[ANNEX]

[DRAFT]

Review of the Main Activities on Transboundary Air Pollution in North-East Asia

Submitted to the SOM 17

NEASPEC SECRETARIAT

NOVEMBER 2012

Table of Contents

List of Tables

List of Figures

1 Review of Existing Mechanisms

Substantial scientific and technical capacities in various aspects of transboundary air pollution monitoring and assessment exist in countries of North-East Asian subregion. Facing the dire challenges posed by transboundary air pollution arising from climatic conditions as well as industrial and economic activities, the North-East Asian subregion countries began to actively seek internationally collaborative measures starting in the 1990s. In this Review, seven major mechanisms are introduced.

1.1 Acid Deposition Monitoring Network in East Asia (EANET)

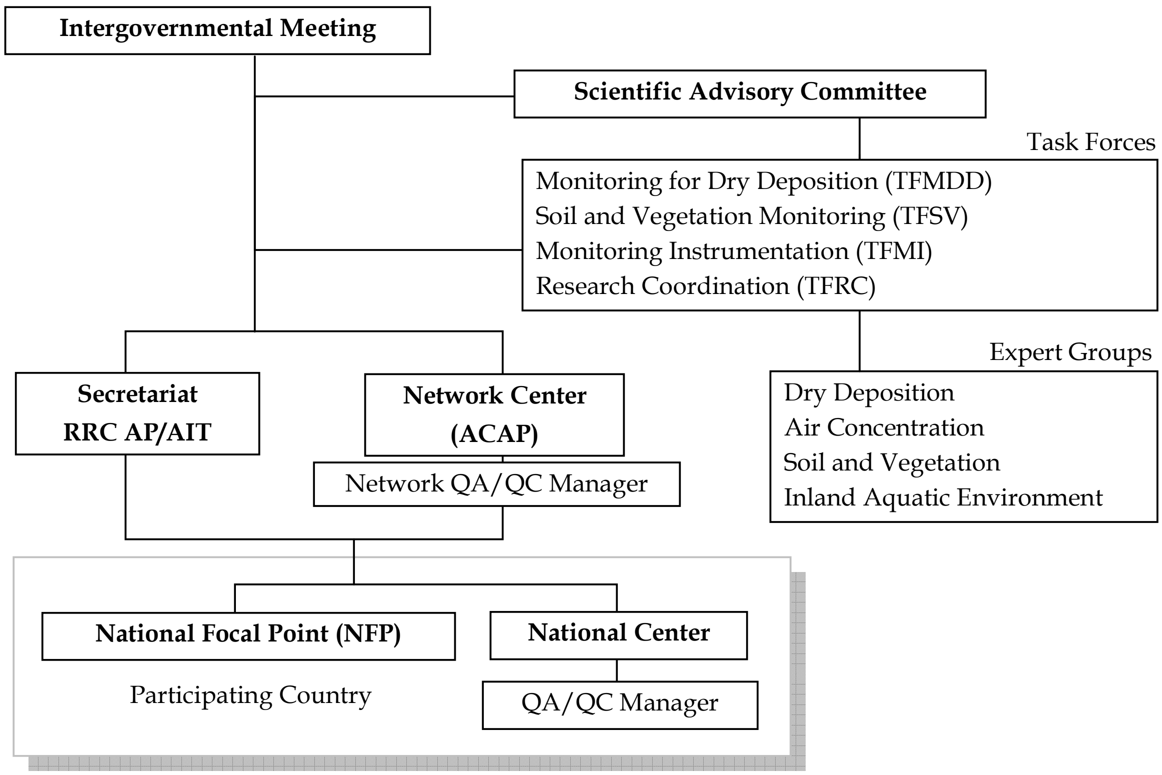
1.1.1 Background

The necessity for establishing a regional monitoring network with standardized monitoring methods and analytical techniques regarding the state of acid deposition in the region was recognized via the Acid Deposition Monitoring Network in East Asia (EANET). Between 1993 and 1997, Japan coordinated four expert meetings to discuss the effects on ecosystems and future steps toward regional cooperation in this issue. The First Session of the Intergovernmental Meeting (IG1) of the EANET was held in March 1998 in Japan to discuss the fundamental characteristics of the proposed network such as objectives, activities, and schedule for establishment, institutional and financial matters. It developed the Tentative Design of the EANET and decided to start the preparatory phase activities of EANET on an interim basis from April 1998. The preparatory phase was from 1998 to 2000 and in this phase preparatory activities were carried out including establishment of monitoring stations and collection of data. The EANET then finally came into existence in 2001 in accordance with the Joint Announcement (JA) on the Implementation of EANET and Tentative Design (TD) of EANET as the regular phase activities of the EANET.

As of November 2012, the Secretariat role is assumed by the United Nations Environmental Programme Regional Resource Centre for Asia and the Pacific (RRC.AP) at Asian Institute of Technology (AIT) – A UNEP Collaborating Centre in Thailand, with the Network Center located in Japan under the name Asia Center for Air Pollution Research (ACAP, formerly ADORC – Acid Deposition and Oxidant Research Center). There are 13 participating countries (Cambodia, China, Indonesia, Japan, Lao PDR, Malaysia, Mongolia, Myanmar, Philippines, Republic of Korea, the Russian Federation, Thailand and Vietnam), brought together under the organizational framework shown in [Figure 1].

The objectives of EANET are to create a common understanding of the state of acid deposition problems in East Asia; to provide useful inputs for decision-making at local, national and regional levels aimed at preventing or reducing adverse impacts on the environment caused by acid deposition; and to contribute to cooperation on the issues related to acid deposition among the participating countries.

[Figure 1] Organizational Framework of the EANET



1.1.2 Achievements

In 2012, in the 13 participating countries of the EATNET, there are 54 deposition monitoring sites (23 urban, 14 rural, and 17 remote sites) in East Asian region. Taking account of harmonization of monitoring methods, and obtaining accurate and precise monitoring data, Guidelines, Technical Manuals, and the Quality Assurance and Quality Control (QA/QC) Programs of the EANET related to acid deposition monitoring have been developed, and Inter-laboratory Comparison Projects have been annually implemented. Furthermore, in order to strengthen technical capacity, various capacity building activities have been implemented such as individual training courses along with technical missions for the participating countries. In order to accumulate scientific findings and share the information among the participating countries, the EANET Science Bulletin (Vol. 1 and Vol. 2) were also published in 2008 and 2011 respectively. Based on the accumulated EANET data from 2000 to 2009 and other scientific findings, the First and the Second Periodic Reports on the State of Acid Deposition in East Asia (PRSAD1/2) were published in 2007 and 2012 respectively. Joint Projects on Public Awareness have been also implemented, and e-Learning programs have been developed to be accessible from the EANET website. In reaching out to policy makers, the Report for Policy Makers on Acid Deposition Monitoring Network in East Asia have been produced in 2005 and 2009. The list of Sessions of the EANET that have/had taken place is as follows:

- Sessions of the Intergovernmental Meeting (IG)
- Sessions of the Working Groups on Future Development of the EANET (WGFD)
- Sessions of the Scientific Advisory Committee (SAC)
- Senior Technical Managers' Meetings (STM)
- Meetings of the Task Forces and Expert Groups (TFs/EGs)

For development of the Periodic Report on the State of Acid Deposition in East Asia (PRSAD):
- Scientific Workshops on Evaluation of the State of Acid Deposition in East Asia
- Regional Scientific Workshops on Acid Deposition in East Asia
- Drafting Committee for the PRSAD

For Public Awareness:
- Workshops on Public Awareness for Acid Deposition Problems

For Further Financial arrangement (in 2002-2003):
- Sessions of the Working Group on Further Financial Arrangement

During the Preparatory-phase (in 1998-2000):
- Working Group Meetings
- Interim Scientific Advisory Group (ISAG) Meetings

1.1.3 Current Scope of Activities and Projects

From the commencement of regular phase activities in 2001, the scope of activities of the EANET was determined in the *Tentative Design of EANET (EANET/IG 2/5/3)*. At the Twelfth Session of the Intergovernmental Meeting (IG12) on the EANET held in November 2010 in Niigata, Japan, the "Instrument for Strengthening the Acid Deposition Monitoring Network in East Asia (EANET)" was adopted and the Instrument has been operational since 1st January 2012 in accordance with the *Decision of the IG12 (Decision 1/IG.12)*, which was signed by the representatives of the participating countries. The activities are stipulated from Item 4 to Item 9 of the Instrument. The core activities include monitoring and associated activities such as quality assurance and quality control (QA/QC) activities and capacity building activities. As was confirmed during the negotiation of the Instrument and as is reflected in the Strategy on EANET Development (2006-2010) and the Medium Term Plan for EANET (2011-2015), the development of emission inventory and the improvement of and calculation with simulation models are included as one of the EANET's research and capacity building activities. For monitoring, the participating countries made efforts to assure the data quality, through the development of Standard Operating Procedures (SOP) and so on. Technical manuals and guidelines have been commonly used by the participating countries. The QA/QC activities including inter-laboratory comparison projects have been also implemented by the Network Center and the participating countries.

The targeted substances of monitoring activities under the EANET include not only acidifying substances but also related chemical species such as ozone and PM. Currently, Japan, Republic of Korea, Russia and Thailand report on ozone and China, Japan, Republic of Korea, and Thailand report on PM, respectively to the Network Center, while monitoring data of other acidifying substances have been reported by all participating countries.

Financial basis of the EANET activities is supported by voluntary contributions of the participating countries. The Instrument, which was adopted after the negotiation for five years, provides stronger basis of such financial contributions through obtaining the signature of high-level officials of each government. At the High Level Segment during the Twelfth Session of the IG12, seven countries among 13 countries signed the Instrument, and additional five countries made the signature after the session as of November 2012. Although one country (Indonesia) has not signed the Instrument yet, the Instrument has been operational since 1st January 2012 in accordance with the Decision by the IG12 (Decision 1/IG.12).

1.1.4 Future Plan

Medium Term Plan (MTP) for the EANET (2011-2015)

At the IG12 in 2010, the EANET participating countries adopted the "Medium Term Plan (MTP) for the EANET (2011-2015)", which describes the strategic direction and objectives of the EANET, activities and their expected outputs, the time table and estimated costs for its implementation. In this plan, 22 activities to achieve the objectives are presented with their set targets, expected outputs and implementation periods. The activities consist of core activities which are indispensable for promoting the network activities and additional activities for strengthening the network by providing technical assistance to the participating countries and by promoting further research activities. Together with the core activities of the EANET, the following activities are scheduled to be implemented during the period until 2015:

- Promotion of capacity building for personnel of the participating countries including training courses, capacity building workshops, fellowships, etc.;
- Promotion of technical support to participating countries by provision of advice, technical information and equipment to countries;
- Promotion of research studies particularly on the applicability of various methodologies for measurement of air concentrations in East Asia;
- Promotion of studies on the effects of acid deposition and other priority chemical species on the ecosystem, human health and socio-economics;
- Promotion of studies on models to assess and analyze the trend of national and regional acid deposition and other related air pollutants in East Asia by evaluation of existing models and providing a suitable one, and promotion of atmospheric simulation model through workshops, training courses, etc.;
- Promotion of emission inventories through workshops, training course, pilot studies, preparation of reference materials, etc.;
- Promotion of public awareness on acid deposition and other priority chemical species to various levels of the community including policy makers, scientists, youth, school children and others;
- Promotion of public awareness to multi-layer stakeholders through the joint project for supporting the environmental education activities on acid deposition; and

- Sharing a common understanding on atmospheric environment issues among the scientific community and policy makers through a network of experts.

Second Periodic Report Recommendations on the State of Acid Deposition in East Asia
At the Thirteenth Session of the IG in 2011, the Second Periodic Report on the State of Acid Deposition in East Asia (PRSAD2) was endorsed. The report contained the evaluation of monitoring data of the EANET for the period from 2005-2009, with general and technical recommendations for further development of the EANET activities. The participating countries agreed to further discuss these recommendations at the future Sessions of the WGFD and the SAC. The recommendations presented in the PRSAD2 include, *inter alia*:

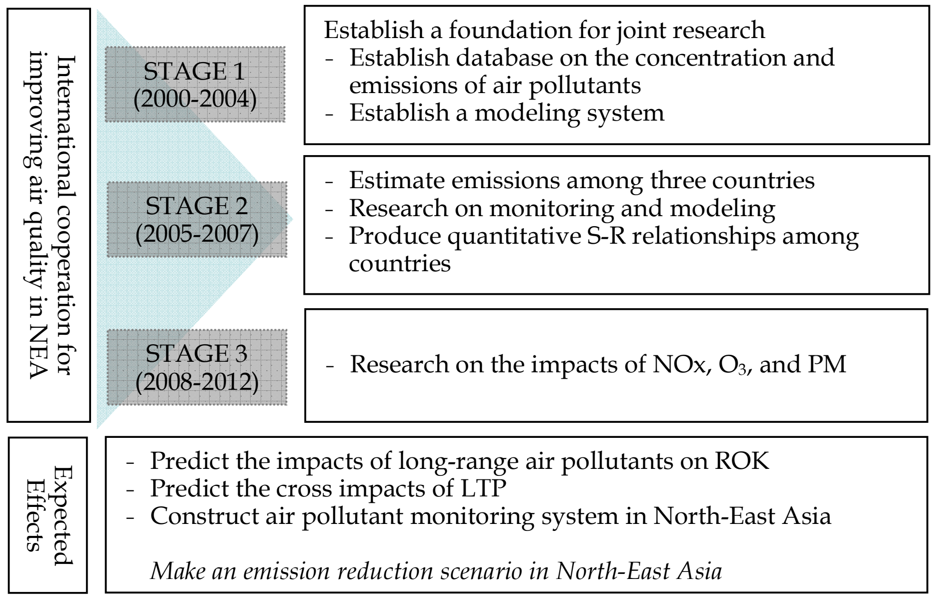
- Extended assessment of the state of acid deposition, including consideration of other relevant atmospheric pollutants and climate change;
- Improvement of acid deposition monitoring, including consideration of other relevant components such as ozone and particulate matter (PM), with increased transparency;
- Promotion of research activities, including modeling and emission inventories;
- Establishment of an epistemic community and promotion of public awareness to achieve a common understanding on atmospheric pollution;
- Enhancement of the policy relevance of activities relating to the provision of policy advice and information based on sound science and assessment; and
- Enhancement of collaboration with organizations outside the region.

Review of current status of air pollution in East Asia and Discussion on expansion of scope of EANET
Review of the present status of air pollution in East Asia, which was decided at the Eleventh Session of the SAC (SAC11) in 2011, will be planned by the Task Force on Research Coordination (TFRC) established under the SAC, from 2012 through 2014. Meanwhile, the actual review will be conducted by an informal Reviewing Committee under the TFRC. The discussion on the membership and detailed schedule is now in progress. At the Sessions of the WGFD in August, the SAC (SAC2012) and the IG in November 2012 (IG2012), the issues on the expansion of the EANET's scope were discussed, together with the consideration on how the above-mentioned review could be used in this context.

1.2 Joint Research Project on Long-range Transboundary Air Pollutants in North-East Asia (LTP)

LTP project is a joint research project in the North-East Asia with 17 years of history. LTP project conducted the survey for long-range transboundary air pollutants and became an international cooperative tool for environmental protection over the North-East Asian region aimed at providing scientific information for developing emission reduction scenarios. In 1995, China, Japan and Republic of Korea reached a consensus that joint efforts should be made to improve air quality in North-East Asia, and they have been conducting international joint research since 2000. During the first (2000-2004) and second (2005-2007) stage, research on air pollutants – sulfur in particular – was conducted via monitoring and modeling. The target pollutants were expanded to other acid compounds during the third (2008-2012) stage. The three stages of the research plan are shown in [Figure 2].

[Figure 2] Stages for LTP project research plan



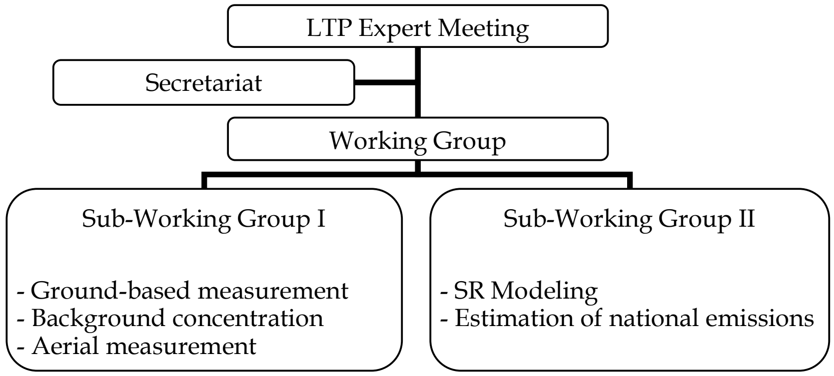
1.2.1 Structure of LTP Project

The terms of reference of joint research included the establishment and operation of the working group, sub-working group, and the secretariat. The working group coordinates collaboration on LTP related research and provides scientific support and suggestion for LTP reduction. The sub-working groups have been established with discussion on specific joint research proposals. Finally, the Secretariat prepares and facilitates the meetings of the working group [Figure 3].

The basic principles of the working group are as follows:

- Strengthen cooperation in LTP research among experts including government officers and research institutions from three countries;
- Establish cooperation networks among the environmental research institution and among experts from three countries;
- Promote standardization on method of field operations for air pollution over the North-East Asia;
- Exchange research information of each country; and
- Increase cooperation with other environmental research networks over North-East Asia.

[Figure 3] Organization of LTP Project



1.2.2 Major Achievements of LTP Project

The Joint Research Proposal, which outlines the scope of activities, is the highest level document of LTP project. The Proposal follows no format of a legally binding instrument and instead deals extensively with research plans. Any pollutant that can be transported on long-range, for example heavy metals and POPs, could be designated as target substance. Such flexibility gives room for expansion in the scope of the project for the future. The initial 6-years research plan was expanded to a 14-year plan, which is divided into 3-stages of basic environmental information exchange, emission evaluation and monitoring, and finally reduction scenario preparation.

Two main methods of research consist of monitoring and modeling. The aim of monitoring is to operate joint monitoring stations in North-East Asia as well as to process and analyze the collected data. The observation data from ground monitoring and aircraft measurement during intensive periods is utilized to estimate the flux. Each participating country has set up two monitoring sites and has produced monitoring data for comparison and analysis as specified in the Terms of Reference for Joint Research on LTP. The monitoring sites of each country include - Dalian and Xiamen in China, Oki and Rishiri in Japan, and Kangwha and Kosan in Republic of Korea. Quality Assurance and Quality Control (QA/QC) programs are undertaken following the guidelines of China National Environmental Monitoring Center, Ministry of Environment of Japan, and Ministry of Environment. QA/QC programs include comparing empirical results with calculated values and instrument calibrations.

The objective in modeling is for conducting an impact assessment of air pollutants in the North-East Asia and is performed by analyzing the emission-scenarios for air quality improvement. The main tool was developed by the three countries via their own numerical model. Simulation works follow the *Work Plan in Modeling Field for the 3rd Year or the 3rd State*, which was adopted in the 13th Expert Meeting in 2010. Source-receptor (S-R) relationships are also analyzed by 5 divided target areas: Northern, Central, and Southern China, Republic of Korea, and Japan. In the modeling endeavors, an important issue is the source-receptor (S-R) relationship calculation. Identifying S-R relationship is an intriguing issue for research and policymakers. In the joint project of LTP, three models created by each of the three countries are used to calculate S-R relationship for sulfur and nitrogen. S-R results for sulfur are similar among the three models. However, the final result of full year simulation still needs one or two years to become available.

1.3 Tripartite Environment Ministers Meeting (TEMM)

1.3.1 Background

TEMM is a tripartite cooperation programme of China, Japan and the Republic of Korea, consisting of a Minister's meeting, three environmental research institutes and a DSS organization. At the first TEMM in 1999, the three ministers exchanged views on the current environmental conditions as well as the concerns of each country and of the subregion. The objective was defined as promoting research cooperation among the three countries to identify and form common understandings on the mechanism of ozone pollution, with the aim to mitigate transboundary photochemical oxidant pollution in North-East Asia. The activity of TEMM has included annual workshop and cooperative research activities.

Since 1999, the three countries held TEMM on a rotational basis with the order of China, Japan and Republic of Korea. A Joint Communiqué is issued after each TEMM summarizing the main consensus among three Ministers. At the Eleventh TEMM, the three ministers shared their views on the progress of tripartite cooperation during the past decade since the First TEMM meeting. They called the three countries to advance green cooperation and promote sustainable economic growth/green growth in North-East Asia. Moreover, the three countries approved 10 areas as new priority cooperation areas in the coming 5 years. At Twelfth TEMM in 2010, *Tripartite Joint Action Plan on Environmental Cooperation* was adopted, which states the goals and joint actions among the three countries in 10 priority areas.

1.3.2 Projects/Activities under TEMM

A number of activities have been launched under TEMM. These include training programs, regular networking conventions, seminars, and workshops that pull together government officials, researchers, and private business experts. One of the first programs launched was the Tripartite Environmental Education Network (TEEN) program, which began in 2000 in order to raise the consciousness of environmental community. TEEN gathers participants including environmental education experts, teachers, and NGO representatives to discuss and exchange views on environmental education initiatives. A Tripartite Roundtable Meeting is held specifically on Environmental Industry, with the aim of discuss and collaborate on the issues of green purchasing, eco-labeling, environmental management, and exchange of environmental industrial technology. Similarly, the Tripartite circular economy/3R/cycle society Seminar is held to share the current status of waste management, while Tripartite Seminar on Green Economy and the Tripartite Policy Dialogue on Chemicals Management are regularly organized. With respect to specific research cooperation efforts, workshop and joint research projects are undertaken for Photochemical Oxidants, Long-Range Transboundary Air Pollutants, E-wastes, and Freshwater Lakes Pollution.

E-waste workshop

In order to implement the consensus achieved during TEMM and to promote tripartite exchange, communication and cooperation on trans-boundary movement of e-waste and e-waste management, Ministry of Environmental Protection of China organized *China-Japan-Republic of Korea Workshop on Control of E-waste Trans-boundary Movement* and *Tripartite Workshop on E-waste Management* in Beijing on 29-30 June 2007 and 26 November 2008 respectively. During these two workshops, the three countries shared policies and regulations on environmental management of e-waste export and import and experiences on supervision and management of e-waste disposal enterprises, extended producer responsibility of electronics enterprises, and trans-regional movement of e-waste.

Freshwater (Lakes) Pollution Prevention Project

The National Institute for Environmental Studies (NIES) of Japan, the Chinese Research Academy of Environmental Sciences (CRAES) and the National Institute of Environmental Research (NIER) of Republic of Korea are playing pivotal roles in this project that aims to promote research and technology development as well as the formulation of programs to research and draft common policies for freshwater pollution prevention. Past specific activities include: a joint study on freshwater (lakes) pollution prevention at Xi Hu (West Lake) and others in Hangzhou, China; a training program on lake management techniques supported by the Japan International Cooperation Agency (JICA), the Korean International Cooperation Agency (KOICA) and others; preparation of official guidelines (in English) of China, Japan, and Republic of Korea for the control measures of eutrophication. In addition, international symposia are held every year.

1.4 Tripartite Presidents Meeting (TPM)

1.4.1 Background

The Tripartite Presidents Meeting (TPM) is formed by the Chinese Research Academy of Environmental Sciences (CRAES), Japan's National Institute of Environmental Studies (NIES), and ROK's National Institute for Environmental Research (NIER). In 2004, the First Tripartite Presidents Meeting was held in Beijing; since then, TPM has been held on a rotational basis among the three countries. In order to address the emerging environmental issues in North-East Asia, the Presidents from the three national environmental research institutes share research progress and experiences of their institutes. Environmental management and decision-making based on research outcomes are also important topics discussed. A parallel workshop to the Meeting also provides a forum for the three institutes' scientists to exchange research information on a designated topic.

1.4.2 Activities and Priorities

Under the TPM mechanism, eight cooperative priorities were identified: fresh water, air pollution including vehicle pollution and transboundary air pollution, dust and sandstorm, hazardous substances pollution, such as EDS and POPs, biodiversity conservation, climate change and solid waste management. Since its first meeting, TPM has been highly recognized by TEMM (see Section 1.3) and has played an important role in the region's environmental management and improvement.

1.5 Model Inter-comparison Study in Asia (MICS-Asia)

The broad objective of the MICS-Asia is to have a common understanding of model performance and uncertainties in Asia. Numerical models have recently become common tools for air quality studies. However, there are inevitable uncertainties in the results of numerical models associated with emission inventories, boundary conditions, meteorological data, physical and chemical processes in the model. Furthermore, even though the same community model (such as CMAQ and WRF-Chem) and input data are used, large variability often appears in the simulated results if the settings of parameters and selections of modules are different. In this context, model inter-comparison studies have been very effective to overcome these challenges. This study can yield information to improve the model's reproducibility and thereby help understand the cause of uncertainties. In addition, it will contribute to establishing a community of researchers in modeling and emission inventories, which is essential for the study of air quality in East Asia. With this background and objectives, Model Inter-comparison Study in Asia (MICS-Asia) was started in 1998.

1.5.1 Achievements

MICS-Asia commenced its activities under Phase I in 1998, Phase II in 2001, and Phase III in 2010. During Phase I from 1998 to 2000, MICS-Asia was carried out with focus on long-range transport and deposition of sulfur, coordinated by Central Research Institute of Electric Power Industry (CRIEPI). The Phase II from 2001 to 2009 was financially supported by the Acid Deposition and Oxidant Research Center (ADORC), which is now known as Asia Center for Air Pollution Research (ACAP). The targets were expanded in the Phase II to cover nitrogen compounds, ozone and aerosols as well. The findings in the MICS-Asia Phase II activity were published in the special issues of Atmospheric Environment in May, 2008. In Phase III, the Secretariat brought together the Asia Center for Air Pollution Research (ACAP) in Japan and Institute of Atmospheric Physics (IAP), Chinese Academy of Science, China. The list of participating members included experts on voluntary bases from countries of Asia (Japan, China, Republic of Korea, Thailand, Malaysia, Vietnam, etc.) and Europe, and in addition the US and Canada.

1.5.2 Scope of Current Activities and Future Plans

The current objectives in Phase III are to evaluate the strengths and weaknesses of current multi-scale air quality models; to provide techniques for reducing uncertainty; to develop a reliable anthropogenic emission inventories in Asia; to understand uncertainty of bottom-up emission inventories in Asia; and to provide multi-model estimates of radiative forcing and other inputs. From 2010, the *International Workshop on Atmospheric Modeling Research in East Asia* has been held annually in China to solicit experts on modeling in East Asia. In February

2011, the Joint International Center on Air Quality Modeling Studies (JICAM) was launched. JICAM is a non-profit joint organization that aims to serve as an internationally acknowledged atmospheric research and training center with emphasis on air quality modeling studies over Asia. JICAM will implement research activities to integrate EANET observations, field campaign, and remote sensing products with air quality modeling studies including ozone, fine particles, dust, and acid deposition. JICAM also organizes MICS-Asia since September 2011 Third International Workshop on Atmospheric Modeling Research in East Asia. At the Third International Workshop, three themes were discussed:

- Theme 1: Multi-scale model inter-comparison
  - Assess models to reproduce pollutants;
  - Isolate the impact from uncertainties of each process;
  - Investigate the air quality responses to specific emissions perturbations and assessments to future projections; and
  - Identify the source-receptor relationships and their uncertainties.
- Theme 2: Inter-comparison of emission inventory
  - Develop anthropogenic and natural emissions datasets for inter-comparison study; and
  - Provide modeling emission inventories to air quality modelers.
- Theme 3: Interaction between air quality and climate change
  - Provide multi-model estimates of SLCF (Short-Lived Climate Forcers) estimates and distributions for depositions in base case and scenarios;
  - Provide multi-model estimates of radiative forcing and regional responses for base case and selected emission scenarios; and
  - Provide analysis of the sensitivity of estimates to key processes/inputs.

The outcome of MICS-Asia can provide important information for policy analysis that aims at devising long-term strategies for air pollution controls at local, national and regional levels in East Asia. Therefore, it is essential to increase model's reproducibility of observational data by improving input data (i.e. emission inventories and boundary conditions), parameters and modules in the atmospheric chemistry model. For this purpose, monitoring data of EANET will be used for model validation in the inter-comparison study. This is even more important since many government monitoring data are hardly used by the scientific community. Thus, the collaboration with MICS-Asia and EANET is required in order to maintain significance in Phase III. The emission datasets from updated REAS (regional emission inventory in Asia) for model inter-comparison study will be provided by the ACAP. Currently in Phase III, the numbers of participants and presentations have been increasing and the research themes and approaches have been diversifying. The research on chemical transport models has become more active in East Asia.

1.6 Convention on Long-range Transboundary Air Pollution (CLRTAP)

The Convention on Long-range Transboundary Air Pollution (CLRTAP) was signed in Europe in 1979. The overall idea of the Convention was creation of new institutional framework for integration of science and environmental policy. Since its inception, the Convention has enlarged its scope of action due to territorial growth of the European Union.

1.6.1 Protocols

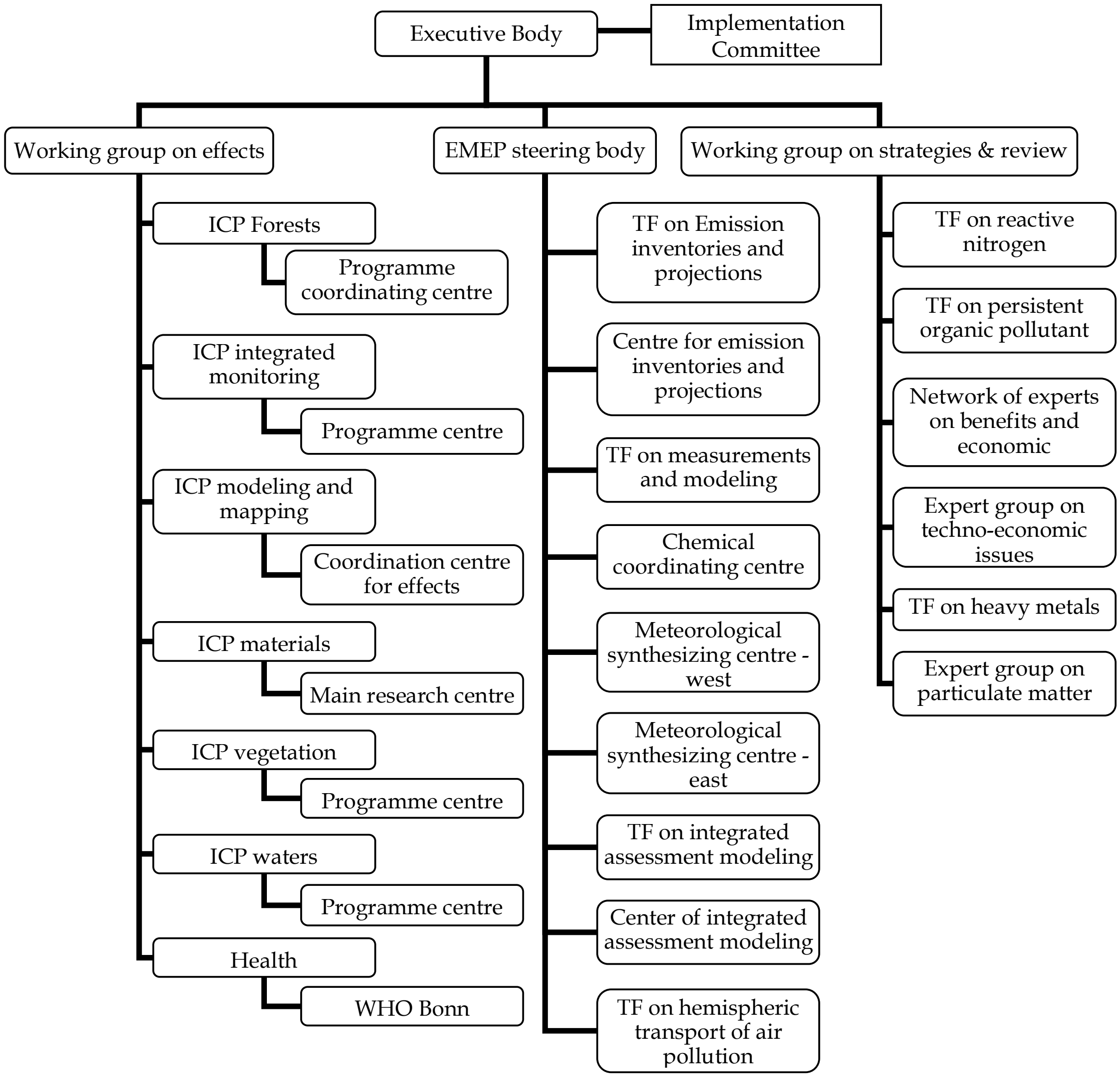
The intergovernmental binding obligations of countries participants was the only way to achieve emission abatement for reducing transboundary air pollution. Protocols to Convention were chosen as a political instrument of environmental management. Eight protocols have been adopted since the adoption of the Convention.

First, the *1984 Protocol on Long-term Financing of the EMEP* entered into force on 28 January 1988, creating a financing mechanism to support scientific data gathering by EMEP program. Next, *Protocol on the Reduction of Sulfur Emissions or their Transboundary Fluxes* entered into force on 2 September 1987 and was the first substantive protocol obliging Parties to reduce their national emissions for abating long-range transboundary air pollution. Third, *Protocol concerning the Control of Emissions of Nitrogen Oxides or their Transboundary Fluxes*, entering into force on 14 February 1991, required national annual emissions of nitrogen oxides to stay below their 1987 levels. Obligation of developing of critical loads was one of the major points of Nitrogen Protocol that elevated technical status on a higher level and opened up new possibilities for broader reach of Convention activities. *Protocol on Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes* entered into force on 29 September 1997, specifying options for emission reduction targets of VOCs. *Protocol on Further Reduction of Sulfur Emissions* was adopted in 1994 and entered into force on 5 August 1998; new standards on large stationary combustion sources and fuel standards became mandatory. The seventh protocol was *Protocols on Persistent Organic Pollutants and Heavy Metals,* which was signed by 27 countries in 1998 and entered into force in 2003, regulating production and storage of 13 POPs Lastly, *Protocol to Abate Acidification, Eutrophication and Ground-level Ozone*, also called the Gotherburg Protocol, was signed in 1999, and entered into force in 2005. It considered the emission regulation for SOx, NOx, NH_3 (ammonia) and VOCs by setting up cost-optimized emission ceiling for 2010. The Gothenburg Protocol became the reference point of Convention activities while demonstrating successful interaction of science and policy via applying multi-pollutant and multi-effect strategy approach for solution transboundary air pollution problem.

1.6.2 Organizational structure of CLRTAP

The organizational structure of the Convention includes Secretariat, Implementation Committee and Executive Body. Executive Body consisting on Working Group on Effects, EMEP Steering Body and Working Group on Strategies and Review provides informational interaction between various International Cooperative Programmes (ICP), Task Forces, Technical Centres and Expert Groups and directs their activity on implementation and development of Convention [Figure 4].

[Figure 4] Intergovernmental bodies, expert groups and scientific centers for CLRTAP



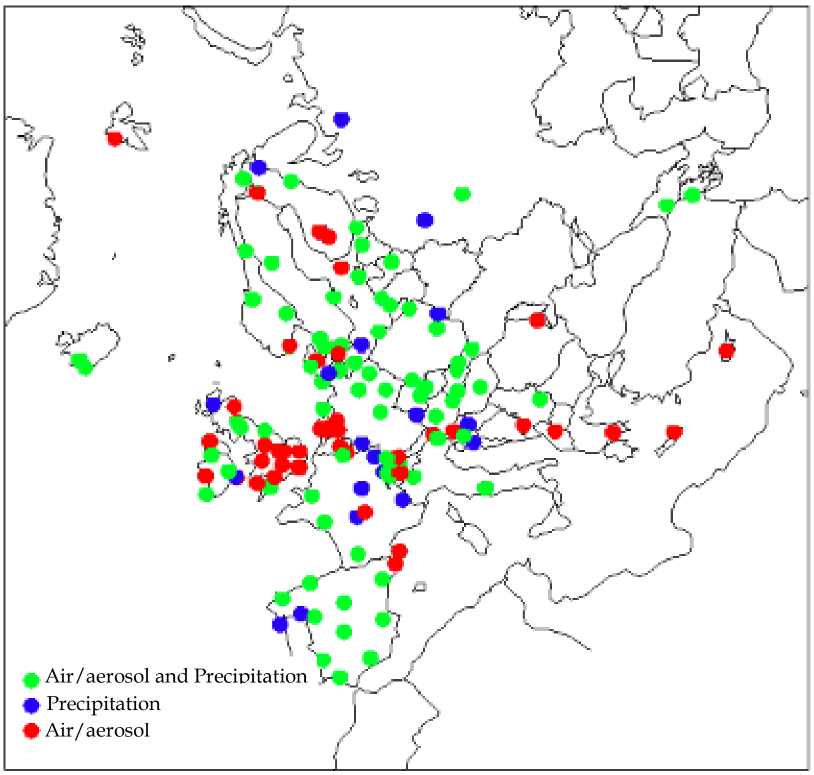
ICP: International Cooperative Programme; TF: Task Force

EMEP Steering Body

The Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP) became an important link for close collaboration of science and policy. Firstly, the EMEP programme was responsible for assessment of transboundary transport of pollutants that cause acidification and eutrophication. But after the launch of EMEP programme under umbrella of LRTAP, the priority fields of the EMEP's activities were enlarged. Currently, the EMEP is the most advanced European programme specializing in 3 aspects of the Convention: collection of emission data, measurements of air and precipitation quality, and modeling of atmospheric transport and deposition of air pollutants. The EMEP work results are reported every other year and are officially made public by the Steering Body of EMEP.

Currently EMEP activities are distributed between 5 designated centers and monitoring network includes 314 sites with measurements of main compounds concentration. Data from all stations are used in the interpretation of model deposition calculations. In 2009, there were 140 sites measuring pollutants that cause acidification and eutrophication, 130 sites for ozone, 71 for heavy metals, 24 for POPs, 12 for VOC, 61 for PM10 and 40 for PM2,5. [Figure 5] shows the monitoring EMEP stations being in operation in 2009. The site coverage of EMEP domain is non-uniform, and the stations quantity is unsatisfactory in some parts of Europe. But every year spatial coverage increases, list of parameters to be measured extend, and stations quality improves with application of new technologies.

[Figure 5] EMEP measurement network of main components in 2009 for CLRTAP



Source: *http://www.nilu.no/projects/ccc/network/index.html*

Task Forces and Centres that fall under the EMEP Steering Body include the *Meteorological Synthesizing Centre – West (MSC-W)*, which is responsible for the modeling transport of acidifying and eutrophying air pollution, sulfur, nitrogen photooxidant pollutants and atmospheric particles. The *Meteorological Synthesizing Centre - East (MSC-E)*, based on the Hydrometeorological Service in Moscow, is focused on assessment of the transboundary transport of persistent organic pollutants (POPs) and heavy metals (HMs). The *Center for Integrated Assessment Modeling (CIAM)* was launched under the International Institute for Applied Systems Analysis (IIASA) in 1999. The main achievement of its activity is the development of the Regional Acidification Information and Simulation (RAINS). All abovementioned centres prepare technical background material for relevant Task Forces, such as the Task Force on Measurements and Modeling (TFMM), the Task Force on Emission

Inventories and Projections (TFEIP), the Task Force on Integrated Assessment Modeling (TFIAM) and Task Force on Hemispheric Transport of Air Pollutants (TFHTAP). Task Forces in turn review the results of activities of Centres and support implementation of the Protocols. The *EMEP Centre on Emission Inventories and Projections (CEIP)* started in 2008 is charged with systematic collection, analysis, and projection of air pollution emissions. Parties to the Convention are required to report their annual emission and activity using the form [Table 1].

[Table 1] Reporting requirements for estimating and reporting emission data, CLRTAP

Description of contents	Components	Reporting years
YEARLY: MINIMUM **(**and *ADDITIONAL*)		
A. National totals:		
1. Main pollutants	SO_x, NO_x, NH_3, NMVOC, CO	1980–2010
2. Particulate matter	$PM_{2.5}$, PM_{10}, TSP	2000–2010
3. Heavy metals	Pb, Cd, Hg / (*As, Cr, Cu, Ni, Se, Zn*)	1990–2010
4. POPs	HCB, HCH, PCBs, PCDD/F, PAHs	1990–2010
B. Sector emissions:		
1. Main pollutants	SO_x, NO_x, NH_3, NMVOC, CO	1980–2010
2. Particulate matter	$PM_{2.5}$, PM_{10}, TSP	2000–2010
3. Heavy metals	Pb, Cd, Hg / (*As, Cr, Cu, Ni, Se, Zn*)	1990–2009
4. POPs	HCB, HCH, PCBs, PCDD/F, PAHs	1990–2010
5. Activity data		1990–2010

Working Group on Effects

The Working Group on Effects was established under the Convention in 1980 with responsibility for assessment of air pollution. Specific areas of work include providing data about the impact on human health and ecosystems of main pollutants; development of multi-pollutants-multi-effects approaches; and identifying the most endangered areas and informing the Executive Body. The Working Group on Effects includes 6 International Cooperative Programmes (ICPs) supported by relevant programme centres and coordinated by relevant Task Forces.

ICP on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) was launched in 1985. The ICP Forests has function of monitoring the effects of air pollution and other environmental factors on forest ecosystems in Europe. Second, the *ICP on Assessment and Monitoring Effects of Air Pollution on Rivers and Lakes (ICP Waters)* was established in 1985, providing the monitoring of acid rain and air pollution effects on surface waters. *ICP on Effects of Air Pollution on Natural Vegetation and Crops (ICP Vegetation)* was established in 1987 and considers environmental problem of ozone impact on crops and (semi-) natural vegetation. *ICP on Modeling and Mapping of Critical Loads and Levels and their Air Pollution Effects, Risks and Trends (ICP Modeling and Mapping)* was created in 1988 and is currently coordinated by Task Force led by Germany and supported by the Coordination Centre for Effects (CCE) at the Netherland. The main objective of the Programme is the development of modeling and mapping methodologies for the assessment of critical loads and exceedance on European scale.

ICP on Effects of Air Pollution on Materials, Including Historic and Cultural Monuments (ICP Materials) was initiated in 1985. The Programme activities focus on quantitative evaluation of the effect of major pollutants on the atmospheric corrosion of important materials and estimation of long-term corrosion trends. *ICP on Integrated Monitoring of Air Pollution Effects on Ecosystems (ICP Integrated Monitoring)* was created in 1987. The Programme is charged with qualitative measurement of physical, chemical and biological properties of an ecosystem and data collection. The *Joint Task Force on the Health Aspects of Long-range Transboundary Air Pollution (The Task Force on Health)* is led by the World Health Organization European Centre for Environment and Health and was established in 1997. Its aim is to assess the health effects of long-range transboundary air pollution based on estimates of major air pollutants concentrations calculated by EMEP and to provide strategic direction of the Convention in abating health impact.

Working Group on Strategies and Review

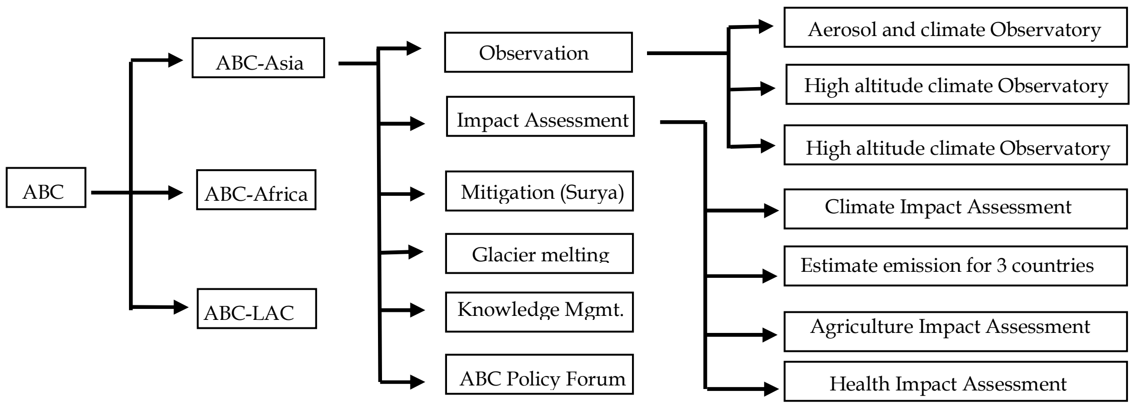
Firstly, *Working Group on Strategies and Review* was established in 1988 as the *Working Group on Abatement Strategies*. Creation of new Convention body was stimulated by increased interest in the critical loads method as an instrument for developing abatement strategies. Development of the Group was supported by close interaction with the *Task Force (TF) on Integrated Assessment Modeling* responsible for implementing model calculations needed for optimized emission reduction strategies research. The Working Group was charged with preparing background for negotiating any Protocols changes. *Network of Experts on Benefits and Economic Issues* research on the economic impact of air pollution, in particular the measurement and economic valuation of health effects and assessment of pollutant caused damage to cultural heritage. Another expert group is the *Expert Group on Techno-economic Issues* that started in 2001. It performs research on costs and benefits of available abatement technologies. The *TF on POPs* and *TF on Heavy Metals* were formed by the Executive Body in 2003 and 2004, respectively. The work is focused on technical support of the reviews and reassessments required by Protocols, including preparation of documents and revision of pollutants considered under Convention. *Expert Group on Particulate Matter* began in 2004 is responsible for investigation of PM control and reduction measures. The *Expert Group on Ammonia Abatement* led by United Kingdom was the result of need to perform Gothenburg Protocol requirements. It was ordered to prepare and promote the Framework Advisory Code of Good Agricultural Practice for Reducing Ammonia Emissions. In 2007 the Executive Body established the *Task Force on Reactive Nitrogen* for developing technical and scientific information as a basis for further emission assessment and implementing reactive nitrogen policies.

1.7 Other Relevant Multilateral Initiatives

1.7.1 UNEP Project ABC (Atmospheric Brown Clouds)

The initiatives on ABC commenced in 2002, with United Nations Environmental Programme (UNEP) serving as the Secretariat. The objective was to investigate the causes, behavior and effects of ABC. Regional scale plumes of air pollutants, mainly aerosol (particles) such as black carbon (BC), and precursor gases and ozone radiation, precipitation and meteorological parameters were under investigation. The organizational framework is shown in [Figure 6], with its scientific basis provided by the ABC Science Team.

[Figure 6] Framework of the Project of Atmospheric Brown Clouds (ABC)



Scope of current activities and future plan

Atmospheric Brown Clouds, observed as widespread layers of brownish haze, are regional scale plumes of air pollutants, mainly aerosol (particles), such as black carbon (BC), and precursor gases that produce aerosols and ozone. ABC and its interaction with build-up of greenhouse gases significantly affect the regional climate, hydrological cycle, glacial melting, agriculture and human health. The ABC effect is a problem that prevents a complete understanding of climate change and its impacts; thus, the ABC needs to be more fully explored. In order to better understand this emerging environmental issue, United Nations Environmental Programme (UNEP) commissioned the Project ABC in 2002 in collaboration with a team of distinguished scientists. In Phase I, Project ABC focused on Asia due to the likely impacts on the region's population (more than 3 billion) and the presence of several special features that are relevant to ABCs. Major achievements in Phase I include:

- Establishment of climate observatories and capacity building (physical infrastructure and human resources), development of light weight unmanned aircraft aerial vehicles (UAVs) to monitor ABCs, and rainwater sampling to document how soot is removed by rain;
- Formation of impact study groups, initiation of impact studies on climate, water, agriculture & human health, and impact assessment with focus on Asia; and
- Formation of emission inventory group, as well as initiation of mitigation studies.

Phase I findings strengthened the understanding of the mechanism and impacts of ABCs through measurements and modeling. ABC hotspots across the globe were identified and ABC influence on regional climate, weakening of the Asian monsoon, melting of the Himalayan glaciers, food security, and human health were studied. Based on such extensive research studies, the *Atmospheric Brown Clouds – Regional Assessment Report with Focus on Asia* was published by UNEP in 2008. The report analyzes ABCs and regional climate change in Asia, with a focus on human health and food security.

To further develop the scientific research and to build developing countries' capacity for monitoring and understanding, ABC-Asia synthesized the science, capacity, and policy aspects of ABC and climate change in Asia. It continued with observation of aerosol, radiation, precipitation and meteorological parameters, while also conducting comprehensive impact assessments on climate, water, agriculture and health. Towards mitigation efforts, emission inventories were compiled, and reduction of GHG emissions, soot, and other air pollutants was carried out by introducing green technologies (baseline studies, indoor and outdoor air monitoring, and assessment of interventions). As part of adaptation plans, studies on the linkage between ABCs and glacial melting were demonstrated through inventory of glaciers/glacial lakes and identification of areas at the highest risk. Endeavors under Knowledge Management consist of archival of data, improvement of knowledge management and awareness-raising efforts. Additionally, ABC-Asia convenes the Regional Policy Forum, where the Regional Resource Center for Asia and the Pacific (RRC.AP) functions as the regional secretariat in Asia.

By 2011 capacity had increased for studying ABC in the region with enhanced understanding of ABC impacts on climate, water resources, agriculture and health. Operation of climate observatories was continued in Maldives, Nepal, Thailand, Kyrgyzstan, and they became coordinated with other observatories under the ABC network. Along with a collection of baseline data and completion of a mitigation pilot project in a rural area of India (Project Surya), other projects in Nepal, India, and Kenya were initiated.

1.7.2 UNEP Joint Forum on Atmospheric Environment in Asia and the Pacific

The Joint Forum was established in March 2009 as Intergovernmental Networks on Regional Air Pollution in Asia and the Pacific Region, with UNEP serving as the Secretariat. Participating organizations included the participating countries of EANET, ASEAN, the Malé Declaration, Central Asian Environment Convention, Pacific Regional Environment Programme (SPREP), South Asia Cooperative Environment Programme (SACEP), Clean Air Initiative Asia (CAI-Asia), Institute for Global Environmental Strategies (IGES), Stockholm Environment Institute (SEI-York), UNEP, and UNEP RRC.AP. In the 2010-2012 Work Plan of the Joint Forum, information-sharing is a priority, which will be promoted by building a clearinghouse for air pollution information based on existing initiatives such as national programmes, EANET, and Malé Declaration, and other networks in the region.

Achievements
The First Joint Meeting of the Intergovernmental Networks on Regional Air Pollution in Asia and the Pacific Region held in March 2009 requested the secretariat to develop a future plan for the activities of the joint forum. It was decided that careful analysis will be conducted regarding the development of the future plan. The Secretariat was also asked to further incorporate comments from the meeting and consult relevant Intergovernmental Meetings, including EANET and Malé Declaration for analyzing gaps and developing an implementation plan. Subsequently, the layout for future activities was consulted among stakeholders and was adopted at the First Meeting of the Joint Forum on Atmospheric Environment in Asia and the Pacific in March 2010.

Scope of current activities and future plan

The *Joint Plan for Joint Activities on Air Pollution in Asia and the Pacific* adopted in March 2010 lays out the vision, goals, scope and activities of the Joint Forum. The vision of the Joint Forum is to achieve a clean atmospheric environment through collective and coherent actions in Asia and the Pacific region, especially through enhanced cooperation and collaboration among regional and subregional networks. To achieve its vision, the Joint Forum set the following five goals:

- Development and expansion of the knowledge base on the cases, sources, types and impacts of air pollution and their relation to associated issues, including cost-effective solutions for the whole region, and good practices for prevention and control;
- Better understanding of the methodologies and technologies involved in managing atmospheric environment;
- Development of skills through systematic capacity-building and training of individuals and institutions and provision of necessary instrumentation and support;
- Integration of this knowledge base with policy-making and public awareness-raising for social, political, moral and economic development to carry forward relevant plans for mutual benefits; and
- Facilitation of consensus-building that takes into account the situation of subregions.

2 National Plans and Potential Linkage with Subregional Frameworks

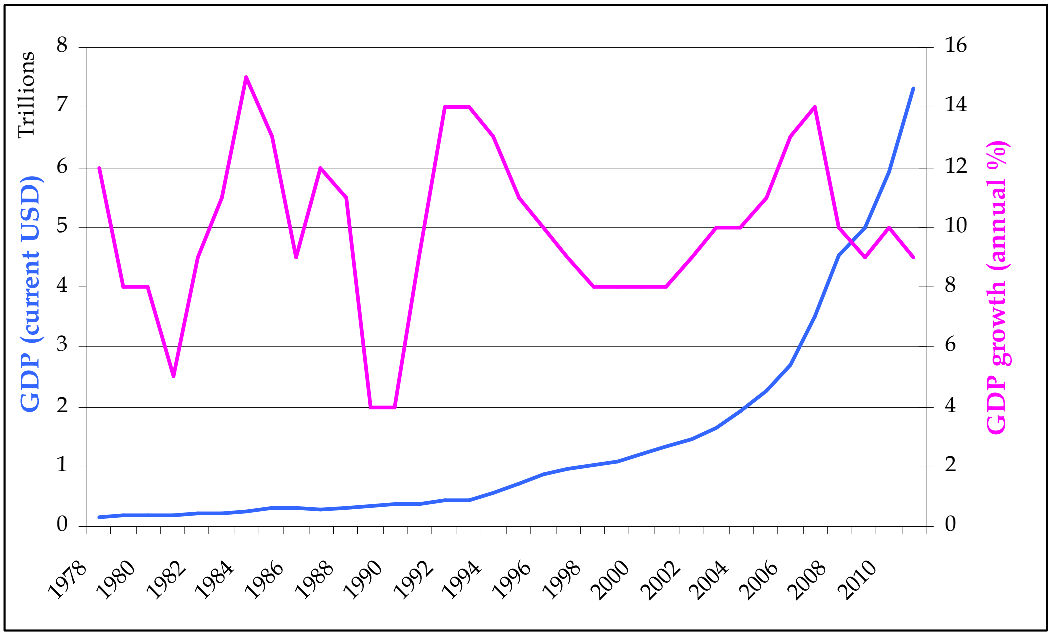
2.1 China

2.1.1 Background

China has undergone very rapid economic growth since the economic reforms began in 1978, but traditional development modes have been accompanied by depletion of natural resources and degradation of the environment. In addition, the large population in China is also environmentally destructive, as a large population base leads to over-consumption of natural resources. In the last three decades, annual growth rate of GDP in China was about 10%. GDP in 2005 reached 18,000 billion RMB, equivalent to 2,200 billion USD [Figure 7].

China is now considered to be the engine of world's economic growth. China's economic growth has resulted in an increase in energy consumption. Primary energy use in China was 26,250 TWh and 20 TWh per million persons in 2009. According to IEA, the primary energy use and electricity use grew 40 % and 70 % respectively from 2004 to 2009.

[Figure 7] GDP and GDP growth rate of China from 1978 ~2010



Six industries – electricity generation, steel, non-ferrous metals, construction materials, oil processing and chemicals are account for nearly 70% of energy use. China is the world's top coal producer and ranks third in the amount of coal reserve. In 2009, China's coal supply was 18,449 TWh, which was 47 % of the world coal supply. In 2010 China was the second top hard coal importer (157 Mt). Coal use in the world increased 48% from 2000 to 2009, and the majority of this growth occurred in China and the rest in other parts of Asia. China's oil and natural gas supply was 4,855 TWh and 1,015 TWh in 2009 that was 10 % and 3% of the world's supply. Although China is still a major crude oil producer, it became an oil importer in the 1990s. In 2002, annual crude petroleum production was 1,298,000,000 barrels, and annual crude petroleum consumption was 1,670,000,000 barrels.

[Table 2] Energy in China

	Population	**Primary energy**	**Production**	**Import**	**Electricity**	**CO_2emission**
	[million]	[TWh]	[TWh]	[TWh]	[TWh]	[Mt]
2004	1,296	18,717	17,873	1,051	2,055	4,732
2007	1,320	22,746	21,097	1,939	3,073	6,028
2008	1,326	24,614	23,182	2,148	3,252	6,508
2009	1,331	26,250	24,248	3,197	3,503	6,832
Change 2004-2009	2.7 %	40 %	36 %	204 %	70 %	44 %
Mtoe = 11.63 TWh, Prim. energy includes energy losses that are 2/3 for nuclear power						

2.1.2 Air Pollutant Emission in China

According to a recent World Bank report, an annual number of 300,000 to 400,000 deaths are estimated to be due to respiratory illnesses triggered by air pollution. In China, SO_2 concentration varies seasonally, high in winter and early spring while low in summer and autumn. It is due to the increase of energy consumption for heating in winter and for washout caused by monsoons in summer. Sulfur dioxide declined from 2007, but Nitrogen dioxide has increased. For PM10, its concentration in Northern China has continued to decrease since 2007, but Southern China showed a stagnant PM10 concentration. Usually, PM10 in Northern China is higher than in the Southern China. Rainout is the main mechanism of the seasonal pattern of PM10, making PM10 concentration lower in the wet season than in the dry season. However, the peak of PM10 in the spring is caused by frequent occurrences of dust and sandstorms. Rain in China is likely to be acidic, with the pH ranging in 4.2 to 6.4.

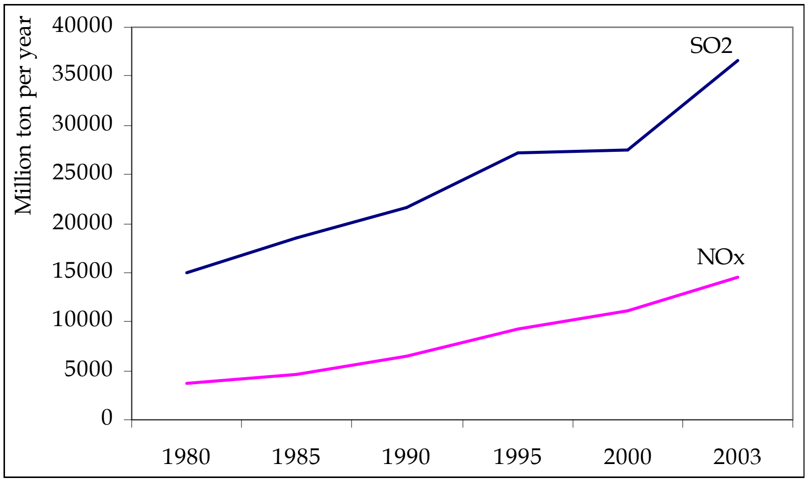
SO_2, NO_2 and PM_{10} are currently used to appraise air quality accordingly to national standard I, II and III, respectively. According to air quality monitoring from 471 cities in China for year 2010, 3.6% cities satisfied the national air quality standard I, 79.2% in standard II, and 15.5% in standard III. Approximately 1.7% cities could not meet standard III. PM10 is the top pollutant leading to bad air quality in almost all cities in China. Compared to monitoring data in 2009, annual mean concentration of NO_2 and PM10 increased in year 2010, while SO_2 decreased. In 2009, the SO_2 emissions amounted to 22.144 million tons, the soot amounted to 8.472 million tons, and the industrial dust was 5.236 million tons, down by 4.6%, 6.0% and 11.7% respectively. [Table 3] shows the emission of SO_2 and soot estimated by MEP of China. From 2006, SO_2 emission shows a decreasing trend due to stringent emission control program.

[Table 3] Annual emission of air pollutants from 2006 to 2010 in China

Year	SO2 emission(kton)			Dust emission(kton)			Fugitive dust from industrial process (kton)
	Total	Industry	Domestic	Total	Industry	Domestic	
2006	25,888	22,348	3,540	10,888	8,645	2,243	8,084
2007	24,681	21,400	3,281	9,866	7,711	2,155	6,987
2008	23,212	19,913	3,299	9,016	6,707	2,309	5,849
2009	22,144	18,661	3,483	8,472	6,039	2,433	5,236
2010	21,851	18,644	3,207	8,291	6,032	2,259	4,487

But over the last 30 years (1980-2010), SO_2 and NOx emission in China has shown a general increase [Figure 8]. SO_2 emission grew from 10,000 to 30,000 kiloton per year in the past 30 years, while NOx emission grew from 4,000 to 11,000 kiloton per year.

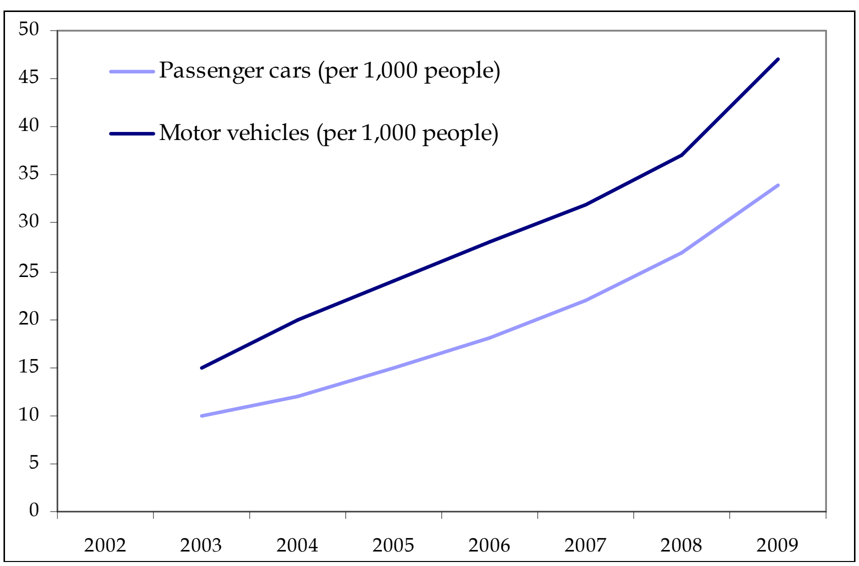
[Figure 8] SO2 and NOx emission in China from 1980 to 2020



Vehicle emission in China

The transport sector is one of the gravest areas of concern, with emissions associated with motor vehicles predicted to significantly increase in major urban areas. [Figure 9] shows the trend of automobile population from 2003 to 2009 in China. A rapid increase of automobile population occurred during the 2000s, compared with a gradual increase in the 1980s. In 2009, China became the first in the world for automobile production and purchase. The production and purchase amount reached 13,791,000 and 13,655,000 respectively. *China Vehicle Emission Control Annual Report* (2010) released by Ministry of Environment Protection of China reported that vehicles accounted for over 70% CO and HC emission, and over 90% NOx and PM emission. Thus vehicle emission is arguably responsible for the total emission increase of NOx, CO and HC in China over the recent years.

[Figure 9] Vehicles per 1,000 people from 2003 to 2009 in China



Passenger cars refer to road motor vehicles that seat no more than 9 people; Motor vehicles include cars, buses, and freight vehicles.

Acid rain

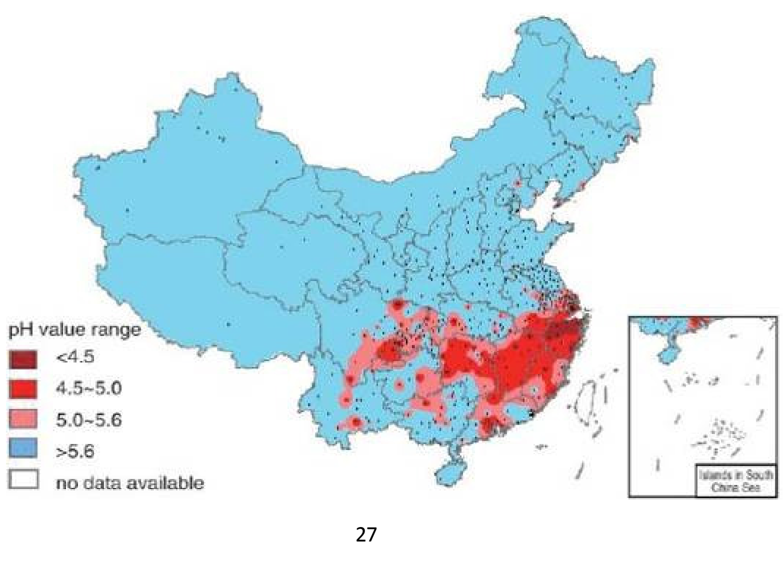
Acid rain monitoring in 494 cities in China revealed that acid rain occurred in 249 cities, which is 50.4% of all cities. There are 160 cities having frequency of acid rain occurrence above 25%, while 54 cities have the frequency above 75% [Table 4]. Also, the statistics of annual mean rainwater pH value shows that if acid rain is defined as annual mean pH less than 5.6, 35.6% cities have experienced acid rain. Cities having annual pH value lower than 4.5 make up for 8.5% of all cities.

[Table 4] Histogram of acid rain occurrence and pH for Chinese cities in 2010

	Level	No. of Cities	Percent
Acid rain occurrence	0	245	49.6
	0-25%	89	18
	25% - 50%	57	11.5
	50% - 75%	49	9.9
	≧75%	54	11
	Total	494	100
pH	<4.5	42	8.5
	4.5~5.0	65	13.1
	5.0 ~5.6	69	14
	5.6~7.0	238	48.2
	≧7.0	80	16.2
	Total	494	100

As shown in [Figure 10], acid rain was mainly distributed to the south of Yangtze River and to the east of the Qinghai-Tibet Plateau, including most areas in Zhejiang Province, Jiangxi Province, Hunan Province, Fujian Province, and Chongqing Municipality, and the Yangtze River Delta and Pearl River Delta. Acid rain covered about 1.2 million km^2, including 60,000 km^2 suffering from serious acid rain.

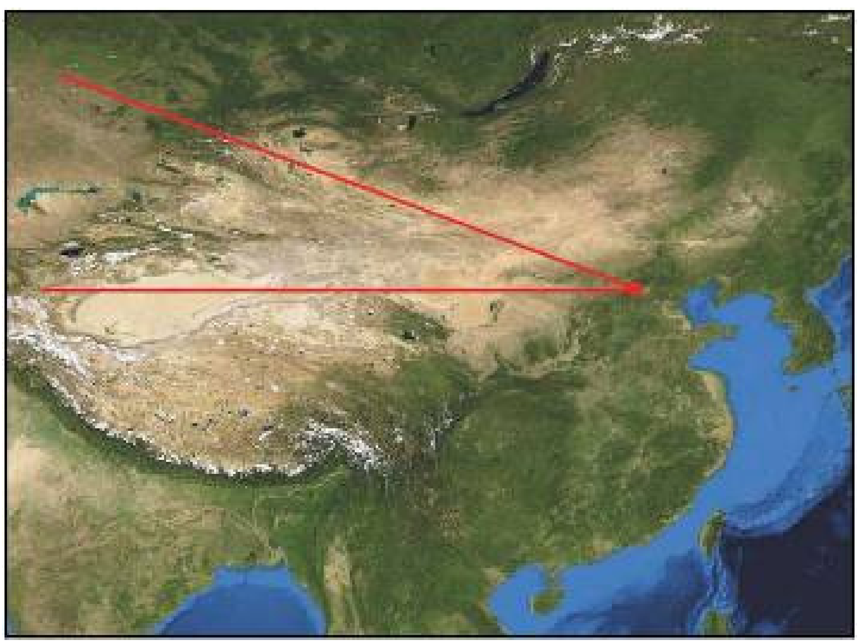
[Figure 10] Annual Average pH values of China in 2009



Dust and Sand storms

The plumes of huge sand storm routinely travel hundreds of miles to populous cities in northeastern China, including Beijing, obscuring sunlight, reducing visibility, slowing traffic, and closing down airports. As the plume passes by, particulate in air goes up significantly high in altitude, and daily Air Pollution Index (API) exceeds the maximum value of 500 in cities along the path of the plume. The eastward plume could then go through the Korean peninsula and Japan, and even reach North America. The natural phenomenon is an important part of the bio-geochemistry cycle and has adverse effects on the quality of human life. Two regions have a high frequency of dust storms: the western Taklimakan Desert and the west Inner Mongolia Plateau. One of the two paths shown in [Figure 11] of sand storm transportation affecting East Asia is the Western path, where cold fronts related to the Siberian High sweep through the east, pushing strong winds over a wide area that includes the Tarim and Turpan basins, the Hexi Corridor, and Ordos Plateau. If conditions are right, the storms then move east or southeast into eastern China. After the fronts move through, Xinjiang and western Inner Mongolia become the center of cold high-pressure. The other one of the two paths of sand storm is the Northern path: Cold fronts from the northwest of Lake Baikal surge south through the basin of the Great Lakes in northwestern Mongolia to the central Gobi Desert, where they merge with strong winds that flow northeast towards a low pressure cyclone over eastern Mongolia. Most multi-regional storms are caused by weather systems similar to this.

[Figure 11] Major Sand Storm Origins and Paths in East Asia



The windiest areas are just west of the Hunshandake sandy lands, and northern Gansu and western Inner Mongolia. Badain Jaran Desert of western Inner Mongolia has had the greatest number of dust storms annually from 1954 to 2000. The portion of the Gobi Desert that spans the central border between China and Mongolia has experienced the greatest number of dust storms over the last 30 years. Despite the fact that some regions are experiencing increased effects of dust storms, historic data from CMA (China Meteorological Administration) meteorology stations reveal that, nationwide, dust storms have displayed a decreasing trend over the last 50 years (1950-2000). For overall China, the highest frequency of dust storms occurred in the 1960s and 1970s. Dust storm occurrence is the result of the integrated influences of climate, geography, society and human factors. Many factors that cause the disasters are natural, but anthropogenic factors may dominate over natural factors in some circumstances.

2.1.3 Chinese Participation in Major Mechanisms

In terms of long range transboundary transport of air pollutants, the pollutants from mainland China could be lifted into the free atmosphere and start long-range transport, particularly in the spring cyclone season. The impact area could extend to North America. To investigate the status and characteristics of long range trans-boundary transport of air pollutants, many scientific projects and programs have been conducted in East Asia. [Table 5] lists the major research activities related to North East Asia by Chinese institutions and universities.

[Table 5] Major research activities by Chinese institutions

Name	Participant	Organization	Funding	Topic
EANET	CNEMC	MEP, UNEP	Each Countries are responsible for the monitoring activities. UNEP, RRC.AP support secretariat, the coordination of the activities of EANET, meetings and activities of the network.	Acid Deposition, Ecosystem
LTP	CRAES, CNEMC, PKU, THU	MEP (China), MOE (ROK)	Environment Ministry of China, ROK, Japan response for research activities. MOE ROK supported LTP secretariat and part of Chinese Research Activities	Trans-boundary Transport, Acid Deposition
ABC	CRAES, PKU, IAP	UNEP	UNEP supported the activities of science team	Impact of Aerosol on Climate
MICS-Asia	IAP, ACAP			Model comparison meeting
NOWPAC		MEP	UNEP	Deposition of Air Pollution in to ocean
Yellow Sand	CNEMC, CRAES	MEP (China), MOE (Japan), MOE (ROK)		Sand storm monitoring
O3		MEP (China), MOE (Japan), MOE (ROK)		O3

LTP Monitoring in China

In 2000, Republic of Korea, Japan and China started joint research project (LTP). The project has been coordinated by LTP Secretariat – the National Institute for Environmental Research (NIER). From the Chinese part, the Ministry of Environmental Protection (MEP China) is in charge of the project. MEP China, Chinese Research Academy of Environmental Sciences

(CRAES), Peking University (PKU) are members of the working group. Experts from Chinese National Environmental Monitoring Center (CNEMC) and CRAES are members of monitoring sub-working group, and experts from CRAES, PKU and Tsinghua University are members of modeling sub-working group project. Gaseous pollutants, airborne particulate matter and precipitation were monitored continuously in Dalian and Xiamen from 2002. Starting in 2003, 10-day intensive monitoring was performed in Dalian (Fujiazhuang) and Xiamen (Xidong) for the spring and autumn periods. During these intensive monitoring periods, PM2.5 and PM10 were collected simultaneously and analyzed for water soluble ions.

Atmospheric Brown Cloud (ABC) Project of UNEP.
An important characteristic of ABC forcing in Asia is that it introduces large north-south asymmetries in the forcing and large land-sea contrasts, affecting the monsoonal climate. ABC-induced atmospheric solar heating and surface dimming are also significant issues especially for India and China. As part of the ABC Project, thirteen mega-city ABC hotspots in Asia have been identified, where the Chinese cities of Beijing, Shanghai, and Shenzhen are included. Towards this end, the ABC project uses satellite data and regional assimilation models to investigate the chemical composition of aerosols in ABCs and how their chemistry contributes to the AOD.

2.1.4 China's National Strategy to Abate PM2.5 Pollution

Aside from the participation in major mechanisms, China also puts great significance on abatement of PM2.5 pollution. The concentration of PM2.5 in most Chinese cities is higher than the safe levels called for by air quality guidelines published by the World Health Organization. In recent years, haze or "gray sky" phenomenon caused by PM2.5 is an increasing public concern. While PM2.5 predominately exist in urban areas posing a serious health risk to Chinese residents, it is not yet a routinely monitored air pollutant in most Chinese cities.

PM2.5 pollution control strategy in China
In 2011, the Chinese government decided to monitor PM2.5 in four municipalities, 27 provincial capitals, as well as three key regions: the eastern Yangtze River Delta, the southern Pearl River Delta, and the northern Beijing-Tianjin-Hebei area. It will be extended to 113 more cities on the state environment protection list in 2013 and to all cities in 2015. The Chinese Academy for Environmental Planning has already drafted a plan to reduce PM2.5 concentrations by 10 percent in 12 key city clusters by 2015. The 12 key zones comprise large industrial regions and city clusters that cover 12 percent of China's territory and 42 percent of its population. Together they account for 67 percent of the country's GDP, and about half of pollution emissions. The power plants, iron and steel factories and cement plants in these areas will have to follow more stringent emission standards, and the areas will also have to upgrade fuel quality for vehicles to reduce pollution emissions. According to the ministry's new environmental standard, which is to be adopted nationwide by 2016, the average yearly ceiling for PM2.5 is set at 35 micrograms per cubic meter, while the daily limit is at 75. Along with the new standards, the existing Air Pollution Index will also be upgraded to Air Quality

Index. Currently, PM2.5 is not included in normal air quality-monitoring system yet.

2.1.5 Other Research Projects

In order to detect the extent and the mechanism of air pollutant long-range transportation, several international projects were conducted over East Asia and Northwest Pacific, such as TRACE-P and INTEX-B. In these projects, large field campaign, including ground observation, flight, satellite and cruise measurement, were launched to study the evolution of air pollutant during the transportation and the 3-D distribution of pollutants. The TRACE-P study showed that cold fronts sweeping across East Asia and the associated warm conveyor belts (WCBs) are the dominant pathway for Asian outflow to the Pacific in spring. INTEX-B research found that the pollutant transport over the central Pacific occurring between 20^{o}N and 50^{o}N in the 2 to 6 km altitude range.

2.2 Japan

2.2.1 Present Situation and Agendas Regarding Air Pollution

Although the trend of air pollution in Japan has been improving as a whole owing to implementation of various measures, there are still many challenges. In some urban areas, the national environmental standard of NO_2 has still not been satisfied yet, and attainment ratio of the national environmental standard of photochemical oxidants is less than 1%. Regarding PM2.5 for which the national environmental standard was established in 2009, some monitoring data suggested that the current nationwide levels would exceed the national environmental standard. In addition, more events of dust and sandstorms (DSS) flying to Japan has been observed, and risks of toxic substances adhered to the DSS particles were also pointed out.

Air pollution in large cities

Air pollution caused by NO_2 and Suspended Particulate Matters (SPM) has been improving as a whole and the national environmental standard has been almost attained. However, there are some areas where the national environmental standard for NO_2 has not been attained. In the case of SPM, it is still necessary to continuously check if the national environmental standard has been satisfied. Taking into account the recent decreasing trend of the number of total automobiles and total driving distance, as well as the future constraints of energy and the trend of population and aging, it is necessary to consider the way to ensure an environmentally friendly transportation system.

Photochemical oxidants

Although the emissions of VOC would be reduced, as expected, by more than 30% in the year 2010 compared with the total amount in 2000, the concentration of photochemical oxidants has not shown outstanding improvement, and attainment ratio of the national environmental standard is still less than 1%. It is therefore necessary to implement in-detail survey and accumulation of new scientific findings on the trend of air concentration of oxidants and mechanism of their formation. Also, the efforts to develop emission inventory on photochemical oxidants and the causative substances should be strengthened, as well as endeavors on simulation models. Appropriate countermeasures against photochemical oxidant should be then elaborated based on the outcome of these efforts, taking into account the influence of regional air pollution from East Asian region.

PM2.5

It is necessary to promote the establishment of a continuous monitoring system on concentrations of PM2.5 and its components. In addition, similar to photochemical oxidants, it is necessary to implement a comprehensive survey on the trend of PM2.5 concentration. Studies on the mechanism of their formation, PM2.5 emission inventory, and simulation models are also priorities.

Regional air pollution

So far, the government has strived toward accumulating scientific knowledge and international cooperation through the initiatives of EANET and TEMM. In order to address regional air pollution in East Asia, international cooperation should be further promoted. As for acid deposition, photochemical oxidants, PM2.5 and DSS – it is necessary to enhance national and international monitoring system including improvement of monitoring technology, and to accumulate scientific information through determination of the mechanism of emission, transportation and deposition, and physical and chemical properties. Furthermore, it is important to extend the administrative efforts towards the management of regional atmospheric environment in East Asia.

2.2.2 Long-term Targets and the Basic Direction of National Policies

Regarding air pollution, the national environmental standards should be attained and maintained, and further effort should be made to improve atmospheric environment. The measures should also contribute to the prevention of global warming. In order to realize a low carbon society, efforts should be made to develop an environmentally sustainable city transportation system, promote sustainable lifestyles and economic activities. Considering that present atmospheric environment has an improving trend, Japan is promoting not only regulatory measures but also economic measures and voluntary activities through provision of relevant information. Japan's national plans for addressing air pollution have been disclosed as part of the *Basic Environmental Plan* of Japan. Following the three plans developed in 1994, 2000 and 2006, the 4th Basic Environmental Plan was adopted by Japanese Government in April 2012.

Environmentally sustainable city/transportation system and review of lifestyle and economic activities

Since acceleration of population decrease and ageing is expected, development of a compact city is needed as well as an environmentally sustainable city/transportation system that mitigates air pollution. In this regard, it is important to aim at economic growth through the technological innovation in the environmental field. In similar light, the government will appeal for less fuel-consuming transportation modes including low pollution vehicles, eco-drive practices, refraining from non-urgent use of cars, public transportation and bicycles, at occasions of business activities and daily life. The government will promote the deployment of automobiles with superior environmental performance. It will review the regulatory measures of individual vehicles and consider the enhancement of allowable limit values, based on development of technical measures to control exhausted gas, and actual situation of driving and application.

Promotion of investigation of actual situation and accumulation of scientific findings
In order to understand the nationwide situation of PM2.5 concentrations, the government will further establish a continuous monitoring system (for concentrations of PM2.5 and its components). For determining the behavior of photochemical oxidants and PM2.5 in the atmosphere, the government plans to promote the development and analysis of national emission inventories and the improvement of accuracy of simulation models, together with the improvement of monitoring data quality. Also, the government seeks to expand its knowledge base on health and ecosystem impacts of air pollutants, including exposure impacts and regional air pollution, in order to help the establishment and amendment of environmental standards and guidance values.

Promotion of cooperation in East Asia
Based on the existing international initiatives such as bilateral cooperation as well as EANET and TEMM, the government will advance its international cooperation toward regional atmospheric environment management in East Asia. As for photochemical oxidants and PM2.5, the government will apply advanced regional air pollution simulation models to capture the trend of concentration of air pollutants and investigate the formation mechanism, develop and improve emission inventories, develop a continuous monitoring system with improved quality of the monitoring data. The government will consider and establish effective countermeasures, taking into consideration the influences of regional air pollution.

2.2.3 Linkage with Subregional and Regional Activities

In order to strengthen the basis of regional cooperation for atmospheric environment management in East Asia, Japan has long seen the EANET as the platform. At the same time, Japan is reconsidering its strategy to improve regional cooperation. The Ministry of the Environment, Japan, has provided financial support to research regional air pollution and possible options for developing and/or strengthening a regional framework, which is named as *Scientific Analysis of Regional Air Pollution and Promotion of Air Pollution Management in East Asia Considering Co-benefits*.

2.3 Republic of Korea

2.3.1 Overview of the Current Status

SO_2 and CO concentration in Republic of Korea dramatically decreased owing to clean fuel replacement policy since middle of 1980's. On the other hand, NO_2, PM and Ozone concentrations have not been improved. Ozone level is increasing rapidly in the large cities due to abundance of ozone precursors, NOx and VOC, emitted from road traffics. PM2.5

pollutants in Republic of Korea are mainly sulfate, organic carbon, and ammonium. The major composition varies seasonally: sulfate in summer and organic carbon in winter. This is caused by the fact that sulfate is formed by photochemical reaction under high temperature and high humidity. About 30% of PM2.5 cannot be explained, but has likely originated from soil or organic matters. The composition of PM2.5 varies according to mass concentration: in low mass concentration organic carbon is dominant, but in high mass concentration sulfate becomes dominant. As PM2.5 increases, the fraction of organic carbon and elemental carbon declines. The source of PM2.5 in North-East Asia may be complex, both anthropogenic and natural. The chemical status of sulfates varies by latitude: acidity increases with increasing northern latitudes. In terms of PM10, three regions of ROK (western, central, and eastern) shows temporal variation in concentration. The dominant region of PM10 changes from central to western region. This implicates that local pollution has weakened, while pollution caused by long-range transport has become stronger in effect [Table 6].

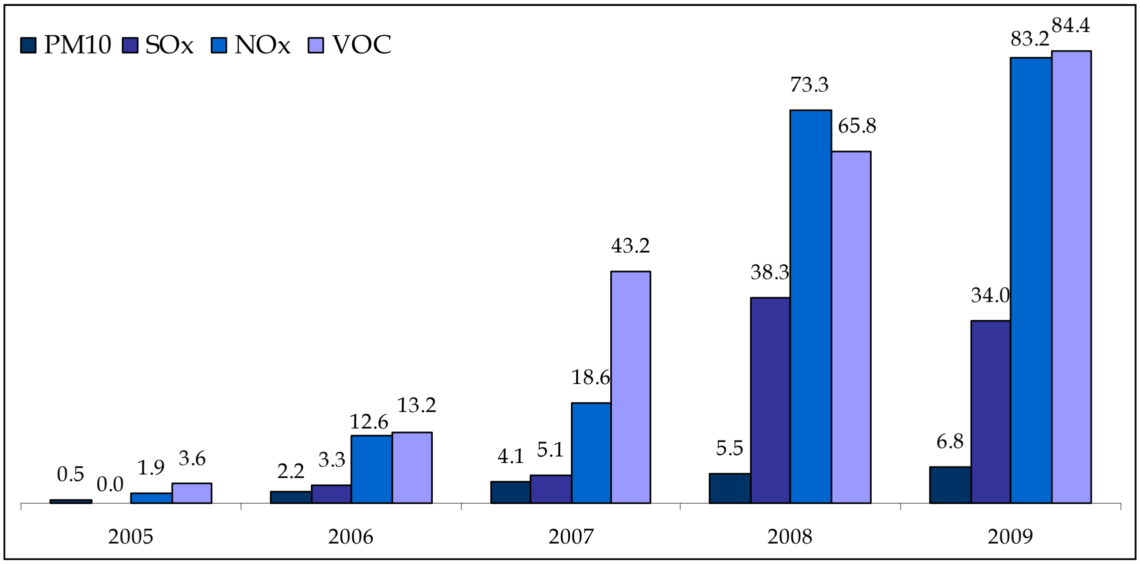
[Table 6] Summary of seasonal variation of PM10 concentration in ROK during 2005-2008

		Spring	**Summer**	**Fall**	**Winter**
		ug/m^3			
2005	Sector1	63.2	50.8	52.4	48.3
	Sector2	77.3	42.9	48.7	58.7
	Sector3	63.9	44.6	46	52.7
2006	Sector1	68.3	38.4	42.6	
	Sector2	89.1	54.4	55.7	66.6
	Sector3	76.1	45	55.3	72.3
2007	Sector1	73.3	40.6	47.8	65.5
	Sector2	74.6	39.5	41.2	
	Sector3	71.5	59	46.2	44.2
2008	Sector1	61.4	48.5	46.7	48.5
	Sector2	69.2	37.9	40.3	50.5
	Sector3	61.9	36.5	33.3	

2.3.2 Government Strategies in Tackling Air Pollution

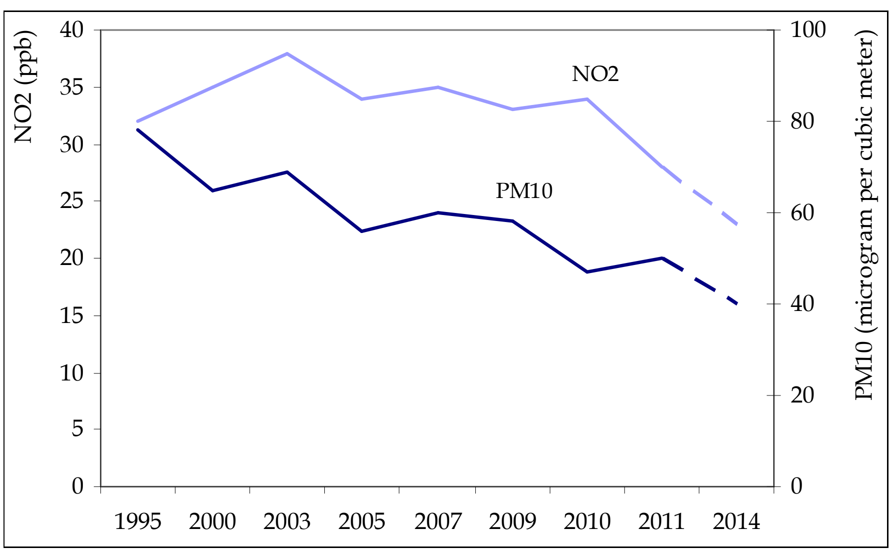
According to the Special Law article 8, *Air Quality Research Board (AQRB)* was established in National Institute of Environmental Research (NIER) on February 3, 2005. The major function of AQRB is to offer technical support such as scientific analysis and prediction modeling and carry the research programs. Eighteen experts/professors were recommended for AQRB member by related organizations. AQRB is carrying out 24 subjects on 4 main sectors selected for 10 year long-term intensive research plan.

[Figure 12] Amount of emission reduced (tons) in ROK 2005-2009



Following various measures, Republic of Korea saw emission reduction of 499,520 tons during between 2005 and 2009 [Figure 12]. It corresponded to 70% of the plan (709,691 tons): PM10 emission reduced by 19,000 tons, NOx by 190,000 tons, SOx by 81,000 tons and VOCs by 210,000 tons. The emission of PM10 and NOx reduced greatly in mobile sources, SO_2 in point sources, and VOCs in area sources. The emission reduction resulted in the decrease in ambient concentration. [Figure 13] reveals that PM10 concentration has been on a decline. However NO_2 did not change during the last 5 years, which may be due to increase in automobiles, population, and fuel use.

[Figure 13] Ambient concentration and target level for NO_2 and PM10 in ROK

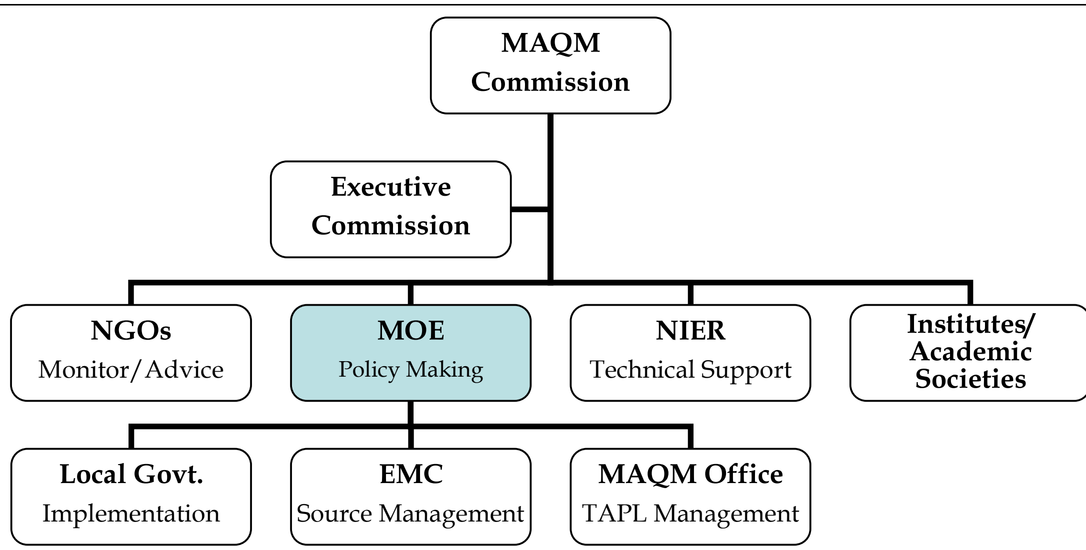


Dotted line represents the target level

Target Air Quality and TAPL Management System
To achieve the levels of developed countries, the concentration of PM10 and NO_2 needs to improve by 40 micrograms per cubic meter and 22 parts per billion, by 2014. SO_2 and VOC should also be reduced in terms of emissions as 'subjected air pollutants'. By recognizing these needs, the MOE has committed to invest 5.4 billion USD for special measures in 2014. The Total Air Pollution Load (TAPL) management system entails a calculation of the atmospheric Environmental Critical Loads, and a policy to 'cap' the amount of pollution emitted in the region. With the adoption of this system, the central government (MOE) allocates the maximum allowable emission load for each pollutant and manages industrial activities accordingly.

Until recently, ROK's environmental regulations such as the emission standards system have monitored the pollution level by each emitter (e.g. smoke stacks) on the basis of pollutant concentration. Although this system was effective in controlling the pollution level of each emitter, it was unsuccessful in constraining the total amount of pollutant within the target level because it lacked control over the increasing number of emission sources collectively. For this reason, MOE introduced the TAPL management system to allocate a total volume of allowable emission for each industrial site (e.g. industrial plants) with cap and trade concept. Also, emission trading is being adopted to create a market for emission credit, which will in turn benefit those who have kept the amount of emission discharge below the allowable level.

[Figure 14] Cooperation and Responsibility scheme for MAQM in ROK



MAQM: Metropolitan Air Quality Management (Prime Minister and related ministers)
MOE: Ministry of Environment
NIER: National Institute of Environmental Research
NGOs: Non-governmental Organizations
EMC: Environment Management Corporation
Local Government: Seoul, Incheon and Gyeonggi Province
MAQM Office: Metropolitan Air Quality Management Office

Such sophisticated program as total emission load regulation and emission trading will only be effective if the proper institutional arrangements are in place to adequately enforce the program. Hence the Korean government has established a competent organization for this purpose, the Metropolitan Air Quality Management Office [Figure 14]. This institution has responsibility for overseeing the emission trading, managing emission data collected from emission sources, and tracking allowance transactions to make sure the program on right track. MOE is engaged with partners in local governments to enhance their capacities to manage the program. In fact, a special division within MOE is set up to administer the programs and make specific rules. Pilot projects will also help local governments adjust themselves to new policies. During 2008 and 2012, 118 workplaces entered the TAPL program and 3,405 small incinerators were shutdown. Furthermore, 1,771 low-NOx burners have been installed with the financial support from government resulting in the decrease in NOx emission.

Control on Vehicle Emission Pollution and VOCs

Ideally, the supply of low emission vehicles (LEV) or zero emission vehicles (ZEV) should be at the forefront of reducing vehicle pollution. Hence the government is working with automakers who sell more than 3,000 vehicles per year in the metropolitan region to supply LEV and ZEVs. In terms of emission standards for newly manufactured vehicles, the standards for CO, HC, NOx and soot for motor vehicles were first introduced on June 1978 and revised several times thereafter. In 2000, the emission standards for newly manufactured automobiles were dramatically changed. For gasoline engine vehicles, the US federal standards for Low Emission Vehicle (LEV) were adopted starting July 2002. EURO III standards were adopted for small-medium and large diesel-powered vehicles in 3 phases starting in July 2002. The standard is continuing to be further strengthened. Also, government bodies and public institutions with at least 10 vehicles in the metropolitan area are required to purchase a certain portion of newly purchased vehicles with LEVs.

For in-use vehicles, the standards have become stricter over time. Diesel vehicles cause especially more serious air pollution with emission of fine particles. In fact, diesel vehicle exhaust emissions account for 100% of PM and 75% of NOx discharged by vehicles. For this reason, MOE strengthened the emission standards for in use diesel vehicles to reduce the PM emission from old diesel vehicles. Also, those who fail the emissions testing will be required to install Diesel Particulate Filters (DPF) or Diesel Oxidation Catalysts (DOC), or to retrofit with cleaner engines. Necessary subsidies will be provided to encourage these activities. Through such efforts, the reduction devices such as DPF have been attached to diesel cars from 2004 contributing. It reached up to 272,671 fleets. 77,172 fleets underwent early disposal. The supply of low emission cars such as clean diesel, hybrid and electric cars was expanded. The permitted emission standard was reinforced, adopting EURO IV in 2006, EURO V in 2009 and EURO VI to be adopted in 2014.

Furthermore, in order to coordinate an environmentally sound energy pricing system, the Korean government has revised the tax rate on diesel vehicles with higher emission exhaust levels. Based on the *Polluter Pays Principle*, MOE has planned to amend its regulation to impose *Environment Improvement Charge* on diesel itself, instead of imposing charges on the diesel vehicles. Other approaches include consideration of introducing *Environmental Zone* or *Low Emission Zone* to reduce the air pollution caused by the diesel vehicles. This approach designates a zone which only allows vehicles with DPF and is learnt from the practices in London and Stockholm. An approach towards accelerating the phase-out of old vehicles, the old vehicle scrapping program has been introduced. The government encourages the old vehicle owners to scrap their cars by providing economic incentive. Yet another initiative of the government was to replace all diesel intra-city buses and garbage trucks with CNG vehicles in the metropolitan area.

In terms of VOCs, MOE has regulated emission sources in the Metropolitan area. Thus, gas station, oil refinery and painting facilities are required to install VOCs control equipments. Furthermore, MOE mandated paint manufacturers to decrease the rate of organic solvent content in paints. In the long term, MOE will reduce the solvent content in paints by 30% on weight basis. In addition, the Ministry encourages painting business to use water-based paint.

2.4 Russian Federation

Until the 1970s, challenges of environmental protection in USSR were mainly considered as a sanitary problem, not ecological. It means that pollution regulation included measures concerning interests of industrial inspection and human health. The main attention of natural resources legislation was focused on controlling of land, water and forests use. Industrialization as a priority for USSR development led to growing emissions and pollution.

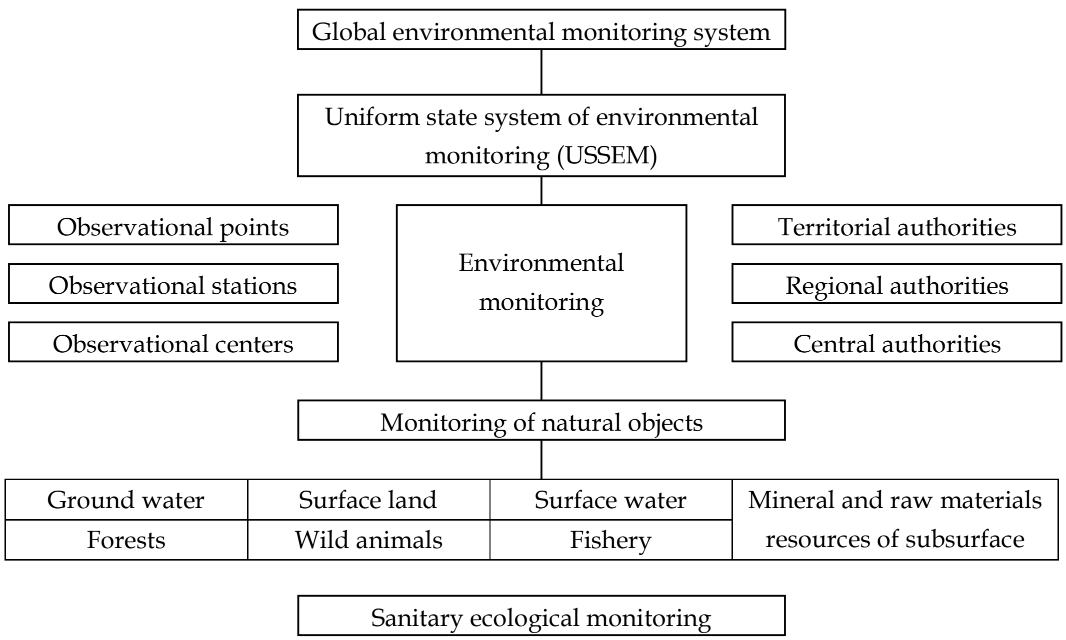
In mid 1960s, the Soviet Ministry adopted a number of resolutions regulating trade and regional aspects of water protection and defining long-term programs of nature conservancy activity. The fundamentals of land and human health legislation of USSR were adopted in 1968 and 1969, respectively. All these documents founded the unique system of principles of socialistic nature management. They later became the basis for further development of environmental legislation. The National Service for Observation and Control of Environmental State was created in 1970s. And in the realm of international environmental activities, USSR was a participant of international interactions intended to abate harmful impact on ecosystems. USSR was one of the first to ratify CLRTAP and adopt Protocols.

2.4.1 Domestic activities

Elaboration on standards for content of chemicals in the air of enclosed work space began in 1922, and the first value of maximum allowable concentration (MAC) for sulfur-containing gas was introduced. The number of established MAC was 181 in 1960 and is now 2,426. USSR played a pioneering role in creating the air emissions rationing system and in establishing standards for MAC. Currently Roshydromet (Federal service for hydrometeorology and environmental monitoring) is the main environmental federal executive authority of the Russian Federation. Roshydromet carries out functions on management of the state property and rendering of state services in the field of hydrometeorology, environmental monitoring, and supervision on meteorological and other geophysical processes.

With an increased role of the department of Hydrometeorological service led to creation of many more services including control services of pollution of the atmosphere and water objects, pollution monitoring called the National Service for Observation and Control of Environmental State (NSOCES), and research in monitoring. Besides NSOCES, environmental monitoring is carried out by a number of other government bodies, leading to duplication of efforts, reducing efficiency of all system of monitoring, and complicating access to necessary information both for citizens, and for the state organizations. Hence in 1995, Uniform State System of Environmental Monitoring (USSEM) was created. The main objectives of system are formation of specialized databases, assessment and forecast of anthropogenic impacts, development of operating decisions on a sustainable development of the environmental protection. The main components of USSEM are subsystems of monitoring of sources of anthropogenic influence, via abiotic and biotic components. The structural organization of USSEM is presented by [Figure 15].

[Figure 15] Federal system of ecological monitoring in the Russian Federation



Ecological information system also plays a key role. With legislation of the 1980 law *Protection of Atmospheric Air,* the relations on environmental protection from physical and biological impacts were included in the sphere of legal regulation. The law necessitates each point of emission to seek permission given out by a competent state authority. Towards this end, inventory of emissions sources data gathering is undertaken.

In 1986 the design procedure of concentration in atmospheric air of the harmful substances containing in enterprises emissions called OND-86 was developed. This methodology established the requirements regarding calculation of atmospheric concentration of harmful substances. OND-86 contains non-Gaussian standard model of pollutant distribution from the multiple sources. OND-86 is applied at the point of registration for a permit to emit. The results of modeling experiments are also used for designating sanitary protective zones (SPZ).

In 1989 the Russian government started the experiment of emissions fee in a number of regions. In 1991, around the time of USSR breakup, *Environmental Protection Act* legalized the system of pollution fees for stationary and mobile air pollution sources, water pollution, and solid waste disposal. This decision opened the possibility of reducing some regional fees due to environmental and economic conditions by negotiating among authorities and adapting to local conditions. It made a special provision to include environmental protection costs in their calculations. Thus, the primary purpose of pollution fees was to generate funds for state-owned enterprises to invest in pollution abatement equipment.

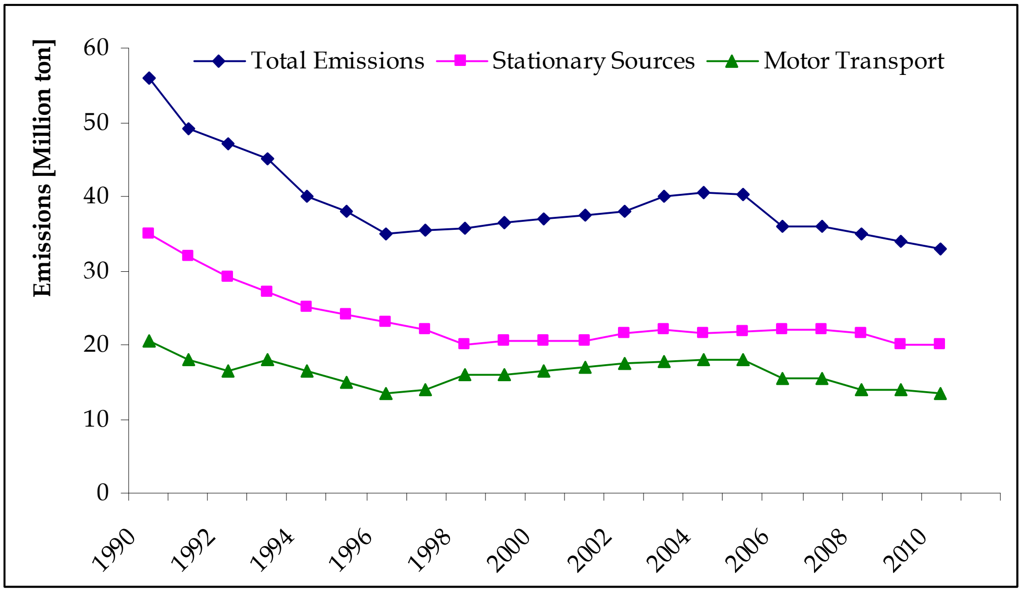
Supplements to the law include rates of fixed fees, where fees for above-limit emissions are five times greater than for below-limit emissions. Furthermore, the Act requires all polluters to have licenses, where a licensee has to sign a legally-binding agreement that fixes fees.

Environmental Protection Act and the law *Protection of Atmospheric Air* have been the basis for whole ecological legislation in the Russian Federation for a decade. During the early 1990s the Ministry of Environmental Natural Protection was created. Nowadays the Ministry of Natural Resources and Environment (MNRE) has a status of federal executive authority performing functions of public policy making and implementing statutory regulation. The MNRE of the coordinates and supervises the activities the Federal Service for Hydrometeorology and Environmental Monitoring, Federal Service for Supervision of Natural Resource Management, Federal Agency for Water Resources, and Federal Agency for Subsoil Management. Each year the MNRE publishes a Review of environmental state and pollution in territory of Russian Federation which contains the relevant describing information according to the supervision carrying out by the regional territorial Departments of Federal service on hydrometeorology and environment monitoring.

In 2010, air pollution monitoring was implemented in 249 cities, at 685 stations. The level of pollution is estimated as comparison of the actual concentration with MAC. Network of stations of supervision transboundary atmospheric pollution includes 4 stations in the European territory of the Russian Federation via EMEP program and 4 stations on Asian Territory of the Russian Federation via EANET. EMEP program analyzes atmospheric precipitation, atmospheric aerosols and gases. EANET performs sampling of atmospheric air and precipitation and the analysis of the main acid-forming substances.

There is a well-developed governmental system of data collection, with an appropriate legal system under the Committee on Statistics. Emissions data received from territorial departments of Rosprirodnadzod are represented in [Figure 16].

[Figure 16] Emissions of polluting substances in RF from 1990 to 2010



Total emissions decreased by 42% during the period 1990 to 2010. In 2010, emissions from stationary sources and motor transport were lower than the 1990 level by 45% and 37% respectively. Three disparate phases can be identified:

- 1990 to 1998: emissions from stationary sources reduced by 46% and from motor transport by 27%. Such decrease is caused by considerable recession of industrial production in all branches of a national economy and disintegration of the USSR.
- 1999 to 2005: value of emissions from stationary sources increased by 9% and from motor transport by 12%. During this period, there was growth of industrial output and increase in motor transport.
- 2006 to 2010: value of emissions decreased from stationary sources by 7% and from motor transport by 25%. For stationary sources, the decrease is due to a world economic crisis which promoted reduction of industrial production. Decrease in emissions from motor transport is connected with change of design procedures of emissions.

2.4.2 International activities

CLRTAP

USSR ratified CLRTAP in 1980. The Russian Federation is participant of only three of eight Protocols - Protocol of 1985 on sulfur, Protocol of 1988 on oxides of nitrogen, and EMEP Protocol of 1988. All obligations on reduction of emissions apply only to the European territory of the Russian Federation (ETR). The Russian Federation initiated the creation of a coordinating group on promotion of actions towards implementation of the CLRTAP in Eastern Europe, Caucasus and Central Asia (EECCA Coordinating Group). The Group has the objectives of developing approaches to atmospheric air quality regulation on national and transboundary level applying the CLRTAP mechanisms, providing assistance to the countries of the region concerning the accounting of air pollutant releases, implementing impact assessment on environmental systems and application of critical loads, analyzing corresponding techno-economic factors, and enhancing regional and international cooperation in the area of transboundary air pollution abatement.

EANET
The Russian Federation is also a participant of the EANET as it partially covers the Russian territory: Siberian and Far East regions. South-Eastern part of Asian Russia was equipped by appropriate instruments for performing measurements with accordance with EANET program. Four stations are currently in operation.

3 Identified Gaps and Recommendations for Subregional Cooperation in North-East Asia

3.1 Common Challenges and Institutional Gaps

Technical aspects such as the tools for monitoring, modeling, and assessment emerged as areas for abundant possibilities of cooperation. China and Republic of Korea explicitly expressed the need for improvement in such technologies. Also acknowledged in common by China and Japan was the challenge posed by the hemispheric and transboundary transport of air pollution. Because the transboundary phenomenon is a problem that transcends political boundaries, the challenge is particularly difficult and requires collaborated measures.

At the top of any country's priority is to heighten their efficiency in tackling a given set of problems. In this regard, the air pollution problems can be linked to the global issue of climate change. The 2011 UNEP/WMO report on the *Integrated Assessment of Black Carbon and Tropospheric Ozone - Summary for Decision Makers* and the UNEP report on the *Near-term Climate Protection and Clean Air Benefits: Actions for Controlling Short-Lived Climate Forcers (SLCFs)* both emphasized the need for integrated approach on climate and air pollution. Especially stressed were the need for co-benefits and co-control approaches for short-lived climate forcers such as tropospheric ozone and black carbon. In similar light, the Fifteenth World Clean Air Congress in September 2010 also highlighted the co-benefit approach linking air pollution and climate change in the Vancouver Declaration.

The Task Force on Hemispheric Transport of Air Pollution (TF-HTAP) within the framework of the Convention on Long-range Transboundary Air Pollution also issued the report *Hemispheric Transport of Air Pollution 2010* (UN Publication Air Pollution Studies No. 20), highlighting the benefits to integrating multiple management strategies for handling the air pollution challenges. In the report, integrated air quality management was described to include monitoring, modeling, creating emission inventories, devising mitigation measures, and assessing the impacts on public health and environmental quality. The TF-HTAP also emphasized the need to consider inter-continental (hemispheric) transport of air pollution.

China recognized major uncertainties related to long-term regional air pollution trends and predictions, air-pollution-climate change interaction, emission inventories (e.g. VOCs) and photochemistry mechanism that are specific to the certain areas of the country as well as across the subregion.

Japan highlighted the need for parallel consideration of local, transboundary and hemispheric air pollution and related climate change aspects, including tropospheric ozone and black carbon, to achieve co-benefits and use co-control approaches. Also recognized was the need for integrated air quality management covering air quality monitoring, emission inventories, dispersion modeling, impacts on public health and environmental quality and emission mitigation measures. Finally, the lack of a comprehensive regional framework covering air quality monitoring, emission inventories, dispersion modeling, impacts assessment, and emission mitigation measures in North-East Asia was put forward as a gap to be filled.

Sharing the concern with Japan, the Republic of Korea recognized the lack of a comprehensive regional framework to tackle transboundary air pollution in North-East Asia. On another note, strong links were thought to be missing between science (research) and policy issues related to air pollution assessment and mitigation. In terms of technical necessities – quantitative impact indicators for acidic gases, ozone and PM, and application of critical load and critical levels were suggested to need further development.

As an extension of the concerns expressed by all others, the Russian Federation identified the lack of a comprehensive approach to regional air quality monitoring and management in its Far East region of the country. This is because CLRTAP regime only covers the European territory for the Russian Federation. Better understanding is desired of transboundary air pollution transport and related effects on the territory of the Russian Federation lying in the North-East Asian subregion. The Russian Federation also recognized as a gap its limited participation in cooperation on transboundary air pollution issues in North-East Asia.

3.2 Formulating Options and Recommendations

Although various aspects of transboundary air pollution monitoring and assessment are addressed through numerous mechanisms, currently there is no subregional framework in East and North-East Asia that provides holistic approach covering all components of transboundary air pollution management, including science-to-policy mechanisms. Based on the Expert Consultation Meeting held in St. Petersburg 9-10 July 2012, the Russian Federation elaborated on the common points of recommendations that were identified among different countries.

- Develop a regional strategy addressing transboundary air pollution in North-East Asia;
- Develop a regional mechanism (framework) for cooperation that would take into account the identified gaps, building on experience and capacity of existing mechanisms;
- Address the air pollution-climate interaction while tackling short-lived climate forcers (SLCFs);
- Implement a holistic program of transboundary air pollution regulation including control of all main pollutants, air quality monitoring and emissions data gathering, atmospheric modeling, impact assessment on health and ecosystems, and an effective emissions abatement strategy;

- Strengthen connection between research and policy, using CLRTAP and its EMEP as a model; and
- Provide a channel for open and effective exchange of knowledge and data among members.

Building on the outcomes of the *Review of existing and required capacities for addressing adverse environmental impact of transboundary air pollution in North-East Asia* project activities and country reports submitted by national consultants, the Russian Federation put forward a proposal as shown in [Table 7]. In addition to the below proposal, another suggestion is establishment of an Expert Working Group under NEASPEC to make further recommendations on TAP areas of NEASPEC's work for the benefit of the whole subregion.

[Table 7] Key Points of the Russian Federation Proposal

The following key points are proposed as next steps that would promote cooperation and sustain the momentum created through the implementation of the *Review of existing and required capacities for addressing adverse environmental impact of transboundary air pollution in North-East Asia* project: • Create a subregional programme for monitoring and assessing transboundary air pollution in North-East Asia with participation of the NEASPEC member countries, similar to the EMEP programme within the framework of the UNECE Convention on Long-range Transboundary Air Pollution; • Set priorities for the programme in terms of assessment, modeling and monitoring of air pollution, e.g. focusing on anthropogenic emissions and the related transboundary air pollution or emissions from natural sources and/or others; • Decide on the spectrum of pollutant emissions that are subject to evaluation, monitoring, and modeling, e.g. particulate matter (PM), ozone, soot, nitrogen oxides, VOCs, methane, etc., as well as on the directions of impact assessment; and • Develop and adopt an institutional structure of the programme, which could include national topical centers of the NEASPEC member countries (e.g. center for monitoring air quality pollution, center for modeling transport and deposition of air pollutants, center for emission inventories, center for assessment of transboundary air pollution impacts, center for analysis of economic aspects of transboundary air pollution, etc.). *Strategic Approach* Implementation of the conceptual approach may be feasible to start with bi- and multilateral consultations among the NEASPEC member countries in order to form an overall strategy aimed at promoting regional cooperation on issues of assessment and ways of reducing transboundary air pollution in North-East Asia. Following the agreed framework, a priority should be given to development of the organizational structure of regional initiatives, work plans, investment plans, etc. Topical interaction between UN ESCAP SRO-ENEA (NEASPEC Secretariat), UNECE, Asian Development Bank and other international organizations should also be promoted.

Technical Approach
The technical aspect of the proposal may include preparation, approval and launch of a joint pilot project to assess the transboundary transport and deposition of air pollution in North-East Asia (e.g. covering partial or full territory of NEASPEC member States) using a single universal model (e.g., CMAQ) and on the basis of necessary data provided by countries in the subregion. Such an exercise can be based on the modeling work previously completed by LTP project and make use of the monitoring data from EANET and other national monitoring sites. In addition, the results of other relevant subregional, regional, and global programmes can be utilized during the pilot project, e.g. ABC, GAINS-Asia, CLRTAP Task Force on Hemispheric Transport, etc.

In 2009, Republic of Korea had also put forward a recommendation to create synergies among existing mechanisms, by integrating LTP into EANET. Although the two programmes opted to maintain their own identity, integration of LTP into EANET would have maintained the common principles of LTP and EANET through an all-inclusive participation as shown in [Table 8].

[Table 8] East Asia Program on Long-range Transboundary Air Pollutants (EAPLTP)

Vision
- Exchange information and make long-term collaboration to improve atmospheric environment in East Asia.

Principles
- Explore measures for mutual development, respecting conventional air quality endeavors as well as considering collaboration among existing mechanisms.
- Countries in East Asia shall participate in this effort voluntarily according to each nation's capability and condition.
- Explore a phased approach towards a legally-binding regional agreement.
  First Phase: accumulate scientific achievements via expansion of research scope and capacity building through technology transfer and awareness-raising.
  Second Phase: secure political support based on the achievements of the First Phase; make regional agreement through regional or UN-based organizations.
- Include sources of acid rain, photochemical pollutants, hazardous air pollutants, and climate change triggering pollutants in the long-range transboundary air pollutants.
- Give support in developing policy and strategies through research, monitoring, advising and information exchange.

Japan suggests that one network may not need to cover all the desirable functions. For instance, subregional frameworks may complement each other and serve as subsets that constitute a broader framework. As one suggestion, the Joint Forum may serve as a platform to discuss the actions taken by subregional frameworks, acting as the counterpart to European and North American networks. In this regard, it is suggested that subregional network(s) can provide adequate input to a regional forum to conduct inter-continental dialogues. Under any circumstances, carefully considering the roles of subregional frameworks in regional and global contexts is deemed as an essential component.

The July 2012 Expert Consultation Meeting recognized that North-East Asian transboundary air pollution cooperation mechanism (framework) can benefit from building upon the capacities and experiences that NEASPEC has generated over nearly two decades of its existence. Throughout the project consultations, establishing a Working Group under NEASPEC was suggested for holding regular meetings of experts and for working on policy-oriented aspects. It is also suggested that related technical cooperation activities to support the policy work of the working group may be included in its mandate with NEASPEC serving as the Secretariat. The working group would gradually elaborate on the required steps for solidifying subregional cooperation.