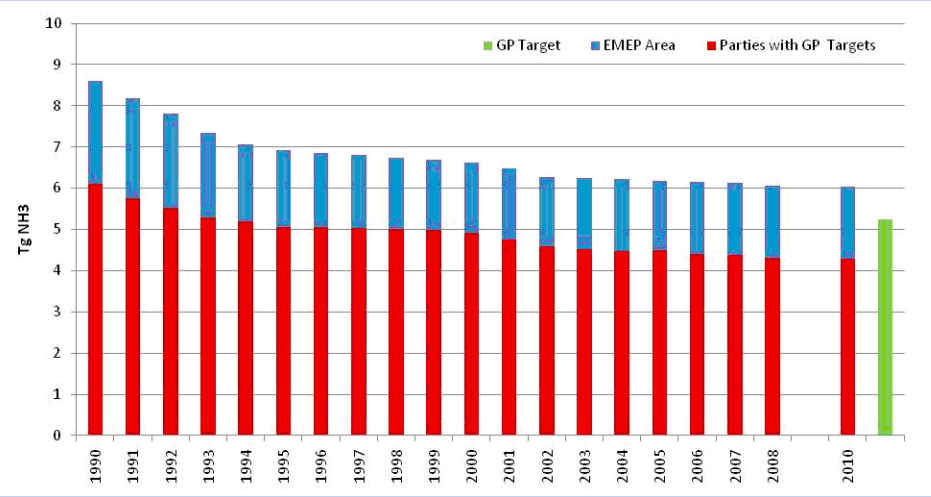

FIGURE 7 **Emission trends of NMVOCs in the EMEP area, 1990-2008 and 2010**

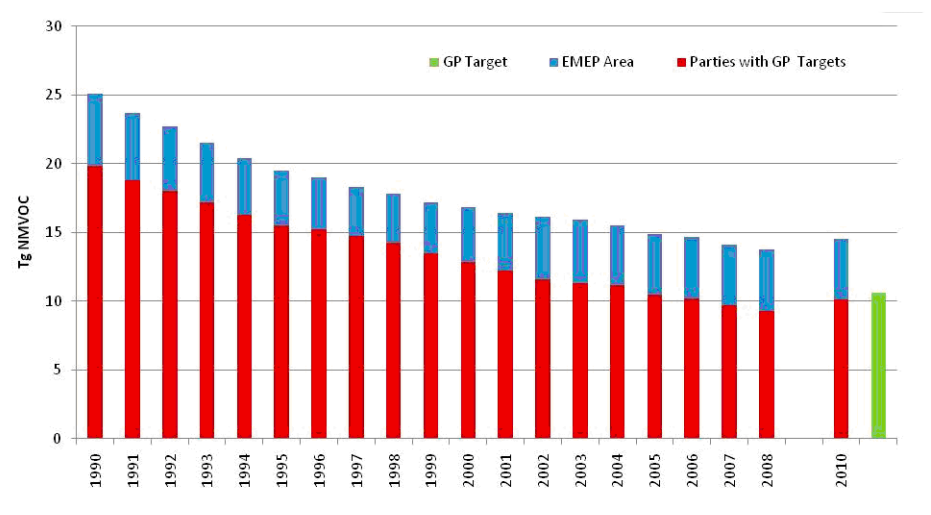

FIGURE 8 **Emission trends of POPs in the EMEP area, 1990-2008**

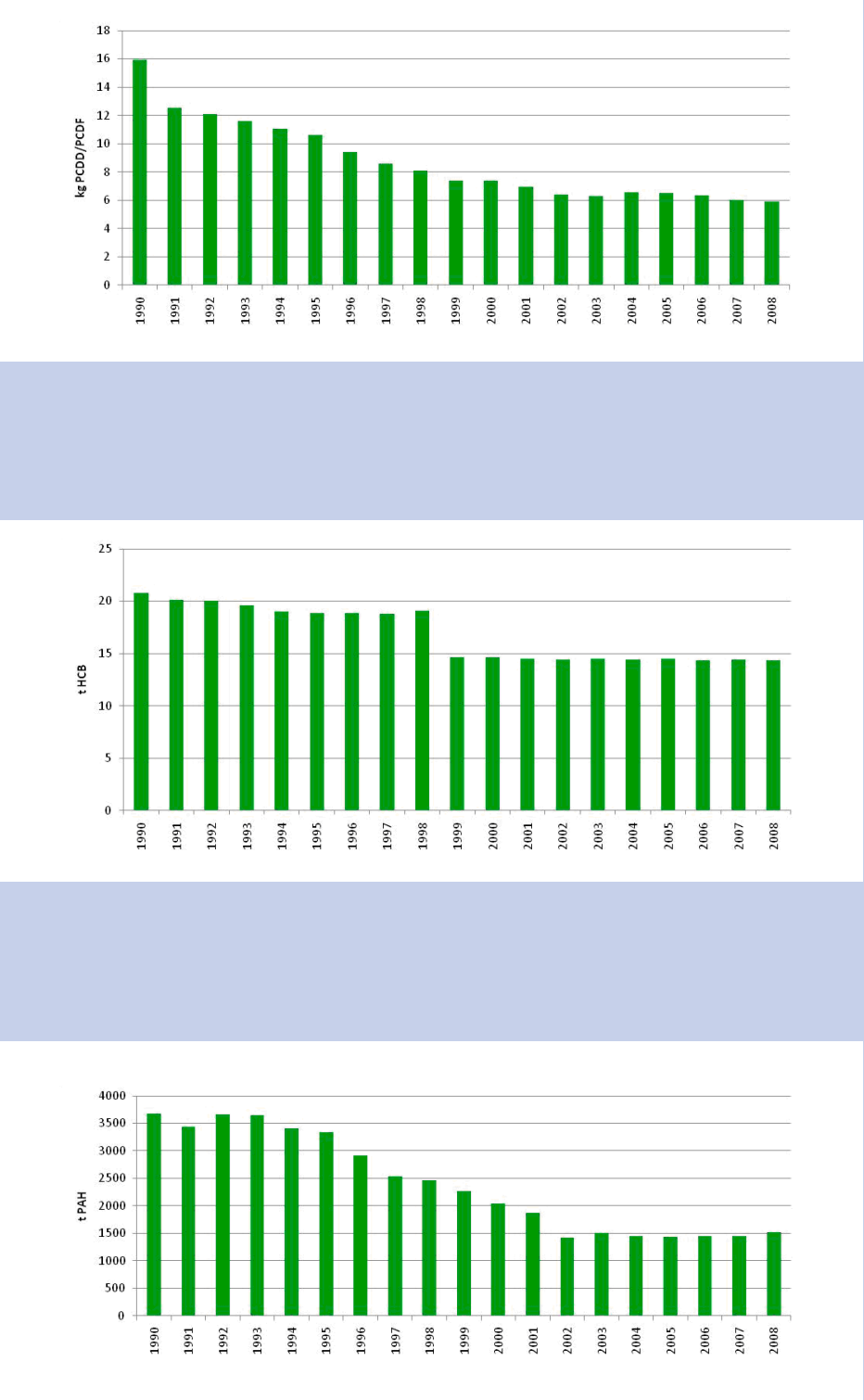

FIGURE 9 **Emission trends of heavy metals in the EMEP area 1990-2008**

FIGURE 10A **Emission trends of SOx in USA 1990-2008**

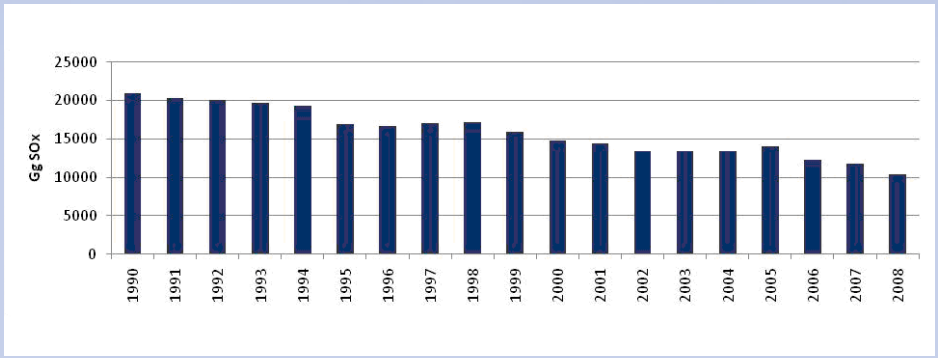

FIGURE 10 B **Emission trends of NOx in USA 1990-2008**

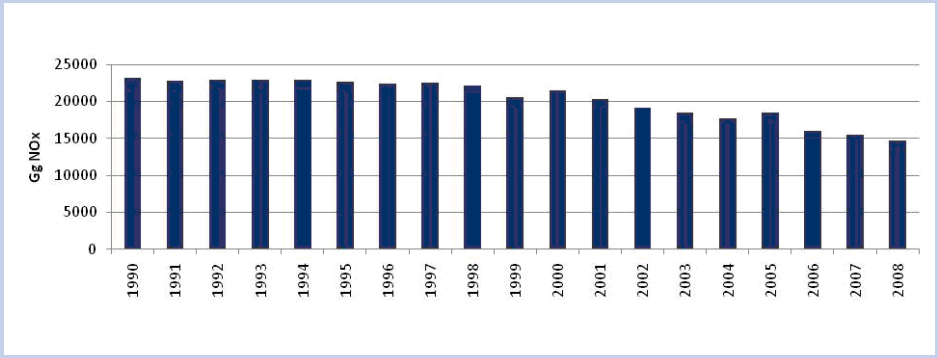

FIGURE 10 C **Emission trends of NMVOC in USA 1990-2008**

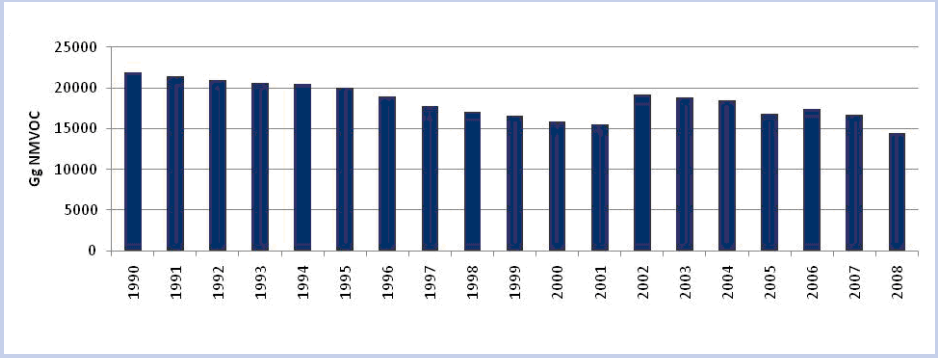

FIGURE 10 D **Emission trends of SOx in Canada 1990-2008**

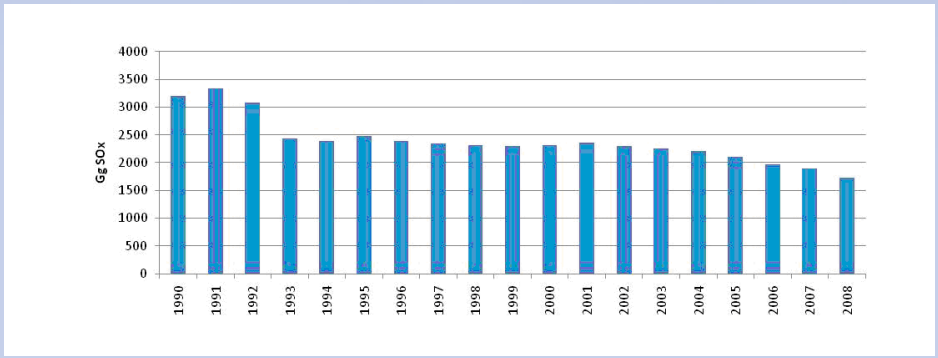

FIGURE 10 E **Emission trends of NOx in Canada 1990-2008**

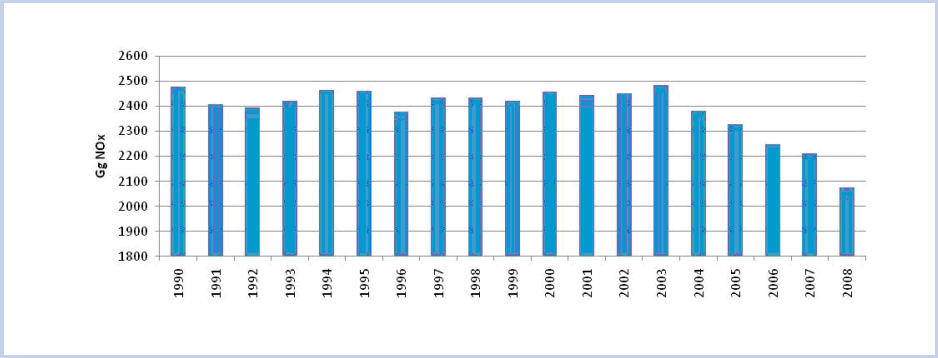

FIGURE 10 F **Emission trends of NMVOC in Canada 1990-2008**

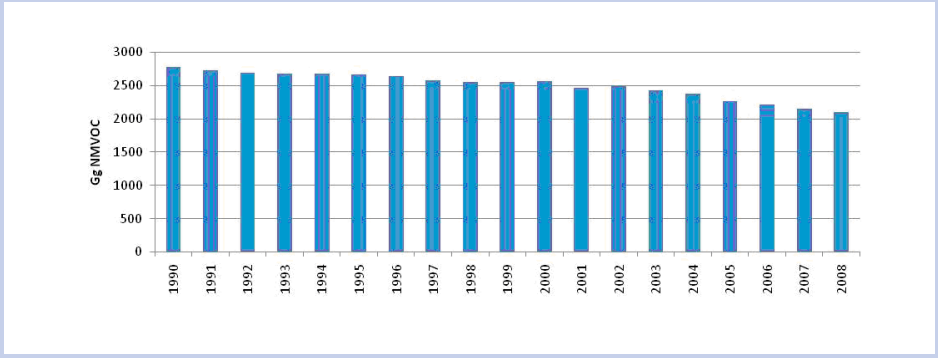

FIGURE 11 **Emissions of sulphur in 2008 at 50 km resolution**

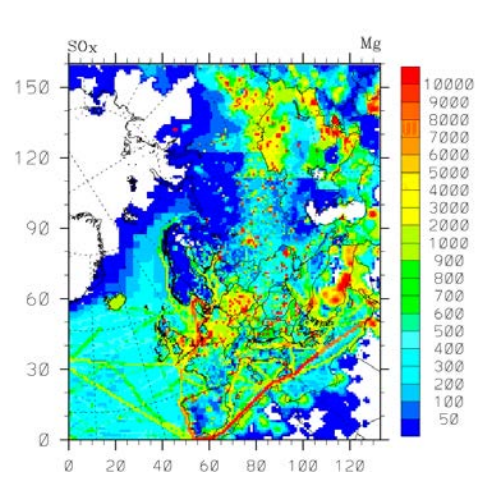

FIGURE 12 **Emissions of nitrogen oxides in 2008 at 50 km resolution**

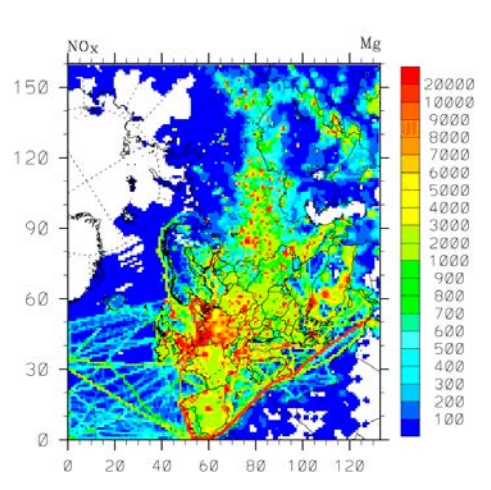

FIGURE 13 **Emissions of ammonia in 2008 at 50 km resolution**

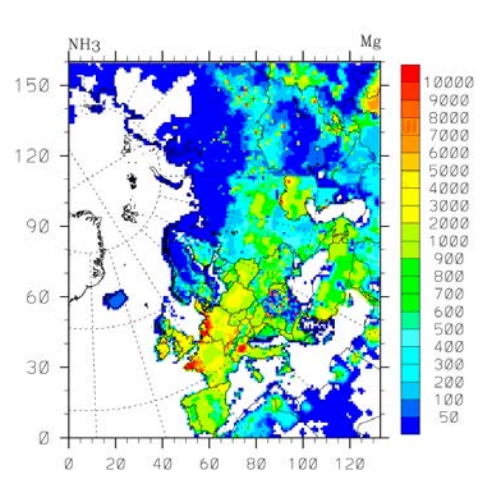

FIGURE 14 **Emissions of NMVOCs in 2008 at 50 km resolution**

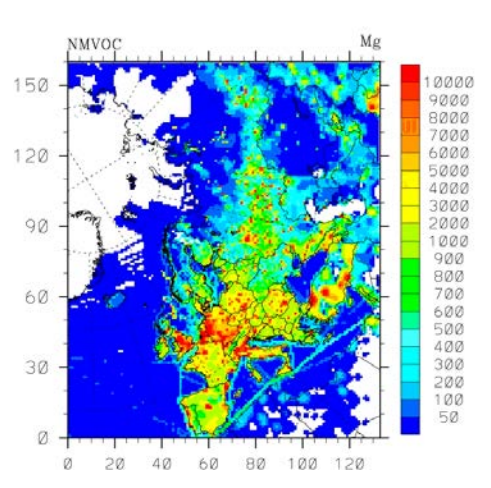

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FIGURE 15 **Emissions of PM 2.5 and PM Coarse in 2008 at 50 km resolution**

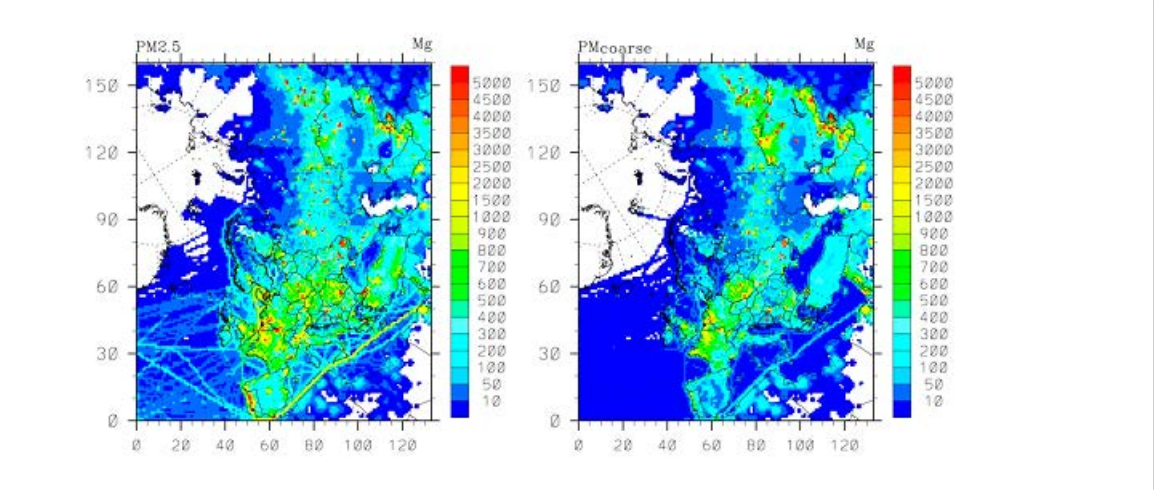

FIGURE 16 **Anthropogenic emissions per sector of SOx in the EMEP area, 2008**

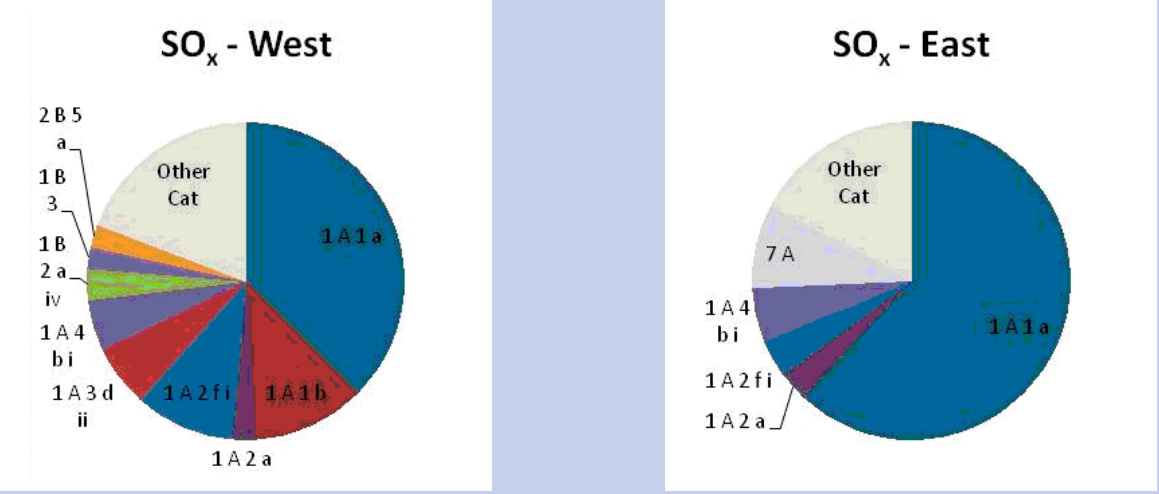

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FIGURE 17 **Anthropogenic emissions per sector of NOx in the EMEP area, 2008**

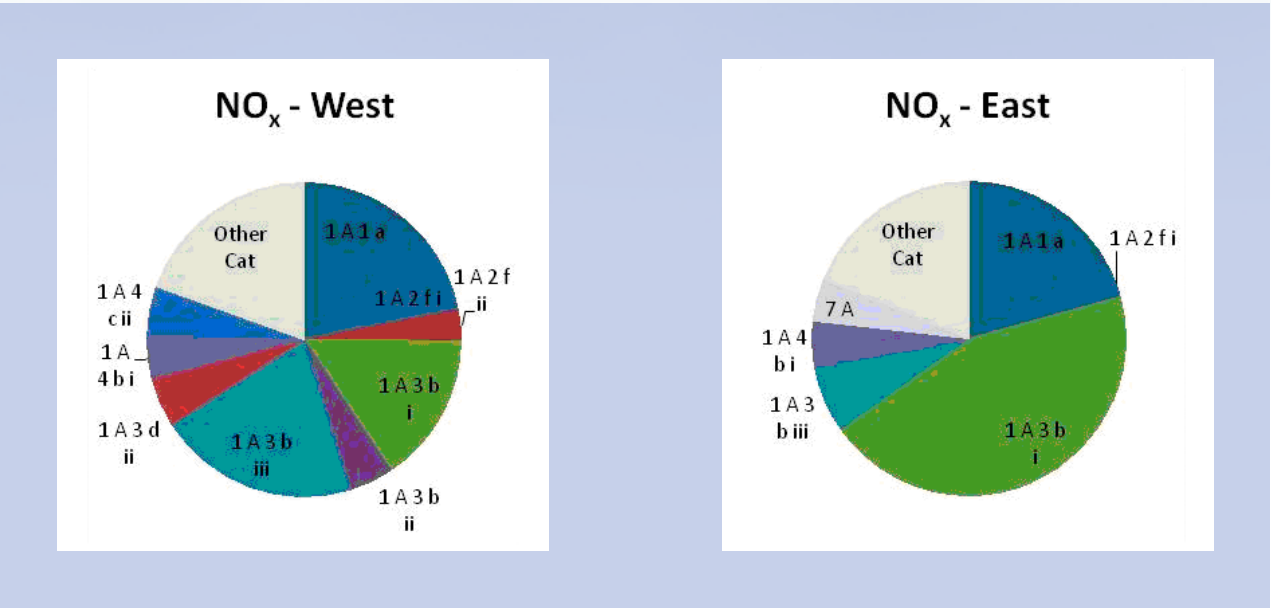

FIGURE 18 **Anthropogenic emissions per sector of NMVOCs in the EMEP area, 2008**

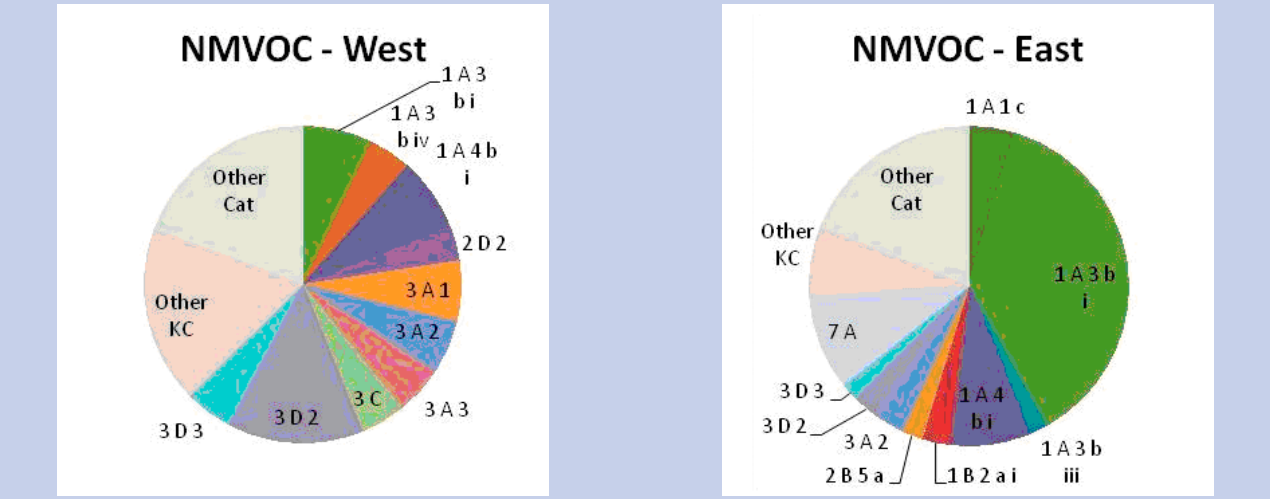

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FIGURE 19 **Anthropogenic emissions per sector of ammonia in the EMEP area, 2008**

FIGURE 20 **Anthropogenic emissions per sector of particulate matter (PM2.5 and PM10) in the EMEP area**

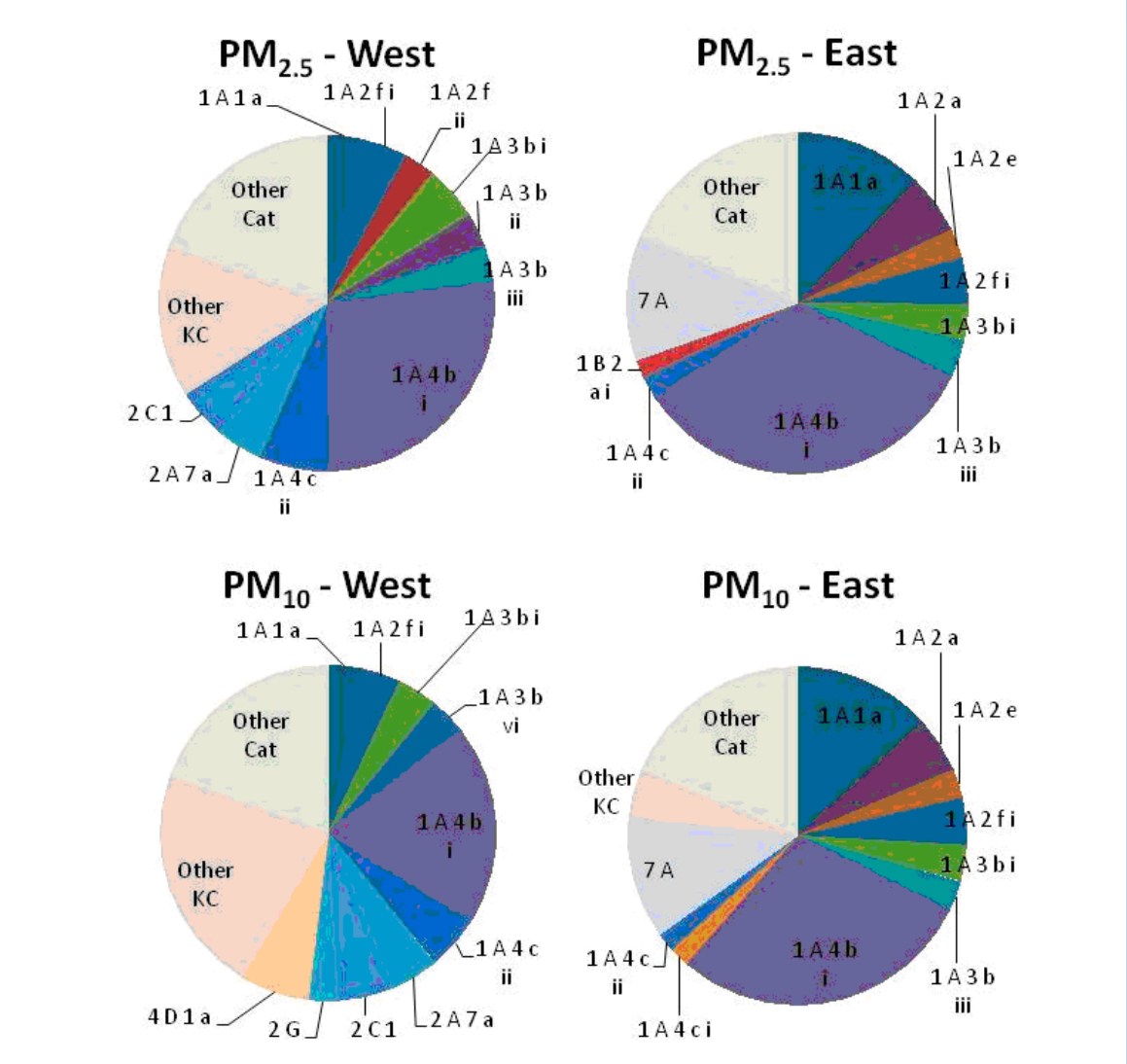

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FIGURE 21 **Anthropogenic emissions per sector of lead, cadmium and mercury in the EMEP area**

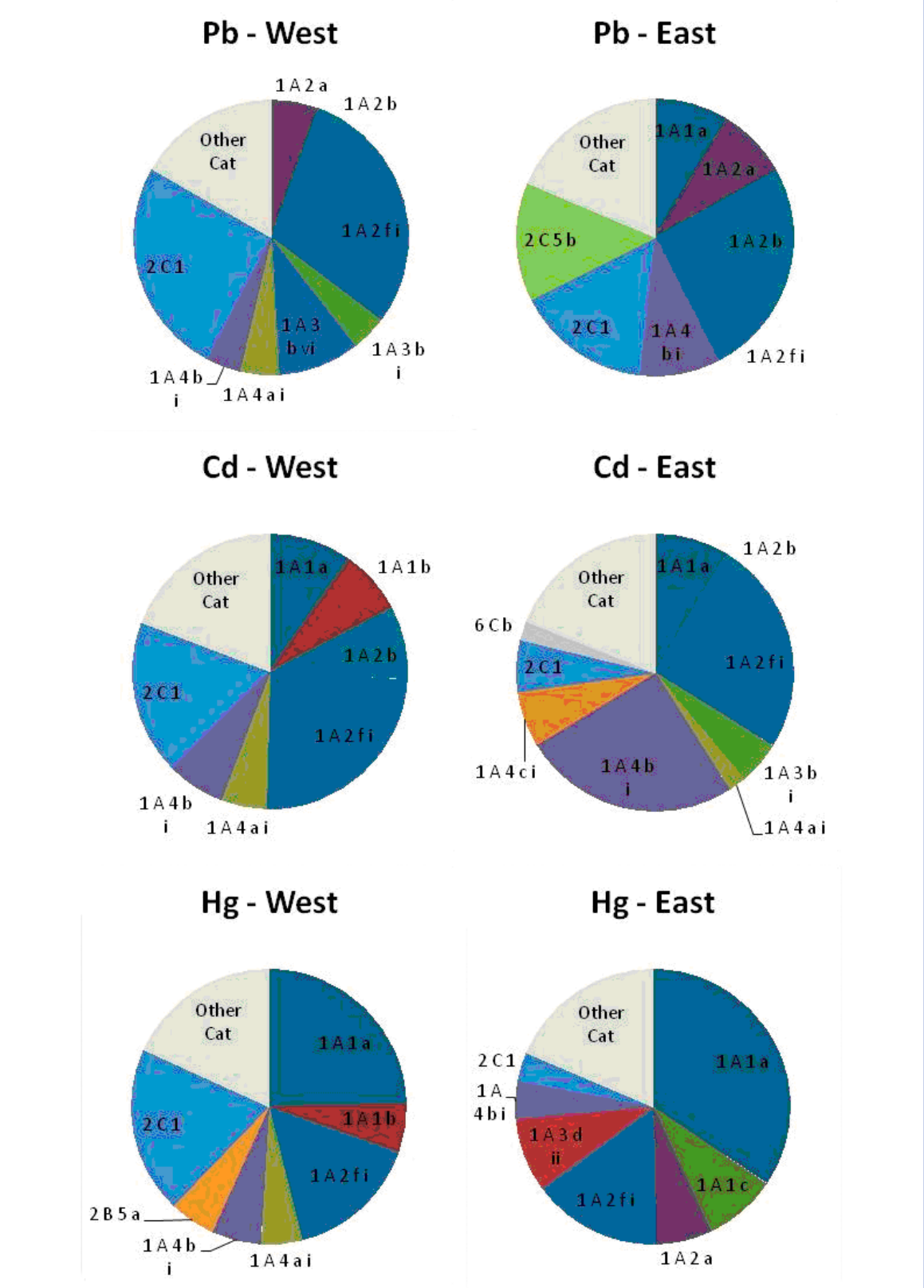

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FIGURE 22 **Anthropogenic emissions per sector of POPs in the EMEP area**

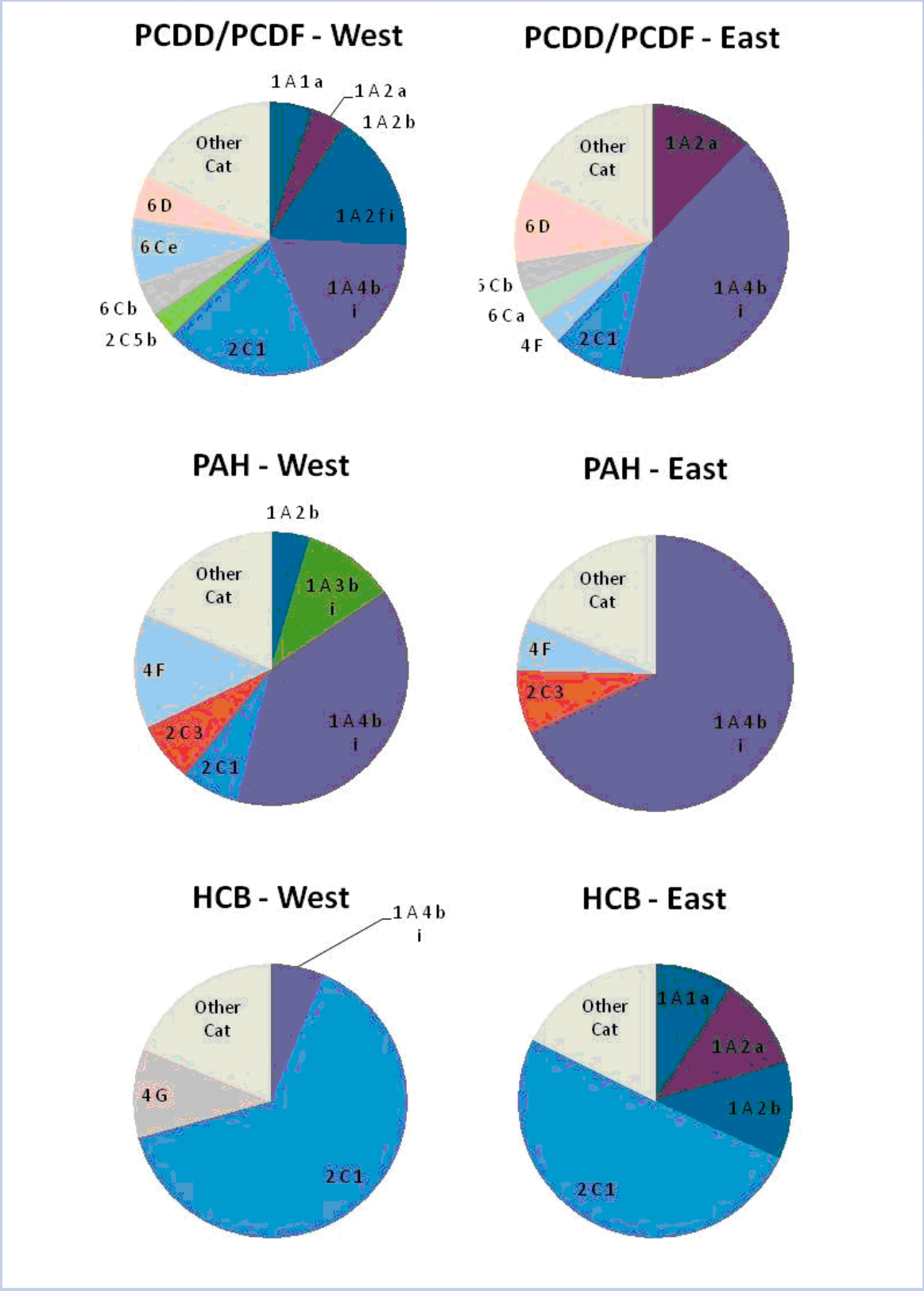

FIGURE 23 **Reduction in emissions of SOx (left) and NOx (right) in the individual Parties of the UNECE region between 1990 and 2008**

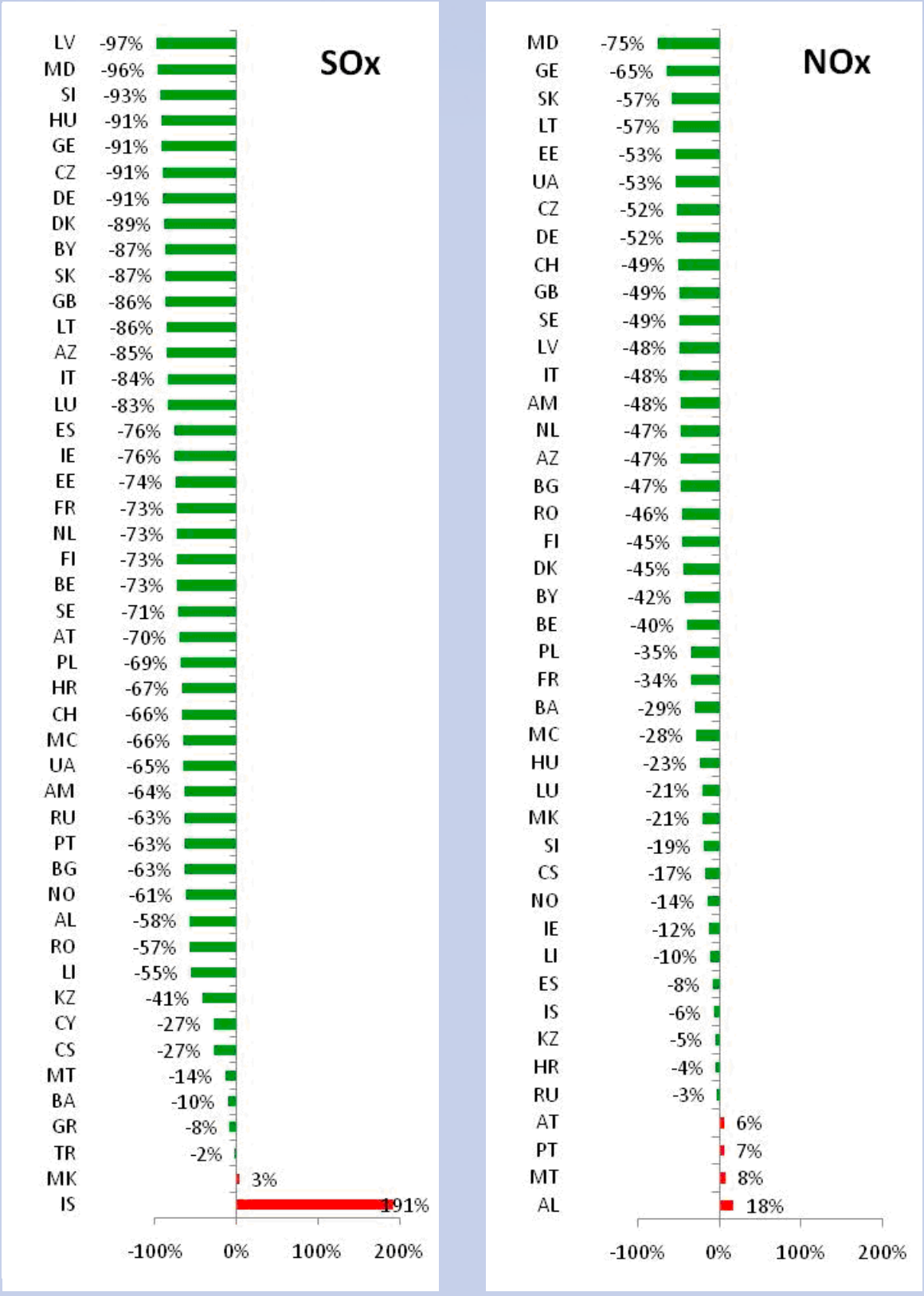

FIGURE 24 **Reduction in emissions of NMVOC (left) and NH3 (right) in the individual Parties of the UNECE region between 1990 and 2008**

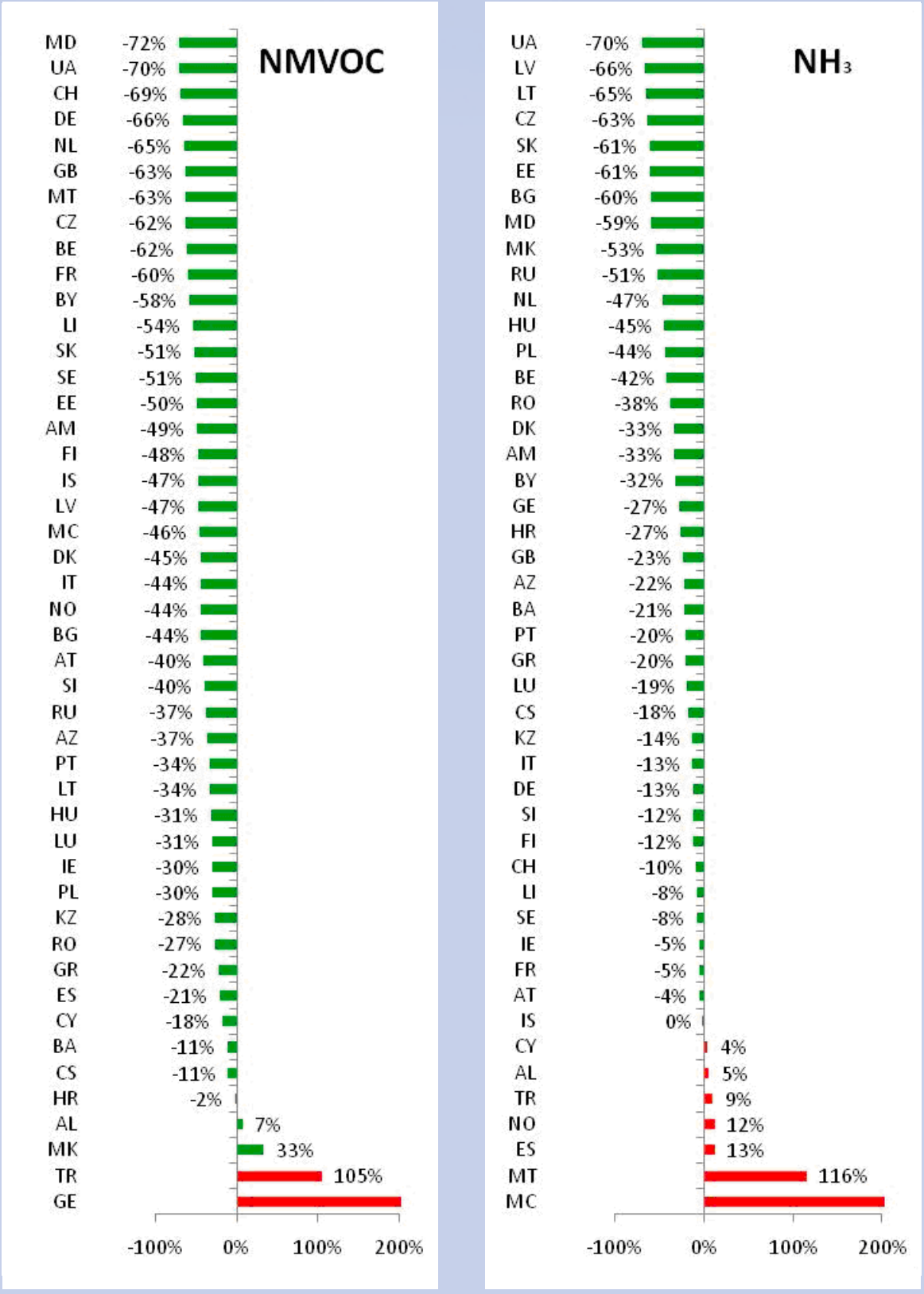

FIGURE 25 **Effects of pollutants covered by the Convention's protocols**

Pollutant	Health Effects	Ecological Effects
SO_2	Respiratory and cardiac diseases Respiratory symptoms in asthmatics	Acid rain (e.g. damage to fish populations and forest soils)
NO_x	Lung irritation (e.g. inflammation, respiratory cell damage, premature ageing) Increased susceptibility to respiratory infection Respiratory and cardiac diseases Asthma attacks	Acid rain (e.g. damage to fish populations and forest soils) Eutrophication (e.g. disruption of ecosystem functions, acidification of surface and ground waters) Regional haze
VOC_s	Lung irritation (e.g. inflammation, respiratory cell damage, premature ageing) Increased susceptibility to respiratory infection Asthma attacks	Decreased commercial forest productivity Damage to ecosystem functions Regional haze
Ozone (from NOx and VOC precursors)	Lung inflammation Respiratory disease (e.g. asthma and emphysema) Impairment of immune system defences	Impede growth, reproduction and health of plants Increase plants' susceptibility to disease, pests and environmental stresses Reduce agricultural yields Alter ecosystems through changes in water movement, mineral/nutrient cycling and habitat Kill/damage leaves Disintegration of organic materials
Heavy metals	Food contamination Premature death Bronchitis - chronic and acute Asthma attacks Lower and upper respiratory illness Blood disorders (e.g. lead poisoning) Effects on functioning of liver, kidneys, circulatory and nervous systems Effects on the development of the foetus and other human health problems caused by mercury in fish	Affects on the decomposition of organic matter Impairs the recycling of important forest nutrients Reproductive problems in birds and other wildlife Wildlife also harmed by mercury in fish
POPs	Reproductive and immune effects Developmental and behavioural abnormalities Cancer	Bioaccumulates in animals Ability to build up in the food chain
Ammonia	Eye and upper respiratory tract irritation Burning and scarring of tissues High blood pressure Lethal at higher concentrations (can cause blindness, lung damage, heart attack, death)	Eutrophication (e.g. disruption of natural ecosystems) Reduction in egg hatching success in fish, reduction in growth rate and morphological development (esp. gills, liver and kidney) Toxic to fish and aquatic organisms at high concentrations
Particulate matter (PM 2.5 and PM10)	Respiratory and cardiovascular morbidity, such as aggravation of asthma, respiratory symptoms and an increase in hospital admissions; Mortality from cardiovascular and respiratory diseases and from lung cancer.	Acid deposition; reduction in photosynthesis Black carbon particles reduce albedo of snow; intensification of climate change effects

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FIGURE 26 **Average Accumulated Exceedance (AAE) in every EMEP-50 km grid cell of critical loads for acidification in 2000 (left) and 2020 under the baseline (middle) and maximum feasible (right) end-of-pipe emission reduction scenarios. Peaks of exceedances in 2000 (red shading) are reduced in 2020, as is the area at risk in general (size of non-grey colour shadings indicates coverage of area at risk) (Source: Coordination Centre for Effects, 2010[49])**

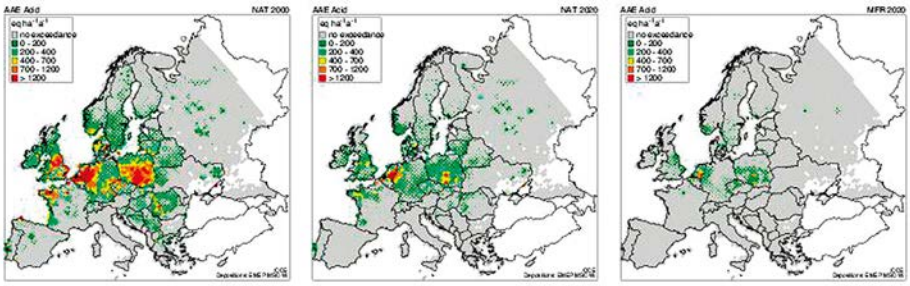
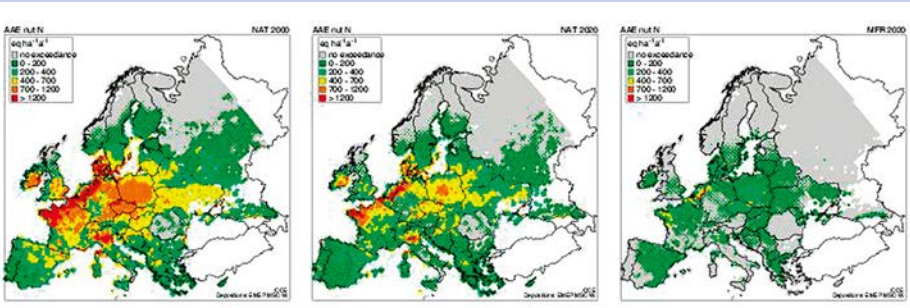
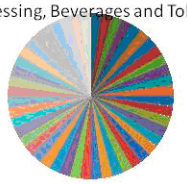


FIGURE 27 **Average Accumulated Exceedance (AAE) in every EMEP-50 km grid cell of critical loads for eutrophication in 2000 (left), and in 2020 under the baseline (middle) and maximum feasible (right) end-of-pipe emission reduction scenarios. The areas with peaks of exceedances in 2000 (red shading) are markedly decreased in 2020. However, area at risk of nutrient nitrogen remain widely distributed over Europe in 2020 (size of non-grey colour shadings indicates coverage of area at risk). (Source: Coordination Centre for Effects, 2010[49])**



[49] Coordination Centre for Effects (2010); Slootweg J, Posch M, Hettelingh J-P (eds.) Progress in the Modelling of Critical Thresholds and Dynamic Modelling, including impacts on Vegetation in Europe, CCE Status Report 2010, RIVM report 680359001, ISBN 978-90-6960-249-3, www.rivm.nl/cce.

Legend for key categories (figures 17-22)



- 1 A 1 a Public Electricity and Heat Production
- 1 A 1 b Petroleum refining
- 1 A 1 c Manufacture of Solid Fuels and Other Energy Industries
- 1 A 2 a Stationary Combustion in Manufacturing Industries and Construction: Iron and Steel
- 1 A 2 b Stationary Combustion in Manufacturing Industries and Construction: Non-ferrous Metals
- 1 A 2 e Stationary Combustion in Manufacturing Industries and Construction: Food Processing, Beverages and Tobacco
- 1 A 2 f i Stationary Combustion in Manufacturing Industries and Construction: Other
- 1 A 2 f ii Mobile Combustion in Manufacturing Industries and Construction
- 1 A 3 b i Road Transport:, Passenger cars
- 1 A 3 b ii Road Transport:, Light duty vehicles
- 1 A 3 b iii Road Transport:, Heavy duty vehicles
- 1 A 3 b iv Road Transport:, Mopeds & Motorcycles
- 1 A 3 b vi Road Transport:, Automobile tyre and brake wear
- 1 A 3 d ii National Navigation (Shipping)
- 1 A 4 a i Commercial / Institutional: Stationary
- 1 A 4 b i Residential: Stationary plants
- 1 A 4 b ii Residential: Household and gardening (mobile)
- 1 A 4 c i Agriculture/Forestry/Fishing: Stationary
- 1 A 4 c ii Agriculture/Forestry/Fishing: Off-road Vehicles and Other Machinery
- 1 B 2 a i Exploration Production, Transport
- 1 B 2 a iv Refining / Storage
- 1 B 3 Other fugitive emissions from geothermal energy production
- 2 A 7 a Quarrying and mining of minerals other than coal
- 2 B 5 a Other chemical industry
- 2 C 1 Iron and Steel Production
- 2 C 3 Aluminum Production
- 2 C 5 b
- 2 D 2 Food and Drink
- 2 G Other production, consumption, storage, transportation or handling of bulk products
- 3 A 1 Decorative coating application
- 3 A 2 Industrial coating application
- 3 A 3 Other coating application
- 3 C Chemical products
- 3 D 2 Domestic solvent use including fungicides
- 3 D 3 Other product use
- 4 B 1 a Cattle Dairy
- 4 B 1 b Cattle Non-Dairy
- 4 B 8 Swine
- 4 B 9 a Laying Hens
- 4 B 9 d Other Poultry
- 4 B 13 Other
- 4 D 1 a Synthetic N-fertilizers

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