Air Pollution

promoting regional cooperation

UNEP

First published by the United Nations Environment Programme in 2010

ISBN: 978-92-807-3093-7

Printed and bound in Bangkok by Thai Graphic and Print Co., Ltd.

UNEP promotes environmentally sound practices globally and in its own activities.This publication is printed on 100% recyled paper, using vegetable-based inks and other eco-friendly practices. Our distribution policy aims to reduce UNEP's carbon footprint.

This book has been compiled by Mr. Lars Nordberg of ScandEnvironment Advisory Services, Stockholm, Sweden in collaboration with the United Nations Environment Programme (UNEP), the Secretariat and the Network Center (NC) for Acid Deposition Monitoring Network in East Asia (EANET) for the "Capacity Building Workshops for Policy Makers of the Participating Countries of EANET", with financial support from the Swedish International Development Cooperation Agency (Sida), as part of the Global Atmospheric Pollution Forum activities through UNEP. The contents of this book do not necessarily reflect the views, policies or opinions of any participating country or organisation.

Coordinating Team:

Lead Author

- Mr. Lars Nordberg, ScandEnvironment Advisory Services, Sweden

United Nations Environment Programme (UNEP)

- Mr. Surendra Shrestha
- Mr. Mylvakanam Iyngararasan

EANET Secretariat

- Ms. Adelaida B. Roman
- Dr. Apipong Lamsam

Network Center for EANET

- Ms. Leong Chow Peng
- Mr. Akira Nitta

Reviewers

- Dr. Keith R. Bull (United Nations Economic Commission for Europe)
- Prof. Amir H. Khan (State University of Bangladesh, Bangladesh)
- Dr. Norichika Kanie (Tokyo Institute of Technology, Japan)
- Participants of the Capacity Building Workshop for Policy Makers of the Participating Countries of EANET on 23-26 September 2008: Mr. Chin Chamroeun (Cambodia), Ms. Dong Yao (China), Mr. Zheng Haohao (China), Ms. Tris Mardiyati (Indonesia), Mr. Hasoloan Panjaitan (Indonesia), Ms. Rie Nishisako (Japan), Mr. Phonethip Phetsomphou (Lao PDR), Ms. Faraheda Bt. Nor Mohamed Ariff (Malaysia), Mr. Mohd Amir Bin Ismail (Malaysia), Ms. Azzaya Dolgorsuren (Mongolia), Mr. Erdenedeleg Tsagaan (Mongolia), Dr. Hrin Nei Thiam (Myanmar), Mr. Kyaw Moe Oo (Myanmar), Ms. Petra Uy Aguilar (Philippines), Mr. Alexander M. Gariyants (Russia), Dr. Wijarn Simachaya (Thailand), Mr. Phunsak Theramongkol (Thailand), Mr. Pichaid Atipakya (Thailand), Ms. Wassana Toruksa (Thailand), Ms. Tran Thi Dieu Hang (Vietnam) and Ms. Thai Thi Ngoc Ha (Vietnam)

Linguistic Editor

- Ms. Alison Nordberg, ScandEnvironment Advisory Services, Sweden

TABLE OF CONTENTS

TABLE OF CONTENTS

II

TABLE OF CONTENTS

FOREWORD

Air pollution has been recognized as a major health issue for citizens and local communities for several hundred years. It has long been recognized as both a national and regional challenge with a historical focus on the highly industrialized parts of the world. Over recent decades growing concern has also emerged over the widespread damage caused by long-range, transboundary, and even intercontinental air pollution.

This was underlined in 1972 at the United Nations Stockholm Conference on the Human Environment where a decision was also taken to establish the United Nations Environment Programme (UNEP).

Transboundary air pollution was further highlighted in the 1975 Conference on Security and Cooperation in Europe (CSCE) Final Act of Helsinki. Improving science and increasingly reliable monitoring led to a political agreement in the United Nations Economic Commission for Europe (UNECE) on the control and reduction of long-range transboundary air pollution within Europe and North America. The Convention on Long-range Transboundary Air Pollution (CLRTAP) was agreed in 1979 followed by eight specific legally-binding Protocols between 1984 and 1999.

These developments have been mirrored in Asia. In East Asia, the “Acid Deposition Monitoring Network in East Asia (EANET)” has been established and in South Asia, a network under the “Malé Declaration on Control and Prevention of Air Pollution and its Likely Transboundary Effects for South Asia” is in operation. The Association of Southeast Asian Nations (ASEAN) countries have established the “ASEAN Agreement on Transboundary Haze Pollution” which aims to prevent and monitor transboundary haze pollution.

Despite these agreements, air pollution continues to rise in many parts of the world with increasing problems for developing countries and regions. Increasingly it is being seen as not just a human health challenge but an economic one with costs to agriculture, important ecosystems such as forests and the productivity of coastal waters.

Improving global and regional cooperation to cut air pollution is thus an environmental but also a social and economic imperative. This book provides insight into the scientific and technical aspects of multilateral cooperation and negotiations as well as guidance on practical science-based development of regional environmental law with the aim of assisting negotiations.

It highlights the achievements of existing conventions, protocols and agreements and offers guidance on how to adapt this experience and tailor it to specific regional circumstances.

The book also underlines the links between air pollution and climate change, economic development and poverty outlining the multiple, Green Economy benefits of integrating air pollution programmes with those of greenhouse gases.

UNEP is pleased to offer this book as one contribution to the regional and global air pollution challenge. It distills the knowledge and experience of close to four decades of evolving policies aimed at bringing emissions under control.

This battle is not over but is decidedly winnable through cooperation between nations. UNEP stands ready to assist member states in advancing air quality management at both the policy and practical level in order to realize a healthier and less polluted world.

Achim Steiner

UN Under-Secretary General and Executive Director
United Nations Environment Programme

INTRODUCTION

The primary aim of this book on Air Pollution Promoting Regional Cooperation is to facilitate the training of governmental decision-makers to further develop cooperation aimed at regional intergovernmental agreements or legal instruments. The book may also find readers among other policy-makers and scientists, as well as university students involved in environmental matters. Practiced negotiators may also benefit from reading selected sections. The book lays down the foundations that will enable potential negotiators to understand the principles of air pollution in its various forms and its effects, how agreements have been and can be developed, before presenting some practical suggestions on how to explore the negotiation process.

The book may be used for background reading and at training events moderated by experts on individual subjects addressed in the book and as a general reference for further development of information in support of multilateral negotiations. It is structured in three separate Modules:

I. Overview of driving forces, science and abatement strategies;
II. Development of regional, multilateral agreements on air pollution;
III. Existing multilateral agreements related to air pollution.

Annex I provides suggestions on practical ways to conduct multilateral negotiations on air pollution. While the study of Modules I, II and III will benefit from the guidance of experts, it is suggested that implementation of the provisions in Annex I be organized with the assistance of personnel practiced in multilateral negotiations and associated scientific, technical and economic programmes. A brief list of references is found in Annex II.

While the book was drafted primarily to satisfy the immediate needs of the Acid Deposition Monitoring Network in East Asia (EANET), it may be used in any of the regions in the world, adapted, if necessary, to special regional circumstances. The general features of the subject are relevant worldwide. It is envisaged that the book may be updated over the coming years in response to experience from its use in various regions of the world.

MODULE I

OVERVIEW OF DRIVING FORCES, SCIENCE AND ABATEMENT STRATEGIES

1. Identification of Driving Forces for Taking National and International Action

Many human activities generate waste and pollution, some of them more harmful than others. Societies have recognized such impact for many years but only fairly recently taken forceful action to curb emissions which have widespread deleterious effects. The growing concern for the wellbeing of citizens and the environment, natural as well as man-made, has triggered political response, and governments and intergovernmental organisations have developed guidelines, rules and regulations to protect countries from excessive pollution. Recognizing the transboundary component of air pollution, and in the spirit of international cooperation, legally binding multilateral agreements have been prepared, adopted and implemented both on the regional and the global scale. However, much remains to be done. While the most prominent driving forces for taking action against emissions of air pollution are related to their harmful effects, factors such as international expectations and regional, as well as global, responsibility and burden-sharing also constitute further strong incentives for taking measures. Political and scientific pressure from countries and regions which have already adopted comprehensive policies and strategies to abate air pollution provides incentives for others to do the same. Growing public opinion regarding environmental matters, not least with respect to climate change and air pollution, is an additional powerful driving force for local, national, regional and global action. When negotiating a multilateral agreement on air pollution, negotiators should base their deliberations on a plethora of strong incentives, identified as driving forces.

1.1 Effects of air pollution

The concept of cause and effect is a basic principle for taking responsive and responsible political action on emissions of air pollution. One prominent case in point was the concern in Scandinavia in the 1960s, manifested in a well-grounded suspicion by one single scientist in Sweden, Svante Odén, that the recorded acidity in lakes and subsequent fish kill could not be caused by emissions of sulphur and nitrogen compounds in Sweden or, for that matter, in Norway. Odén and fellow scientists concluded that the deposition of acidifying substances must, to a very large extent, come from continental Europe and the United Kingdom. At that stage science and monitoring were not sufficiently robust to confirm the full extent of long-range transboundary air pollution. Moreover, the political readiness to take action in major polluting countries such as the United Kingdom, the Federal Republic of Germany, the German Democratic Republic and Poland, was less than satisfactory. The issue of transboundary pollution became a contentious issue but, nevertheless, intergovernmental cooperation on the matter did take place although initially reluctantly by some countries. However, as further findings from science and monitoring emerged, some decisive steps were taken. In hindsight, it is obvious that the scientific community and individual scientists fuelled the political debate. In a situation where there was a wide East-West divide in the world, with mutual distrust and the rift very visible in Europe, environmental protection actually became a topic that could distract, it not unite, political enemies from mutual suspicion of military power games and security considerations. Thus, somewhat surprisingly, the Conference on Security and Cooperation in Europe (CSCE) Final Act of Helsinki in 1975 introduced environment and air pollution as new items among their traditional "baskets". It was a logical development of ideas that had been adopted at the 1972 United Nations Stockholm Conference on the Human Environment when transboundary air pollution was addressed in the context of national sovereignty and intergovernmental cooperation. The ultimate and concrete testimony to the importance of the subject came with the 1979 Convention on Long-range Transboundary Air Pollution (CLRTAP), signed by 34 governments including Canada and the United States and the European Community at the United Nations Economic Commission for Europe (UNECE) in Geneva.

This pioneering framework convention, now with 51 Parties, has, since 1979, been followed by seven specific, legally binding effects-oriented protocols on targeted pollutants and one on international cost-sharing for monitoring and modelling.

The process that started in Europe in the 1960s was driven by concerns about the deleterious effects of air pollution and the somewhat discouraging conclusion that no country could solve its problems alone. Initially it was the environmental effects on freshwaters, soils and forests that were the policy drivers and sulphur emissions were the prime target. Only later did the concern for human health emerge as a driving force for emission reduction schemes, something that led to protocols which addressed ground-level ozone (via NOx and VOC), heavy metals and persistent organic pollutants (POPs) and, indirectly, small particles.

The effects-oriented approach, while very demanding on science and modelling, provides strong incentives for remedial action. It can be based on dose response functions and the concept of critical loads which makes the link between emissions and deposition/concentrations and their effects understandable to the general public and to politicians. It is also a logical way to explain and understand otherwise obscure relationships. It offers a choice of levels of sophistication suited to the layman or the scientific specialist. Even the most fundamental knowledge provides a good basis for building awareness and for influencing people's attitudes and behaviour.

Nowadays negotiators of multilateral agreements on air pollution are expected to share common ground regarding the effects of selected pollutants on sensitive receptors. Different countries may have different priorities and targets when it comes to emissions and their effects but they can all be accommodated under one common umbrella, i.e. a set of framework provisions. CLRTAP should not be seen as a simple blueprint for other regions of the world since from the very inception of that treaty it enjoyed comparative advantages with its relative homogeneity regarding economic and social matters in spite of the deep East-West divide. It also benefited from the strong and politically recognized organisational support of the UNECE and from links with European Union policies. The differences between the UNECE region and other regions must, however, not deter negotiators from learning from the European experience as they strive towards advancing multilateral environmental law in their particular regions. While many fundamental concerns are shared by everybody, although possibly with different degrees of emphasis, optimal solutions may vary from region to region according to specific priorities and concerns.

In the following paragraphs a number of such priorities and concerns are briefly addressed all of significance for international cooperation. It must be stated that not only transboundary concerns will drive policy development but also local and national concerns. The effects-based approach, of which the protection of human health and the environment is the prime objective, is useful on all geographical scales. In a strictly national context it also benefits from international cooperation on exchange of information, standard setting, guidelines, reporting, etc. Fulfilment of the effects-oriented approach considers technology applications and structural change in society as a means of reaching the goals. This process will also benefit from international cooperation.

The full recognition by negotiators of the power of the science-based driving forces for change will ideally strengthen their motivation and their resolve to enter, conduct and conclude multilateral negotiations so as to reach agreement on emission reductions and other strategic commitments in a timely fashion. The control of excessive long-range air pollution is a prerequisite for protection schemes but local and national mitigation programmes are also necessary. Such dual efforts must be supported in multilateral negotiations and accommodated in agreements and resolutions. As a matter of fact, comprehensive arrangements on the international scale will ideally trickle down to national programmes, including, as appropriate, development of laws and regulations applicable to each individual country. The opposite may also be true, i.e. a national concern paves the way for international action. Often the process is a loop: a national, sometimes even individual, concern leads to international cooperation and an associated agreement, the provisions and obligations of which lead to national action (laws and regulations) in all countries which are Parties to the agreement.

Negotiators, well aware of the scientific foundation for effects-generated policy development, will gain in credibility vis-à-vis the general public, Non-Governmental Organisations (NGOs) and fellow government representatives and will most likely arrive at better solutions for their countries as well as for the region as a whole.

1.1.1 Human health and wellbeing, mortality, morbidity, work–force repercussions

The World Health Organization (WHO) estimates that some 800,000 premature deaths occur annually in the world due to urban air pollution (cities with more than 100,000 inhabitants) while 1.5 million deaths are attributed to outdoor air pollution in general, mostly ozone and small particles, i.e. 6,300 per day. These numbers are valid every day, every week, and every year. In Africa some 50,000 people die every year from outdoor air pollution, i.e. 140 a day. The World Bank estimates that 11 million children under the age of six die from starvation and related illnesses every year, i.e. a child every third second around the clock. Half a million mothers die annually for the same reason. A major part of the problem of starvation is linked to insufficient agricultural production and general poverty. Droughts and desertification in some places, floods and erosion in others, all associated with deteriorating climate conditions, are behind much of the misery. Air pollution, particularly ozone, contributes to agricultural yield loss (see 1.1.2 below). Negotiators will also have to consider programmes for the control of greenhouse gases since joint measures may lead to significant co-benefits for countries and regions. The fact that in most cases carbon dioxide and air pollutants derive from the same emission sources speaks in favour of coordinated approaches.

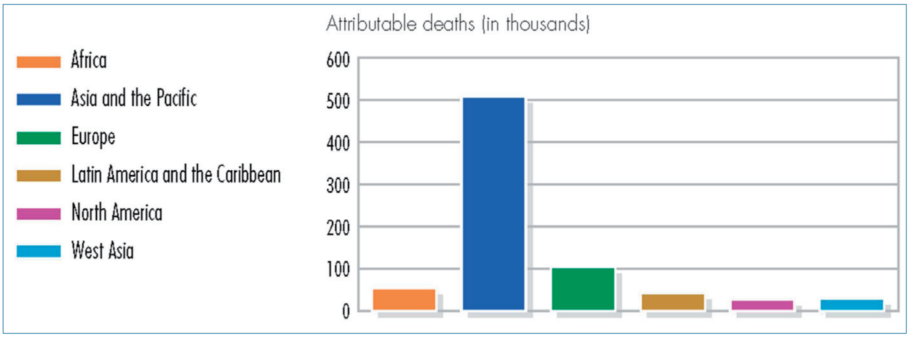

Figure 1 - Premature deaths due to outdoor urban PM_{10} exposure by region in 2000
Source: Cohen and others 2004

While the general relationship between air pollution and health, mortality and morbidity, is well recognised, information on a more specific level has so far not been sufficiently well utilized for policy development. The awareness has not been translated into adequate programmes for abatement of emissions of air pollutants even where the precautionary principle is acknowledged. Scarce information on the extent and effects of indoor air pollution in urban and rural societies may hamper necessary policy development. The medical community puts emphasis on respiratory effects, much less on cardiovascular, reproductive, haematological and carcinogenic consequences; thus the wider medical community has to become more involved in assessments of the effects of air pollution. Confounding factors are not well understood: poor nutrition, deteriorated general health status, low level of education and socio-economic status, behavioural patterns, etc., may exacerbate effects of air pollution. These inadequacies lead to a lack of convincing incentives for taking measures and remedies for these obstacles should be explored. It should be recalled that not only conventional air pollutants such as sulphur and nitrogen compounds, ozone and small particles impair health and cause deaths, but also e.g. persistent organic pollutants (pesticides, industrial chemicals and unintended by-products) and heavy metals. These pollutants have serious effects at short term exposure at high concentration episodes but also at long-term low concentration exposure.

Since the subject of air pollution and health has been addressed at various degrees of sophistication in various countries, many developed countries having performed significant scientific studies on the relationships, much is to be gained from worldwide cooperation. The possible lack of data in one country, or one region for that matter, must not prohibit policy development in any country. Even if circumstances and confounding factors may vary considerably across the globe, some basic facts are general and ubiquitous.

It should be a high priority for every government to safeguard its population against threats and hazards from dangerous processes. Every government should have a legitimate concern for the well-being of its citizens and in a cooperative scheme, as expressed in Principle 21 of the UN Conference on the Human Environment, for the well-being of citizens of other countries as well. Moreover, every government understands that the economic repercussions of mortality and morbidity on the workforce, productivity and GDP due to air pollution may be staggering, as evidenced by World Bank estimates. Thus, it is in the interest of all parties to combat emissions of air pollution with health concerns as a driving force.

Negotiating governments may benefit from scientific and administrative cooperation to strengthen the rationale for health-based policy measures.

1.1.2 Agricultural crops, food security, starvation

Besides health concerns, the effects of air pollution on crops are closely linked to the fundamental conditions of man in society. An adequate supply of food and water is instrumental for the survival, functioning and development of mankind. Thus, safeguarding agricultural production against the impact of air pollution must be a strong driving force for policy interventions, not least in developing countries. Studies in Europe, Africa and Asia suggest that agricultural output may be dramatically reduced by air pollution, above all ozone (formed by chemical reactions with nitrogen oxides and volatile organic compounds in the presence of sunlight).

The Sida funded programme on Regional Air Pollution in Developing Countries (RAPIDC) includes studies in e.g. India, Pakistan and Bangladesh, as well as in southern Africa, which indicate that the crop yield of wheat may be reduced by some 30% due to air pollution (based on European dose response functions). Investigations in these countries and in Sri Lanka suggest a potential yield loss of 50-80% for mung beans, spinach and potatoes. It has been indicated that rice yield in Japan has been reduced due to the influence of long-range transport of air pollution.

Figure 2 - The impact of local air pollution on the growth of wheat in suburban Lahore, Pakistan
Source: Wahid et al., 1995

The impact of air pollution on agricultural crops and quality of produce and ensuing food security has hitherto been largely ignored by policy makers. The ubiquitously rising ambient ozone levels are a matter of serious concern in a world with growing food shortages and increasing food prices. Some 75% of the world's cereal is grown in areas which are exposed to damaging ozone concentrations.

In the ongoing debate on the effects of climate change matters such as floods and soil erosion, drought and desertification are seen as detrimental to sustainable livelihoods, including falling agricultural production. It should be kept in mind though, that air pollution, and above all ground level ozone, may also lead to the impairment of such production where the conditions for agriculture and food production are otherwise excellent.

Negotiators may find very strong incentives for agreeing on programmes for the control and reduction of emissions of air pollution from concerns for sustainable food production. This driving force for action can easily be linked to the health related concerns addressed above. Malnutrition and poverty exacerbate the direct medical effects of air pollution.

1.1.3 Corrosion on man-made structures, including cultural heritage

Studies carried out in support of the 1999 Gothenburg Protocol under CLRTAP to Abate Acidification, Eutrophication and Ground-level Ozone showed that when fully implemented the agreement would, as a side effect, result in cost savings of some USD 9.5 billion a year in Europe from avoided repair and replacement of man-made structures otherwise damaged by corrosion. Subsequently this was seen as an additional driving force for implementation of the agreement, raising macro-economic interest in many countries. On the basis of the monitoring programme under CLRTAP, the International Cooperative Programme (ICP) Materials, a similar programme, CORNET, is now operating in South Asia and southern Africa (under RAPIDC). Regional dose response functions are being developed as a complement to the European ones. The functions enable calculation of corrosion attack based on environmental parameters and are a prerequisite for the production of corrosion maps and for cost calculations of corrosion damage. The impact of gaseous pollutants such as SO_2, NO_2, O_3 and HNO_3 as well as particulate pollutants and pH are implicated in corrosion on carbon steel, zinc, copper, limestone and paint coated steel. To be fully policy-relevant, corrosion studies must be able to produce assessments of stock of materials at risk and evaluation of corrosion trends.

Negotiators of an agreement may find an additional driving force for policy intervention in the economic aspects of corrosion. Another important aspect is the ongoing deterioration of many historical and cultural buildings and monuments which belong to the common heritage of mankind. Such objects exist in most countries and there is national as well as global interest in preserving them for future generations. The transboundary component of air pollution adds to the relevance of multilateral negotiations and agreements for the long-term protection of such irreplaceable values. At present it is perceived that there is a gap between research output and policy interventions which calls for urgent and focused considerations by policy makers. The combined driving forces of major cost-savings from damage avoidance, cultural preservation and human responsibility offer opportunities for quick progress.

1.1.4 Acidification and eutrophication

While acid rain was the initial trigger for action in Europe in the 1970s and 1980s, resulting in the 1985 Sulphur Protocol and the 1988 NOx Protocol, the risk for acidification has been judged at present to be of less general importance in Africa and Asia. However, areas in India and China suffer from acid rain and a recent estimate by China's Environmental Protection Agency (SEPA) suggests that the annual loss in China due to acid rain impact on forestry and agriculture amounts to USD 13.25 billion. This calls for continued vigilance regarding acid rain in sensitive areas of Asia and beyond.

Apart from the well documented acidification of freshwaters and soils, fears of long-term negative impact on oceans have also been expressed recently. Weak carbonic acid derived from emissions of carbon dioxide and strong sulphuric acid derived from emissions of sulphur dioxide will lower the pH of ocean waters and may cause damage to marine ecosystems.

Given the wide range of relevance in various countries, acid rain will have to be accommodated in an agreement accordingly, i.e. the fact that it is not an important issue in some countries must not lead to complacency regarding emission reductions since the concerns of all countries have to be honoured in a multilateral instrument addressing transboundary air pollution.

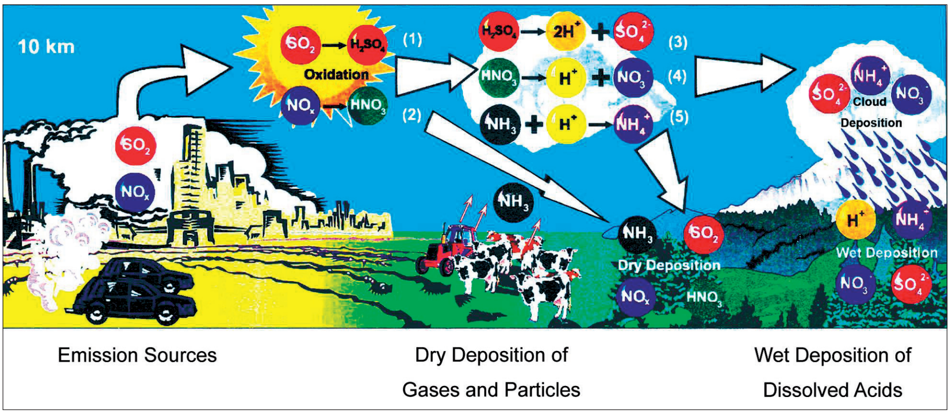

Figure 3 – Acidification process
Source: Adapted at Stockholm Environment Institute (SEI) from Swedish Ministry of Agriculture Environment '82 Committee, 1982

A serious problem in soils is that nitrogen saturation may lead to nutrient leakage to freshwaters which will cause eutrophication.

Eutrophication of freshwaters and coastal sea areas, i.e. surplus of nutrients such as nitrogen and phosphorous, is caused only in part by air pollution but also, and probably foremost, by water-carried pollutants from agriculture, industrial and municipal sewage, waste treatment and households. Thus, coordinated efforts must be applied to optimize the mitigation programmes. In some places dried sewage from purification plants is still incinerated without restrictions. This type of application may move water-based eutrophying nutrients to the atmosphere with subsequent deposition over very wide areas, thus shifting a problem from one medium to another. Such procedures must be stopped where possible.

Apart from eutrophication of waters, excess nitrogen deposition over land areas, even at fairly low deposition rates, may lead to a change of plant community composition and biodiversity loss. This change in the ecosystem can have a potentially huge impact on world biodiversity and may be the third greatest driver of biodiversity loss on the global scale (after land use and climate change). Policy makers seem not to be aware of this, focusing on other urgent topics.

Nitrogen is, of course, a prerequisite for food production but in excess on unmanaged land, it is a threat to nature and wildlife.

Both acid rain and excessive nitrogen deposition may have negative effects on the composition of whole ecosystems. Virgin land and unmanaged forests and other natural biotopes are shrinking worldwide. National parks and nature reserves have been set aside to preserve samples of the environment for the long-term benefit of science, history and recreation. Even if air pollution is ubiquitous, selected areas can be sufficiently protected to act as biological and geological banks for future generations. Adequate protection is, however, not an easy matter. While the biggest impact may be on woodlands along the fringes of reserves, with respect to biodiversity whole areas could be changed quite dramatically by excess nitrogen input.

Negotiators of a multilateral agreement on air pollution are also advised to consider acidification and excessive nitrogen deposition as driving forces for programmes on emission control, as appropriate, taking into account the various scales of commitment.

1.1.5 Cost-benefits, economic development and poverty

Some economic ramifications of air pollution are indicated in the above sections on health, crops and corrosion. In a world governed by economic realities such considerations become strong political driving forces. Government Finance Ministries set the framework for national expenditures aimed at getting good value for money. With regard to air pollution, several cost-benefit analyses point to the overwhelming benefits of taking measures. Already in 1999, in connection with the preparatory work for the Protocol to Abate Acidification, Eutrophication and Ground level Ozone, an international Expert Group estimated the costs and benefits of implementing the Protocol provisions (reduction of emissions of sulphur dioxide, nitrogen oxides, ammonia and volatile organic compounds). Based on a number of assumptions not all uncontroversial regarding the economic value of human life, the Group concluded that the total cost for reaching the emission ceilings stipulated in the Protocol and elsewhere would be about USD 75 billion a year until target year 2010 for Europe as a whole. The indicated cost was most likely an over-estimation because the calculations had focused on the application of technological "end of pipe" control measures (e.g. catalytic converters on cars), not on less expensive structural measures such as energy efficiency undertakings. Moreover, an expected decrease in cost over time as technology progresses was not factored in. The benefits of meeting the Protocol's emission ceilings were estimated at roughly USD 214 billion a year indefinitely. The benefits were calculated as the result of significant reductions in the negative effects of ozone and particulate matter on human health. Other effects included increased agricultural productivity, although the quantification of that increase as well as the damage incurred is not very well documented, and reduced damage to buildings and materials. The Group further stated that many benefits such as reduced damage to ecosystems from acidification and eutrophication and to cultural objects had not been included in the calculations because of the difficulty in ascribing a monetary value to them. At the same time it was concluded that the benefits of implementing the core 1990 Clean Air Act Amendment in the United States would exceed the costs by USD 510 billion over the period from 1990 to 2010. Again, many health and ecological benefits were still not quantified or monetized, including all effects of hazardous air pollutants, which implies that the benefits could be significantly higher.

Even if the estimates made in 1999 are subject to discussion, it is exceedingly clear that it pays to take action. The political problem with winning public acceptance for measures seems to be the fact that the full benefits will come several years later than the investments made for these measures. It may even be different people than those who paid for them who will reap the benefits. More recent investigations point in the same direction. In April

2008 a study on the Costs and Health Benefits of Reducing Emissions from Power Stations in Europe estimates that the benefit-to-cost ratio for measures at the 100 most polluting plants in Europe is 3.4, i.e. the estimated health benefits are 3.4 times higher than the estimated emission control costs. There is no reason to believe that similar relationships are not valid for other regions of the world. Thus, a very strong additional driving force for concluding agreements on emission control is at hand. Negotiators will no doubt see the potential of referring to cost-benefit analyses and economic development as a vehicle for promoting mitigation programmes. The cost-effectiveness relationships of taking measures are becoming increasingly interesting. The implications for poverty alleviation in poor countries are all too obvious to be ignored. In the long run the international competitiveness of countries may be partly qualified by the state of abatement programmes concerning production units and associated work force conditions.

1.2 Common but differentiated responsibilities

International cooperation regarding the environment is governed by universally accepted rules as expressed in the Declaration of the 1972 United Nations Conference on the Human Environment (the Stockholm Conference). Principle 21 of the Declaration states the following: “States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental policies and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction”.

The latter part of this Principle clearly addresses the responsibility to prohibit transboundary fluxes of pollution that can cause damage in neighbouring countries. This is a political commitment, formulated when science on long range transboundary movement of pollution was still very sketchy. Nevertheless, it firmly recognizes the problem, thereby setting the stage for subsequent international cooperation. It stops short of defining damaging transboundary pollution as being a violation of the receiving country's sovereignty, which, as a matter of fact, it is.

While Principle 21 has been heralded as the overarching guidance for multilateral cooperation, Principle 22 is also highly relevant in this context. It reads: "States shall cooperate to develop further the international law regarding liability and compensation for the victims of pollution and other environmental damage caused by activities within the jurisdiction or control of such States to areas beyond their jurisdiction".

It is noteworthy that Principle 22 uses the word "shall" when it comes to international cooperation on environmental law. Thereby, it sets the stage for multilateral negotiations.

Principle 24 states: "International matters concerning the protection and improvement of the environment should be handled in a cooperative spirit by all countries, big and small, on an equal footing. Cooperation through multilateral or bilateral arrangements or other appropriate means is essential to effectively control, prevent, reduce and eliminate adverse environmental effects resulting from activities conducted in all spheres, in such a way that due account is taken of the sovereignty and interests of all States".

These principles, and others, have stood the test of time. They have guided the preparation of subsequent regional and global treaties such as CLRTAP, the Convention for the Protection of the Ozone Layer and the Framework Convention on Climate Change and Protocols associated with these Conventions. Concerning air pollution, CLRTAP makes explicit reference to Principle 21 in the Preamble and addresses the matter further in articles on fundamental principles. The EMEP Protocol on international cost-sharing for monitoring and evaluation addresses economic burden-sharing among participating countries and second generation protocols on emission reductions provide for optimized differentiated obligations in the spirit of burden-sharing.

The spirit of cooperation set forth in the Principles is, in itself, a driving force for multilateral negotiations on the control and reduction of air pollution. No country wants to be left on the sidelines in international collaboration.

A successful multilateral agreement is characterized by promoting, inter alia, a national interest for reduction of a country's own emissions (if there are no national incentives then there is no willingness for international burden-sharing); a conviction that the agreement leads to common and collective improvements; willingness to implement and comply with the treaty (there must be both carrot and stick attached to the agreement); and a feeling of shared responsibility, justice and fairness.

While ideally an agreement is an expression of common responsibilities and commitments, it must be acknowledged that some countries, according to their economic resources and other circumstances, are expected to contribute more than others, e.g. by assuming lead country functions for particular activities, making resources available for them, and by accepting seemingly disproportionate mitigation commitments in line with the idea of burden-sharing. It can be argued that equity and fairness are not honoured properly in such schemes but the end result will be to the benefit of all parties involved.

Negotiators will make progress if they are prepared to be flexible and accept the differentiated responsibilities and obligations of participating countries.

1.3 Effectiveness of policy interventions

Countries, just like industries and individual people, may be reluctant to invest in projects if the payback is unclear. Investments made for environmental protection in the energy and transport sectors are very demanding and the payback period long and possibly difficult to quantify.

However, over the last 10-15 years evidence has emerged which shows that policy interventions taken have been highly effective. The economic benefits of taking measures were addressed in section 1.1.5 above.

In line with recorded emission reductions according to Protocols under CLRTAP, deposition and concentrations of targeted pollutants have decreased in Europe and North America, which has led to recovery of damaged ecosystems. Between 1980 and 2000 sulphur emissions decreased by some 60%. The biological response is, however, sluggish but recovery can now be recorded in many ecosystems. Base saturation in some soils in Europe fell considerably from 1900 to 2000 when the decline was halted and, in response to policy interventions, a steady increase started to take place. Reactions in soil systems are, however, slow and it is predicted that it will take several decades, if ever, before the pre-industrial situation can be reached, provided that emissions are kept at bay.

Another example of the effectiveness of policy interventions is seen in the observed and predicted loss of life expectancy due to small particles ($PM_{2.5}$) from anthropogenic sources. Following the full implementation of current legislation on air pollution in Europe in 2010, life expectancy may increase by up to three years in the most affected areas all other factors being equal. Such statistical forecasts may carry an important message but perhaps even more important is the fact that people will be able to live longer, not only statistically, but above all in a healthier environment which provides better quality of life.

The successful programmes in many big cities aimed at curbing air pollution, not least smog, provide further testimony to the effectiveness of policy intervention, e.g. London, Los Angeles, Tokyo and Hong Kong. Discouraging examples can also be found in megacities where insufficient policy interventions, in combination with increasing urbanization, have not led to any improvements for the city dwellers, rather the opposite. The opposing examples provide strong driving forces for multilateral negotiations.

1.4 Scientific progress

The effects-oriented approach, as addressed above, provides for the combination of physical science with abatement strategies. While science progresses almost continuously, policy applications must come in intervals, sometimes with years between the successive steps. A telling story is the development of protocols under CLRTAP. While science produced a continuous flow of data and information on the effects of air pollution on different receptors, negotiators had to set cut-off dates for science to be used in negotiations so as to avoid the confusion of moving targets. The first sulphur protocol was signed in 1985, followed by protocols on NOx in 1988 and VOC in 1991. A second sulphur protocol was adopted in 1994 and in 1998 protocols on heavy metals and POPs, respectively, were signed, to be followed in 1999 by the Gothenburg protocol on sulphur, NOx, ammonia and VOC. Since then work has focused on implementation and revision. A step-by-step approach is thus combined with a discrete build-up of scientific information. It is often stated that science drives policy but the opposite may also be true. While scientific findings underpin policy development, policy makers, i.e. negotiators, may put specific demands on the research community in order to facilitate needed progress. This type of cross-fertilization has proved beneficial to both communities bringing them very close to each other, even sharing common objectives. The general credibility of both communities has been strengthened, both benefiting from the reputation of the other. As a matter of fact, members of both communities form an "epistemic community", a professional group that shares common values, believes in the same cause and effects relationships and tests to assess them. They share a "consensual knowledge" from which they convert facts or observations to policy-relevant conclusions (definition by Haas, 1990). While being closely connected, it is however imperative that science can develop independently of political trends and economic circumstances, so as not to compromise its important non-alliance with current power structures.

Two fields of science in particular have played and continue to play decisive roles in the progress on policy regarding air pollution and they are interlinked. The first one is the development of the critical loads approach, i.e. the notion that there are pollution thresholds for different receptors below which damage is thought not to occur. The operational, cautiously phrased definition reads: "a quantitative estimate of exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge". When such threshold values are defined and mapped over large areas and compared with current deposition values and concentrations (critical levels) state of the art maps can be drawn up. If deposition/concentration is higher than the critical loads/levels then the exceedance can be quantified. With that, negotiators have a benchmark against which to discuss emission reductions. The ultimate goal must be, of course, to remove all exceedances so as to protect the environment from further damage. Science has shown the capacity to predict environmental performance, i.e. the degree of protection against damage, with various emission reduction scenarios, thereby providing the negotiators with powerful tools for their consensus-seeking efforts. The science of critical loads and related dose response functions is progressing with increasingly sophisticated detailed information concerning dynamic processes in soils and waters, biological response, geographical and temporal scales, extension of number of pollutants and effects.

Scientists provide policy makers with information which will underpin political decisions. The second of the two major scientific fields concerns integrated assessment modelling, i.e. a way to find the most cost effective and environmentally sound manner to reduce exceedances over large areas and to distribute emission reductions to countries, and parts of countries, where they will make the greatest contribution to damage-avoidance in the whole region. Without these two inputs from science, negotiators would find themselves in a much more difficult position when agreeing on emission reductions and other strategic commitments. Both concepts critical loads and integrated assessment modelling are sophisticated, data intensive and resource-demanding. For countries lacking sufficient infrastructure and funds to carry out desirable work on these issues, simpler methods may be employed. The RAINS (Regional Acidification Information and Simulation) model, developed by the International Institute of Applied Systems Analysis, (IIASA) employed in Europe in connection with the preparation of CLRTAP Protocols and European Union Directives has been used in Asia, partly based on default values, and is an important contribution to the regional science platform.

In the absence of complete regional data sets to define critical loads and levels and for sophisticated integrated assessment modelling, negotiators may initially aim at framework arrangements, leaving more specific provisions to subsequent revisions or additional instruments. In due course, scientific progress will facilitate new undertakings. In the meantime, liaison with other countries and regions will offer opportunities to further improve the scientific underpinning of policy development.

1.5 Regional initiatives

Any regional initiative aimed at multilateral negotiations on the control of air pollution will benefit from consultations with the Secretariat and Executive Body for CLRTAP. As stated above, that Convention and its eight associated Protocols provide a useful example of science-based instruments. While being valid for Europe, including the Russian Federation, Central Asia and the United States and Canada, it is of relevance to all other regions of the world. All United Nations Member States, as well as accredited organisations, may attend meetings of the Executive Body and its subsidiary bodies, which is facilitated by invitations from the Convention Secretariat, but only UNECE Member States can be Parties to the Convention and its Protocols. The possible opening of the Convention for accession by other United Nations Member States is now on the agenda of the outreach programme of the Executive Body and non-ECE States have been specifically invited to its sessions in recent years. In the meantime, the Secretariat and Parties to the Convention are developing cooperative links with interested countries and organisations, in particular concerning scientific and technical matters. The Task Force on Hemispheric Transport of Air Pollution is actively cooperating with countries in the northern hemisphere. It is not only the legal framework of the Convention that provides a relevant example to other regions. The organisational structure consisting of Secretariat, Executive Body, Implementation Committee, Subsidiary Bodies, International Cooperative Programmes (ICP), Task Forces, Technical Centres and Expert Groups provides guidance for similar undertakings elsewhere. The fact that many of the 51 Parties to the Convention are countries with economies in transition (e.g. former republics of the Soviet Union and Yugoslavia) may have a relevant bearing on some developing countries in Africa, Asia and Latin America.

Sub-regional initiatives, networks and programmes such as EANET, the Malé Declaration and the ASEAN Haze Agreement in Asia, as well as the Atmospheric Brown Clouds (ABC) project and APINA (Air Pollution Information Network for Africa) are nodes in an emerging network of cooperative schemes which, ideally, one day will cover the whole world. The Global Atmospheric Pollution Forum (GAPF) is a Sida-funded non-governmental endeavour to further expand these initiatives and to facilitate cooperation between them. Ultimately, a global framework convention on air pollution could possibly be envisaged under which the various regional schemes could be accommodated, each according to the specific priorities and circumstances. Another possibility is the preparation of separate regional agreements without a chapeau. A third alternative could possibly be some sort of affiliation with future developments under the Climate Change Convention. This alternative is not very likely in the foreseeable future.

While the need for worldwide cooperation on the control of air pollution is obvious, it is foreseen that, in the absence of a global framework, regional multilateral negotiations will also accelerate for the purpose of solving common problems. Negotiators can find comfort in the examples available, in particular CLRTAP, and may adapt their provisions to the regional circumstances. Novel approaches will also most certainly be introduced, approaches that were not contemplated or relevant when CLRTAP was prepared some 30 years ago.

The intercontinental, trans oceanic and inter-regional dimensions of air pollution will fuel further work in many regions. These contexts will constitute driving forces for multilateral negotiations as witnessed by ongoing endeavours. The benefits of learning from each other must be utilized to their fullest extent, while focusing the efforts on the specific sub-regional or regional aspects of air pollution.

1.6 Public awareness

A very strong driving force for taking action is the concern of the general public. Education and awareness-raising will eventually lead to public reactions against continued emissions of air pollution. A well informed population can drive policy development in democratic societies and politicians are sensitive to the concerns of their constituencies. Many examples can be given of such successful interventions, mostly on the local scale (regarding e.g. emissions and releases from industrial plants) but also nationally (regarding e.g. location and operation of nuclear power reactors and radioactive waste repositories).

The 1998 Aarhus Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters provides a prominent legal framework for the relationship between governments and the general public on environmental matters. The 1999 Gothenburg Protocol under CLRTAP to Abate Acidification, Eutrophication and Ground level Ozone includes an article on public awareness (Article 5) which stipulates that each Party to the Protocol shall provide information to the general public on a number of issues such as national annual emissions, deposition and concentrations and strategies and measures applied to reduce air pollution.

Other provisions call for governments to publicize information on less polluting fuels, renewable energy and energy efficiency, products containing pollutants, good practices and health and the environmental effects of pollutants.

The purpose of these provisions is to guarantee an open, reliable and transparent information policy vis-à-vis citizens in order to facilitate their participation in decision making regarding air pollution. It also facilitates a vigorous and informed debate in society regarding matters of concern to the people which, ideally, will have an impact on political bodies. In many cases the public concerns are channelled and formulated by non-governmental organisations (NGOs) and various public interest groups to national as well as international addressees. Groups from industry also take part in such awareness-raising endeavours.

In this day and age, negotiators must have the concerns of the general public in mind when entering negotiations. To ignore such a strong driving force might have serious political repercussions.

1.7 Inter-linkages between air pollution and greenhouse gas programmes

It is now becoming increasingly clear that there are co-benefits to be gained from taking joint measures on air pollution and greenhouse gases. There are also economic benefits from coordinated emission inventories and reporting. The scientific effects community will also see opportunities to address impacts in an integrated fashion, e.g. regarding effects on agricultural crops, human health and corrosion. There is also scope for synergetic gains when addressing socio-economic aspects of climate change and air pollution. Thus, a problem that is global in scope will be better addressed if the predominantly regional concerns of air pollution are also included in the programme.

One obvious health-related issue is the combined effect of heat waves and high ozone levels. Recent studies in France and elsewhere suggest that the overall contribution of ozone to mortality in cities may range from 2.5% to 85.3% in periods of high temperature. Each increase in ozone concentrations results in increased risk of death (an increase of 10 ug/m^3 is reported to increase the excess risk of death by 0.3-0.5%). It must also be noted that ozone is a powerful greenhouse gas more powerful than carbon dioxide which contributes to global warming. It has several deleterious effects on health, environment and climate. Thus the abatement of greenhouse gases and air pollution must take these obvious inter-linkages into consideration.

GAPF organized a conference on Developing a Framework for Integrated Co-benefits Strategies in Stockholm in September 2008 and the Clean Air Initiative for Asian Cities (CAI-Asia) organized the Better Air Quality 2008 (BAQ 2008) Conference in Bangkok in November 2008 also focusing on the co-benefits of joint action. These two events propelled further development along these lines, mainly by focusing on the scientific links between air pollution and climate change; review of the effectiveness of integrated assessment techniques; challenges in developing and applying integrated approaches at various policy and geographic levels; and developing strategies, frameworks and processes to better integrate air pollution and climate change programmes.

While air pollutants such as black carbon, ozone and methane contribute to global warming, sulphate aerosols are believed to mask part of the committed temperature rise. Abatement programmes for reducing emissions of sulphur dioxide (which leads to formation of sulphate in the atmosphere) must therefore consider the possible implications for the climate by targeting also other pollutants in an integrated fashion.

Negotiators of a regional multilateral agreement on air pollution are advised to explore the linkages between air pollution and greenhouse gases and design any abatement schemes, implementation programmes and reporting procedures with the possible co-benefits in mind (see Section 6.7 of Module I).

2. Sources of Air Pollution

The effects-oriented approach, as described above, provides a basis for linking environmental and health related effects to emission sources of air pollution. Emission inventories are therefore a pre-requisite for the preparation of tailormade programmes aimed at alleviating or eliminating the observed or predicted effects of air pollution. In order to design cost-effective and optimal mitigation programmes, information on source allocation will have to be made available. A comprehensive source sector split is provided by the joint EMEP-CORINAIR Atmospheric Emission Inventory Guidebook using SNAP (Selected Nomenclature for Air Pollution) codes in which eleven main source categories are identified, all further elaborated with detailed sub-sectors. Seven of them coincide with the emission inventory system of the United Nations Framework Convention on Climate Change (UNFCCC) common reporting format. The SNAP nomenclature is used for European countries reporting on national annual emissions. Regional networks in Africa and Asia have developed emission inventory manuals and workbooks suited to their specific circumstances and have defined programmes and reporting schemes accordingly.

For practical reasons emissions are not usually measured directly at their sources. Instead, they are calculated and aggregated with the use of so called emission factors. An emission factor is a representative value relating the quantity of one or more pollutants released to the ambient air with an economic activity associated with the release of that or those pollutants (e.g. kilograms of particulate matter emitted per ton of coal burned under given fuel, combustion and scrubbing circumstances). The emission factors may be site and sector specific, not necessarily identical for the whole world. Regionally valid emission factors may apply.

In view of envisaged multilateral negotiations on air pollution in regions of Africa and Asia, governments must compile as much data as possible on emissions from the main sources of air pollution from all relevant sectors starting with the fundamental split between stationary and mobile sources. Such information is indispensable when designing optimal control programmes that will differ from country to country. Draft emission inventories for 2000 show, for example, that road transport and households account for the overwhelming portion of air pollution in Sri Lanka (mainly in the form of small particles and carbon monoxide) while in South Africa emissions from coal-fired power plants (sulphur dioxide), households and savannah burning (carbon monoxide) dominate the picture. In countries such as Botswana, Zambia and Zimbabwe, vegetation fires are the main source of air pollution. It goes without saying that policy interventions have to be designed with differentiated approaches so as to target emission sources.

For detailed information on source sector split, negotiators are referred to the SNAP guidebook and other similar sources, e.g. those prepared under the Malé Declaration and APINA.The monitoring programme of EANET also provides essential information on selected sectors.

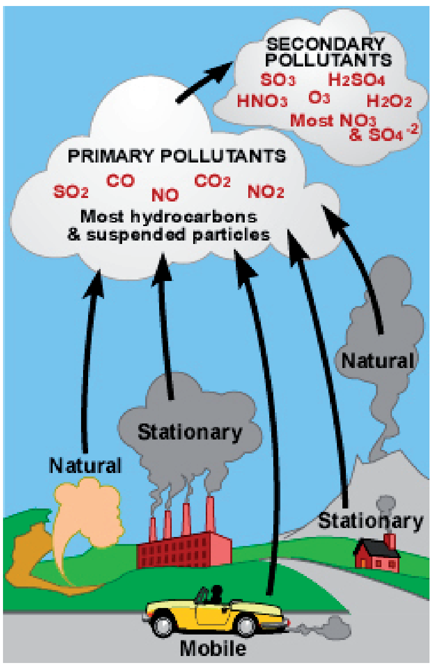

Figure 4 - Types and sources of air pollutants
Source: USEPA. Sources of Pollutants in the Ambient Air.
(http://www.epa.gov/apti/course422/ap3.html)

The overall most significant sectors for emissions of air pollution are the following:

2.1 Energy generation

The major sources of air pollution from this sector are utilities for electric, public power generation and district heating plants. The use of coal, oil, gas and bio-fuels is implicated in these activities. Installations for solid fuel transformation and similar energy related facilities such as petroleum refining plants, coal, oil and gas extraction and pipeline compressors could also be included in this category.

2.2 Transport

The most prominent emission sources from the transport sector are private and public passenger cars, on-road light and heavy-duty vehicles, mopeds and motorcycles, including so called three wheelers. Other significant mobile sources of air pollution are maritime activities (shipping), inland waterways transport, air traffic, railways, military operations and off road vehicles and activities related to construction, agriculture, forestry, industry, households and gardening. Most of the fuels used in this sector are liquid (petrol, diesel, kerosene, etc.) but gas is also being increasingly used.

2.3 Industry

Combustion of fossil fuels in the manufacturing industry includes applications in boilers, gas turbines and stationary engines. Processes without contacts (blast furnace cowpers (cupolas or hot stoves) and others) and with contacts (metallurgy and paper mills) are also significant emitters. A number of production processes are linked to emissions of air pollution, e.g. the petroleum industry, iron and steel and collieries, non-ferrous metal industries, inorganic chemical industries (e.g. production of acids), organic chemical industries (e.g. production of ethylene, propylene, etc.), wood, paper, pulp, food and drink production and production of halocarbons and sulphur hexafluoride. Cement industries are known to put large demands on energy and consequently constitute major sources of air pollution, including small particles. The industry sector generates a plethora of air pollutants from the traditional ones to a range of volatile compounds, some of them persistent.

The extraction and distribution of fossil fuels and geothermal energy generates air pollution linked to the treatment and loading of solid, liquid and gaseous fossil fuels. The distribution of these fuels is also a significant source of pollution, e.g. losses at petrol stations due to evaporation. An increasingly important sector is the extraction of geothermal energy and the use of heat-pumps and similar devices.

Another type of industrial emission source is linked to the manufacture of solvents and similar volatile compounds: paints, degreasing agents, dry cleaning, electronics, chemical products, etc. The use of these products and others (e.g. HFC, N_2O, NH_3, PFC and SF_6) may also generate pollution.

2.4 Households

The use of electricity for heating, cooking, cooling and lighting may generate pollution at the power production site (2.1 above) but domestic applications such as the burning of wood, coal, kerosene and biomass for household purposes are also an important source of pollution. Indoor air pollution is a significant threat, particularly to women and children in many developing countries and must be addressed as a source of un-health, discomfort and even death in some societies.

2.5 Agriculture

Agricultural practices constitute a major source of pollution. Management of fertilizers and manure leads to emissions of ammonia and, if not properly applied, to leaching of excess nitrogen to adjacent water bodies, including groundwater. The use of pesticides may generate releases of persistent organic pollutants (POP). Enteric fermentation in husbandry (cattle, pigs, poultry, etc.) adds to greenhouse gases (particularly methane) in the atmosphere. In some areas and countries the agricultural sector is a dominating source of air pollution.

2.6 Burning of waste and biomass

Persistent organic pollutants such as dioxin/furans and PAHs are formed when certain types of waste is burned but traditional pollutants, not least small particles and carbon monoxide, are also formed in these processes. Intentional burning of biomass in agriculture and forestry is a significant source of pollution (see the ASEAN Agreement on Transboundary Haze Pollution in Module III, Section 2).

2.7 Natural sources

It is known that from time to time volcanoes contribute very large volumes of a wide range of pollutants such as black smoke, ash, metals (including mercury), carbon dioxide and sulphur compounds. Methane is released from thawing permafrost areas in the northern hemisphere (possibly adding to reaching the so-called tipping point for climate change). It can also be released from oceans and wetlands as well as from sanitary landfills (waste dumps). (See Module I, Section 3.9 below). Dust storms from arid land areas are a source of particulate matter pollution in many regions of the world. Unintentional fires in forests, savannahs and natural grasslands are other natural sources of air pollution as are gas seeps, lightning (causing wildfires), sea spray and land use conversions (the latter most often induced by man). One particular natural source of volatile organic pollution is the release of isoprenes and terpenes in forests which may add to the precursors of ground-level ozone.

3. Major Pollutants

In the process of providing amenities for man's consumption and use, production facilities generate by products in the form of waste and pollution. Some of the emitted and released primary pollutants undergo transformation to secondary pollutants on their movement from source to deposition or to resulting gas or aerosols. Examples of chemical transformation are the creation of sulphuric acid (H_2SO_4) from emitted sulphur dioxide, or the formation of ground level ozone (O_3) from the impact on oxygen (O_2) of emitted nitrogen oxides (NOx) and volatile organic compounds (VOC) in the presence of sunlight. Secondary aerosols are formed from SO_2, NOx, NH_3 and VOC. Examples of primary pollutants that do not undergo any significant change are heavy metals, soot and persistent organic pollutants.

Emission control programmes target specified pollutants based on environmental effects that have been defined for mitigation. The European concern for acid rain in the 1960s and 1970s made sulphur emissions the obvious first target for negotiations. As scientific evidence of other effects came forth, the political scope was widened to include other pollutants such as NOx, VOC, heavy metals and persistent organic pollutants. The present focus on health effects and agricultural crops is shifting the main attention to small particles and ozone, while the traditional air pollutants continue to be high on the agenda. Another novelty is, of course, the joint concern for climate change and air pollution effects which, apart from addressing carbon dioxide (not to be viewed as a pollutant), will require that more attention be paid to pollutants such as methane, N_2O and aerosols.

Monitoring programmes have been set up mainly in response to the effects of acid rain, eutrophication, ground level ozone and small particles, and, for climate change purposes, carbon dioxide and other greenhouse gases. Heavy metals and POPs are monitored in many places in support of health related programmes.

When negotiating a multilateral agreement on air pollution the choice of priority pollutants must rest on sound science and monitoring. The effects of pollutants will guide the choice as will the availability of reliable emission data or the possibility of applying default values. Any agreement on emission reductions must ideally contain a realistic mechanism for compliance monitoring, i.e. annual national reporting on emissions of the targeted pollutants. Such schemes will set requirements for equipment, sampling and analysis and must contain methods (whether top-down or bottom-up) to aggregate data and reporting. These requirements may deter some countries with inadequate resources and infrastructure from entering into the desired arrangements.

However, progress can also be achieved with incomplete data as a basis on the proviso that monitoring improvements will come with time. As a matter of fact, it can be argued that programmes for emission reductions can also be introduced in the absence of long-term benchmark data, e.g. in the form of programmes to reduce pollution per production unit, or the application of Best Available Technology (BAT). The accommodating notion of Best Available Technology Not Entailing Excessive Cost (BATNEEC) was introduced for countries in Europe with centrally planned economies or, later, economies in transition. While providing considerable leeway for some countries, the notion also opened the door for subjective and uncontrollable exemptions. Therefore it is not encouraged in a confidence-based and transparent intergovernmental undertaking.

With the above options in mind and applying a flexible approach to the priorities and capabilities of participating countries, reaching agreement on which pollutants to target and in which order should be high on the agenda for negotiators. Without prejudice to forthcoming negotiations, conducted only on the terms of the participating governments, it is envisaged that the following pollutants be considered in an effects-based approach:

3.1 Sulphur compounds

Emission of sulphur dioxide from the combustion of fuels leads, above all, to acidification and is implicated in effects on environment, human health and materials. Sulphate aerosols are thought to mask climate change induced temperature increases by up to 50%.

3.2 Nitrogen compounds

NOx is formed in combustion processes, adds to acidification (HNO_3) and contributes to eutrophication and to the formation of ozone and smog. Ammonia (NH_3) comes mainly from agricultural practices and adds to acidification and eutrophication.

3.3 Small particles

Particulate matter (PM_{10}, $PM_{2.5}$) is implicated in a number of serious health related effects and has its origin, above all, in incomplete combustion (soot, black carbon), road and rail wear and some industrial processes. It is noteworthy that the control of PM has not yet been subject to any international treaty; it is, however, indirectly and implicitly addressed in agreements on sulphur, nitrogen and heavy metals.

Particulate matter is together with other pollutants a major source of impaired visibility with repercussions for traffic safety and recreation. Small particles are also thought to play a major role in climate change, since black carbon contributes to global warming.

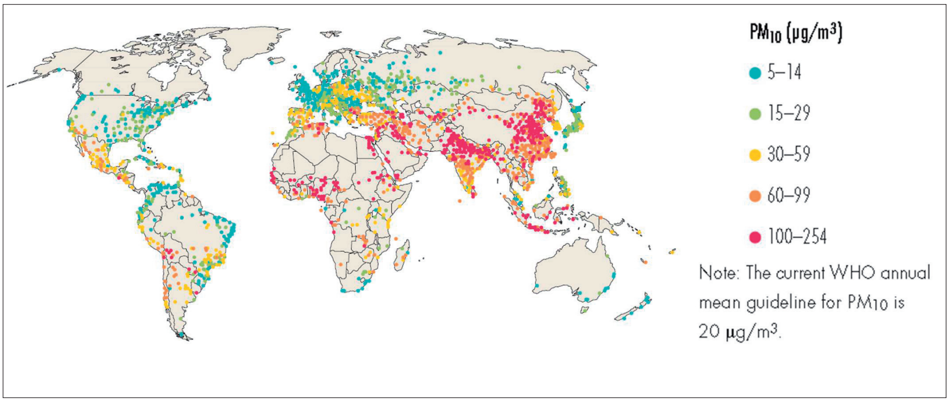

Figure 5 - Estimated annual average concentrations of PM_{10} in cities with populations greater than 100,000, and in national capitals, for 1999
Source: Cohen and others 2004

3.4 Ground-level ozone

As indicated above, ozone is a secondary pollutant linked to emissions of NOx and VOC in the atmosphere. The chemical relationships are intricate and the control of NOx and VOC is not unambiguous for the reduction of ozone concentrations. Measurement programmes for ozone are essential.

3.5 Volatile organic compounds (VOCs)

VOCs consist of a long list of compounds with different photochemical ozone creation potential (POCP). The 1991 Protocol on VOCs (under CLRTAP) classifies 85 different species such as methane, ethane, propane, etc., chloroform, methanol, ethanol, etc., acetone, isoprene (highest potential), toluene and aldehydes. Accordingly, VOCs derive from many sectors such as vehicle exhausts and fuel evaporation, combustion, solvent production and use, surface coating, industrial chemicals, petroleum refining, natural gas leakage, agriculture, coal mining, waste treatment and dry cleaning. It goes without saying that a range of sectoral measures will have to be considered to curb emissions of VOCs.

3.6 Persistent organic pollutants (POPs)

The three main categories of POPs are pesticides, industrial chemicals and unintended by products. Among pesticides aldrin, chlordane, chlordecone, DDT and heptachlor can be mentioned; among industrial chemicals polychlorinated biphenyls (PCB) stand out; and among by products dioxins and furans should be mentioned as well as polycyclic aromatic hydrocarbons (PAHs), the latter usually represented by the indicator compound benzo(a)pyrene. Pesticides are used in agriculture and DDT for public health protection from diseases such as malaria and encephalitis. PCB has several applications, most prominently as a cooling and insulating fluid for transformers and capacitators (previously also as a hydraulic fluid). Dioxins (and furans) and PAHs derive from waste incineration, metallurgical industry, combustion of fossil and wood fuels and residential combustion.

POPs are toxic compounds which cause health related and environmental problems, not only following their release into the atmosphere, but also during production, storage and handling. A 1998 Protocol under CLRTAP regulates these matters for 16 pollutants and a global convention in 2001 includes 12 of these POPs. Work is underway for possible additions to the number of substances to be regulated.

POPs are subject to very long range transboundary atmospheric transport, enhanced by the propensity of certain POPs to be remobilized from temporary stores between equatorial and polar areas.

A multilateral agreement on POPs beyond the UNECE region may not offer substantial advantages to being or becoming Party to the global convention and to implementing its provisions. However, regional progress could be facilitated by partnership with likeminded governments in the particular region.

3.7 Heavy metals

Heavy metals are commonly defined as those metals or metalloids which are stable and have a density greater than 4.5 g/cm^3 and their compounds. Many of them have deleterious health effects. Three heavy metals cadmium, lead and mercury are usually considered to be the most relevant ones for control. A Protocol under CLRTAP was adopted in 1998 on these three substances and UNEP is now reviewing mercury for possible global regulation. Heavy metals are not only of local significance but can also be subject to long-range transboundary atmospheric transport.

Main stationary emission sources of heavy metals are combustion installations, metal ore roasting and sintering, pig iron and steel production, ferrous metal foundries, copper, lead and zinc production, smelting and alloying, cement kilns, glass manufacturing, chlor-alkali production, incineration of hazardous and medical waste and municipal waste incineration. Lead in petrol is a source of emissions from mobile sources. Some products such as thermometers, laboratory equipment and batteries contain heavy metals.

Besides targeting sulphur, NOx, VOC and small particles, it is envisaged that multilateral negotiations for an agreement on the control of air pollution might, in due course, also target selected heavy metals. Given the documented health effects, the first choices should be cadmium, lead and mercury, since such initiatives could be guided by the existing experience of the work carried out in connection with the preparation of the Protocol under CLRTAP. However, the specific circumstances of the particular regions, including the character and extent of emission sources, existing legislation and industrial practices would have to be considered. Local hot-spots in industrial and urban areas may require more attention than national and international programmes, although long-term exposure to relatively low concentrations has harmful effects as well.

3.8 Greenhouse gases

Ideally negotiators should address the main climate-forcing gases while considering programmes for the control of air pollution so as to find synergies and co-benefits by addressing both in parallel (see Module I, Sections 1.7 and 6.7).

3.9 Naturally emitted pollutants

It is not envisaged that negotiators will devote much attention to emissions of pollutants from natural sources apart from making reference to the relationship of certain substances deriving from both man-made and natural sources, such as volcanoes (sulphur and small particles), sandstorms (dust), wildfires (small particles), forests (isoprenes and terpenes) and sea spray (e.g. chlorides). The natural contributions to the polluted environment must be recognized as a background against which to design programmes to abate man-made emissions. Ongoing climate change may influence the character and extent of some of the naturally emitted pollutants, not least those related to sandstorms and wildfires. This possibility should be assessed.

4. Atmospheric Transport of Pollutants

Knowledge of source receptor relationships regarding air pollution are key to the design of intelligent abatement policies. This is true for local conditions around individual emission sources such as industrial plants and refineries, and for fluxes of air masses across countries and borders and between continents and, for that matter, across oceans. Information on atmospheric transport is therefore indispensable for making progress. Hard facts come from emission inventories and meteorological conditions, i.e. measurements and observations, and from the insight of chemical transformations in the atmosphere. However, without modelling of atmospheric transfer of pollutants, the basis for action will be very weak. This is particularly true for the understanding of transboundary fluxes even if some obvious cases were observed a long time ago without any modelling. Such a case for example is the undeniable transport of oxidized sulphur from the Ruhr area in Germany towards the Netherlands when the wind blew in that direction. An initially subtle allegation of long-range transboundary air pollution surfaced when, in the 1960s and 1970s, the Scandinavians put the blame for acid rain on countries in continental Europe and the United Kingdom. Negotiators of a multilateral agreement on the control of air pollution will have to address various scales and various consequences of atmospheric transport.

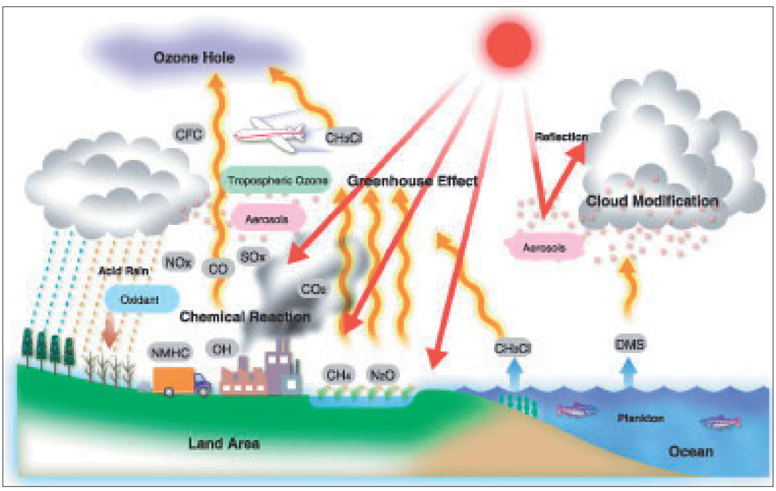

Figure 6 – Typical atmospheric transport of various pollutants
Source: Japan Agency for Marine-Earth Science and Technology (http://www.jamstec.go.jp/)

4.1 Short-range local transport

Emissions from hot spots are known to inflict significant damage on human health and the environment in areas adjacent to the emission sources. The dramatic forest dieback in the "black triangle" of Central Europe is a well known example from the 1970s, caused by excessive pollution from industrial facilities in the German Democratic Republic, Czechoslovakia and Poland and from the combustion of low quality coal and lignite for power generation all carried out without any emission control devices. A multitude of examples of hot spot pollution is available worldwide. Linear pollution along major traffic conduits has also been recorded. Recent studies linked to the Malé Declaration in e.g. India, indicate that agricultural production and quality of harvest can be seriously damaged by pollution close to emission sources, even showing a gradient from the very source towards the outskirts of the area of direct impact. Negotiators will benefit from discussing harmonized programmes to address short-range and local air pollution in order to alleviate the negative effects of high concentration pollutant releases and episodic plumes, keeping in mind that local conditions may contribute to national and transboundary problems.

4.2 Long-range and transboundary transport

The objective of multilateral negotiations is to arrive at programmes that will benefit the whole region. Therefore the long-range transport of pollutants must take centre stage in considerations. For large countries such as China, trans-provincial pollution must be addressed with the same concern as transboundary. Emission reductions in one area may be totally offset by increases elsewhere due to the long-range transport of air pollution. On the basis of emission inventories and meteorological conditions, models are now available which can calculate fluxes between grid squares of sizes such as 50x50 kms or 150x150 kms, as in the EMEP domain and subsequently between countries. This can be done on a routine basis for sulphur and nitrogen oxides and provisionally for other pollutants. Such calculations provide negotiators with a very powerful tool with which to address the so-called blame matrices, i.e. the source-receptor relationships. These matrices show the contributions of each country to the deposition in all other countries. The model can also calculate how much of a country's own emissions fall within its territory and how much will settle somewhere else. The matrices also form the basis for scenario analysis of the overall regional effects of any country's emission reduction scheme and ensuing integrated assessments. While sophisticated modelling of long range transboundary air pollution was not available when the first sulphur protocol under CLRTAP was concluded in 1985, stipulating a flat-rate reduction of sulphur emissions by at least 30% by all Parties, later modelling has shown that 80-90% of sulphur and nitrogen deposition in Norway and Sweden derived from countries other than their own. Thus, science has confirmed the early assumptions of significant transboundary fluxes. Nowadays such modelling provides more and more detailed information of great value for compliance monitoring and for performance assessment in relation to commitments for emission reductions and other strategic programmes. The regularly updated matrices on long-range transport across borders are also driving forces for the revision of protocols or for the preparation of new ones. The ongoing ambition of CLRTAP to include northern hemispheric considerations finds its rationale in emerging information on long-range intercontinental transboundary air pollution.

Negotiators of any multilateral regional agreement on air pollution are advised to be cognizant of interregional atmospheric transport of major air pollutants. Even heavily polluted urban areas may be substantially influenced by pollution derived from outside and possible abatement programmes should be designed keeping this in mind so as to employ an optimal and cost-effective approach.

4.3 Global transport

While the greenhouse gas carbon dioxide has a global impact, traditional air pollutants have usually been viewed as regional problems. That is true in most cases but evidence is now emerging of global implications of air pollution e.g. with regard to small particles and some POPs. Such pollutants are thought to travel readily across the world and from hemisphere to hemisphere and contribute to the worldwide build-up of pollutants in the atmosphere causing effects anywhere in the world. There is still scarce information on the extent of this type of transport but satellite imagery indicates its qualitative existence, e.g. in the form of dust and smoke. Measurements of certain POPs in biological material in pristine environments in the extreme North suggest global origins. Precursors of ground level ozone are transported long distances and, while part of the effects is caused by locally or nationally generated emissions, the transboundary component is in many cases very significant. Recent findings claim for example that 15% of air pollution over the western United States and Canada originates in East Asia. Several other studies and projects show in a more qualitative way long-range transboundary air pollution in East, Southeast and South Asia partly monsoon dependent and in southern Africa (the "river of smoke"). For South and Southeast Asia, the Atmospheric Brown Clouds (ABC) project and the haze from forest fires (ASEAN agreement) testify to the significance of long range air pollution. The intercontinental dimension of air pollution is a reality. Therefore, ultimately, the problem has to be solved through wide reaching multilateral arrangements and agreements based on sound science and reliable monitoring, starting at the subregional or regional levels. As previously pointed out, negotiators will benefit from considering all geographic scales, including the global aspects, with a view to gaining co-benefits with climate change programmes.

4.4 Estimation of atmospheric transport

As indicated in the previous sections, air pollution is subject to atmospheric transport on all geographical scales. Quantitative estimates of the magnitude of such transport are provided by models based on emission inventories and meteorological conditions. Such model work is highly data demanding and necessary data are still missing in many countries. The routine experience of EMEP (the European Monitoring and Evaluation Programme) under CLRTAP sets examples for other regions of the world in their strive to define the transboundary component of air pollution as regards sulphur and nitrogen compounds, VOCs, PM, POPs and heavy metals. The model work underpins necessary policy development and provides input to compliance monitoring with regard to countries' commitments to reduce emissions of air pollution and associated deposition and concentration.

To elucidate the significance of transboundary sulphur air pollution the following examples are given based on calculations by EMEP for the year 2000. The main polluters of Kazakhstan are in order of importance: Russian Federation (222 hundred tons S), Ukraine (146), Turkey (120), Kazakhstan (108), Romania (51), etc. For Sweden the main polluters are: Poland (276), Baltic Sea shipping (149), Germany (120), Sweden (112), United Kingdom (107), etc. The main polluters of the United Kingdom are: United Kingdom (1310), North Sea shipping (143), Northeast Atlantic shipping (74), Spain (72), France (70), etc. The figures explain the different willingness of various countries to enter into far-reaching agreements on emission reductions since the benefits (and burdens) vary quite considerably from country to country. A big receiver of transboundary pollution (such as Sweden) will naturally take another position than a big polluter (such as the United Kingdom). However, any polluting country must also consider the pollution it deposits on its own country and take measures accordingly of benefit to the whole region.

In this connection it is relevant to point to pollution from shipping, as indicated in the above example. While land-based sources have already been controlled to a large extent, shipping now contributes to an increasing share of long-range pollution. EMEP has made the following model calculations regarding European sea areas: the North Sea receives sulphur pollution primarily from: the United Kingdom (1,638), North Sea (1,058), France (288), Germany (262), Spain (209), etc.

The Northeast Atlantic receives its airborne pollution from: itself (2,861), Spain (1,467), the United Kingdom (1,116), Russia (916), Portugal (441), etc., and the Mediterranean Sea from: itself (3,121), Italy (1,346), Turkey (1,063), Greece (836), Spain (784), etc.

Negotiators of any multinational, regional agreement on the control and reduction of air pollution must consider the transboundary component of pollution and also the significant contributions from international shipping. In the latter case, delegations are advised, as appropriate, to work with the International Maritime Organization (IMO) to further restrict emissions from ships.

4.5 Special climatic conditions

Many parts of the world, not least Asia, are subject to particular climate conditions which significantly influence the seasonal movement of moisture and atmospheric pollution over large areas. Systems such as tropical storms (cyclones) enjoy a high degree of general predictability which makes it possible to take precautionary measures such as issuing warnings against high winds and heavy rains.The relative predictability may also facilitate the issuance of alerts for populations against extensive influxes of dust and other air pollutants to particular areas. Already impaired visibility may, for short or long periods of time, be substantially reduced (or temporarily improved) by the influence of such climate systems. Tropical cyclones carry heat and energy away from the Tropics and transport them towards temperate latitudes which makes them an important part of the global atmospheric circulation mechanism. Thus, tropical cyclones help to maintain equilibrium in the Earth's troposphere and to maintain a relatively stable and warm temperature worldwide. Ongoing climate change is believed to intensify these systems, potentially or in reality causing disasters over oceans and in particular when they make landfall.

The most important case in point is found in the monsoon regime in many countries. The Southwest Summer monsoon

(June to September) brings heavy rains to the Indian subcontinent (India, Pakistan, Bangladesh, Sri Lanka) and adjacent areas. Due to the blocking effect precipitation on the southern side of the Himalayas can amount to 10,000 mm per year. While the extensive rain may cause flooding and material damage to buildings and land erosion, it also relieves the heat and flushes out small particles and other air pollutants from the atmosphere.

The Northeast monsoon (the retreating monsoon) is a winter phenomenon, carrying relatively dry air from the northeast towards the Indian Ocean and the adjacent part of the Pacific Ocean. It has its peak strength in November-December, usually providing fine weather, although it can also generate considerable rain in the eastern part of India (moisture being picked up over the Bay of Bengal). In between the two monsoon seasons, i.e. in spring and autumn, violent shifts of wind direction may take place leading to unstable weather conditions.

From the air pollution perspective, the significance of monsoons lies in their capacity in winter to carry dry desert dust and pollution from Central Asia, including northern China, to coastal areas of China and countries further to the south and west. This transboundary surge of pollution can be very persistent during the season and can make up a major share of ambient air pollution. Although still not sufficiently quantified, it must be recognised as an important feature in multilateral negotiations in country groupings in East, Southeast and South Asia. Knowledge assembled within the framework of the Atmospheric Brown Clouds (ABC) project, the Malé Dclaration, EANET and the ASEAN Haze Agreement, will facilitate the development of models able to better describe the movement of air in Asia controlled by the monsoon regime.

While monsoons are usually described as features typical to continental Asia, they also occur in e.g. Indonesia (Southeast monsoon April-September and Northwest monsoon November-March), in central and eastern sub-Saharan Africa (Southwest monsoon March-October), Australia and in North and South America. In each particular case they have an impact on the air pollution situation, adding and, as appropriate, cleaning out pollution in the atmosphere, according to the particular wind direction and persistence and to other physical properties of the systems.

More short-lived, but potentially disastrous phenomena, linked to tropical storms, are hurricanes and typhoons formed over warm oceans in the northern hemisphere from May to November. On making landfall, these storms may wreck havoc in coastal communities. Apart from causing flooding, erosion and material damage and besides the immediate socio-economic impact on human beings and communities, they also carry sea salts to land areas which may impair drinking water supplies, vegetation and agricultural produce. Their impact on general air quality is not sufficiently well known.

5. Critical Loads and Levels

The adoption of the critical loads approach in 1988 for negotiation of agreements on air pollution under CLRTAP was done in response to growing effects-oriented concerns and the political strive to find more effective abatement measures to reduce damage caused by long-range transport of sulphur and nitrogen compounds. The first emission reduction protocols (1985 on sulphur and 1988 on nitrogen oxides) under CLRTAP were later regarded as inadequate because the reduction (or freeze) of emissions that they specified was not specially targeted at the largest emitters of pollutants and the 30% flat rate reduction of sulphur in the 1985 protocol was seen as insufficient for recovery to take place. Nor did the first generation agreement address the issue that some areas had been affected by acid deposition more than others. Since acid rain was the main driving force for the development of the critical load approach, deposition of sulphur and nitrogen oxides became prime targets for action, thereby addressing the indirect biological effects on the environment. Somewhat later the direct effects on vegetation from concentrations of pollutants in the air were also included in the concept. This facet is known as critical levels. Both critical loads proper and critical levels are usually referred to as parts of the general critical loads approach, sometimes collectively named critical thresholds (or limits).

Maps of critical loads for acidity and nitrogen eutrophication, as well as critical levels maps for ground level ozone, played a decisive role in the development of science-based policy on air pollution in the late 1990s in Europe and continue to play such roles.

Calculation of critical loads can be done in various ways, depending on which receptors are targeted and which spatial and temporal scales are applied. Steady state water chemistry models have been employed as have acidity balance models for soils. Calculations address sensitivities to pollutant loads from individual species to sites, ecosystems, areas, grid squares and countries. A widely used model for the assessment of lake acidification all over the world is the Model of Acidification of Groundwater in Catchments (MAGIC). Other relevant models are the Soil Acidification in Forest Ecosystems (SAFE) and the Simulation Model for Acidification Regional Trends (SMART) which addresses chemical processes in soils over long time periods.

5.1 Critical loads (deposition)

The following review primarily concerns the use of the approach regarding deposition and its policy implications but it is also conceptually valid for concentrations, i.e. so-called critical levels. With the recognition that nature offers thresholds of pollution load below which irreversible damage to ecosystems is not likely to occur, decision-makers received a tool with which the specificity of different types of geological terrain, climate and ecosystems could be accounted for. The concept opened a new avenue for finding common goals (e.g. uniform percentage reductions of exceedances above critical loads, so-called gap closure scenarios). The scientific community realized the opportunity to provide highly relevant information to the policy process and this opportunity created a boost for analysis of the impact of air pollution. It is also conceivable that some countries saw a new possibility to delay policy-decisions on debated emission reductions by requesting ever more scientific data to underpin negotiations. Suspicions of political manipulation of critical load values were voiced in some communities but the concept has an inherent incentive for honest reporting. Setting critical loads too low in a particular country would increase the necessary abatement costs for all countries involved in the arrangement, including the allegedly manipulating country itself. Setting too high critical loads would, on the other hand, depreciate the value of its natural resources with due risk for continued damage to them. The best way to avoid suspicions of political tampering with the numbers is, of course, to be totally transparent and to give full credit to scientific findings. However, on the matter of critical loads, science was, and is, not always unanimous.

Uncertainties exist regarding the calculation of critical loads and applied steady-state models have their limitations. Scale issues also introduce uncertainties related to atmospheric transfer models and critical loads, hence influencing the calculation of exceedances (when e.g. extending from national analyses to regional assessments).

Nevertheless, while the ultimate goal is to reduce emissions and exceedances to below critical loads, that goal is not readily achievable everywhere. Intermediate steps towards the elimination of all exceedances are known as target loads, i.e. politically agreed maximum deposition (and concentration) for individual countries and for regions as a whole. The setting of a target load is an expression of how much damage a country will tolerate given the economic, technological, social and political realities. Bluntly speaking, it reflects how much of the environment and of human health policy-makers are, for the moment, ready to sacrifice in a world of competing priorities.

The gap closure approach is therefore a politically realistic and equitable way of addressing the exceedances of critical loads in a step-by-step fashion. The environmental performance of any target value and the cost of achieving it are usually estimated with integrated assessment modelling (IAM) such as the Regional Acidification Information and Simulation (RAINS) model mentioned before. The scientific links between the critical load approach and IAM are very obvious which provides negotiators with a sound scientific footing for their cooperation.

By accepting the critical load concept negotiators may take into account national and regional differences in the area of concern. By ascribing critical load values to grid squares (50x50 kms or 150x150 kms) intra-state conditions can also be addressed. Large countries such as China and India will find the approach useful for addressing trans-provincial air pollution as well.

A major attraction of the critical load approach is that it provides information necessary for reducing the effects of air pollution where they occur-not focusing on technological abatement at source. Thus it is environmentally friendly. Criticism has been voiced that the approach is not strictly objective or neutral since assumptions and technical characteristics such as aggregation and treatment of data, scale and type of relations between grid squares may influence the output and that countries can apply different conditions to their calculations. Such limitations can be used to promote vested interests in countries reluctant to enter into far-reaching and timely commitments. The best way to stay clear of any possible manipulation is to be totally transparent with science-based information and totally open to confidence-building cooperation with other countries. The question of scientific uncertainty must be addressed openly and sensitivity tests must be carried out to clarify any possible weaknesses so that necessary remedies can be employed. As a matter of fact, the critical load approach forces countries to work together in interplay, investigating the various outcomes of alternative scenarios for the whole region. It also provides incentives for cooperation on domestic implementation of internationally agreed commitments, exchange of information on abatement options, costs and national strategies.

The most sophisticated application of the critical loads approach so far is seen in the 1999 Gothenburg Protocol under CLRTAP to Abate Acidification, Eutrophication and Ground level Ozone simultaneously targeting sulphur, NOx, NH_3 and VOC. The agreed national emission reduction obligations are based on critical loads and levels and specified for each of the four groups of pollutants in tonnes and percentage reductions. This very demanding multi-pollutant, multi-effect agreement considers all major aspects of air pollution regarding small particles, however, only indirectly. Nitrogen is of particular concern since this substance is an essential nutrient for life on Earth at the same time as it is implicated in acidification, eutrophication and the formation of ground level ozone and other photo-chemical pollution (smog). The critical loads for sulphur, as well as nitrogen, can be expressed in the unit kg/ha.yr, varying in a site-specific way from a few kilograms to tens of kilograms according to the sensitivity of the soils and type of vegetation.

The scientific integration of several pollutants and several environmental effects, based on the critical load approach, paves the way for policy integration across different disciplinary fields, taking into account different political, technological and economic constraints, methodologies and stakeholder positions. Such integration of issues brings countries closer to each other, they carry out joint projects and they share common goals for the benefit of the whole region and beyond. In a large region, individual countries may have different priorities as regards mitigation of air pollution; some experience acid rain as the prime target for action while others are more concerned with ozone or small particles. They can all come together in an effects oriented cooperation based on source-relationships and dose response functions as reflected in the critical loads approach. Together they can analyse different emission scenarios and their resulting effects on regional and local exceedances of critical loads and they can evaluate the environmental and economic benefits of taking alternative measures. Using the agreed critical loads as a benchmark for envisaged environmental performance, it is also possible to forecast the results of chosen target loads which may provide a tool to evaluate the need for additional measures. The negotiators of the Gothenburg Protocol agreed on a 60% gap closure between 1990 and 2010. The implementation of that agreement will result, inter alia, in a drop from 93 million hectares to 18 million hectares in the area of ecosystems in Europe where critical loads for acidification are exceeded. Regarding ozone, the excess exposure for the population will be 78% less and, for vegetation, the exposure in excess of critical levels would be more than halved.

Regarding eutrophication, the area of ecosystems where the critical load is exceeded is predicted to drop from 165 million hectares (30% of the total area) to 94 million hectares (17%). These environmental improvements are very encouraging although they will still leave substantial areas unprotected from air pollution, i.e. above critical loads. Thus they should be seen as intermediate steps towards ultimately reaching a state without any exceedances of critical loads.

The development and implementation of the critical loads approach is a continuous learning process. One region entering into negotiations for an agreement may benefit from the experiences of other regions. The most advanced countries, while further developing their science, also have something to learn from wide cooperation and exchange of information with countries not advanced to the same degree. The constraints of one country may shed light on problems ignored in others.

The lack of adequate data on critical loads is a major constraint in many developing countries something that could hamper progress on effective emission control programmes. However, basic information on soil sensitivity, buffering capacity and alkalinity of freshwaters can also be derived from crude small scale maps for soils and bedrock, thus providing physical input for bench marking. The mapping of biological sensitivity is much more demanding but some information is usually available in many universities and research institutes. The application of European and North American critical load values in other regions of the world may introduce errors since many area specific circumstances influence these values. If used with caution and scientific disclaimers, such applications can, however, provide insight into optional considerations pending the envisaged increased flow of local research findings. The lack of perfect data on critical loads should absolutely not be taken as a reason for a country to abstain from taking national measures in partnership with like-minded countries. Joint research projects will ideally speed up the production of scientific information on critical loads and policy-makers are encouraged to support such endeavours while they continue negotiations.

5.2 Critical levels (concentrations)

In a conceptual way the observations on critical loads above are also valid for critical levels. As a matter of fact, for policy reasons distinctions between deposition and concentrations of air pollutants can be accommodated under one common umbrella, as is the case with the 1999

Gothenburg Protocol. The national implementation of such an agreement may be decided in consultation with sector experts, regarding requirements on e.g. industry, agriculture and the transport sector. The direct effects of gaseous air pollution on crops, vegetation, human health and materials as related to exceeded critical levels of concentrations, are linked to indirect effects of deposition and, in many cases, probably interact with them. It becomes a question of emphasis as regards mitigation measures. A particular concept for estimating crop damage due to ozone is the AOT 40 exceedance approach. AOT 40 is understood as a cumulative exposure over a threshold ozone concentration of 40 ppb (parts per billion). It is calculated as the sum of the differences between the hourly mean concentration (in ppb) and 40 ppb for each hour when the concentration exceeds 40 ppb, accumulated during daylight hours. Areas at long-term risk for significant crop damage can be defined as having an AOT 40 of 3,000 ppb.hours for a typical growing season (May-July in the Northern hemisphere) in daylight hours. That is then regarded as the critical level of ozone. WHO has suggested that 120 ug/m^3 as an 8-hour average is the critical level of ozone for human health. This approach has been found to be very useful, particularly when comparing the risk for crop damage between countries and continents. Measurements of ozone levels are taking place in many countries and science on effects is progressing very fast. A notion related to effects of ozone (and small particles) on human health, and perhaps also on man-made materials, claims that there may be no threshold value below which damage does not occur, i.e. the critical level is zero. The medical community seems to support such a notion regarding ozone, small particles, certain POPs and possibly heavy metals.

Such conclusions, while still tentative, add to the urgency for negotiators to come to timely agreements on the control and reduction of emissions of air pollution. The scientific community is advised to increase their efforts to clarify these matters and make them available to policy-makers in a user-friendly format. Policy-makers, on the other hand, are encouraged to be proactive in their deliberations with the scientific community and specify their requirements for additional scientific support so as to strengthen the justifications for emission reductions.

6. Abatement Options and their Costs for Targeted Pollutants

Any agreement on reduction of emissions of air pollution will normally require the application of hardware technologies and techniques in a wide range of sectors energy, transport, industry, agriculture and households. However software non-technical measures such as energy conservation, management, saving, efficiency measures, and traffic management also play an important role in the reduction of air pollution. Negotiators should take note of the options available for achieving agreed emission reduction targets and should, ideally, find a suitable mix of measures to be taken at source (fuels), combustion and end of pipe. Economic and technical considerations, as well as administrative and managerial circumstances, will guide progress. Trade offs will influence the optimal mix. It is envisaged, however, that all options will be addressed.

The application of Best Available Technology (BAT) for stationary and mobile sources is an often quoted means of reaching agreed emission limit values (ELV) for installations and vehicles. It can be seen as a realistic way towards achieving environmental and health related objectives. Other means, also related to BAT and ELV, are product control and product management measures such as those particular to cadmium, lead and mercury in various products and the release of by products such as PAH and dioxin/furans from certain activities. DDT and PCB belong to the same category of pollutants that can be addressed through product control and management.

In connection with the consideration of abatement options and their costs, it should be recalled that the Polluter Pays Principle (PPP) is normally, at least conceptually, applied to programmes which address the control of emissions of air pollution. PPP is an environmental policy principle recognised as fundamental to international environmental law, which requires that the costs of pollution be borne by those who cause it. While originally aimed at internalizing the cost of waste disposal into the cost of the product, i.e. targeting the manufacturers, PPP is now applied in multilateral contexts where transboundary issues are at stake. Also known as Extended Polluter Responsibility (EPR), it is a concept relevant to all mitigation programmes which aim at internalizing the environmental externalities of economic activities so that the prices of goods and services fully reflect the costs of production. PPP promotes economic efficiency and legal justice but also the harmonization of international environmental policies. Moreover, it defines how to allocate costs within a country. It is also a powerful tool to be recognized as a basic principle in multilateral negotiations for mitigation of air pollution. Since all countries in a region pollute each other, more or less, PPP must be implemented in transparent and reciprocal arrangements leading to equitable burden-sharing among countries as regards costs, whether or not a command and control or a market based approach is employed. The chosen approach will be reflected in the technical measures taken to mitigate air pollution.

6.1 Mitigation at source (fuels)

The combustion of fuels such as coal, oil and natural gas generate atmospheric pollution and solid and gaseous by products, depending on the quality of the fuel, combustion technologies and end-of-pipe applications. A relatively clean fuel generates relatively cleaner exhaust emissions than a less clean fuel other factors being equal. While the sulphur content in coal varies over a very wide range, typical sulphur content in per cent from refinery products are:

Petrol	0.1
Jet kerosene	0.1
Diesel	0.05-0.3
Heating oil	0.1-0.2
Fuel oil	0.2-3.5
Marine diesel	0.5-1.0
Bunker oil	3.0-5.0

In many parts of the world these values are being lowered by technical means following negotiations in international fora. United Nations bodies such as UNECE, the International Civil Aviation Organization (ICAO) and the International Maritime Organization (IMO) are instrumental in these efforts but national and subregional initiatives are also important. The driving force behind this endeavour is the well justified concern for the environment and human health and the recognition that all sectors have to contribute to desired improvements. At present, particular attention is paid to the environmental damage caused by emissions from shipping. The combustion of high-sulphur bunker oil in international and coastal shipping, e.g., may offset far-reaching mitigation commitments concerning output of emissions from land based sources. Moreover, while control of land-based sources by relatively simple and inexpensive measures has already taken place, it is now cost effective from a regional point of view to target shipping. Since many of the megacities of the world which suffer from heavy urban pollution are coastal cities with significant harbour activities, there are good reasons, also in the local context, for restricting pollution from shipping. Vested interests in the shipping industry have recently yielded to persistent demands to substantially cut the sulphur content of bunker oil, however with differentiation for coastal areas and high seas. In April 2008, IMO agreed to curb shipping emissions by capping the sulphur content at 0.5 per cent worldwide from 2020 with an intermediary step at 3.5 per cent in 2012. Special low-sulphur zones, called Emission Control Areas, such as the Baltic Sea and the North Sea, will face an even stricter limit of 0.1 per cent in 2015.

Fuel cleaning is, thus, an important option for reducing sulphur emissions from combustion processes, in particular as regards liquid fuels and natural gas. The technologies for these measures are fully operational.

Emissions from on and off road vehicles are constantly increasing in spite of a number of technological low-emission measures applied. This negative development is fuelled by the growing fleet of cars with conventional petrol and diesel engines. Governments can influence the composition and quality of the vehicle fleet by enforcing strict regulations on technical requirements (e.g. lead-free petrol) and regular maintenance and inspection but also by introducing strong economic disincentives and incentives (differentiated taxes) to promote a switch to more environmentally benign vehicles. It can also apply structural measures such as the further strengthening of public transport and traffic management and by making competitive rail transport available as an alternative to road transport.

When it comes to cleaning hard coal for power generation and industrial purposes, current technologies can remove some 50 per cent of the inorganic sulphur but none of the organic. More effective technologies are being developed however. Thus, for the moment, the efficiency of sulphur removal by coal cleaning is limited compared to flue gas desulphurization.

6.2 Mitigation at combustion

A number of advanced combustion technologies are commercially available providing improved thermal efficiency and reduced sulphur and NOx emissions (low NOx burners). They include fluidized bed combustion (FBC); bubbling (BFBC), circulating (CFBC) and pressurized (PFBC) combustion. The integrated gasification combined-cycle (IGCC) combustion and combined-cycle gas turbines (CGGT) also belong to these advanced systems. They all provide significant environmental improvements but they also generate substantial volumes of problematic by products. Whereas FBC is basically a technology for burning hard coal and lignite, it can also be used for other solid fuels such as petroleum coke, waste, peat and wood.

The IGCC process includes coal gasification and combined-cycle power generation in gas and steam turbines. This technology is also used for burning oil residues and bitumen emulsion. CCGT is applied in power stations using natural gas as fuel.

6.3 Mitigation at end-of-pipe

Technical measures for the removal of sulphur oxides that have been formed during combustion are sometimes referred to as secondary measures. The end-of-pipe removal of sulphur in flue gases can be achieved by wet, dry, semi-dry and catalytic chemical processes. In some cases, options for reducing sulphur emissions may also result in the reduction of emissions of carbon dioxide, NOx and other pollutants. Denitrification can be achieved with selective catalytic reduction (SCR) and other pollutant removals by electrostatic precipitation and catalytic thermal oxidation.

In public power, cogeneration and district heating plants, flue gas treatment processes used include: lime/limestone wet scrubbing (LWS), spray dry absorption (SDA), Wellman Lord process (WL), ammonia scrubbing (AS) and combined NOx/SOx removal processes (activated carbon process (AC) and combined catalytic NOx/SOx removal). Another advanced FGD process under development is known as electron beam dry scrubbing (EBDS). Typical reduction efficiencies from the application of some technological end of pipe measures to fossil fuelled boilers, compared to uncontrolled emissions, are 60 per cent for additive injection, 95 per cent for wet scrubbing and 90 per cent for spray dry absorption.

It should also be understood that control techniques for the power plant sector consist of similar facilities in other sectors of industry, most noteworthy in sectors such as roasting of non-ferrous sulphides, viscose production, sulphuric acid production and kraft pulp production.

Fuel cleaning, combustion modification and end of pipe technologies generate solid by-products which may cause environmental problems. Desulphurization of fuels results in sulphur being removed from the fuel. Ideally it can be used for the production of sulphuric acid to be utilized in industrial processes. By-products from FGD may cause problems with respect to use and/or disposal. End of pipe measures generate calcium and ammonia salts and fly ashes, as well as gypsum, sludge and waste water. Criteria for disposal and siting will have to be developed and implemented with regard to side-effects of by products from the abatement of air pollution. Some particular side-effects to be observed are: additional energy requirements linked to fuel cleaning and flue gas treatment, corrosion attacks due to the formation of sulphuric acid by the reaction of sulphur oxides with water vapour, increased use of water and waste water treatment, reagent requirements and solid waste disposal.

6.4 Product control

Product control measures may be applied to reduce releases of airborne pollutants to the environment. The most prominent and successful control intervention concerns the phasing out of lead in petrol for use in on-road vehicles, i.e. cars, lorries and buses. So-called lead free petrol may, however, contain small amounts of lead, up to 0.013 g/l. Lead has been implicated as having a serious negative impact on the development of the human brain and this has been the main driving force for taking action. The development towards "lead-free" petrol is now very strong worldwide and in some countries, e.g. Sweden, it is illegal to market, sell and use leaded petrol. The State of California passed laws to this effect early on. With the use of catalytic converters in cars to reduce emissions of major air pollutants, leaded petrol must be abandoned since it would compromise the efficiency of the converter. Thus, the phase out of lead has resulted in joint benefits for the environment and for human health.

Mercury, another toxic metal, is used in many types of equipment and alkaline manganese batteries. Accordingly, control measures have been introduced in order to reduce possible releases in connection with manufacturing, storage, use and waste handling of such batteries, setting ceilings for permissible concentration levels.

Product control measures can also be applied to materials that have the propensity to release POPs such as dioxin/furans and PCB when used or finally disposed of (incinerated).

Commercial fertilizers may contain heavy metals such as cadmium which, however, is not primarily released to the atmosphere but rather potentially taken up by cereal crops.

The application of product control measures is, in relevant cases, a necessary complement to other mitigation programmes to be addressed by negotiators when devising schemes for the implementation of agreements on air pollution.

6.5 Integrated approaches, national plans

Air pollution must be viewed as such a serious multi-sector problem that its handling should be embedded in a country's national plan. It should be a cross ministerial concern in any progressive government, thereby attracting the attention it deserves. In previous segments of this book, technical and structural abatement options have been reviewed, as well as product control measures. It is important to conclude that the optimal approach consists of a broad spectrum mix of measures which can be designed according to the priorities and capabilities of each participating country.

Management measures such as the development and implementation of programmes for the collection, recycling or disposal of products containing hazardous substances (heavy metals for instance) should be considered. Economic incentives or voluntary arrangements to reduce or eliminate the pollution load must be considered and advisory services should be offered to the general public so as to better understand what is at stake. Information on effects, costs and benefits should be provided and alternatives should be offered, e.g. regarding substitution of materials causing damage.

In an integrated approach, energy, transport, industry, agriculture and households must be addressed together. Apart from previously considered measures, the energy sector may also address the prospects of an improved fuel mix (coal, oil, natural gas and other sources such as solar and wind power). The fuel mix in the transport sector may also offer opportunities for improvements. Further achievements in the industry sector may be derived from fuel upgrading, combustion and process modifications such as closed circuit processes, internal recycling, product and energy management and good housekeeping. Agriculture is a major contributor to air pollution. The agricultural sector is responsible for more than 90 per cent of the ammonia emissions in Europe. If farmyard manure is handled in the wrong way, more than half of the ammonia content can evaporate before the manure reaches the soil. Governments should provide advice on how to cut ammonia emissions (the loss being an economic loss for the farmers) through proper livestock feeding strategies, low emission manure spreading and storage, low-emission animal housing systems and measures connected to the use of mineral fertilizers, including their restriction.

Governments should also support the household sector in its ambitions to alleviate the burden on the environment.

6.6 Consumption and consumer behaviour

Human consumption is the basic driver for production of goods and services. Thus the individual consumer can influence what is being produced be it food, shelter, transport, electricity or any type of consumer goods. By one's own choice, the consumer also decides what waste and pollution will emanate from one's consumption. Since this choice is linked to the economic conditions of everyone, it varies from individual to individual and from country to country. As a matter of fact, the choice is rather illusive in many poor societies. The waste and pollution generated in affluent societies pose a heavy burden on the environment with dire repercussions on human health and well-being. A sustainable society is one in which the actions of today do not prohibit the prospects of future generations from leading a comfortable life. This overarching principle has a bearing on air pollution since continued or increasing emissions may compromise those prospects. Public interest groups and others are aware of these threats and are alerting decision makers and the general public to them. Sometimes the concern for the future raises well-grounded questions about morals and responsibility in a globalized world. It also raises the question of equity and fairness when developing countries legitimately strive to achieve the comfortable life that affluent societies have enjoyed for a long time. The subsequent generation of waste and air pollution is then, perhaps, seen as a necessary price to pay for progress. That progress is also linked to a significant depletion of limited natural resources.

Governments involved in multilateral negotiations for agreements on air pollution no doubt address these pressing issues with great apprehension and will have to find a balance between the need to protect the environment and human health in the long run against air pollution and the ambition to secure a better life for their citizens, i.e. the consumers of today. Education, training and information campaigns will certainly have to be used to adapt all societies to the new requirements posed by the emerging energy, food and water crises in the world not least in relation to the effects of climate change and air pollution at a stage when developing countries progress from poverty to affluent consumer behaviour. Economic instruments are an important tool for governments to use to influence consumer behaviour and should be applied with cautious responsibility so as not to unduly distort market mechanisms in the short term. In the long term the market will adapt to new consumer patterns and production will be geared towards meeting new consumer demands.

6.7 Inter-linkages with climate change programmes

Greenhouse gases and air pollutants may cause effects that are the result of interacting processes. This was touched upon in section 1.7. Some air pollutants (AP) have effects on climate change and some greenhouse gases (GHG) are also pollutants which cause damage to the environment and human health. Therefore, gains can be found in the design of mitigation programmes that, as appropriate, target both types of emissions.

Any decrease of combustion of fuels leads to decreased emissions of carbon dioxide usually also to a decrease in air pollution. Some quantitative and preliminary examples of assessments can be made as to the dual effects on emissions of selected mitigation measures:

Fuel switch can have both positive and negative consequences. A transition from coal to gas leads to lower emissions of GHG in an otherwise constant energy scenario and a switch from fossil fuels to bio-fuel decreases the addition of carbon dioxide to the atmosphere but may go both ways regarding air pollution, depending on the techniques applied. The relative advantages of replacing fossil fuels with biomass combustion are positive for coal but mainly negative for gas and oil. This assumption refers to SO_2, NOx, VOC, CO, PM and PAH and dioxin/furans based on studies in small and medium-sized installations in Scotland. The utilization of nuclear and hydropower as well as solar and wind for electricity generation, significantly lessens the burden on the atmosphere. Many developing countries are in the process of extending electricity grids to citizens and communities across their territories that hitherto have had no access to such utilities. It is estimated for instance that 70 per cent of Sub-Saharan households are still without electricity. A shift from burning wood, dung and other bio-fuels to the use of electricity instead would no doubt reduce air pollution, in particular the hazardous indoor pollution, but may also create new major sources of air pollution if, for instance, electricity is generated in coal-fired power plants with insufficient purification facilities. Such possibly negative trade-offs must be kept in mind.

A shift in the mode of transport e.g. from roads to rail and from private cars to public transport would generally decrease GHG and AP emissions. That is also the case for programmes on energy saving, efficiency and conservation, depending to a large degree on which energy sources are involved. These measures would have no or little effect in societies which are, for instance, wholly dependent on hydropower. Changed consumption patterns, including recycling, reuse and low-waste applications in households are beneficial for both GHG and AP emissions.

Desulphurization of fuels and flue gases, as well as abatement of small particles, leads to lower emissions of conventional AP but may have no significant impact on the emissions of GHG. Such applications and combustion modifications may even require more net energy, thus possibly increasing emissions of GHG.

Ideally, process modification leads to lower emissions of GHG and AP alike, depending however on the techniques applied and associated energy requirements.

Management interventions for energy and industrial processes normally lead to gains for both polluting sectors since that is the basic reason for the intervention, but again the specifics may vary.

Deforestation leads to an increase of GHG and, if caused by burning, a temporary increase in AP. In the long run, some AP may decrease, e.g. VOCs such as isoprenes.

Waste burning is believed to have a neutral effect regarding carbon dioxide but it certainly contributes to increased emissions of AP. Improper handling and storage of manure in the agricultural sector have similar impacts.

As can be seen from the examples above, synergies and trade offs between selected climate measures and air pollution must be acknowledged with caution. Some relationships are obvious while others require more research and demonstrations. The lack of conclusive knowledge, such as reliable predictions of the impact of climate change measures and emissions of AP and cost-effectiveness assessments, may impede policy development. Much attention is at present devoted to the inter-linkages, both as regards scientific studies on effects and the most cost-effective policy response. On a qualitative basis it is claimed that coordinated or joint measures will lead to synergetic co-benefits both for the environment and for the economy.

At present the question of bio-fuels is high on the agenda and many assessments point to the need for a more balanced view on the prospects. The discussion on food vs. fuel already influences policy developments and puts the focus on bio-fuels and their costs.

The point of departure is the assumption that bio-fuels reduce GHG emissions compared to the use of conventional fuels. Recent findings in the Dutch Policy Research Programme on Air and Climate (BOLK) show the following typical reduction rates for GHG in major bio-fuel chains for the generation of equal energy amounts:

- bio-diesel from rapeseed	-36%
- bio-diesel from palm oil	-59%
- ethanol from sugar cane	-87%
- ethanol from sugar beet	-57%
- heat/electricity from crude palm oil	-75%
- heat/electricity from wood pellets	-94%

While showing very significant reductions of GHG, the associated effects on AP have not been sufficiently quantified. Information on wood pellets, however, suggests that they may reduce emissions of conventional AP compared to fossil alternatives. The same report claims that bio-fuel chains used in the transport sector result in lower emissions of SOx, benzene and toluene but higher NOx, NH_3, PM_{10} emissions than fossil references. A second generation bio-fuel chain is represented by the production of ethanol from straw and lignocellulose biomass (basically wood).

More speculative techniques for CO_2 capture (pre-combustion, post-combustion and oxyfuel methods) have been evaluated with regard to the impact on AP. It is suggested that these techniques, probably not commercial until 2020, will result in very low emissions of SO_2 and NOx but possibly higher PM and much higher NH_3. However, these speculative techniques also impose negative side-effects regarding the safety of CO_2 transport and storage and generation of large volumes of toxic wastes of chemical solvents.

The inter-linkages between mitigation programmes on greenhouse gases and air pollution call for the design of integrated measures, both technical and structural, so as to reap the co-benefits of invested money. Negotiators will benefit from consultations with scientific, technical and economic experts in this rapidly progressing field of activity. The concern is global in scope and international cooperation and exchange of information will facilitate progress.

6.8 Response to measures: recovery of systems, environmental and health performance, time scales

While the response of the climate system to greenhouse gas management is slow and difficult to assess conclusively in a cause-effect relationship, measures to curb emissions of certain air pollutants may have immediate effects. An illustrative case in point was the clear skies over North America on the days following the terrorist attack on the World Trade Center in New York on 11 September 2001. With a temporary ban on commercial air traffic in the United States, much of the visible air pollution vanished for a short time. Similar examples can be quoted from the enforcement of "car-free" days in some mega-cities of the world. Such events are very useful for raising general awareness about the relationship between emissions and visible air pollution. Similarly, episodes with high summer ozone levels, particularly in major cities, which cause increased hospital admissions and mortality, provide strong evidence of very quick response functions. The phasing out of lead in petrol has also been shown to quickly decrease the build up of lead in blood in previously heavily exposed populations. Such almost immediate responses to measures applied testify in an illustrative way to the obvious benefits of taking action on air pollution. Monitoring of corrosion in Europe has also shown a decreased rate in response to emission reductions implemented according to Protocol commitments with clear economic benefits.

On the other hand, soils, waters and ecosystems recover slowly in response to decreased pollution loads. While the chemical response may be readily discernible, the biological one is more sluggish but it does take place. Most systems are dynamic and even a theoretical total termination of further emissions of air pollution could only be gradually recorded in the environment this would also depend on how much pollution had been added to the systems over the years and their resilience, and on how much the critical loads were exceeded. Models can predict the time scales for recovery.

A flexible approach to the abatement of air pollution provides a choice for countries to reduce national, annual emissions in order to comply with agreed commitments, policies and strategies, whether domestic or international. With the ambition to maximize the performance of environmental and health-related measures, action will be taken accordingly. It is believed that the strongest driving force for government action at present is the concern for human health, the second strongest being the safe guarding of agricultural food production and security. On these assumptions, small particles and ground-level ozone would most likely be targeted as priority substances for policy intervention. In the case of ozone, this implies that emissions of the precursors NOx and VOC would top the agenda. In order to optimize the measures in relation to calculated and measurable performance indicators, such as improved public health, fewer hospital admissions, less absence from workplaces due to sick-leave and lower death rate, as well as higher agricultural productivity and better quality and shelf-life of food, governments should introduce a battery of targeted activities. They should include a step-by-step fuel switch in the energy sector, e.g. by promoting the use of renewable resources such as hydropower, solar and wind, thus diminishing the reliance on combustion of fossil fuels.

The switch from petrol and diesel in the transport sector will have a similar beneficial impact, provided they are replaced by e.g. compressed natural gas (CNG) and liquefied petroleum gas (LPG) or the increased use of hybrids (electricity and petrol/diesel/gas).

Sound combustion and process modifications in the energy and industry sectors would also add to a positive response in human and environmental receptors, thereby augmenting the performance of measures introduced. A change in agricultural practices would also add to the performance.

While primarily aimed at improving human health and agricultural production, measures introduced for those reasons would also have halting effects on other processes such as acidification, eutrophication, corrosion and deterioration of visibility. Some of them may also contribute to ongoing efforts to control climate change.

With this in mind it is important for negotiators to agree on long-term commitments for ambitious target-setting aimed at ultimately reaching below critical loads and staying there the stand still approach. That approach should also be honoured in cases where the current pollution is clearly below critical loads. Ideally, pollution should not be allowed to reach the ceiling of critical loads, which is in line with the precautionary principle. Provisions of the Gothenburg Protocol under CLRTAP however, actually allow one country (Greece) to somewhat increase its emissions of sulphur between 1990 and 2010 and two other countries (Spain and Portugal) to do the same regarding NH_3. The justification for this allowance lies in the calculation that the targeted emissions in those countries do not contribute to any exceedance of critical loads domestically or in other countries. It may be regarded as disturbing that countries are allowed to increase their emissions in a legally binding agreement on emission reductions but science and policy provide that flexibility. It should not be seen as an example to follow for other negotiations if not for any other reason than the moral one.

6.9 National ambitions and aspirations

In line with the provisions of Principle 21 of the Declaration of the United Nations Conference on the Human Environment, as quoted in part 1.2 above, a country is committed to developing its own resources pursuant to its own environmental policy. In this context, such a policy is understood to include far-reaching commitments for the protection of its own citizens and its own environment, man-made and natural, from harmful air pollution. The prime ambition of a government must be to design and implement programmes which safeguard the wellbeing and sustainability of its own population and territory. To be able to do that properly, guidance can be found in international fora, e.g. guidelines prepared by the World Health Organization (WHO) regarding human health. The international community also provides recommendations on fuel standards, emission limit values, product control and similar advice regarding techniques, policies and strategies. Ideally a government should be keen to promote education and training for its citizens, to raise awareness and to facilitate public involvement in matters related to air pollution.

Apart from domestic concerns, a government also cooperates with other governments to reach common goals. The second part of Principle 21 clearly states that one responsibility of a government is not to cause damage in other countries. This responsibility, being reciprocal, must be exercised with the highest possible ambition. All multilateral agreements on air pollution are based on this principle but it is not always fully realised. While the exclusive concern for one's own country remains the prime target for action, it is incumbent upon all countries to ensure that other countries are not unduly damaged by transboundary pollution. In many negotiations of multilateral treaties there is a feeling that each country would like to commit as little as possible, leaving others to do more. This is certainly not a good starting point for confidence-based deliberations. A competition between countries to do as little as possible cannot lead to a very successful agreement with regard to substantive and substantial obligations. Ideally, all governments should compete to do more than others! In a world which is not ideal, the ambitions should be realistic and commonly accepted, if not shared. A concluded agreement should leave all participating governments equally satisfied with their own performance and for the region as a whole. There are no quick fixes for reaching the desired goal in a timely fashion; progress must be allowed to proceed as negotiations progress.

National aspirations must be accommodated with international realities. A firm conceptual commitment to the effects-oriented approach and to flexible and cost-effective mitigation options should be common ground for all negotiators. On that basis, progress towards merging national and international ambitions may be facilitated.

6.10 Costs and benefits, minimization of costs for the sub-region

The abatement of air pollution entails costs for some measures very substantial costs. The costs for different control options vary from country to country and according to mode of application and capital depreciation practices. Thus, cost calculations are subject to interpretation which may be influenced by national accounting practices and policies. With the increased practical experience of technology applications and with transparent exchange of information between countries, room for diverging interpretations is narrowed down. A general observation is that costs show a declining trend over time, especially with respect to new stationary sources. For example, the costs for FGD halved between 1980 and 2000 in Europe. Cost-effective technical solutions are also ideally integrated with measures on structural change which leads to optimal gains. Such changes may include fuel switch from coal to gas, increased energy efficiency, more use of alternative and renewable energy sources and changes in the transport and agricultural sectors.

Costs are, of course, related to the agreed emission reduction targets and associated national ambition levels. Easy and inexpensive measures are introduced first (picking the low hanging fruit first). Then gradually more sophisticated and costly measures are introduced as targets to close the gap between actual pollution load and critical load are set lower and lower. A concrete and telling example of this type of consideration is found in the fact that in 1999 the International Institute for Applied Systems Analysis (IIASA) showed that the attainment of a reduction of an ozone exposure index of 500 million person-hours.ppm across Europe would carry an additional annual cost of USD 2 billion, whereas the attainment of 400 million person-hours. ppm would cost USD 5 billion and 300 some USD 18 billion. The steep increase in costs is related to the need to apply more and more sophisticated and expensive techniques as the ambition level is increased. In 1999 negotiators were concluding the Gothenburg Protocol under CLRTAP to Abate Acidification Eutrophication and Ground-level Ozone which reached consensus on a cost-effective provision for the whole region leading, when fully implemented, to an ozone exposure index of some 480 at a total cost of USD 3 billion a year. It is worth mentioning that this ozone-related concern was but one component among the many items considered in the negotiations. It may even be said that the outcome was one of many integral side-products of the agreement. As for all other concerns, the final consensus was based on solutions optimized for the whole region. By comparison, a scenario with uniform flat rate per capita emissions across Europe would have resulted in an ozone exposure index of 450 at an annual cost of USD 15 billion, which was not considered to be cost-effective. Likewise, with a uniform emission reduction rate in all European countries, the index would have been some 480 at a cost of USD 12 billion per year, neither considered to be cost-effective.

The above example testifies to the logic of proceeding step-by-step, taking into account environmental performance and abatement costs in parallel and to the sensible decision of distributing costs over many years and all countries involved. Further progress may be achieved as countries successively review the performance of measures already taken, identify shortcomings and emerging needs and consider the cost implications of additional undertakings. Such progress will be facilitated by working together in an international cooperative spirit which involves all countries participating in multilateral negotiations.

6.11 Financing

While countries which cooperate on a multilateral agreement are expected to ascribe high priority to such endeavours and accordingly allocate funds over their national budgets for this purpose, it may be necessary to seek additional international funding. For developing countries in particular, it might be very relevant to address financial mechanisms to facilitate the implementation of various provisions, keeping in mind the wide disparity in the economic capacity of participating countries and the need for international burden-sharing.

Following a detailed analysis of the costs of introducing technical abatement measures and other programmes and their benefits in various sectors of society, a country or a group of countries may seek additional funding so as to reach the envisaged benefits for the region as soon as possible. This can be done with full recognition of market-based principles. Cooperation on exchange of technology within and beyond the region may be a component of such schemes. Other and more substantial components could be contemplated, such as the application for grants and loans from international financial institutions – the World Bank, the Global Environmental Facility (GEF), Clean Development Mechanisms (CDM) under the Kyoto Protocol and regional development banks (Asian Development Bank, African Development Bank, etc.). Cooperative programmes of the European Union may also be able to contribute to facilitating progress in developing countries. National aid and development organisations may also wish to co-finance selected projects and programmes for the improvement of air quality. Provisions for possible access to international financing should be addressed by policy makers at an early stage of their deliberations on an instrument for the control of air pollution.

It is important that the negotiating body maintains a high degree of flexibility and allows for national initiatives according to the particular requirements of each country and that consultations with international financial institutions are carried out in a spirit of regional cooperation. The secretariat for an agreement will, as appropriate, support progress on this matter.

MODULE II

DEVELOPMENT OF REGIONAL MULTILATERAL AGREEMENTS ON AIR POLLUTION

1. Rationale for Developing Regional Multilateral Agreements on Air Pollution

Economic development in the 20th century, and in particular the greatly increased production of energy through combustion of fossil fuels thereby resulting in increased anthropogenic emissions of different pollutants, has disturbed the equilibrium between the amounts of naturally occurring pollutants and the ability of the environment to cope with them. Some years ago air pollution was treated as a local problem, particularly in urban areas. While urban problems tend to be continuously exacerbated in most big cities of the world, air pollution is today recognized as a global issue with transboundary consequences. Sulphur dioxide, nitrogen oxides, hydro-carbons, carbon oxides, heavy metals and small particles are among the major concerns related to air pollution. The economic sectors that are by far the major sources of anthropogenic emissions are energy generation and transport. Many industrial sectors, as well as the household sector, also contribute to significant emissions.

The fact that the UNECE Convention on Long-range Transboundary Air Pollution was already adopted in 1979 and has since been followed by seven successive, legally-binding Protocols on specific pollutants and one on international cost-sharing for monitoring, modelling and evaluation provides a strong incentive for other regions of the world to endeavour to prepare, adopt and implement similar agreements suited to their particular circumstances. Each country, region or sub-region suffers from emissions of air pollution originating within that particular country, region or subregion which implies that all countries contribute to transboundary flows of pollutants. Growing evidence also points to the significance of intercontinental and trans-oceanic pollution. As a matter of fact, the problem is global in scope. Of particular concern in this context is the fact that the achieved reduction of emissions in one region may be partly offset by increased emissions elsewhere. Thus, substantial emission cuts in any single country will be to the benefit not only of that country but also to the region at large and to the global environment. Much is to be gained from recognition of the inter-regional context as a driving force for taking action, although the fundamental incentive for a country to cut emissions must be the desire to protect its own population and environment, not least in urban agglomerations. Air pollution and its effects have traditionally been viewed as an essentially regional or sub-regional problem, in particular as regards acidification, eutrophication, ground-level ozone and small particles. Over the years the hemispheric and global scales have been added to the considerations. Therefore, policy action to curb emissions of air pollutants is supported by the need to reduce harmful effects on all geographical scales. The regional and sub-regional scales are the natural starting points for international concerted action to solve common problems related to traditional air pollutants. Since the 1979 CLRTAP for Europe and North America, a number of subregional initiatives have been put in place such as the Malé Declaration, EANET, the ASEAN Haze Agreement in Asia and APINA in southern Africa. Such initiatives must be supported and further encouraged so that they can become viable parts of a worldwide network of arrangements to address air pollution.

1.1 Overarching vision statement

Multilateral negotiations for an agreement on the control of air pollution may be facilitated by having an agreed overarching vision statement as a reference. Such a statement can serve as a guide during the whole negotiation period and beyond and can be referred to if negotiations run into seemingly insurmountable problems which threaten progress towards consensus agreement. Therefore, while reflecting a high ambition level, the vision statement must also be seen as realistic by all participating countries. It should be phrased in such a way that all countries can take pride in it and share ownership of it. It is therefore important that such a statement is prepared and agreed upon at an early stage in the process. The Chairman of the negotiations may wish to refer to the statement as negotiations progress step-by-step, reminding delegations of their overarching visionary commitments. Ideally each negotiating group will define its own specific vision, keeping it detached from any form of concrete work plan or timetable - rather reflecting a philosophical understanding of the rationale for negotiations. While specific for each region, it may contain a number of common aspects such as:

- recognition of the need to take action to protect local, national, regional and, as appropriate, global environments, thereby honouring Principle 21 of the United Nations Stockholm Declaration and the need to take action against transboundary air pollution;

- the need to base all discussions on sound science and reliable monitoring, where available;

- the employment of an effects-based approach to promote policy action and, in that respect, to recognize the usefulness of dose-response functions including, where appropriate, the application of the concept of critical loads and levels;

- the need to work to improve conditions in the whole region and, as appropriate, beyond;

- the ambition to improve the situation for poor people by taking appropriate measures to alleviate poverty and social deprivation;

- the opportunity for interregional cooperation to promote progress;

- the instrumental importance of stable and long-term monitoring of air pollution and its assembly of data and dissemination of information;

- the prerequisite of transparent and complete national reporting of emissions, fluxes and domestic measures taken, or to be taken;

- the usefulness of atmospheric transfer models to describe fluxes of selected air pollutants to be targeted for regulation;

- the usefulness of integrated assessment models for making scenario analysis to support cost-effective solutions for the whole region;

- the use of techniques, technologies and structural measures in society to reach environmental goals, including the protection of human health in each country;

- the application of flexible approaches so that all participating countries will sign the intended agreement, making leeway for differentiated responsibilities and obligations, exemptions and derogations for the purpose of facilitating, where relevant, ratifications and subsequent implementation of all provisions;

- the need to support emission reduction schemes by introducing national strategies, policies and laws, as well as practices, regulations and other means to promote such schemes; and

- the application of economic incentives and disincentives to facilitate the implementation of agreed commitments.

A vision statement should be fairly brief and must not contain issues which are likely to raise obstacles during negotiations. It should therefore be phrased with political and diplomatic sensitivities in mind and accepted by all authoritative representatives of participating governments. When all main provisions of an agreement have been concluded, parts of the vision statement may be used to draft some of the perambulatory text of the instrument. The preamble is expected to be a foundation that will stand the test of time.

1.2 Search for a common understanding of the problem

Many of today's environmental problems are complex in nature and widespread in extent, cut across national boundaries and are often global in scale regarding their effects. However, the so-called global environmental problems are also rooted in human activities which take place at local and national levels and are therefore best dealt with at the levels closest to the source rather than at the global level, although in most cases they do require some kind of regulatory action and cooperative effort at the international level (referred to in the vernacular of international law and international relations as the subsidiarity principle).

This does not negate the importance of regional approaches when dealing with environmental problems commonly shared by countries within a geographical or economic/ geopolitical region. UNEP, having long since recognized the importance of regional approaches, has established regional offices in each of the five United Nations regions of the world. Accordingly, UNEP and other bodies have set up coordinating units and secretariats in support of regional and sub-regional initiatives, not least regarding air pollution. The Institute for Global Environmental Strategies (IGES), a Japan-based scientific establishment, concluded in 2001 that "Environmental problem solving in the Asian region is made complex by differences in economic, political and cultural conditions. A challenge for the region is to develop governance mechanisms that can address both regional and global environmental problems. Selected national and subregional environmental governance systems will be examined [by IGES] in a cross-sectoral and comparative manner".

While the initiative and determination to take action and to negotiate multilateral agreements generally originates in the governments themselves, the fora necessary for coordinated support, such as regional UNEP offices, regional United Nations Economic Commissions and non-UN intergovernmental bodies, may propose cooperation on commonly shared issues such as transboundary air pollution. Countries should take advantage of such opportunities and fully use available secretariat services for coordination and liaison and for assistance on a number of practical and economic matters. A common understanding of these opportunities is conducive to the development of multilateral agreements on air pollution, based on shared concerns for the harmful effects of emissions of major pollutants and knowledge of measures available to alleviate the burden. Such shared concerns may be qualified by the particular focus of individual countries on their priority issues.

1.3 Acceptance of differentiated and flexible responsibilities and commitments among collaborating countries

Based on the common understanding of the problem, negotiating governments should aim at granting flexible commitments to countries so as to obtain as wide adherence to the agreement as possible. For instance, flat-rate emission reduction schemes may not offer any cost-effective nor environmentally optimal solutions, while differentiated regimes can offer both. The most sophisticated basis for differentiated responsibilities and obligations is integrated assessment modelling (IAM) with scenario analysis and resulting, optimized least-cost solutions. In the very likely absence of sufficient data for IAM to be carried out across regions, simpler methods may be employed such as analysis of economic activity, application of emission factors, monitoring data and effects studies. Even anecdotal information may significantly contribute to underpinning differentiated undertakings. Provided that an agreement includes flexible stipulations and the understanding that future amendments or revisions will be required in order to fulfil the overarching objectives, the differentiated obligations may also have to be changed. That will most likely also be the case if and when new parties wish to join the agreement, i.e. a comprehensive review of original commitments and programmes may be necessary when more countries accede to the agreement.

1.4 Recognition of sound science and reliable monitoring as a basis for policy development

The general acceptance of an agreement on the control and reduction of air pollution and the associated requirements for a positive response from the general public and from industry is facilitated by a firm adoption of science and monitoring as a basis for policy development. Successful international agreements such as the regional CLRTAP and the global Convention on the Protection of the Ozone Layer and their associated Protocols, build very much on sound science and reliable monitoring, in particular regarding the effects of the pollutants in question. Less successful agreements are those that have a less robust and convincing science basis. It has generally been observed from internationally negotiated regimes that if science leaves room for interpretation and questioning, there will be governments who will question the findings, usually as a means of delaying or refuting decisions that would be counter to their national interests. While such questioning may be highly justified, it could also be a way of directing attention away from one topic to another, thereby reaping comparative benefits from other countries. The questioning of scientific findings is, of course, a totally legitimate activity which, in many cases, leads to an improved science basis. However, perfect science, i.e. a science that answers all questions posed, does not exist and never will. Negotiators therefore will have to live with moving targets but at crucial steps in the development of an agreement they will have to freeze the flow of scientific information, simply by setting a cut off date after which no further science can be included in the considerations. That level must consist of sound and generally accepted science and reliable monitoring data compiled for the purpose. The subsequent and continuously accumulating scientific data will be added to the platform for possible future follow-up such as compliance monitoring, performance review, revisions and new negotiations.

1.5 Precautionary Principle

Under the motto “Only One Earth” the 1972 United Nations Stockholm Conference on the Human Environment put the environment firmly on the international political agenda. It underlined our common responsibility and the need to act together. Twenty years later, in 1992, in connection with the United Nations Rio Conference on Environment and Development, the Brundtland Commission on Environment and Development (Our Common Future) introduced the concept of sustainable development, defined as “development that meets the needs of the present without compromising the ability of future generations to meet their own basic needs”. The Commission emphasized two key priorities: to meet the increasing needs of the world’s poor and to understand that prevailing technology and social organisation cannot guarantee the ability of the environment to meet present and future needs.

Based on these premises some fundamental principles have been formulated all taking credence and strength in Principle 21 of the Stockholm Declaration: prevention, common but differentiated responsibility (between rich and poor countries), precaution in resource use where there is limited scientific knowledge and the polluter pays for environmental damage.

While all of them are equally important and addressed in other portions of this book, the precautionary principle deserves some additional attention. It is a moral and political principle, often defined as follows: “if an action or policy might cause severe or irreversible harm to the public or to the environment, in the absence of a scientific consensus that harm would not ensue, the burden of proof falls on those who would advocate taking the action”. In other words: the absence of full scientific certainty shall not be used as a reason to postpone measures where there is a risk of serious or irreversible harm to public health or the environment.

Elsewhere in this book, it is advocated that action should be taken on the basis of sound science and reliable monitoring.

But it has also been said that a perfect science does not exist. In case of lack of full understanding of cause-effects relationships, negotiators must act in response to less than perfect underpinning of policy by applying the precautionary principle in an intelligent way in line with common sense adages such as “be careful”, “better safe than sorry”, “look before you leap” and “first do no harm”. Waiting for final proof could mean waiting too long. For instance, tobacco smoking was strongly suspected of causing lung cancer long before the scientific links were demonstrated conclusively, i.e. to the satisfaction of scientific standards of cause and effect. By then many smokers had died of lung cancer while others, exercising precaution, had quit smoking because of the growing evidence that smoking was linked to lung cancer.

While the exact climate-related effects of emissions of greenhouse gases may still be subject to discussion, the case of air pollution is more straightforward. The detailed effects in space and time may still be under investigation but the overall picture is clear. That overall picture provides a solid justification for applying the precautionary principle in those cases where the relationships are insufficiently well mapped. A reference to the principle in an envisaged agreement on control of air pollution is therefore highly relevant and should have the status of a commitment.

1.6 Availability of data, quality, access, ownership

Relevant data for the negotiation of a multilateral agreement may include emission inventories and their aggregation, episodic emissions, monitoring results regarding deposition and concentrations, information on effects of air pollution, meteorological observations and scientific compilations of any relevant parameters. In the context of intergovernmental cooperation on emission control, it is usually aggregated national data that are required. For modelling purposes site-specific and grid data may also be of great interest. While originating in many different programmes and institutes, all data collection should be carried out with standardized, ideally internationally harmonized methods, analysed and assembled according to approved protocols, and officially disseminated by authorized expert bodies. Some data may require extensive quality control and inter-calibrations regarding laboratory analyses to meet the requirements of officially submitted data. A government participating in international programmes on air pollution will benefit from appointing a data manager responsible for the proper and timely assembly of data from different national sources, general quality control and reporting. Once officially submitted, data should be regarded as approved and correct. For various reasons, some of them commercial or political, many stakeholders, domestic as well as foreign, may wish to have access to data before they are officially assembled and submitted. It is up to each individual country to decide on access to raw data but it is recommended that such data should be restricted for use only by researchers. Data are basically owned by the producers of the data, unless otherwise stated. Data of strategic importance, e.g. emission data, should be freely available only when they have been cleared by the respective government. Upon such clearance, data will be made available for international evaluation and comparison with data from other countries.

It is important to put high quality demands on data, particularly regarding emissions, since they are used as a basis not only for agreement of differentiated emission reduction commitments, but also for subsequent compliance monitoring during implementation of the agreement. Emission data, apart from inherent uncertainties, should not be questionable, unless qualified by circumstances announced and accepted in advance by all participating countries.

1.7 Consideration of base year and target year for commitments

An envisaged agreement on reductions of emissions of air pollution requires that a benchmark is set against which agreed reductions will be compared. The benchmark is usually a base year chosen to reflect a situation which all participating countries can assess. It is understandable that a country would wish to propose a year in which emissions were relatively high in order to facilitate achieving agreed emission reductions before a set target year. Traditionally, even decade years such as 1980 and 1990 have been chosen as base years, given the varying lengths of the implementation period. Many emission inventories within current regional initiatives aim at defining emissions in the year 2000. Countries still not able to produce conclusive national emission data for that year may require assistance regarding the assessment of economic activity leading to emissions and regarding appropriate emission factors. Auxiliary or default data may be used if necessary to be replaced later by factual data if possible. The choice of the year 2000 as the base year seems logical for negotiations taking place in the time span 2005-2010. The target year for implementation might be 2020, taking into account the fact that final emission inventories can usually be compiled only a few years after the end of the assessed period. Negotiators might also use the opportunity to set intermediary control targets in the implementation period, e.g. every five years. However, any agreement should call for annual reporting by countries according to agreed timescales. Such annual reporting will help in assessing progress towards the set goals for a ceiling and will provide stepping-stones for necessary policy development and possible adjustment of mitigation programmes.

An agreement that specifies base and target years for national emission reductions may also contain provisions for application of technical measures such as Emission Limit Values (ELVs) and standards for sources of air pollution. While the choice of technology to be applied may be based on recommendations, the ELVs may be stipulated in relation to binding target years. ELVs will refer to stationary and mobile sources and to main pollutants such as sulphur, nitrogen, VOC and small particles. It is customary that technical requirements for timescales are differentiated regarding new and existing sources, giving more time for application of ELVs to existing sources than to new installations. Since the application of ELVs for stationary and mobile sources, as well as for fuel standards, will ideally be integral parts of the agreement, target years could be related to the year when the agreement takes effect (or becomes legally binding). The degree of detail for the applications will be decided in negotiations based on realistic goals and economic capability. Using a flexible approach, negotiators may agree on differentiated obligations among participating countries, with possible derogations for national requirements regarding rules, procedures and laws already in force under other programmes of national governments (e.g. regarding energy, transport, manufacturing, industry, agriculture and trade).

Countries with different economic capacities and levels of development, not least in regions comprising both developed and developing countries, must be granted a wide range of options in order to make implementation possible. So-called grace periods will most likely be given to some poor countries, i.e. they will have extended timescales and target years for adoption of techniques required for application of ELVs. Thus, the range of target years required to achieve identical goals may vary by 5-10 years, following the year of entry into force of the agreement. However, the basic obligation to reduce national, annual emissions to below agreed ceilings, between an agreed base year and an agreed target year must, ideally, not be open for exemptions.

Base year and target year for the basic obligations should simply be set so that all Parties to the agreements feel that they can fulfil the commitments. Countries that feel that the ambition level is too low can always decide to do more than the agreement stipulates, e.g. by implementing tighter ELVs and shorter timescales. Such countries may even wish to sign separate declarations to that effect indicating more ambitious targets and thereby providing an example to others to strive for.

1.8 Type and status of agreements

The objective of any type of multilateral agreement on air pollution must be to permanently protect terrestrial and aquatic ecosystems and human health against the effects of air pollution local and national as well as long range transboundary pollution. Being intergovernmental in character, concluded agreements will set the stage for international cooperation on a range of issues such as emission inventories, science and monitoring, technology applications and policy development. Long-term and stable exchange of information and reporting are also common components of ambitious agreements.

Types of agreements may range from political non-binding statements by Ministers to legally binding treaties possibly carrying sanction requirements in the case of non-compliance with agreed obligations. The likelihood of full implementation of provisions may vary with the type of instrument in place the more demanding legally binding treaty possibly introducing more far-reaching obstacles for compliance.

1.8.1 Political statements and declarations

A political statement can take the shape of an interministerial decision, declaration or resolution or any other form of expression. It may be signed by Ministers responsible for the environment. Such a statement may not necessitate an intergovernmental depositary function such as the United Nations, nor any official record of it. However, a suitable international forum could act as an informal depositary which would facilitate subsequent review and follow-up. It may not require the establishment of a specific Secretariat to support its implementation. Such functions may be subsumed under the work plan of an existing Secretariat dealing with related matters. Pending approval by all relevant ministries in all involved governments, such a declaration or resolution might be called Draft Declaration or Draft Resolution. It is not subject to ratification by Parliaments. Additional countries may easily join such an instrument without any need for formal amendments or adjustments. Thus it is a quick and simple way to enhance cooperation on the reduction of air pollution. A political declaration or resolution as mentioned above does not carry any legally binding obligations but politicians who sign it will be held accountable for failure to implement it. Thus it has moral implications for signatories. All signatories would monitor progress in their own and other countries and the general public would, through Non-Governmental Organisations (NGOs), play a role as vigilant watchdogs.

A political declaration or resolution can be attached to a legally-binding instrument thereby gaining visibility and expectations of fulfilment. It may also be possible for individual signatories to a legally-binding instrument to make declarations, describing specific national caveats or circumstances in connection with the adoption of such instruments.

1.8.2 Legally–binding instruments

In order to secure long-term stable commitments from countries which have decided to cooperate on the mitigation of air pollution, legally binding instruments must be the ultimate goal. Such instruments are designed to survive possible political power shifts in countries, meaning that an incoming government is expected to honour the stipulations of the agreement signed by its predecessor. That function is guaranteed by parliamentary ratification processes, whether it is ratification proper or acceptance, accession, approval or any other procedure specific to the laws and practices of individual countries. A legally binding instrument such as a convention or protocol has a formal treaty depositary, normally the United Nations, which has a treaty section at its Headquarters in New York. The treaty section is the depositary responsible for the adopted and signed instrument, original ratification documents and related declarations, if any. That body also keeps track of submissions of any governmental statements related to the instrument, issues status reports regarding ratifications and other circumstances such as possible withdrawals and reports on entry into force of the instrument. It also records any possible amendments to the agreement. It does not have any function in connection with substantive progress reports or matters regarding implementation, compliance or non-compliance of Parties. That is the responsibility of the Conference of the Parties (COP) and, as appropriate, the operative secretariat for the agreement or any other function set up for this purpose by the COP which is the highest and sovereign decision-making body for the treaty.

A legally binding instrument can take the form of a Framework Agreement such as the UNECE Convention on Long-range Transboundary Air Pollution or the United Nations Framework Convention on Climate Change (UNFCCC) which sets out the overarching commitments, not necessarily specifying any concrete numbers or timescales for emission reductions. In such cases substance-specific Protocols are accommodated under the Framework Convention such as the eight Protocols under CLRTAP and the Kyoto Protocol under UNFCCC. Normally only Parties to the Framework Agreement can sign Protocols under it. The structure of Framework Agreements and associated Protocols offers an opportunity for governments to adhere to the overarching commitments while possibly opting out of subsequent Protocol obligations, if deemed to be too demanding at the time of adoption. Later accession is always an option. There is also an expectation that a country which signs an agreement will also ratify and implement it. There are, however, moral expectations that a Party to a Framework Convention will work in the spirit of the subsequent Protocols, even if still not Party to them. This type of flexibility encourages desired long-term commitment for cooperation among the participating countries and promotes a stable exchange of information, joint research projects and assistance initiatives. The experience of regional and global arrangements, as suggested above, speaks in favour of such structures since they provide for step-by-step progress as agreed by the participating countries.

Main components to be considered in a legally binding instrument, whether a Convention or a Protocol, may be the following, all to be adapted, formulated and supplemented as necessary, in respect of the particular regional circumstances:

- preamble
- definitions
- objective
- basic obligations
- exchange of information and technology
- public awareness
- strategies, policies, programmes, measures and information
- reporting
- research, development and monitoring
- compliance
- reviews by Parties
- settlement of disputes
- annexes
- amendments and adjustments
- signature
- ratification, acceptance, approval and accession
- depositary
- entry into force (number of ratifications required)
- withdrawal
- authentic texts (if more than one language) and final clause on date and place for signature

The above list is drawn from the CLRTAP 1999 Protocol to Abate Acidification, Eutrophication and Ground-level Ozone. It is given as an example only, to be used as possible guidance for negotiators in other regions. While some of the provisions may be of less relevance worldwide, additional ones may be considered, e.g. regarding innovative mechanisms (emission trading, joint implementation), financial arrangements, sanctions and secretariat functions. In this context it is important to stress the sovereignty of each group of countries negotiating an agreement to formulate its own provisions independently so as to gain full and exclusive ownership of the instrument. Cooperation with other similar initiatives, old and new, will however offer viable examples.

1.9 Exemptions and derogations

When negotiating a multilateral agreement, negotiators are expected to aim at winning adherence to it by as many of the cooperating countries as possible. Some particularly ambitious countries may find themselves in a dilemma when it comes to the requirements of basic obligations. A proper trade-off must be found in the conflict between the ambition to have as demanding provisions as possible and the objective of having as many signatories to the agreement as possible. A flexible approach leading to differentiated responsibilities and commitments in a legally binding instrument, as addressed in Section 1.3 above, offers opportunities to have both. The flexibility should be used both ways: on the one hand legal exemptions and derogation for countries with implementation obstacles and, on the other hand, the possibility for countries that can do more than legally provided for to do so.

1.10 Constraints on national action and international cooperation

There may be many constraints on a country to accept far-reaching commitments regarding reductions of emissions of air pollution, particularly when contained in a legally binding agreement. The most obvious constraint is no doubt of an economic nature. The perceived costs for switch of fuel, new combustion technology and end-of-pipe application may seem staggeringly high and might lead to higher costs for consumers. The curtailment of private cars and road traffic in general and the expansion of public transport systems carry monetary costs but there may also be non-monetary costs in connection with dissatisfied citizens.

In the industry and agricultural sectors the measures necessary for the implementation of an agreement may also be perceived as costly and may add to the reluctance of governments to take on desired obligations. Well justified action may be seen as politically costly.

Other domestic constraints may be linked to commercial, administrative and legal provisions already in force in individual countries that might set sector against sector and distort competitiveness in business causing a risk for significant dissatisfaction and even public unrest (lay-offs, unemployment, labour conflicts, etc). Countries striving to achieve the standard of living long enjoyed in many developed countries may not want to jeopardize benefits now within reach of their citizens by enforcing environmental restrictions which, in the short-term, may be perceived as obstacles to desired personal comfort and satisfaction. Some measures may be seen as unjustified and unfair.

A government may see the need for short-term investments for the environment as a threat to GDP development (in spite of evidence to the contrary) and may be reluctant to introduce additional economic instruments in the form of consumer taxes. It may also wish to strengthen its base industries, including energy, mining, steel, cement and refineries for both domestic and export purposes. Trade issues and national competitiveness may play a dampening role on measures to curb emissions of air pollution. However, a government must always handle conflicts of interest and will handle them according to their priorities and ambitions.

Other constraints may be found in insufficient infrastructure in general and the available facilities for political power sharing. Public acceptability is important for enforcing measures that are not always met with support, rather reluctance.

Lack of data and information and of mechanisms for compilation, reporting and dissemination of such material may also be seen as a constraint. A major concern of governments is and must be the prospect of successful compliance with obligations and the perceived accountability in case of non-compliance. Weak enforcement procedures and possible sanctions may also restrain the ambitions of countries. Some countries may question the adequacy of sound governance in other countries.

A country may also see proposed commitments as unfair in relation to those of other countries. It is likely that all countries involved in a negotiation may, from time to time, share this concern with reference to past and present transboundary air pollution and the harmful effects of it. Thus, even the historical aspects of pollution may constrain a country from accepting obligations if they are regarded as unfair. The best way to disarm such constraints on international cooperation is to use sound science as a common platform for discussions and to be open minded and, if possible, non-political, with regard to historical source receptor and cause-effects relationships regarding air pollution. An agreement must aim at solving present and future problems for the whole region in question and reasonably equitable burden-sharing must be a component in the solution.

One circumstance in particular, if raised, may cause problems in negotiations: the uneven emissions per capita in different countries. Such disparities may be caused by different development stages, economic activity and standard of living but also by wasteful practices and procedures, fuel mix, available natural resources climate, obsolete combustion technology and the organisation of society at large. It is therefore difficult to consider emissions per capita as a driving force for differentiated obligations in a fair way. It may, however, figure as a feature when recommending certain technical measures or when addressing consumer behaviour.

1.11 Revisions in response to new ambition levels and scientific findings

While a Framework Convention is ideally written to stand the test of time, i.e. not requiring any amendments or revisions in the foreseeable future, Protocols under it may have to be revised in response to upcoming scientific findings and to the subsequently increased ambition levels of governments.
The concept of target-setting was addressed in Module I, Section 5 on Critical Loads. The philosophy behind step-by-step target - setting is the aspiration to ultimately eliminate

exceedances above critical loads so as to provide full protection for the environment and for human health. A Protocol may provide for reductions of the exceedance in some way - optimized or as flat-rate reductions - by an agreed target year. Some years before such a target year, Parties may review progress and restart negotiations for a revision of the Protocol in force or, possibly, for a new Protocol altogether, depending on the new scientific basis for further action and the political readiness and economic capability to respond to scientific conclusions, warnings and suggestions.

The long-term and stable engagement of governments is essential for making progress on an accumulating problem which has been with us for a long time and will continue to be with us for a long time to come. The possibility of renegotiations, revisions and new agreements should be provided for in the text of initial instruments, including the envisaged Framework Convention.

1.12 Expansion of geographic scope and interregional cooperation

A multilateral agreement, whether soft or legally binding, may be open for accession by countries other than the original core signatories. Since air pollution is a transboundary issue, it is in the interest of the core governments to welcome additional latecomers provided that certain basic requirements are met, such as being part of the region in question and being a member of the same intergovernmental organization. Provisions for expansion may be contained in the instrument to be signed. Regions sharing common problems with respect to air pollution are not necessarily defined as United Nations regions which are political groupings but rather sub-regions with countries generating and receiving the main share of air pollution from each other. They usually also share some cultural and historical background as well as climatic conditions. They may, however, have very different economic capabilities, e.g., reflected in a wide range of GDP figures and per capita income. Nevertheless, countries in subregions usually find common ground for cooperation and the groupings become natural and logical.

The recent sub-regional initiatives in East Asia (EANET), South Asia (Malé Declaration) and Southeast Asia (ASEAN Haze Agreement), as well as cooperative schemes of countries in the Southern African Development Community - SADC (APINA), have emerged through natural processes, fuelled by administrative links established early on. Other candidates for additional sub-regional initiatives are e.g. East, North and West Africa, Central Asia, southern and northern Latin America and, possibly, the Middle East. The many island states of the Pacific Ocean, including Australia and New Zealand are, for the time being, less likely to come together to address regional transboundary air pollution, mainly because of the vast geographical space between them. However, individual provisions of envisaged sub-regional agreements may offer incentives for any country to work in line with selected provisions and to report accordingly. A case in point is CLRTAP, initially signed in 1979 by 34 governments and now having 51 Parties, spanning the whole northern part of the Northern Hemisphere. The ongoing initiatives in Asia and Africa all make reference to relevant features of CLRTAP and links are being established to improve both science and policy. EANET, the Malé Declaration and the ASEAN Haze Agreement have many reasons not only to further link up with each other but also to seek to incorporate more countries into the respective schemes. It is envisaged that in the future basically the whole world will be covered by interlinked networks and programmes. The Global Atmospheric Pollution Forum (GAPF) is actively promoting such a development. In the meantime, ongoing efforts to promote inter-regional cooperation must be further strengthened and, to the extent possible, coordinated and harmonized as regards inventories, monitoring, assessments and reporting. Joint training events might also be considered for the purpose of streamlining approaches and programmes. Policies and strategies should also be the subject of information exchange and review, while fully recognizing the specific circumstances in each sub-region. Initiatives such as EANET and the Malé Declaration which have their secretariats within the same body (AIT/UNEP RRC.AP in Bangkok), may profit from even closer links with each other, e.g. by sharing information on monitoring, methodology and, not least, policy development. The expansion of APINA in southern Africa to beyond the seven core countries, first to all 14 member countries of SADC, later to non-SADC countries, could pave the way for further cooperation between the sub-regions of Africa. Strong sub-regional and regional programmes facilitate worldwide collaboration. It is therefore in the interest of each initiative to develop as strong a regime as possible in order to make the envisaged global network viable and sustainable. The prospects of substantially contributing to such a scheme are a driving force for all negotiators to conclude comprehensive agreements.

1.13 Opportunities for interaction on greenhouse gases and air pollution

In Sections 1.7 and 6.7 of Module I, the inter-linkages between programmes on greenhouse gases and air pollution were addressed as regards combined driving forces and joint abatement options. Once such inter-linkages have been further corroborated and economically evaluated, negotiators of a multilateral agreement on air pollution may also wish to consider them for policy development. Such considerations should be carried out in consultation with representatives of the climate change community with a mind to designing cost-effective and environmentally efficient joint measures so as to gain co-benefits. The inclusion of such measures in a strategic agreement on air pollution, whether soft or legally binding, may still present considerable challenges while on the technical level much stands to be saved by coordination of monitoring and reporting. Further effects-oriented studies will most likely provide a rationale for joint policy action. The current absence of sufficient information on the trade-off effects of joint action must not be taken as an excuse for postponing decisions on the urgent mitigation of air pollution. In due course, science will provide incentives to widen the provision of multilateral agreements on air pollution to include policy stipulations for the abatement of greenhouse gases, as appropriate.

2. Coming Together for Cooperation

This book focuses on negotiating and developing a multilateral agreement/instrument the aim of which is to achieve a cleaner atmosphere and at the same time protect ecosystems and human health from the effects of air pollution. Although the book states that an agreement/instrument could be a successful way to reduce transboundary air pollution, this approach should not be perceived as the only way to realize the goal as other means could also be applied depending on the particular socio-economic conditions of the sub-region or region.

Once momentum for taking international action has been established, governments may appoint representatives and a forum for multilateral discussions. Numerous such decisions have been taken in many regions of the world and at present (2010), the time is ripe for moving further towards the preparation of agreements. Suitable fora exist within the United Nations family and elsewhere, which are ready to service and support government delegations. It is now incumbent upon governments to seize the opportunity propelled by the increased worldwide concern for environmental matters, each subregion according to its specific circumstances and priorities. If not already taken, the following steps may be considered in preparation for negotiations proper.

2.1 Issues

Module I of this book lists a number of issues to be considered. It is suggested that all issues be reviewed and assessed in a systematic fashion by government representatives, possibly assisted by a secretariat and a facilitator. The review should include assessment of national conditions and capabilities as well as overall ambitions. Possibilities and obstacles should be tabled using Module I as a check-list. Issues not relevant to the region should be identified and additional issues should be considered. A provisional table may be prepared showing each country's view of the listed driving forces, sources of air pollution, major pollutants, atmospheric transport of pollutants, critical loads and levels, abatement options and their costs for targeted pollutants. Other issues may be added to the list. This exercise should basically be non-political allowing full freedom to address scientific and technical matters without pre-conditions.

2.2 Availability of data

The above review and assessment of issues will most likely result in some conclusions as to additional data needed and availability. Government representatives may wish to compile a table linked to the one suggested above concerning data and information necessary to address all issues considered in Module I. In the case of lack of data, such a lack should be specified and the degree of urgency to fill the gaps should be ranked. Countries may have divergent views as to the immediate needs of particular data and a flexible approach should be applied and compromises sought, possibly with the assistance of the secretariat and the facilitator.

2.3 Further data collection

As a result of considerations in Section 2.2 above, procedures should be agreed for further data collection if necessary. Format and timescales for such collection should be decided and methods of assessment, evaluation and reporting decided. Coordination of these activities may be provided by the secretariat.

2.4 National and international priorities

Countries should define their national priorities regarding air pollution as a result of deliberations based on the issues of Module I. Even in a subregional context priorities may differ from one country to another, although many issues may coincide. Government representatives should seek the least common denominator and find consensus accordingly. Outstanding issues will most likely be accommodated in the framework discussions and flagged for consideration in subsequent negotiations.

Many countries have commitments with respect to global or regional agreements, e.g. the global Conventions on Climate Change and on Persistent Organic Pollutants (POPs) or bilateral arrangements with neighbouring countries. Participants in discussions on multilateral agreements on air pollution will have to consider their international commitments and ambitions in relation to such instruments and define their priorities accordingly. Conflict of interest is not very likely to occur because of such arrangements; rather they may offer opportunities for synergies and further work may be designed accordingly.

2.5 Provisional and conclusive negotiations in parallel with continued data collection

It is important that negotiations can start, even if provisionally, while further data collection continues. At some stage in the process the negotiations will become conclusive i.e. backtracking should not be seen as an exit. All participating countries should recognize this general principle although they still have the formal right to change their view, reserve their position, or even withdraw from cooperation. An agreement is not cut in stone until it is formally adopted and signed by government representatives authorized to do so.

3. Negotiations

Before government representatives reach the stage when basic obligations such as substantive, quantified emission reductions and time scales are addressed, a number of other important issues should be considered and solved so as to facilitate progress on the subsequent politically more demanding provisions. Such issues also require consensus and are therefore subject to provisional negotiations. The results of such provisional negotiations should be reflected in a decision document to avoid later disagreements which might disturb the substantive negotiations. A very practical aspect of this matter is the fact that government delegations may change their composition from one session to the next, the more so since a rather lengthy period of negotiation must be anticipated, usually several years. All delegations should, of course, regularly inform their national government colleagues and possible successors of progress made and decisions taken in the process at the same time as the delegations receive instructions from their governments regarding their political readiness to take on board obligations and the conditions for doing so. It should be understood that tactical considerations are also taken into account in all negotiations, including the use of game theoretical approaches to gain as much advantage as possible without jeopardizing the desired outcome for the whole region or sub-region. Members of a negotiating body will no doubt be aware of these opportunities and will address them, as appropriate, according to the occasion. Possible strategic disagreements should never be allowed to become personal. A friendly atmosphere among delegates is always conducive to making progress, and will facilitate reaching desired win-win situations among countries.

3.1 Terms of reference and rules of procedure

Formal negotiations of a multilateral agreement on air pollution should be conducted against an agreed framework which is also applicable in the long term to bodies established for the implementation of the agreement. Terms of Reference

(ToR) describe the remit for the work, possible elements of that work, governmentally authorised representatives and possible observers and other participants, arrangements for consultations and similar matters. Instead of formulating its own ToR, a negotiating body may decide to apply, as appropriate, the ToR of the parent body which provides secretariat services to the negotiations. A negotiating body may, however, at any time, adopt its own ToR if it finds the existing ToR unsuitable for the constituency in question.

Rules of Procedure (RoP) are usually more specific than ToR. They specify the requirements for meetings, (items for the agenda and distribution of it, reports and related documents), official representation and credentials, accreditation, officers (chairperson and vice-chairpersons), inter-session work, organisational structure (supporting bodies, etc.), secretariat functions and conduct of business. While negotiations of a treaty must always aim at reaching full consensus, occasions may arise when a vote becomes necessary. RoP must specify the procedure in case such a rare occasion arises and also the consequences of the vote. RoP may also contain provisions for the status of meetings (public or private) and how deliberations should be reported. While transparency and openness are key components of intergovernmental work, a negotiating body may wish to apply restrictions while negotiations are ongoing and preliminary consultations with governments are taking place. The role of the media is important in promoting awareness but it might also create confusion about the real status of negotiations if the whole picture is not known. RoP should contain provisions which allow a negotiating body to avoid being misinterpreted or misrepresented, e.g. by holding certain private sessions without media present.

As with the ToR, it might be appropriate for a negotiating body to apply the RoP as adopted by the parent body, possibly adjusted to the specific circumstances of the negotiations.

3.2 Structure and status of the treaty or instrument

Various options for a multilateral agreement on air pollution were discussed in Section 1.8 of this Module. At the start of negotiations the ambition level should be clearly stated and agreed. The well-motivated indication that a legally binding instrument is the ultimate objective of the deliberations might be a goal currently perceived as too ambitious for some delegations and this might dampen the determination of others to proceed forcefully towards such a goal. With the introduction of a legally binding framework agreement (such as a convention) all countries might, however, be accommodated under such an umbrella. The obligations of a framework instrument can be formulated in such a way that virtually all participating countries can adhere to it. More substantive agreements (e.g. protocols, to be provided for in the framework agreement), would subsequently introduce obligations for quantified emission reductions, national ceilings, technical and non-technical measures, time scales, policies and strategies, etc. The major disadvantage with such a lengthy step-by-step approach is, of course, the considerable delay in necessary interventions. In order not to lose momentum unnecessarily, a reasonable compromise would be to include in the framework agreement some particularly urgent commitments regarding emission control or reductions, e.g. with respect to selected pollutants such as sulphur and small particles, leaving the methods open for countries to achieve agreed national emission numbers. Since differentiated obligations will most likely be a major feature of any envisaged agreement, this flexibility should be offered to accommodate countries which might initially be reluctant to sign a legally binding instrument. Ideally, differentiations are based on optimizations using integrated assessment models but in the absence of such calculations, adjusted flat-rate reductions may be applied, e.g. for countries with particular problems, temporarily prescribing a freeze of emissions to be followed at a later stage by overall reductions.

The possible reduction of pollution per production unit is generally not a sufficiently good measure to reduce the national emissions, given the increasing number of units taken into operation, but it must nevertheless be regarded as a useful contribution in a mitigation programme. While encouraging its application, it should not be seen as a preferred element in a compromise instrument.

Very large countries (e.g. those having an area exceeding 2,000,000 sq. kms) and with a very unequal distribution of emissions may wish to advocate that only specified parts of their territory should be subjected to emission reductions while other areas should be allowed a stand-still status. Such options might be considered by negotiators in order to be able to move ahead. However, it puts major requirements on data and other documentation and introduces additional tasks for compliance monitoring and reporting.

As regards the ultimate choice of structure and status of an agreement, it is important to recall that all options remain open for negotiators, including working towards a soft political declaration or resolution. In this day and age, however, anything less than a legally binding instrument may at best be viewed by some only as a stepping-stone towards a legal instrument, although a soft agreement, or similar arrangements, could, of course, serve the immediate needs of a sub-region or region in an adequate way.

3.3 Level of delegations and their authority

While it is the prerogative of each government to designate its own representatives for multilateral negotiations, it is to the advantage of the process if such representatives are decision-makers or senior advisers to decision-makers in their respective ministries. They should be part of the policy-making functions of their governments. A provisional negotiation may possibly start on a lower level of authority to be upgraded as the negotiations proceed to strategic issues. Each delegation should speak with one voice and a Head of Delegation should be appointed by each government. Since negotiators of a multilateral agreement on air pollution deal with a wide range of disciplines, as addressed in Module I of this book, delegations may include experts from relevant institutes and institutions in their countries according to their needs and own choice. A delegation cannot express any requirements on the composition of the delegation of other countries but it is expected that all delegations will operate on the same level of authority so as to secure reliable progress in negotiations from session to session. Diplomatic missions in the country of negotiations may provide support and continuity within their field of competence, as appropriate for each individual country.

It is also customary that small groups of countries with a common outlook on certain issues hold informal preparatory meetings to coordinate their views on matters to be addressed at the negotiations. Such informal groups, being issue-driven, may act with different combinations of countries from case to case. In some cases bilateral consultations between government representatives may also take place in order to facilitate smooth deliberations during negotiations. Where feasible, regional economic integration organisations may develop a common view which they can advocate on behalf of their member states. While this is relevant in Europe (European Commission) there may not be any formal counterparts beyond that region although intergovernmental cooperative schemes exist on different authoritative levels elsewhere e.g. SACEP in South Asia, ASEAN in Southeast Asia and SADC in southern Africa. The possible participation and authorization of such organisations should be regulated in the Terms of Reference.

It is understood that countries in a region have very different capacities when forming delegations from one single person to any reasonable number of representatives. This fact may be a disadvantage to some delegations but since a perfect balance can hardly be struck by prescription, this is a situation that has to be accepted and handled with understanding and respect. Informal bilateral or multilateral consultations, as suggested above, could possibly be of assistance to countries with very small delegations, if conducted in an equitable way.

3.4 Observers and non-governmental organisations

The negotiating body may wish to allow observers and Non-Governmental Organisations (NGOs) to attend sessions to secure public insight into the process regarding items such as transparency, accountability and nature of issues. As stated above (3.1) such attendance should be regulated in the Terms of Reference (ToR) and Rules of Procedure (RoP). It will remain the prerogative of the negotiating body to rule on the application of ToR and RoP and to make exceptions when deemed necessary. From time to time, negotiations may address sensitive issues containing preliminary opinions, not confirmed by the government. In such cases, it is in the interest of all persons involved to exercise some restrictions, i.e. not to allow observers and NGOs to take part in such meetings. To meet the public demand for information, progress on negotiations could, from time to time, be reported in statements and press releases issued by the secretariat after having been cleared by the negotiating body or its Chairperson.

3.5 Timetable for negotiations and method of work

It might be useful if, already at the start of their deliberations, negotiators agree on a tentative timetable for conclusion of negotiations and for the adoption and signature of the envisaged agreement. The final event might be held at ministerial level and preparations for the formalities connected with it should be allocated the time necessary. The required secretariat services must also be planned and budgeted as soon as possible. Provided that the negotiating body has agreed on the type and status of the envisaged agreement and on the timely conclusion of it, a work plan for negotiation rounds and supporting data collection and consultations may be set up. Experience from negotiations of legally binding protocols under CLRTAP suggests that, if well prepared, two or three years may be required for the conclusion of negotiations on the understanding that several sessions can be held each year and that the necessary secretariat resources are available all through that period. It must be understood however that each negotiation has its own life given the specific circumstances, ambitions and resources of the region in question. External expectations may promote progress but are, in essence, futile. However, consideration and possible coordination of, and with, other regional relevant initiatives may be useful for progress, e.g. regarding development of EANET and the Malé Declaration in Asia.

The method of work for negotiations must apply not only to the negotiations proper but also, and perhaps foremost, to activities underpinning the policy development, i.e. technical and scientific data collection from monitoring programmes and compilation of information on all other relevant aspects of air pollution legislation such as economic and legal matters. These activities must be planned at an early stage and organized accordingly.

Subsidiary bodies or expert groups may have to be set up for this purpose or consultants hired resources permitting. It is, however, understood that most tasks as suggested can be carried out as in-kind contributions by country experts e.g. through nationally funded manpower for studies, assessments and analyses. A reasonable conclusion is that the more sophisticated an agreement, the more technical and scientific support it will require and probably also a longer period of execution. The proper balance will be linked to the realistic ambition level of negotiators and timetable, work plan and method of work will be set accordingly.

3.6 Experts and expert groups

Apart from what has been said above on the possible need for experts in general, it is suggested that draft technical annexes of an agreement should be prepared by designated experts, preferably on an intergovernmental level. Such work may include the assessment, possibly also costs, if available, of relevant technologies and techniques to be used in the implementation of an agreement on emission reductions. Whether technical annexes should be of an obligatory or recommendatory character will be decided on by the negotiating body not by the experts.

3.7 Cut-off date for inclusion of new scientific or monitoring data

It will help the negotiating body if a cut-off date is decided on beyond which new scientific information and monitoring data should not be considered. Negotiations must be conducted against a firm background of information not a moving target. Science and monitoring will continue to produce data indefinitely which might be taken as a reason to postpone the conclusion of negotiations. There might be cases when additional data will improve the basis for negotiations but, nevertheless, a cut-off date has to be set. Data collected and reported after that date may be used in possible negotiations for subsequent agreements, if any, and in connection with performance and compliance reviews of the agreement under preparation. Setting a cut-off date may also encourage negotiators to conclude their deliberations in a timely fashion with reference to the actuality of the scientific basis.

3.8 Tentative draft text of an agreement

A draft of an envisaged final agreement might be prepared early on e.g. by the secretariat but leaving emission reduction numbers and timescales open. Such a draft should be discussed by delegations and successively adjusted and refined. At some stage in the development the draft may be abandoned for another version or it may be revised leading to the final agreement and provisionally, wholly or partly endorsed by the negotiators. Numbers for the control or reduction of air pollution (percentage and tonnes, as appropriate) and timescales for it will be agreed during this process. The tentative draft text will thus develop gradually into a final product. More suggestions on the practical conduct of this process are given in Annex I.

3.9 Accommodation of solutions which are equally good for each individual country and for the region as a whole

It must be a prime objective of the negotiation to arrive at solutions that do not favour or disfavour any particular country. Since transboundary issues figure prominently in global, regional and subregional considerations it must be recognized that some countries, due to economic activity, environmental programmes in force and climatic conditions, generate more transboundary air pollution than others. Consequently, some countries receive more pollution from abroad than others. Therefore the concept of "equally good solutions" cannot imply that all countries must reduce their emissions by equal volumes or percentages. Flat-rate reduction schemes are neither cost-effective, nor environmentally motivated or fair. While each country has the legitimate right to design its own environmental programme, it also has, in accordance with Principle 21 of the United Nations Stockholm Declaration, a responsibility vis-à-vis other countries. In some cases therefore, the purely national interest must yield to international concerns which, in the long run, will most likely lead to solutions acceptable to all governments involved. Sound science concerning emissions, transboundary fluxes and environmental impact assessment must guide negotiators in finding good solutions for all countries, even if perceived as not equally good by every country at the time of negotiation.

3.10 Lead-country functions

Concerning intergovernmental cooperation on environmental matters, countries have varying degrees of access to resources and different scientific capabilities for carrying out studies, research and assessments. Many activities geared towards underpinning policy development are conducted only in some of the countries involved in the cooperative scheme or with considerable disparities in extent and intensity between countries. Since all countries in a region directly or indirectly benefit from many of these activities, they can be seen as spearheads for the advancement of science for the whole scheme. While such a lead-country may provide the lion's share of competence and resources, other countries may be affiliated to it through joint research projects, monitoring programmes or exchange of students and scientists. The lead-country has a coordinating function, although ideally operating under the guidance of the intergovernmental policy body (the negotiators) to which it reports on progress. This division of work is result-oriented and cost-effective and might be considered for further development. Topics suitable for lead-country arrangements may vary within each region but effects-oriented projects such as studies of effects of air pollution on health, agricultural crops and corrosion are prime targets. Specific studies on anthropogenic small particles in relation to naturally derived dust and other aerosols may also be candidates for lead-country operated projects as may modelling applications and cost-benefit analyses. The topic of impaired visibility due to air pollution, which up until now has basically been ignored, may also call for subregional cooperation which could be helped by a lead-country. Assessment and evaluation of technical abatement options might also be successfully substantiated through lead country initiatives. It is important to stress the need for lead country conducted projects to be fully relevant to the envisaged policy development and approved by the negotiating body or its parent body.

3.11 Allocation of national resources for cooperation and negotiations

In order to demonstrate its determination to cooperate on issues related to air pollution, a government must include in its national budget sufficient resources for the development of science, monitoring and negotiation over several fiscal years. Such allocations are facilitated by the successful embedment of the concern for air pollution (and greenhouse gases) in the national plans of every country. Increasing public and political pressure, now being witnessed all over the world, will ideally find response in increased budget allocations over the next few years. NGOs and other lobbyists will keep the subject on the front line and the international community will expect concerted action worldwide. Resource allocations must therefore be a major issue for governments engaged in multilateral negotiations on air pollution. The quality of a concluded agreement will depend on the resources available for the work – and the accruing benefits for a country will most likely also depend on the funds put aside for negotiations. The fact that experience has shown that the benefits of action on air pollution widely outweigh the costs, must speak in favour of substantial investments for the conclusion and implementation of multilateral agreements to mitigate emissions of air pollution.

4. Institutional Arrangements

Parties to a multilateral instrument on air pollution will profit from setting up a stable institutional arrangement under which necessary cooperation can develop and be maintained through the implementation period and beyond. This should be done before the instrument has entered into force. The institutional set-up should comprise political, scientific and administrative bodies as well as a secretariat. The Terms of Reference for these entities, as well as their method of work, should be decided by the Parties. The set-up can be more or less comprehensive, most likely developing with time in response to emerging needs. The present mature structure of CLRTAP, although allowing great flexibility, has proven to be a significant strength adding to the sustainability and status of the machinery of the agreement. A list of bodies, which is not exhaustive, is offered below. A prime duty of all subsidiary bodies is to continuously follow developments in their fields of competence and to report to the Governing Body accordingly. The Governing Body and its subsidiary bodies may establish Bureaux to handle emerging issues and to prepare draft decisions for their bodies to consider. It must be understood that a comprehensive institutional structure such as the one indicated below is highly resource-demanding and personnel-intensive and simply not possible in most sub-regions and regions of the world. Nor is it necessary for the support of new and limited undertakings, whether in regions of developed or developing countries. Functions such as those suggested below, while probably optimal for a very comprehensive regime, may be streamlined to the specific requirements of smaller regimes and may, if need be, be partly upheld by individual experts designated for such tasks, or not addressed at all at the current state of development. Progress will be made anyway and might even be facilitated by the absence of a heavy and complex administrative structure.

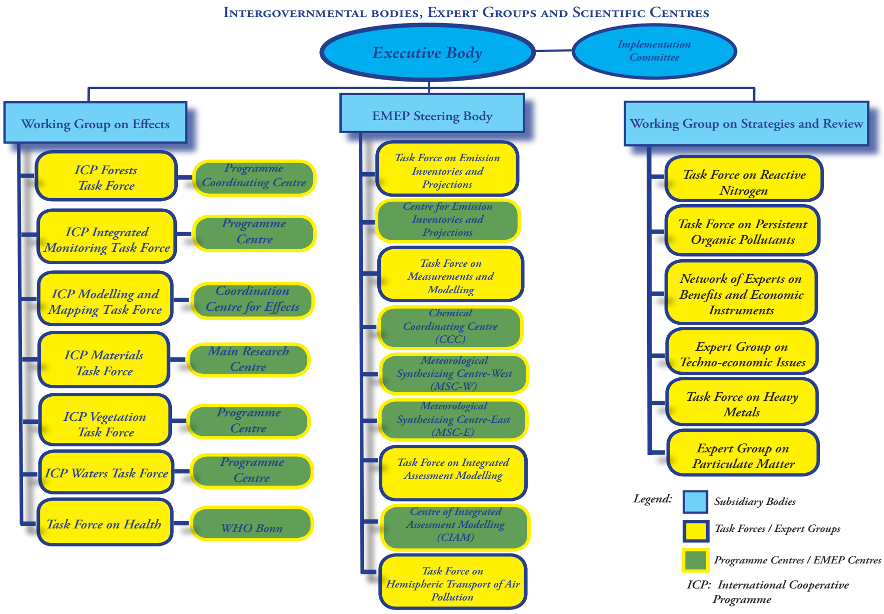

Figure 7 - Organisation structure of LRTAP Convention
Source: UNECE, LRTAP Convention. (http://www.unece.org/env/lrtap/)

4.1 Governing body (governments)

The agreement will have a sovereign decision-making policy body, usually known as the Conference of the Parties (COP), Executive Body or a similar expression. Such a body consists of governmental representatives, formally most likely from Ministries of Foreign Affairs, but in practice usually delegated to the Ministries of Environment or similar ministries, government institutions or diplomatic missions in the country where the secretariat is located.

The Governing Body reviews progress on science, monitoring and implementation and decides the work plan of all bodies under the regime. It decides training needs, as appropriate, and delegates tasks accordingly. It also handles any budgetary and financial matters. Legal issues are a high priority. The Governing Body may conduct negotiations itself or, most likely, set up a negotiating body for that purpose. All subsidiary bodies set up by COP report to the COP which also sets the general framework for the secretariat. Being a sovereign treaty body, the COP has normally no reporting duties vis-à-vis other bodies although it usually provides information to its parent body such as the relevant United Nations secretariat. In cooperation with the secretariat, COP provides liaison with other regional and global programmes and organisations, including the Global Atmospheric Pollution Forum and shares information with such initiatives.

4.2 Scientific bodies

Since the effects of air pollution constitute the major driving force for the existing or envisaged agreement, a scientific body consisting of experts from the participating countries may be set up. It will address the effects of air pollution on human health, on sensitive receptors such as crops, soils, forests, water and manmade material and on visibility. It will ideally conduct and coordinate studies and research on cause and effects and dose-response relationships, including, if possible, critical loads and recovery of ecosystems in response to reduced emissions.

Another type of scientific body may be set up for cost calculations regarding abatement options and integrated assessment modelling, preferably closely cooperating with the effects-oriented groups so as to be able to suggest abatement options that are not only cost-minimized for the region but also maximised regarding environmental performance.

4.3 Technical bodies

The implementation of an agreement on reduction of emissions will require major technical measures to be introduced. Technical bodies for the assessment of available techniques and their costs, relevant for stationary and mobile sources of air pollution, will advise the COP on important developments as input for further negotiations and follow-up of existing agreements. Agricultural practices may be reviewed by a technical body and recommendations issued accordingly. Technical bodies will be entrusted by the COP to prepare technical documents to facilitate implementation of agreements, possibly in the form of obligatory or recommendatory annexes to instruments.

4.4 Monitoring bodies

Monitoring bodies develop draft guidelines and manuals for emission inventories, atmospheric transfer modelling, deposition and concentrations and assessment of effects. Such bodies, each particular to its defined duty, coordinate and supervise the monitoring activities and prepare reports according to agreed formats for submission to the COP.

4.5 Negotiating body

For the preparation of an instrument, the Governing Body, if such a body exists, may wish to set up a temporary body to conduct negotiations on behalf of the Governments of the cooperating constituency. Most often such a body is composed of the same policy-makers, designated by their Governments, as those of the Governing Body. In the case of initial negotiations of an agreement, the negotiating body is the highest authority. Its members will most likely make up the Governing Body once the agreement has been concluded, adopted and entered into force. Pending entry into force the body would be an interim governing body. Working on behalf of their Governments for an intergovernmental agreement, it is expected, formally speaking, that it is the Ministry of Foreign Affairs of the respective Government that is represented in the negotiating body. Normally, however, this task is delegated to the Ministry of Environment or a similar ministry, authority or institute. Delegations of the negotiating body are usually supported by national experts according to the resources, capacities and priorities of individual countries. Delegations from small countries may often find themselves at a disadvantage in relation to other countries which may be an obstacle to full participation in some aspects of the negotiations.

4.6 Implementation body

To review implementation and to assist in case of envisaged non-compliance, a relatively small implementation body may be set up. Its purpose is to assess annual and other reports required by the work plan with a view to identifying any shortcomings by Parties at an early stage. It addresses the reasons for such possible shortcomings and suggests in an assisting and non-confrontational way remedial action, whether technical, administrative or legal. It may propose that Parties, or the secretariat, provide assistance and training to a Party with obvious enforcement problems in complying with its obligations.

4.7 Expert groups

From time to time the COP may see a need to establish expert groups to address certain urgent issues in order to facilitate subsequent decision-making. Such groups work during a relatively short period, one or two years, report on their findings to the COP and are thereafter dissolved.

Over the years a number of expert groups have contributed to the preparation of Protocols under CLRTAP. Already in 1985 the Group of Experts on Cost and Benefit Analysis provided crucial expertise related to the control of sulphur emissions. That group was followed by many others, e.g. on Control Techniques for Emissions of VOC and NOx from Selected Mobile Sources, on Ammonia and on Techno-economic Issues.

A prominent example of a scientific group within the framework of EANET is the Expert Group on Revision of the Technical Manual on Wet Deposition Monitoring which identifies the technical and administrative problems associated with wet deposition monitoring encountered in EANET since the beginning of the preparatory phase, evaluates the differences in the measurement techniques of other regional monitoring programmes and suggests modification of procedures, etc. It is tasked to produce a revised technical manual on wet deposition monitoring.

Other expert groups in EANET include those on Dry Deposition Flux Estimation, on Preparation of the Second Periodic Report on the State of Acid Deposition in East Asia, and on Revision of the Technical Manual on Inland Aquatic Environment Monitoring.

4.8 Technical centres

Scientific and technical programmes, producing vast volumes of data, will benefit from well-functioning technical centres. Such centres operate under the auspices of intergovernmental bodies, as listed above. They develop standards and formats for the programmes, provide training and assistance, recommend equipment and analytical procedures to be used and compile progress reports and statistical information. As appropriate, they act as the implementers of decisions taken by political bodies. Excellent examples of such centres are those for EANET in Niigata, Japan and for CLRTAP (EMEP Centres, effects-oriented centres connected to International Cooperative Programmes) in Oslo, Moscow, Stockholm and elsewhere.

4.9 Preparatory body for further policy development

In view of possible revision of existing agreements or preparation of an additional instrument, COP may set up a specific body to review the need, rationale and options for further strategic work. Such a body will draw on the work of other bodies of the regime as well as on findings by other groupings within or beyond the region. The preparatory body will, as appropriate, suggest modes of operation and practical methods for the advancement of multilateral environmental law in accordance with emerging requirements. Under a comprehensive regime such as CLRTAP this body will be semi-permanent advising COP on strategy developments, revisions of agreements and preparations of proposals for further negotiations.

4.10 Preparatory body for inter-regional and hemispheric cooperation

While inter-regional cooperation until now has been mainly a matter for secretariats acting on behalf of their stakeholders, it is foreseen that the decision-making bodies will become more directly involved in cooperative schemes worldwide. The Task Force on Hemispheric Transport of Air Pollution under CLRTAP is an initiative along these lines. It was set up to enhance technical and scientific cooperation on regional and intercontinental transport of air pollution and has led to several cooperative frameworks such as those with the EANET Scientific Advisory Committee and similar bodies under the Malé Declaration. Joint regional workshops were held in developing countries, e.g. 15-17 October 2008 in Hanoi, Vietnam. Regimes other than these will find it increasingly urgent to develop inter-regional links and may wish to set up preparatory bodies for that purpose, or designate spokesmen to handle such topics. Issues such as modelling of atmospheric transport of pollutants, monitoring, emission inventories and projections and impact of pollutants are prime topics for interregional cooperation. Secretariats are expected to continue to play important roles in interregional cooperation and inter-secretariat meetings facilitate progress.

4.11 Task forces

Action-oriented task forces may be set up to assist any of the subsidiary bodies with scientific and technical undertakings. While like all other groupings under the regime they are intergovernmental by nature, they consist of independent experts designated by their governments and charged with the task of generating results required for optimal progress within their specific field of competence.

Examples of task forces under CLRTAP include effects-oriented bodies on forests, integrated monitoring, modeling and mapping, materials, vegetation, waters and health; and those on emission inventories and projections, measurement and modeling and integrated assessment modeling. The work of the Task Forces on POPs and Heavy Metals, respectively, was to support the preparation of Protocols on these substances. A salient example of a task force within EANET is the Task Force on Monitoring Instrumentation. Its task is to review acid deposition monitoring instrumentation and laboratory equipment, including its operation, to recommend suitable cost-effective monitoring methodologies for EANET, to review current QA/QC procedures and to recommend improvements and develop monitoring manuals and guidelines in cooperation with other subsidiary groups under the Scientific Advisory Committee (SAC). Other task forces in EANET include those on monitoring for dry deposition, on soil and vegetation monitoring and on research coordination. These task forces will fulfill specific duties and tasks based on the terms of reference and provide input to the SAC.

4.12 Treaty secretariat

The secretariat for a multilateral agreement on air pollution is the stable centre-point for the regime. Apart from servicing the COP and subsidiary bodies with meeting and conference facilities, documentation and exchange of information, it provides support for all developments connected to the agreement. Guided by the COP, it may take initiatives on procedural and substantive matters and training and may develop information strategies and programmes to increase the visibility of the agreement. A secretariat establishes and maintains links with other relevant secretariats and initiatives and provides liaison with the scientific community. It prepares budget proposals and when financial mechanisms are involved in the agreement, handles matters related to funds and payments. The staff composition of the secretariat and related terms are normally decided on by the secretariat itself or its administrative parent body in line with rules and regulations governing personnel matters.

An ideal secretariat is one which consists of experts who have competence in various fields relevant to the treaty and which has all the conference facilities necessary to service an intergovernmental body. It may be part of a larger secretariat, as in the case of CLRTAP (UNECE), or be independent from its parent body, as in the case of the UNFCCC secretariat. Advantages and disadvantages can be found with both options.

Pending the conclusion, adoption and entry into force of the envisaged agreement, the servicing secretariat may carry out its functions as an interim secretariat, usually simply called the Secretariat.

MODULE III

EXISTING MULTILATERAL AGREEMENTS RELATED TO AIR POLLUTION

1. Fundamentally Different Concerns Driving Regional and Global Schemes

Any regional or sub-regional initiative on mitigation of air pollution aimed at the preparation of multilateral agreements may take guidance from already existing instruments, regional, subregional as well as global. The ultimate reason for initiating negotiations can be found in the notion of emitters/polluters on the one hand and receivers/victims on the other and the political tensions sometimes caused by this perspective. The most striking example of this type of conflict-driven scheme is the 1979 Convention on Long-range Transboundary Air Pollution and its associated Protocols, in particular the first generation Protocols in which down-wind Scandinavian countries (Norway and Sweden) laid the brunt of the blame for acidification in their countries on up-wind emitters south of them, such as the United Kingdom, the Federal Republic of Germany, the Democratic Republic of Germany and Poland. Initially, the problems encountered in Norway and Sweden were not seen as being common to the rest of Europe and this divide delayed progress. In time, however, the obstacles were turned into opportunities for fruitful cooperation, supported by the growing awareness of emitters, based on sound science, that while causing significant transboundary fluxes of air pollution, they primarily polluted their own countries.

Another example of a conflict-driven sub-regional regime which clearly indicates major up-wind emitters on the one hand and major down-wind receivers on the other is the ASEAN Agreement on Transboundary Haze Pollution. In this case Indonesia in particular was blamed for polluting countries north of it by widespread biomass burning (forest fires).

Global instruments such as the United Nations Framework Convention on Climate Change (UNFCCC) and the associated Kyoto Protocol, as well as the Convention on the Protection of the Ozone Layer and its subsequent Montreal Protocol on Ozone-depleting Substances, are based more on the notion that the whole world is equally impacted by emissions in any one country. The question of upwind or downwind position is of no relevance. All countries being emitters of greenhouse gases and ozone-depleting substances and all countries being collectively impacted, the international conflict of interest was rather defined according to the disparities between very large and very small emitters and the strive for some intergovernmental, equitable burden-sharing between them, taking into account historic developments. The approach to solutions therefore had to be different from up-wind/down-wind approaches.

Consequently, a possible future global convention on air pollution must accommodate the regional specifics of up-wind/down-wind situations and, at the same time, include global concerns similar to those related to climate change. Most likely therefore an envisaged global instrument must be structured in two or more tiers, perhaps allowing for separate regional and subregional protocols under an umbrella convention.

The current sub-regional initiatives on air pollution in southern Africa and East and South Asia have a transboundary dimension with emitter/receiver relationships, much like the CLRTAP. However, while transboundary air pollution is a driving force for action, domestic, and for large countries trans-provincial, concerns must also be addressed in the cooperation. Negotiators of new agreements will no doubt benefit from the experiences of other similar undertakings, in particular CLRTAP, even though local, regional and sub-regional circumstances will require significant adaptations.

In the following overview of some multilateral agreements, most attention is consequently devoted to CLRTAP since that regime is deemed to be the most relevant example for other regional initiatives on air pollution legislation worldwide, but each instrument has something to offer in terms of guidance to current and future sub-regional and regional initiatives.

2. The ASEAN Agreement on Transboundary Haze Pollution

The Association of Southeast Asian Nations (ASEAN) has concluded an effects-driven sub-regional agreement to curb emissions from biomass burning, in particular forest fires.

2.1 History

In the late 1990s an environmental crises unfolded in Southeast Asia. It was caused by widespread land clearance via open forest burning in many countries, the most prominent hotspots (as revealed by satellite imagery) being in Sumatra, Borneo and the Malay Peninsula. Most of the smoke came from oil palm plantations which used burning instead of expensive heavy equipment to clear land. The year 1997 was particularly noted for the raging forest fires in Indonesia which sent a pall of small particle pollution over the region for several weeks at an estimated cost of almost USD 10 billion, not counting the impact on people's health and well-being. Due to the prevalent monsoon winds the most affected countries were Malaysia, Singapore, Thailand and Brunei.

2.2 Negotiation process

The forum chosen for addressing this transboundary problem was ASEAN, but AIT/UNEP RRC.AP could also have hosted negotiations (theoretically maybe also ESCAP, i.e. the United Nations regional Economic and Social Commission for Asia and the Pacific). The participating countries in the negotiations agreed from the very start to aim at an instrument stipulating that legal, administrative and technical measures must be taken to reduce pollution. All ten ASEAN countries, forming a logical and well delineated group of countries concerned with the haze problem, took part in the negotiations and the agreement was adopted and signed in 2002. The speed with which it was prepared and concluded was encouraging since it indicated a concerted determination to take action. Already the following year, 2003, the agreement entered into force for the ratifying countries when the required six ratifications had been launched by governments.

2.3 Text of the instrument

The agreement contains provisions for monitoring, assessment and prevention, technical cooperation, scientific research, mechanisms for coordination and lines of communication as well as simplified customs and immigration procedures for disaster relief. More specifically it provides for cooperation on the development and implementation of concrete measures to prevent and monitor transboundary haze pollution, early warning systems and mutual disaster assistance. It also provides for the establishment of an ASEAN Coordinating Centre on the Control of Transboundary Haze Pollution.

The full text of the agreement can be found at www.aseansec.org/agr_haze.pdf.

2.4 Implementation (progress and obstacles)

In line with the provisions of the agreement a Regional Action Plan was prepared, supported by numerous detailed guidelines and other documents. A Haze Technical Task Force meets twice a year within an established cooperative scheme. Progress towards curbing haze from biomass burning has, however, been modest and serious haze episodes have been recorded after entry into force of the agreement. The obstacles to significant progress may partly rest with the structure and priorities, including available secretariat resources, of ASEAN as a political/technical body, not a recognized United Nations body. However, the less than satisfactory implementation record is mainly caused by Indonesia's current decision not to ratify and implement the instrument. Thus, the provisions of the agreement are not legally binding for the country which is perceived as being by far the greatest contributor to haze in Southeast Asia. Another obstacle to real progress is the lack of enforcement and liability clauses in the agreement and that the Polluter Pays Principle is not honoured. An envisaged future revision of the instrument should address the weaknesses and ideally also quantify required emission reductions based on assessment of effects and damage, including costs for the whole region. Liaison with other regional initiatives could facilitate and better underpin further action, e.g. by considering monitoring results from the project on Atmospheric Brown Clouds (ABC) and the Malé Declaration network. In preparation for a possible revision Parties might also want to consider ways to assist each other to ratify and implement present and envisaged future obligations.

3. Convention on Long-range Transboundary Air Pollution (CLRTAP) and its Protocols

CLRTAP was the first multilateral, legally binding treaty on air pollution. It brings together a number of environmental and political concerns. Its success is based on strong science-policy interactions in a flexible and innovative manner and its implementation is carried out with a minimum of bureaucracy. The Convention is buoyed by strong lead-country contributions and a stable institutional framework as well as a well-recognized Secretariat within the United Nations system.

3.1 Convention history

Numerous scholars have given accounts of the history of the CLRTAP and its features and it is assumed that the development of this flagship treaty is well known to everybody interested in multilateral agreements on air pollution. The important steps have been indicated in Module I of this book drawing attention to the highly political framework at the time of its inception. Based on scientific findings in Scandinavia in the 1960s, the concern for transboundary pollution was brought to the highest intergovernmental level at the 1972 United Nations Conference on the Human Environment where the decision to establish UNEP was also taken. Reference has already been made in this book to Principle 21 of the Stockholm Declaration from that Conference and to the Helsinki Final Act of CSCE in 1975. It is worth mentioning that in the political tension of those days, the Soviet Union and its allies boycotted this major United Nations Conference as a protest against the Swedish Government's decision on certain visa issues. Thus the conditions for cooperation on the environment were marred by political measures and counter-measures from the very start, something that would last for almost two decades until the dissolution of the Soviet Union. It has been said that CLRTAP is the fruit of the Cold War. The unusual and sometimes stormy marriage between East-West high level politics and genuine concern for the environment was an exception to the very frosty relations between the two Blocs in which the Scandinavian countries played an important, sometimes intermediary role.

Following the end of the Second World War, the economic, ecological and socio-political situation in Europe was characterized by rapid production growth and increasing consumption of goods but also by depletion of natural resources and ensuing pollution. The memory of hazardous and lethal smog events in London in 1952 and 1956 was still vivid many years later, as were similar episodes in Los Angeles, Chicago, Tokyo and other big cities. The concern for the local effects of air pollution was already in place when, in 1968, Svante Odén pointed to the transboundary nature of acidifying substances. Thus the stage was set for intergovernmental action.

3.2 Negotiation process

Convention

The only existing operational forum for pan-European political and economic cooperation on a convention in the 1970s was the United Nations Economic Commission for Europe (UNECE) which also hosts Canada and the United States as members. UNECE, one of the five regional UN Commissions operating under the Economic and Social Council (ECOSOC) was established in 1947 with its Secretariat in Geneva. Its main aim was to facilitate the reconstruction of Europe after the war. In 1972 a body called the Senior Advisers to UNECE Governments on Environmental Problems was set up. At that time acid rain was only briefly mentioned as a possible matter for concern. The USSR, having found evidence of acid rain within its sphere which was derived from other countries, pushed for this matter to be put on the agenda. (The term “acid rain” had been coined already in 1872 by the Scottish chemist Robert Angus Smith who described a local and episodic phenomenon in the United Kingdom with these words). Scandinavians were naturally concerned about transboundary acid rain and, referring to its down-wind position vis-à-vis countries to the south and south-west, were at odds with many countries belonging to the European Economic Community (forerunner to the European Union). In the Senior Advisers, Norway and the USSR in particular acted together against reluctant countries such as France, the United Kingdom and the Federal Republic of Germany. When the United Kingdom refuted the idea of transboundary air pollution, Norway and Sweden were able to show that the deposition of sulphur dioxide over their territories exceeded their own national emissions several times. The transboundary dimension was amply corroborated by the global radioactive fallout after nuclear bomb tests. The scientific-political conclusion was that no single country could solve the problem of long-range transboundary air pollution on its own.

These observations were addressed in the arduous negotiations of the Senior Advisers and reference was made by progressive countries to international responsibilities reflected in Principle 21 of the Stockholm Declaration. The arguments against transboundary pollution were gradually undermined by additional scientific observations but the negotiations in Geneva were often complicated by the political differences between the two Blocs. Finland, Norway and Sweden pushed for firm obligations while the opponents tried to weaken them and wanted to have blunt provisions in the instrument. Canada and the United States took a sideline position. The USSR and its allies supported the Nordic countries against EEC countries. Striking a compromise, negotiators agreed that the instrument should be a framework convention with clear statements of its ultimate goal and that it should contain provisions for subsequent negotiations for the reduction of emissions of sulphur and other substances, based on scientific studies of transboundary air pollution. Compilations for this purpose were to be carried out by the existing European Monitoring and Evaluation Programme (EMEP).

The Convention was adopted and signed by 34 governments and the European Economic Community in 1979 and entered into force in 1983 when the required 24 ratifications had been launched. It is fair to say that despite the disputes and political obstacles the Convention could be accepted thanks to the fact that scientists, experts, the general public and politicians in Europe and North America were convinced that the problem could be solved only through intergovernmental cooperation. The Convention actually became a bridge across the invisible Cold War front, later to be reinforced by subsequent Protocols.

Protocols

As provided for in the Convention, the first substance to be addressed was sulphur compounds giving rise to acid rain. At its session in 1983, the Executive Body for the Convention reviewed a proposal by Finland, Norway and Sweden to initiate a programme to reduce emissions of these compounds by 30 per cent between 1980 and 1993. The United Kingdom tried to present a less ambitious proposal but had to yield to the majority. Three major events provided strong incentives for taking action, firstly the 1982 Stockholm Ministerial Conference on Acidification of the Environment which, among other things, refuted the "tall chimney" policy hitherto advocated by some countries to disperse air pollution (potentially, actually creating even more transboundary pollution); and secondly, the Multilateral Environment Conference in Munich in 1984 which addressed, among other things, forest dieback due to acid rain and flue gas desulphurization technology as a means to abate emissions; and thirdly, an international acid rain conference in Muskoka, Canada in 1985 which confirmed the scientific basis for taking action. The Muskoka Conference had been preceded by a Ministerial Meeting in Ottawa in 1984 at which the 30 per cent reduction scheme had gained support by the so-called "30% Club". At a summit meeting in Quebec City in 1985, President Reagan and Prime Minister Mulroney re-emphasized the need to address acid rain. Thus the stage was firmly set for the start of negotiations of a first-generation protocol in Geneva. The debate for the resulting 1985 Protocol on the Reduction of Sulphur Emissions or their Transboundary Fluxes by at least

30 per cent had shown the inherent weaknesses of a flat-rate reduction scheme which was regarded as scientifically questionable and economically unfair by some Parties to the Convention. Consequently, major emitters such as the United Kingdom, Poland, Spain and the United States did not sign the Protocol. In hindsight it is worth mentioning that non-signatories as well as signatories also met the reduction target of 30 per cent or more. The international situation had made mitigation measures necessary and acceptable to all Parties to the Convention.

While being an ice-breaker for instruments on specified emission reductions, the Sulphur Protocol was far from perfect and negotiators realized early on that it would have to be supplemented by a more science-based agreement in the future. Before that happened, however, the Parties to the Convention initiated negotiations on the other major traditional air pollutant, nitrogen oxides. Science was still not sufficiently well advanced to base the negotiations on sophisticated critical loads calculations although the notion was on the minds of Parties in a qualitative sense. Thus the 1988 Protocol Concerning the Control of Emissions of Nitrogen Oxides or their Transboundary Fluxes contains no optimized reduction schemes for individual countries but a basic freeze of emissions between 1987 and 1994. The instrument contains an important action-oriented provision for starting negotiations no later than six months after entry into force of the Protocol with the aim of reducing national annual emissions of nitrogen oxides on the basis of critical loads. This provision was a breakthrough for more sophisticated second-generation types of agreements which were to follow. Negotiators had realized that not only sulphur but also nitrogen, oxidized to nitric acid in the atmosphere, contribute to acidification. It also caused nitrogen leaching from saturated soils in parts of Europe, leading to eutrophication of waters. Twelve countries demonstrated their disappointment with the low ambition level of the Protocol and, in connection with its adoption, signed an informal declaration of their intention to reduce NOx emissions by 30 per cent between 1985 and 1998.

In addressing nitrogen oxides, Parties to the Convention had widened the scope of their work to include the concern for human health. With the smog problem a driving force and with the observed damage to natural ecosystems from exposure to ozone, they took a further step when negotiating the 1991 Protocol Concerning the Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes. The preparation of this instrument encountered problems related to strong sector interests in some countries, such as those linked to chemicals production facilities, petroleum exploration and refinery installations. Interest groups from industry voiced concern for the further development of their activities and some countries could show that their emissions of VOC were insignificant. Moreover, science on the photochemical ozone creating potential (POCP) of the some 85 compounds addressed was not unambiguous. Much work was therefore devoted to scientific assessments during the negotiations. The political problems that had been predominant in the negotiations of the Sulphur Protocol were now replaced by mainly scientific ones. Commercial considerations also figured prominently in the deliberations. However, a flat-rate approach to emission reductions was the only one possible. The basic obligation of the Protocol is a 30 per cent reduction by all Parties between 1988 and 1999. The instrument introduces flexibility concerning the base year as long as it is between 1984 and 1990. Further flexibility is offered to countries which have substantial emissions in only part of their territory by applying the reduction commitments solely to such specified areas (Tropospheric Ozone Management Areas TOMAs), provided that overall national annual emissions do not increase between 1988 and 1999. Even further flexibility is offered to Parties with very small national annual emissions by only requiring a stand-still approach. In their negotiations for the VOC Protocol, Parties to the Convention showed great flexibility by offering options to individual countries. They also agreed, as reflected in Basic Obligations, that future steps should be based on critical levels for photo-chemical oxidants.

While the NOx and VOC Protocols were being prepared, Parties were able to review progress on the initial Sulphur Protocol. Whereas the implementation of the 30 per cent reduction scheme went very well, it became increasingly obvious that the flat-rate commitments were not sufficient to solve the acid rain problem. At this time late 1980s/early 1990s the critical load concept had been developed and could form a basis for new negotiations. The political East-West divide was no longer a fundamental feature in the work of the Executive Body for the Convention. All Parties concerned had now adopted a more scientific approach to transboundary air pollution but it was still the Nordic countries that were the strongest advocates for further measures on acid rain. Even though maps were prepared on critical sulphur deposition across Europe showing the different sensitivities to acid input between the North and the South, other factors played a role when considering a new Protocol, not least economic realities. The resulting 1994 Protocol on Further Reduction of Sulphur Emissions contains provisions for individual countries to commit themselves to sulphur emission ceilings and percentage reductions between 1980 and 2000 with indicators also for 2005 and 2010, where possible. The range of national reduction commitments goes from 0 per cent to 83 per cent. In line with provisions of the VOC Protocol, very large countries have the option to designate Sulphur Oxides Management Areas (SOMAs) for their reduction commitments.

The workload of the Executive Body for the Convention and its negotiating body, the Working Group on Strategies, had been very heavy during the preparation period of the NOx, VOC and second Sulphur Protocols. The Secretariat resources were stressed accordingly. Nevertheless, negotiators started to address the need for protocols on heavy metals and persistent organic pollutants (POPs), and discussed which of them to target for an instrument. With the usual enthusiasm and determination of the Executive Body, they decided to go for both in parallel which put even more stress on delegations and Secretariat resources. Once again the deliberations turned to the protection of human health and once again the demands on science and technology were considerable. Once again also, industry interests figured prominently in the work. Lead countries played important roles in the collection of data necessary for the negotiators. There was no major conflict between governments as to the need for action on both heavy metals and POPs, only regarding the choice and limitation of numbers of pollutants and time scales for reduction and elimination. For the first time in negotiations trade issues also had to be addressed, in particular regarding POPs. The 1998 Protocol on Heavy Metals and the 1998 Protocol on Persistent Organic Pollutants were both adopted and signed on the same day, a major feat in itself.

The masterpiece of negotiations, the 1999 Protocol to Abate Acidification, Eutrophication and Ground-level Ozone presented major challenges for the Parties to the Convention. That Protocol was to supersede two previous protocols on sulphur, one on NOx and one on VOC. It was to be based on critical loads and levels and was to address multi-effects and multi-pollutants in a cost-effective manner, optimized for the whole region. Thus, it was very demanding on science and required considerable resources. As with the 1994 Sulphur Protocol, it was also prepared on the understanding that programmes under UNFCCC to combat climate change could lead to reduction of emissions of sulphur and other pollutants. The complexity of the interlinked topics for negotiation required significant input from scientists reporting directly to the negotiating body. Besides addressing sulphur, nitrogen oxides and VOC, it also targets, in a pioneering fashion, reduced nitrogen, i.e. ammonia, thereby drawing attention to emissions from agriculture. The demands on policy-makers to understand the consequences of abatement decisions were considerable. Therefore exercises were organized at which negotiators were able to consider and review the outcome of various scenarios based on integrated assessment modelling. Very large countries were given the option of designating Pollutant Emissions Management Areas (PEMAs) for which agreed emission reductions would apply. The close links between scientists and policy-makers were indispensable for progress and the input from the

International Institute for Applied Systems Analysis (IIASA) provided the necessary guidance without which such a complicated instrument would not have been possible. The Protocol was adopted and signed in Gothenburg in 1999. Since then no new protocol has been prepared under the Convention (status 2010).

To complete the account of protocols under CLRTAP, the 1984 Protocol on Long-term Financing of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP) must be mentioned. Already in the early 1970s systematic monitoring programmes had started under the Organisation for Economic Co-operation and Development (OECD). Forerunners to those programmes existed in the 1950s. When the Convention was negotiated in 1978-1979, policy-makers acknowledged the importance of the already existing EMEP for the implementation of the Convention and future envisaged Protocols and the EMEP Protocol was negotiated to secure an equitable scheme for international cost-sharing of necessary monitoring, modelling and evaluation. The cost-sharing system is based on adjusted United Nations assessment rates and provides for mandatory annual contributions to EMEP. As expected, negotiations quickly ran into problems when delegations questioned the very basis for the calculations, e.g. the significance of population numbers and gross national products. The fact that Norway and the USSR hosted technical EMEP centres was also an issue and some countries regarded themselves as peripheral in the EMEP domain and demanded smaller payment obligations. The reluctance of Eastern Bloc countries, having non-convertible currencies, to assume obligations for contributions in USD cash was accommodated by allowing mandatory contributions-in-kind, e.g. through the carrying out and delivery of relevant projects and programmes of use to EMEP. The scale of agreed contributions is contained in an obligatory annex to the Protocol. It has been adjusted several times as more Parties joined the Protocol and in connection with the dissolution of centrally planned economies in Eastern Europe. Canada and the United States are included in the scheme but, being outside the EMEP domain, they provide only voluntary contributions. A United Nations Trust Fund was set up for the purpose.

The basic obligations of all the Protocols and the Convention itself have stood the test of time. No amendments have been necessary for almost 30 years except for those pertaining to technical annexes to the NOx and VOC Protocols.

3.3 Texts of the instrument

Full texts of the Convention on Long-range Transboundary Air Pollution and its eight associated Protocols are contained in Handbook for the 1979 Convention on Long-range Transboundary Air Pollution and its Protocols, United Nations, New York and Geneva, 2004 (ECE/EB.AIR/85) Sales publication No. E.04.II.E.9, ISBN 92 -1-116895 - 3. The handbook also contains ministerial declarations and statements issued in connection with the adoption of protocols as well as important decisions of the Executive Body for the Convention.

Information on CLRTAP can be found on www.unece.org/env/lrtap.

3.4 Implementation (progress and obstacles)

Obligations of the CLRTAP and its eight Protocols span a wide field of commitments agreed on and adopted over a period of 20 years. Major general provisions of one Protocol have usually been repeated successively in subsequent Protocols. Fundamental commitments include provisions on e.g.:

(a) Convention

- general, unspecified protection of the environment against air pollution
- exchange of information, consultations, research and monitoring, development of policies and strategies
- reviews of measures aimed at combating emissions of air pollution
- air quality management
- cooperation on abatement technologies, instrumentation, modelling, effects studies

- assessment of economic, social and environmental effects of alternative measures to combat air pollution
- exchange of meteorological and physico-chemical data related to processes during atmospheric transmission of pollutants and biological data related to effects of long-range transboundary air pollution

(b) 1985 Sulphur Protocol

- items relevant to the Convention (see (a) above)
- reduction of national annual sulphur emissions by at least 30 per cent between 1980 and 1993
- reporting on progress
- calculations of transboundary fluxes

(c) 1988 NOx Protocol

- items relevant to the Convention (see (a) above) and the Sulphur Protocol (see (b) above)
- control of NOx emissions so that national annual emissions in 1994 do not exceed those in 1987
- application of national emission standards to stationary and mobile sources of pollution
- introduction of pollution control measures
- commencement of new negotiations, based on critical loads, no later than six months after entry into force of the Protocol
- exchange of technology
- introduction of unleaded fuel
- review of performance of Protocol
- work plan for further work on, inter alia, technology and critical loads
- model calculation by EMEP

(d) 1991 VOC Protocol

- items relevant to the Convention (see (a) above)
- items from (b) and (c) above, as appropriate
- reduction of national annual emissions of VOC by at least 30 per cent between 1988 and 1999
- application of Best Available Technologies to stationary sources and appropriate techniques for mobile sources

- cooperation on critical levels for photochemical oxidants
- application of economic instruments to achieve cost-effective solutions
- industrial cooperation and joint ventures
- technical assistance

(e) 1994 Sulphur Protocol

- items relevant to the Convention (see (a) above)
- items from (b), (c) and (d) above, as appropriate
- reduction of national annual emissions of sulphur between 1980 and 2000 according to differentiated obligations regarding national ceilings and tonnes of SO_2
- measures to increase energy efficiency
- measures to increase the use of renewable energy
- measures to reduce sulphur content in fuels
- application of emission limit values

(f) 1998 Heavy Metals Protocol

- items relevant to the Convention (see (a) above)
- items from (b), (c), (d) and (e) above, as appropriate
- control of emissions of cadmium, lead and mercury by setting limit values and time scales with 1990 as the base year and target years differentiated in relation to year of entry into force of Protocol
- product control and alternatives
- product management
- recycling and disposal of waste containing one or more heavy metals
- studies of effects on human health
- socio-economic considerations related to alternative control strategies

(g) 1998 POPs Protocol

- items relevant to the Convention (see (a) above)
- items from (b), (c), (d), (e) and in particular (f) above, as appropriate

- elimination of production and use of 16 specified substances, most of them pesticides, and subsequent disposal or destruction, taking into account provisions of the global Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal
- restriction in the use of DDT, HCH and PCB
- application of best available techniques to sources emitting PAHs, dioxins/furans and hexachlorobenzene, having 1990 as base year and target years differentiated in relation to year of entry into force of Protocol
- public awareness
- management programmes

(h) 1999 Protocol to Abate Acidification, Eutrophication and Ground-level Ozone

- items relevant to the Convention (see (a) above)
- items from (b), (c), (d), (e), (f) and (g) above, as appropriate
- reduction of national annual emissions of sulphur, nitrogen oxides, ammonia and VOC between 1990 and 2010 according to differentiated obligations regarding national ceilings and tonnes of pollutants
- technical measures on stationary and mobile sources as well as agriculture

(i) 1984 EMEP Protocol

- mandatory cost-sharing for coordination of monitoring, modelling and evaluation
- recognition of international coordinating and synthesizing centres

The successful development of the Convention and its eight Protocols over a period of 20 years testifies to the progress of this very significant regime. The implementation of all the provisions of the instruments, including stipulated emission reductions, has been carried out with determination in a cooperative spirit based on considerable resource allocations. The Executive Body for the Convention assesses progress annually on the basis of reports by its Implementation Committee. Regarding emission reductions stipulated in Protocols, it can be concluded that major reductions have taken place across the board, the most remarkable being a 60 per cent reduction of sulphur emissions between 1980 and 2000 in Europe (or 65 per cent between 1990 and 2004, which means that the 2010 target for the Gothenburg Protocol (61 per cent) was already achieved six years before the target date). NOx emissions for Europe as a whole decreased by 30 per cent between 1990 and 2004. The Protocol target for 2010 is 39 per cent. Ammonia emissions fell by 22 per cent, the target being 25 per cent and VOC decreased by 38 per cent against the target for 2010 of 45 per cent. Thus it is clear that emissions of all pollutants show a significant downward trend for Europe as a whole since the signing of the Gothenburg Protocol but individual countries may have problems in reaching the agreed goal. Approximately half of the Signatories had already reached the target in 2004 but the obligations are, of course, for every country to reach its target.

The different degree of envisaged compliance among countries can be linked to sectors. Some sectors have reduced their emissions more than others. For SO_2, the largest reductions were reached for large point sources while for NOx and VOC, emissions from the transport sector showed the strongest decline. Ammonia emissions from agriculture decreased only moderately. In contrast, emissions from international shipping increased more rapidly than expected and are estimated to surpass the total emissions from land-based sources of SO_2 and NOx by 2020.

The main conclusions of implementation of the Gothenburg Protocol, taken from a report compiled by the Centre for Integrated Assessment Modelling under the Convention

(Review of the Gothenburg Protocol, CIAM Report 1/2007) are summarized as follows:

1. Emissions of all pollutants have shown a downward trend since the signing of the Gothenburg Protocol.

2. Deposition of acidifying substances in Europe has declined since the 1980s, with positive effects on the chemical composition of soil and lakes. Nitrogen deposition remains a widespread problem for European ecosystems. Despite reductions in precursor emissions, no clear downward trend in ozone indicators for human health and ecosystems can be detected in Europe.

3. Latest scientific findings suggest that current levels of exposure to fine particulate matter in Europe cause significant reductions in life expectancy. Secondary aerosols, formed from precursor emissions of SO_2, NOx, VOC and NH_3 constitute a significant fraction of $PM_{2.5}$ in ambient air.

4. The benefits of current efforts under the Protocol exceed abatement costs. According to new scientific insights, however, efforts under the Protocol lead to less improvement towards the ultimate objectives of the Protocol, in terms of the protection of ecosystems and health, than originally estimated.

5. To reach the ultimate goal of the Protocol - the protection of ecosystems and human health - further measures will be needed.

6. The effectiveness of the Protocol could be further improved by increasing the number of ratifications. There are strong synergies between the environmental objectives of the Protocol (i.e. reducing acidification, eutrophication, ground-level ozone) and a reduction of health impacts from fine particulate matter. Extending the remit of the Protocol to cover particulate matter could increase the cost-effectiveness of pollution control strategies.

7. In addition, the cost-effectiveness of further measures needs to be analyzed in close conjunction with other policy objectives, including those on climate change, energy security, transport and agriculture.

8. In addition to available end-of-pipe emission control measures, non-technical and local measures will be of increasing relevance, especially if multiple policy objectives are pursued. Emissions from international shipping will still offer a large potential for cost-effective abatement measures.

With respect to compliance with the 1998 Protocols on Heavy Metals and POPs respectively, almost all Signatories have met their commitments.

The significant progress on implementation of all protocols, albeit with some individual shortcomings, testifies to the realistic ambitions of negotiating governments. It is also a testimony to the viability of optimized approaches with differentiated obligations and responsibilities. Major obstacles to compliance with the Gothenburg Protocol, when encountered, are linked to not fully foreseen developments in selected sectors such as offshore oil and gas exploration, increase in international shipping and growth of the car fleet. The sometimes slow pace of ratification is also an obstacle to region-wide progress. The Executive Body for the Convention regularly reviews options to assist with advice on all these issues.

4 Vienna Convention on the Protection of the Ozone Layer and the Montreal Protocol on Substances that Deplete the Ozone Layer

The recognition that the stratospheric ozone layer which provides protection against harmful solar radiation was threatened by emissions of manmade substances, led to the negotiation of global multilateral agreements on the control of such substances in the 1980s. The world community responded with determination through the United Nations Environment Programme (UNEP). The result of the policy intervention has been a steady decline of ozone depleting substances since 1994. The scientific community was virtually undivided and to the point in underpinning policy development. This fact is a major contributor to the success of the instruments.

4.1 History

Already in the 1880s stratospheric ozone was recognized as a natural atmospheric constituent. Experiments were carried out which showed that ozone strongly absorbs solar ultraviolet (UV) radiation. In 1913 it was concluded that most of the ozone is located in the upper part of the atmosphere, the stratosphere, 20-40 km above ground. Later, scientists described how the stratospheric ozone layer was being depleted by emissions of certain anthropogenic substances, in particular chlorofluorocarbons (CFCs) and halons (bromochlorodifluoromethane BCF) and that the depletion led to excessive UV-B radiation reaching the Earth, which may cause skin cancer (melanoma) and eye cataracts. The radiation was also found to be implicated in lower productivity of vegetation, loss of immunity to certain diseases and as having adverse effects on some plastics.

CFC, sometimes known under its commercial brand name freon, was invented in 1928 for use in aerosols, refrigeration, air conditioning and manufacturing of foams. Halon has similar applications and is a major component of flame retardants. It was widely used during the Second World War as a fire extinguisher in military operations. The production and consumption of CFCs rose very substantially in the 1950s, 1960s and 1970s. In 1974 three scientists, all to become Nobel Prize Laureates in 1995, Sherwood Rowland, Paul Crutzen and Mario Molina, linked the ongoing ozone depletion to previous emissions of CFCs and in response to those findings UNEP and WMO drew up a Plan of Action on the Ozone Layer and UNEP established a Coordinating Committee on the Ozone Layer. The growing concern for the adverse effects of UV-B radiation was propelled by the findings in 1985 of the Antarctic "Ozone Hole". The successful history of the Vienna Convention and the Montreal Protocol on stratospheric ozone is due to the strong and virtually unanimous scientific backing. The effects of radiation are also rather straightforward, capturing the attention of scientists, the general public, industry and politicians across the board. That encouraging history continues.

4.2 Negotiation process

The scientific findings provided strong incentives for further measurements and for taking action. Thus, in 1985 the global Vienna Convention, a Framework Convention on the Protection of the Ozone Layer, was adopted by initially 21 countries. With foresight, the negotiators included in the provisions of the Convention a mechanism for adding a legally binding protocol on substances that deplete the ozone layer and annexes to further specify future obligations.

Since the Convention does not contain any legally binding commitments for quantitative control of emissions and releases, negotiators started deliberations on a science-based Protocol to address the need for concrete measures. Industry interests figured prominently in these intergovernmental deliberations since the production of CFCs was essential for a range of goods and conveniences. The scientific assessments of cause and effect were, however, overwhelming and the need for replacement of CFCs was understood by all parties concerned. Thus, the phase-out of ozone-depleting substances became the agreed target for negotiations and in 1987 the Montreal Protocol on Substances that Deplete the Ozone Layer was adopted and signed. It was subsequently to be supplemented by a number of specific amendments. These amendments (e.g. London, Copenhagen, Vienna, Montreal and Beijing) added stipulations for accelerated phase-out of CFCs and halons which were generally approved by a large majority of the 188 Parties to the Convention and the Protocol. It truly reflects a global commitment.

4.3 Text of the instruments

The Vienna Convention on the Protection of the Ozone Layer contains general provisions for cooperation on observations, research and information exchange on the effects of human activities on the ozone layer and the effects on human health and the environment of modification of the ozone layer. It also provides for legislative and administrative measures to control, limit, reduce or prevent human activities that may have adverse effects on human health. Other obligations concern cooperation on measures, procedures and standards; international undertakings; scientific and technical development; research and systematic observations; and the establishment of a Conference of the Parties and a Secretariat (in Nairobi). A particularly important provision concerns the notion to adopt subsequent protocols and annexes.

The Montreal Protocol on Substances that Deplete the Ozone Layer specifies control measures in the production and consumption of ozone-depleting substances using, among other things, consumption per capita in individual countries as a parameter. The main substances regulated by the Protocol are: chlorofluorocarbons, halons, carbon tetrachloride, hydrochlorofluorocarbons, hydrobromo-fluorocarbons and methyl bromide. A grace period of 10 years is given to developing countries with small per capita consumption (<0.3 kg/person). Other major issues of the Protocol concern the control of trade and licensing, financial mechanisms, transfer of technology, research and development, public awareness and exchange of information, destruction procedures and exemptions. The main financial mechanism consists of a Multilateral Fund financed by Parties on the basis of the United Nations scale of assessment. The Fund provides resources for agreed incremental costs of Parties so they are able to comply with their obligations. It is led by an Executive Committee which carries out its tasks in cooperation with the World Bank, UNEP, UNDP and UNIDO. The Global Environmental Facility (GEF) has assisted many developing countries and countries with economies in transition to phase out production of CFCs and halons. The Fund is regularly replenished and has up until 2008 received over USD 2 billion.

The full text of the Vienna Convention can be found on www.ozone.unep.org/Publications/VC_Handbook and of the Montreal Protocol on www.ozone.unep.org/Publications/MP_Handbook.

4.4 Implementation (progress and obstacles)

The overall commitments of the Vienna Convention are being implemented in full recognition of their importance. The various obligations of the Montreal Protocol are also well on track towards implementation. The decrease in production and use of CFCs and halons is very significant – 89 percent between 1986 and 2000. This means that millions of cases of skin cancer and eye cataracts have been averted. If the present obligations of the Protocol are fully implemented by all Parties, it is expected that the stratospheric ozone layer will recover by the year 2050. If there had been no Protocol, the UV-B radiation would have doubled in the North and quadrupled in the South in response to the ozone depleting substances being five times higher. That increase would have caused 19 million more cases of non-melanoma cancer, 1.5 million more cases of melanoma cancer and 130 million more cases of eye cataracts.

While these results are very encouraging, there are now signs that the ozone depletion may continue in spite of lower pollution levels. Global warming is thought to be implicated in a process where chemical reactions in the atmosphere take place more easily. Greenhouse gases trap heat in the lower atmosphere while the stratosphere gets colder, forming ice clouds at levels where the protective ozone layer is found, which contributes to further ozone destruction. The relationship between the depletion of the ozone layer and climate change is a very complex one in which traditional air pollution also plays a role. The scientific community is now addressing this challenging issue with priority.

Crucial to progress is the implementation of all amendments to the Montreal Protocol. Many countries have still not ratified all of them. Some developing countries may face difficulties in meeting their obligations to phase out the production and consumption of CFCs, halons and methyl bromide. Another obstacle to progress is the flow of illegal CFCs to industrialized countries as well as to developing countries by the import of obsolete products such as refrigerators. A more efficient control and licensing system may have to be introduced to close this loophole.

A further threat to continued progress is, as mentioned above, the side-effects of global warming and the fact that alternatives to CFCs, such as HFCs in some applications, have global warming potential (controlled under the Kyoto Protocol).

The global disparities regarding control of ozone-depleting substances are illustrated by the fact that the share of total worldwide production of CFCs and halon in developing countries has risen from five per cent to 60-90 per cent over a 15 year period. This matter shows important shortcomings in global cooperation. However the overall conclusion on implementation must be that it is a highly successful regime thanks to, among other things, the recognition of:

- precautionary principle
- sustainable development
- integration of science with policy

- special circumstances of developing countries
- international cooperation to solve transboundary environmental problems
- common but differentiated responsibility among Parties
- flexibility to respond to scientific and technological developments over time

However, the newly discovered inter-linkage to climate change poses a novel challenge to further progress.

5. The United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol

Geological records show that Earth was subject to dramatic climatic change long before man came to inhabit our planet. Changes in solar activity and in the angle of the Earth's axis as well as other geophysical and astronomical events and volcanic activity are seen as reasons for catastrophic climate change, pushing regions of the world from tropical to glacial conditions and back all of them, however, happening over relatively long transition periods. However, in 1896 the Swedish scientist, Svante Arrhenius, awarded the Nobel Prize in Chemistry in 1903, showed that man-made additions to the natural concentrations of carbon dioxide in the atmosphere influence average temperatures on Earth. He even predicted a global increase in temperatures linked to increasing emissions of carbon dioxide as a result of the industrial revolution and associated combustion of fossil fuels in the Western world. With rough and time-consuming methods he calculated envisaged temperature increases and time scales. The impact foreseen was regarded, at best, as scientifically interesting but practically insignificant for the foreseeable future. While correctly describing the basic relationship between carbon dioxide in the atmosphere and temperatures (climate) his suggested time scales were incorrect. It can now be estimated from computer models that the temperature increase Arrhenius thought would take thousands of years to occur may, in fact, take place in less than a couple of centuries and with ever increasing intensity.

5.1 History

By taking action on ozone-depleting substances the world community had demonstrated collective responsibility for having tampered with a global atmospheric system that virtually all living matter on Earth is dependent on. At about the same time an even more obvious global system, our common climate, became the object of attention. Fickle weather, unreliable weather patterns and long-term climate observations started to worry scientists and the general public alike. Politicians woke up to pending threats to nature, human life, structures and economic development. Climate change was put on the agenda, fuelled by a flow of warning signals from the scientific community.

Policy-makers realized that climate change was a very serious issue and that world leaders would need unbiased scientific advice independent of national interests and corporate influence. In 1988 therefore, the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) established the Intergovernmental Panel on Climate Change (IPCC). Over the years IPCC has issued a number of major assessment reports, increasingly substantive and unanimous in their conclusions. The initial caveats and qualifications have successively given way to more confident and categorical statements about the prospects for very significant threats to the Earth's climate[1]. The fourth Assessment Report in 2007 which comprises three parts (The Physical Science Basis; Impacts, Adaptation and Vulnerability; Mitigation of Climate Change) makes any denial of climate change reasons and effects a futile exercise. IPCC has convinced the world at large about facts concerning climate change. The strength of IPCC reports comes from the fact that a large number of internationally respected experts, for the fourth report some 2,500, cooperate in the assessments and stand collectively responsible for the conclusions. The experts are nominated by governments and international organisations and selected for specific tasks according to their field of expertise.

[1]Some scientists claim that the observed climate change is caused by natural phenomena such as variation in solar activity and cosmic radiation. Moreover, the carbon dioxide theory has been challenged by some scholars who claim that the anthropogenic contribution of greenhouse gases is less significant than that derived from natural sources.

IPCC's findings published in its fourth Assessment Report substantiate and confirm impacts of climate change, thereby providing additional arguments for more forceful mitigation programmes, e.g.:

- eleven of the last twelve years rank among the twelve hottest on record
- global sea level rise has accelerated
- mountain glaciers and snow cover have declined in both the northern and southern hemispheres
- more intensive and longer droughts have been observed over wide areas since the 1970s, particularly in the tropics and sub-tropics

In its report, IPCC further concludes that if no action is taken to reduce emissions of GHG, the warming will be twice as much over the next two decades than if heat-trapping gases are stabilized at the levels of the year 2000. In their projections, IPCC states that the full range of temperature increase is 1.1-6.4°C, with a best estimate range of 1.8-4.0°C. This will most likely lead to more intensive tropical cyclones (typhoons and hurricanes) with higher peak wind speeds and heavier precipitation. The likelihood that extreme heat, longer heat waves and heavy precipitation events will become more frequent is more than 90 per cent.

Over the years much reference has been made to the world's longest monitoring record of carbon dioxide in the atmosphere, collected at the Mauna Loa Observatory in Hawaii, United States, which was originally erected in 1958 to study the volcano on site. While the annual average in 1959 was 316 ppm.v (parts per million by volume), it was 377 in 2004, 387 in 2009, and further increasing to around 390 during the first six months of 2010. At the beginning of the observation period, the annual growth was around 1 ppm whereas over the last eight years it has been around 2 ppm per year. It has been suggested that a concentration of around 400 ppm could be a tipping point beyond which climate change cannot be halted. Likewise, it has been suggested that an ensuing increase in global atmospheric temperature of 2°C could have associated dramatic and irreversible consequences.

In 1990, on the basis of findings by IPCC, the United Nations General Assembly decided to start work on a global climate change agreement which was later to become a framework convention. At the 1992 UN Summit in Rio de Janeiro, the United Nations Framework Convention on Climate Change (UNFCCC) was adopted and signed by 154 countries. The Kyoto Protocol was agreed on at the third session of the Conference of the Parties in 1997.

5.2 Negotiation process

From the very beginning of negotiations, the tension between developed and developing countries came to the fore. The developing countries claimed, as was their right, that current concentrations of GHG in the atmosphere were, to a large extent, the result of emissions in developed countries during their industrial and post-industrial development. Any country, they claimed, should have the sovereign right to develop in a similar fashion with ensuing emissions of GHG as a side-effect. At the start of the process doubts were also voiced as to the true relationship between emissions and climate change.

Thus, the UNFCCC became an aspirational agreement the goal of which was to stabilize the amount of GHG in the atmosphere at a level that prevents dangerous manmade climate change. Negotiators agreed that this stabilization must occur in such a way that ecosystems would have the opportunity to adapt naturally. This means that food security must not be compromised and that the potential to create sustainable social and economic development must not be endangered. However, the Convention does not include any firm commitments on emission reductions. As of 2008, 192 countries, including the United States, have ratified the Convention.

Many countries realized early on that firm reduction commitments must be developed worldwide. Thus the Kyoto Protocol was subsequently prepared under the umbrella of UNFCCC and within the framework of its Conference of the

Parties. It has 180 Parties. However, possibly the biggest emitter of all, the United States, has not ratified the Protocol something which has become a contentious issue in present day intergovernmental cooperation.

5.3 Text of the instruments

In its preamble, the UNFCCC concludes that change in the Earth's climate has adverse effects which are of common concern to humankind. That is the very point of departure for taking action. While cautiously phrased, it states that manmade GHG enhance the effects of natural GHG and that the largest share of them originated in developed countries. An obvious perambulatory conclusion is that the global nature of climate change calls for the widest possible cooperation, keeping Principle 21 of the 1972 United Nations Stockholm Declaration in mind. It is also noteworthy that the Convention makes reference to the instruments on ozone-depleting substances which were concluded in 1985 and 1987. Other chapeau paragraphs of the Convention refer to the precautionary principle, sustainable development, national inventories, implementation of mitigation programmes, exchange and transfer of technology, adaptation to climate change and cooperation on science and technology. So-called Annex I Parties (developed countries and others) have specific commitments regarding adoption of policies, measures to limit emissions, protection of sinks, reporting on progress as well as on education, training and public awareness.

The Convention provides for the establishment of a Conference of the Parties (COP) and a secretariat (now located in Bonn, Germany) as well as the setting-up of subsidiary bodies and preparation of subsequent protocols. It also provides for the establishment of a financial mechanism to offer assistance to developing countries. This assistance is channelled through the Global Environment Facility (World Bank) and is supported by proceeds from the Clean Development Mechanism (CDM), a form of joint implementation scheme for developing countries to facilitate adaptation to the adverse effects of climate change. The special Climate Change Fund finances technology transfer and adaptations within sectors such as energy, transport, industry, agriculture, forestry and waste management, It also assists developing countries which have economies largely dependent on income generated from fossil fuel to diversify. An important feature in this scheme is the Least Developed Countries (LDC) Fund.

Contrary to the Convention, the Kyoto Protocol contains firm commitments for industrialized countries, so-called emission targets that constitute the "assigned amounts" for Parties. The major distinction between the Protocol and the Convention is that while the Convention encouraged industrialized countries to stabilize GHG emissions, the Protocol commits them to do so. Annex II Parties (EU and OECD members) have differing reduction obligations which have been adjusted over the years since the entry into force of the Protocol (2005).

The base year for commitments was 1990 but other years were applied by some countries. The EU-15 chose 1990 as the base year for CO_2, CH_4 and N_2O but 12 of the countries chose 1995 for fluorinated gases. The final target year is 2012. Typical obligations for reductions 2008-2012 are:

European Union	-8 per cent
Canada, Japan, Hungary	-6 per cent
Croatia	-5 per cent
Russia, Ukraine, New Zealand	freeze from 1990
Norway	+1 per cent
Iceland	+10 per cent
Australia	+8 per cent

The collective target for developed countries, Parties to the Protocol, is a 5.2 per cent reduction. The United States, not a Party, has indicated its intention to reduce emissions by 7 per cent over the same period. There are no agreed emission reduction goals for developing countries.

In 2007, the Council of the European Union (EU-27) decided that the EU would commit to a 20 per cent cut of GHG between 1990 and 2020.

The Kyoto Protocol contains annexes. Annex A lists the greenhouse gases to be considered:

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Di-nitrogen oxide (N_2O)
- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs)
- Sulphur hexafluoride (SF_6)

The same annex lists all relevant sectors and sources of emissions.

Annex B quantifies emission limitations or reduction commitments (percentage of base year or period).

Full texts of the Convention and the Protocol can be found on www.unfccc.int and in document FCCC/informal/84 (GE.05-62220(E) 200705).

5.4 Implementation (progress and obstacles)

The aspirational provisions of UNFCCC are recognized by all countries of the world and intergovernmental cooperation has developed to facilitate the mitigation of climate change. Progress is certainly being made but at the same time emissions of GHG are not being reduced to the levels necessary to halt the adverse effects of climate change suggested by the scientific community. The commitments of the Kyoto Protocol are perceived as insufficient, being set so low that their implementation can be achieved without much effort. The fact that developing countries have no firm reduction obligations, just as the United States, adds to the perceived weakness of the instrument.

Given the lenient obligations of the Protocol, progress on implementation is being recorded. For instance, the EU-15 is well on track to meeting the target of keeping average emissions between 2008 ad 2012 to at least 8 per cent below base year levels. An interesting observation is that the EU-15 decrease in emissions of 0.8 per cent between 2005 and 2006 is in contrast to an increase of GDP of 2.8 per cent over the period, indicating that the EU continues to succeed in its efforts to decouple emissions from economic growth. However, a major reason for the decrease which is equivalent to 34.9 million metric tons of CO_2 is warmer weather, in itself which affect climate change!

While progress on mitigation of emissions of GHG is usually linked to the commitments of developed countries which have been responsible for the brunt of emissions for more than 150 years of industrial activity, placing a heavier burden on such countries, the principle of "common but differentiated responsibilities" includes all Parties to the Convention. Non-Annex I Parties to the Protocol are of great importance to climate change policy. Economic growth in these countries suggests that by 2016 they will account for more than 50 per cent of global GHG emissions[2].

Obstacles to progress are rife. Besides the fact that the instruments are perceived as being insufficient to reach the desired targets, the Kyoto Protocol contains provisions that have been questioned by many scholars. The international trade in quotas, the so-called flexibility mechanisms, may not lead to substantial emission cuts since countries that overshoot their emission reduction targets can buy emission rights from nations which have excess space for emissions. The inclusion of so-called carbon sinks in the scheme makes

---

[2]Much focus is being placed on China, now probably the biggest emitter of all countries in the world. It must be noted, however, that China produces 5.1 tons of carbon emissions per head, one quarter of the United States, but with a population of 1.3 billion it would equal the planet's entire emissions on its own if it hit U.S. levels. But including per capita emissions in legally binding instruments on climate change is just as utopian as in other similar treaties. However China and other developing countries have a very valid point in drawing attention to emissions per capita. China is presently a world leader in the production of solar power panels, wind turbines and solar water heaters. It is also a leading producer of energy-efficient domestic appliances and rechargeable batteries. Countries which have no reduction commitments in the Kyoto Protocol, such as China and India, are taking major steps towards a world of low carbon dependency. At the same time, emissions in China have surged from 7 per cent of global emissions in 2002 to some 25 per cent in 2008. Meanwhile a new coal-fired power station is put into operation in China each week. Implementation of the ambitions of the UNFCCC and the Kyoto Protocol face enormous challenges to reconcile desired economic development with technological and structural development for environmental protection.

it possible for a country to subtract the amount of gases absorbed by such sinks (e.g. forests) within its borders from its emissions, a method marred with uncertainties. Another possible loophole to progress is the so-called emission banking, i.e. the possibility for a country to carry forward the surplus of one year to another. Yet another loophole is the concept of joint implementation, by which a country investing in climate friendly projects such as reforestation or clean energy facilities elsewhere can claim credits to offset its own emissions.

These creative mechanisms may not give the proper incentives for polluting countries to readily replace fossil fuel installations with renewable energy facilities since some countries can purchase rights to more emissions from other countries. It may, thus, be perceived as an obstacle to global technological development.

Emission reductions from land-use changes are permitted, thus, e.g. land clearing or forestry can be used to meet target commitments but land use emission calculations are characterized by high levels of uncertainty.

Another obstacle to implementation is the lack of enforcement procedures and liability clauses as regards non-compliance with obligations. The Kyoto Protocol does not contain any provision for sanctions which, however, is normal for international treaties of this type. Parties rely on the "blame and shame" factor to facilitate implementation but maybe that is not sufficient in this day and age.

While the Kyoto Protocol is a global legally binding document, it is not perfect. One of its strengths is the fact that it has united the countries of the world at the highest possible level in their concern for the future of the Earth's climate. It has also demonstrated the divide between rich and poor countries. We know that the emissions of GHG are geographically very skewed. We know that people in the developed world produce many times more GHG per person than people in the developing world. The rich world has 20 per cent of the world's population but uses 80 per cent of its resources, at the same time as the poor 80 per cent of the world strive to achieve the same standard of living as the rich world. With economic growth consumption patterns change. A much debated matter is the increasing consumption of meat and dairy products in countries that previously relied on other types of food, mainly vegetarian. It has been suggested that cattle-raising and meat production account for up to one fifth of the releases of reactive GHG. The ongoing shift cannot be envisaged without ballooning GHG emissions. How this has to be accommodated in a world with competing interests and priorities is the overarching challenge to our leaders. A possible solution must lie in novel and integrated approaches to tackling climate change, air pollution, economic development and poverty alleviation in a fair and equitable way, based on sound science and reliable monitoring. The solution must also take into account socio-economic aspects and moral values and responsibilities and may need to address education and training to facilitate behavioural change in society in order to secure a sustainable world.

Negotiators of regional multilateral agreements on air pollution may wish to keep these very demanding and interlinked societal problems in mind when addressing their immediate concerns. Issue integration is a way to gain synergies.

ANNEX I

PRACTICAL WAYS TO CONDUCT MULTILATERAL NEGOTIATIONS ON AIR POLLUTION

Steps for the practical preparation of a consensus agreement:

On the basis of progress made in line with Modules I, II and III (above) this module may be carried out as an interactive seminar with discussions, exercises and practice rounds, including negotiations proper, with the participation of representatives of all participating countries, assisted by the Secretariat, network centres as appropriate, external resource persons and the facilitator.

Study material:

A. 1979 Convention on Long-range Transboundary Air Pollution (CLRTAP).

B. Substance-specific Protocols under CLRTAP

(a) 1985 Protocol on the Reduction of Sulphur Emissions or Their Transboundary Fluxes by at least 30 per cent (first generation flat-rate agreement)

(b) 1999 Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (second generation multi-pollutants and multi-effects agreement with optimized and differentiated obligations)

(c) 1998 Protocol on Heavy Metals (cadmium, lead and mercury)

(d)1998 Protocol on Persistent Organic Pollutants (pesticides, industrial chemicals and by-products)

C. Other agreements, regional or global, as appropriate.

1. Method of Work

The suggestions in this Module are given only as guidance and food for thought. Participants in the training events will themselves develop their mode of operation for preparing and conducting negotiations of a multilateral agreement on air pollution.

In response to their particular circumstances they may wish to put extra emphasis on some items, add new ones and perhaps even ignore others. Thus, the suggestions below should be seen as examples of how to proceed without exclusion of any other options. It is important that all participating countries voice their opinions on all items tabled and that the Chairperson can gain support from delegations for consensual compromises when necessary. The secretariat, invited experts and a possible facilitator will provide guidance and advice during the process but the final decisions lie wholly with the government representatives authorised to negotiate on behalf of their governments.

To fulfil the expected aspirations of governments a number of steps to be taken and provisions to be addressed are indicated:

1.1 Definition of the merits of different scope, approach, relevance and purpose of available agreements, taking into account specific environmental, health-related, economic, geographic, political, legal and social circumstances in participating countries

1.2 Assessment of strengths and weaknesses of available instruments

1.3 Discussion and agreement on most relevant issues for participating countries and the sub-region as a whole and seeking consensus accordingly

1.4 Discussion and agreement on main provisions of an instrument (pollutants, emission control or reductions, product control, base and target year, policies and strategies, reporting, cooperation, exemptions and derogations, etc)

1.5 Discussion and agreement on most appropriate structure of instrument

1.6 Possible obstacles and constraints to making progress in all countries

1.7 National and intergovernmental concerns, including transboundary issues

1.8 Formulation and agreement on a timetable for ultimately reaching the goal and definition of the necessary steps towards reaching it

1.9 Definition of possible need for external assistance in the process

1.10 Discussion and assessment of each segment of tabled texts

- 1.10.1 Preamble
- 1.10.2 Definitions
- 1.10.3 Operative clauses
  - 1.10.3.1 Basic Obligations
  - 1.10.3.2 Other Articles
- 1.10.4 Technical Annexes
- 1.10.5 Additional provisions
- 1.10.6 Possible associated resolutions and declarations

2. Preparation of a draft text adapted to the specific needs of participating countries with as few square brackets [i.e. unresolved issues] as possible practical considerations

Suggestions for work elements and considerations for the preparation of a draft agreement.

2.1 Start with general considerations of the scope, preamble, definitions, basic and other obligations.

2.2 Seek as large a consensus as possible at each negotiation round.

2.3 Do not open up issues closed on previous occasions.

2.4 Set up small drafting groups (including advocates of opposing views) to solve separate issues to be reported to plenary.

2.5 Conduct introductory plenary discussions of the preamble, definitions, administrative provisions in agreement, recommendatory and obligatory annexes, possible associated resolutions and declarations, amendment procedures but establish small drafting groups to prepare tentative texts for reporting to plenary.

2.6 Use the resources and competence of the secretariat to assist with drafting.

2.7 Adhere to strict time limits (certain drafting groups should be given only 1-3 hours to prepare texts for further consideration).

2.8 Avoid getting bogged down in "impossible" disagreements.

2.9 Leave square bracketed texts for later consideration.

2.10 Do not be confrontational but accommodating and assisting.

2.11 Look for creative formulations but do not leave too much room for different interpretations of crucial provisions.

2.12 Act so that the general public, the international community, media and concerned NGOs will not blame you for failures, i.e. avoid what can be understood as shortcomings.

2.13 Review possible financial mechanisms to facilitate conclusions of agreement, ratification, implementation of provisions and reporting.

2.14 Allow accommodating but decisive chairmanship.

2.15 Use formal as well as informal methods.

2.16 Work together in a flexible, patient way and in a cooperative spirit.

2.17 Take advantage of the secretariat services for assisting with drafting and legal matters.

2.18 Take advantage of experts and facilitator for addressing particular problems.

3. Seek timely concurrence in your governments for draft provisions and other arrangements provisionally agreed

4. Conclude a sub-regional multilateral agreement on air pollution and possible associated resolutions

5. Pending required ratifications and entry into force of the agreement, be resolved to cooperate in the spirit of the provisions of the instrument

ANNEX II

REFERENCES

References

Bäckstrand, K. 2001. What Can Nature Withstand? Science, Politics and Discourses in Transboundary Air Pollution Diplomacy. Lund University, Sweden. ISBN 91-88306-35-6.

Castells, N. 1999. International Environmental Agreements. Institutional Innovation in European Transboundary Air Pollution Policies. European Commission Joint Research Centre, Ispra, Italy. Publication S.PI.99.182.

Cohen, A. J., Anderson, H. R., Ostro, B., Pandey, K., Krzyzanowski, M., Künzli, N., Gutschmidt, K., Pope, C. A., Romieu, I., Samet, J. M. and Smith, K. R. (2004). Mortality impacts of urban air pollution. In Comparative quantification of health risks: global and regional burden of disease attributable to selected major risk factor Vol. 2, Chapter 17. World Health Organization, Geneva.

Elvingson, P. and Ågren, C. 2004. Air and the Environment. The Swedish NGO Secretariat on Acid Rain. ISBN 91-973691-7-9.

Levy, M. A. 1993. European Acid Rain: The Power of Tote-Board Diplomacy, in Haas, Keohane and Levy (eds.). Institutions for the Earth: Sources of Effective International Environmental Protection. Cambridge. MIT Press.

Odén, S. 1968. The Acidification of Air and Precipitation and its Consequences in the Natural Environment. Ecology Committee Bulletin No. 1, Stockholm. Swedish Natural Science Research Council.

Regional/Sub-regional Environmental Cooperation in Asia. 2001. Institute for Global Environmental Strategies (IGES). Kanagawa, Japan.

Selin, H. 2000. Towards International Chemical Safety. Linköping University, Sweden. ISBN 91-7219-727-7.

Sliggers, J. and Kakebeeke, W. (eds.). 2004. Clearing the Air. United Nations Publication. New York and Geneva. ISBN 92-1-116910-0.

Stockholm Thirty Years On. Progress Achieved and Challenges Ahead in International Environmental Cooperation. 2002. Ministry of the Environment, Sweden. ISBN 91-631-2847-0.

Victor, D. G., Raustiala, K. and Skolnikoff, E. B. (eds.). 1998. The Implementation and Effectiveness of International Environmental Commitments: Theory and Practice. Cambridge. MIT Press.

Wahid, A., Maggs, R., Shamsi, S. R. A., Bell, J. N. B. and Ashmore, M. R. 1995. Air Pollution and its Impacts on Wheat Yield in the Pakistan Punjab. Environmental Pollution. 88 (2): 47-154.

Wettestad, J. 2002. Clearing the Air. European Advances in Tackling Acid Rain and Atmospheric Pollution. Ashgate Publ. ISBN 0-7546-0959-6.

www.unep.org

United Nations Environment Programme
P.O. Box 30552 - 00100 Nairobi, Kenya
Tel.: +254 20 762 1234
Fax: +254 20 762 3927
e-mail: uneppub@unep.org
www.unep.org

UNEP