



# clearing the air

POPs  
**SO<sub>2</sub>**  
HNO<sub>3</sub>  
AMMONIA  
PM<sub>2.5</sub>  
2009  
energy  
yield losses  
human health  
agriculture  
traffic  
acidification  
industry  
eutrophication  
health  
losses  
agriculture  
eutrophication  
acidification  
industry

**NO<sub>x</sub>** NITROGEN DIOXIDE  
**SO<sub>2</sub>** SULPHUR DIOXIDE  
AMMONIA  
HNO<sub>3</sub>  
VOCs  
VOCs




UNITED NATIONS

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clearing the air





→ The atmosphere is one of the largest waste disposal units for mankind. It has handled gaseous and particulate waste from combustion and other human activities for hundreds of years. These activities have had serious consequences such as acid rain, the degradation of valuable ecosystems and agricultural soils, and detrimental impacts on human health.



## → A thirty-year fight continues...

It was in Scandinavia in the late 1970s that the problems of acid rain were first observed. People began to realize that the origins of this pollution was not in their national boundaries. In 1979, some 30 nations signed the Convention on Long-range Transboundary Air Pollution (CLRTAP). Initially aimed at reducing the effects of acid rain through control of the emissions of sulphur, its scope later widened to include nitrogen pollutants, volatile organic compounds, heavy metals and persistent organic pollutants. The Convention functions within the United Nations Economic Commission for Europe (UNECE) of which all the countries of Europe, the Caucasus and Central Asia are members, as well as the United States and Canada. The Convention entered into force in 1983; currently, 51 out of the 56 UNECE member States are Parties.

The Convention provides a general framework for collaboration to limit, gradually reduce and prevent air pollution. It has been extended by eight protocols that impose concrete obligations to tackle specific pollutants and environmental problems. The sufficiency and effectiveness of these obligations are regularly under review.



# From acid rain...

## Nitrogen Oxides and Sulphur Dioxide

Acid rain is a result of air pollution. When any type of fuel is burnt, a lot of different chemicals are produced. The smoke that comes from a fire or the fumes that come from car exhaust do not just contain the sooty grey and black particles that you can see – they also include invisible gases that can be even more harmful to our environment. Some of these gases (especially nitrogen oxides and sulphur dioxide) react with the tiny droplets of water in clouds to form sulphuric and nitric acids. The rain from these clouds falls as a very weak acid – which is why it is known as “acid rain”. In the effort to curb air pollution impacts, the Convention targeted two key pollutants early on: nitrogen oxide ( $\text{NO}_x$ ) and sulphur dioxide ( $\text{SO}_2$ ). Both of these pollutants have decreased significantly.



### SULPHUR DIOXIDE ( $\text{SO}_2$ )

Emitted when fuels containing sulphur are burned

Contributes to acid deposition leading to adverse affects on materials, and terrestrial and aquatic ecosystems

Since 1990, emissions of  $\text{SO}_2$  have decreased by about 70% in Europe and about 35% in the United States

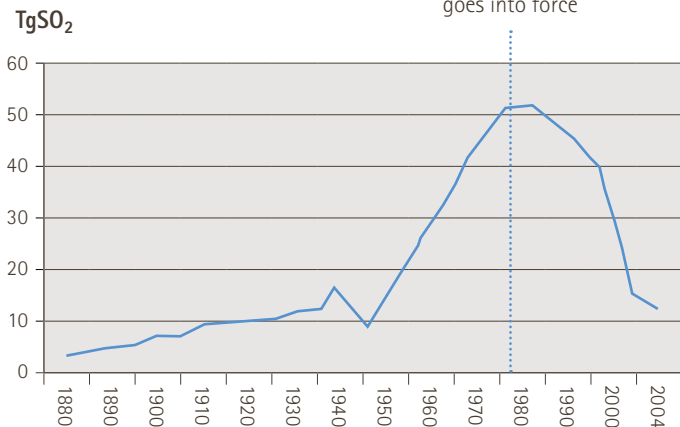
### NITROGEN OXIDES ( $\text{NO}_x$ )

Also contributes to acid deposition and is responsible for eutrophication, reduction in water quality and species richness, and contributes to ground-level ozone formation

Associated with adverse affects on human health as high concentrations cause respiratory illnesses

Since 1990, European  $\text{NO}_x$  emissions have been reduced by 35% while U.S. emissions have been reduced by 25%

The Convention on Long-range Transboundary Air Pollution goes into force



Emissions of sulphur dioxide in Europe over the period 1880–2004

Source: Verstreng et al. *Atmospheric Chemistry and Physics* 2007



# ...to air pollutants with severe health and environmental effects

## Persistent Organic Pollutants, Volatile Organic Compounds and Heavy Metals

As the detrimental effects of air pollution are linked to numerous issues ranging from human health to ecosystem degradation, the Convention has extended its influence by regulating an increasing number of harmful pollutants through its protocols. These include volatile organic compounds (VOCs), persistent organic pollutants (POPs), and heavy metals. Over the past 30 years, the targets for these pollutants have become increasingly stringent, and member countries have consistently worked to reduce emissions in the effort to curb air pollution impacts.



### Volatile Organic Compounds

The Convention's VOC and Gothenburg protocols establish strict emissions targets for these air pollutants

Are responsible for the formation of ground-level ozone, amongst other harmful substances

Emitted from various sources of combustion (i.e. vehicular, industrial), dry-cleaning and paint application

Evidence that relative leukemia and lymphoma can increase through prolonged exposure to VOCs

### Persistent Organic Pollutants

The Convention's protocol on POPs addresses pesticides, industrial chemicals, by-products and contaminants

The Protocol notably bans the production and use of some of these toxic substances, while severely restricting the use of others

Exposure can cause the disruption of the endocrine, reproductive, and immune systems; neurobehavioural disorders; and cancers

### Heavy Metals

The Convention's protocol on Heavy Metals focuses upon reducing lead, cadmium and mercury

The Protocol obliges its Parties to reduce the emissions through actions such as the phasing-out of leaded petrol

Exposure to these three metals has been linked to increased risk of cancer, respiratory illness, neurological disorders and ecosystem degradation

# Tackling multiple effects with multiple targets

## The Gothenburg Protocol

The impacts of air pollution are vast and require an integrated approach that can reduce the levels of multiple pollutants and thus better protect the environment and our health. In response the Convention's Gothenburg Protocol entered into force in 2005, with 25 countries ratifying it, thus far. The Protocol sets emission ceilings for 2010 for four pollutants: sulphur, NO<sub>x</sub>, VOCs and ammonia. It addresses acidification, eutrophication and ground-level ozone in an effect based and integrated manner, motivated by the substantial increase in cost-effectiveness of a combined policy strategy. It has been estimated that this combined approach will reduce the cost of air pollution policy by about 75% as compared to a single pollutant approach. The Protocol is expected to be extended via the inclusion of particulate matter (PM<sub>2.5</sub>) – a harmful pollutant linked to higher rates of asthma and respiratory illness, and through the acknowledgement of links to climate change. For the purpose of analyzing integrated emission reduction strategies, integrated assessment models have been developed. Such models have allowed for the development of scenarios showing how to achieve multiple environmental goals in a cost-effective manner.



Sources .....

Emitted  
compounds .....

Effect-causing  
pollutants .....

Effects/receptors .....





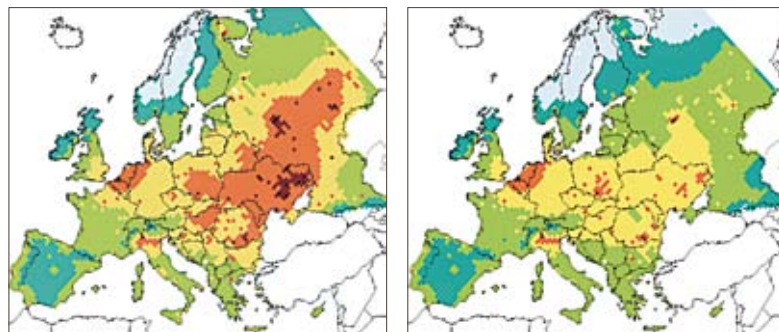




# Scientific Networks

Strong science is a major reason for the Convention's success. Experts within its scientific and technical programmes/networks work together in a wide variety of ways, and the results of their research and monitoring not only inform actions under the Convention, but often lead the way to domestic and subregional initiatives. For data collection, the Convention relies on its various networks, all of which are based on the latest science to air pollution policy development.

While the Convention's early work on effects addressed only sulphur compounds, it covered all receptors, i.e. materials, health, aquatic and terrestrial systems. The effects-oriented activities were later organized into the International Cooperative Programmes (ICPs), and the Joint Task Force on Health. Today, they form the world's largest network for scientific monitoring and modelling of air pollution effects. The work includes the development of key indicators for environmental sustainability targets, critical loads and levels, for use in formulating policy.



Baseline projection 2020

With measures scenario 2020



Loss in statistical life expectancy due to anthropogenic  $PM_{2.5}$

Source: Convention's Centre for Integrated Assessment Modelling, 2009

## Emissions, Atmospheric Monitoring and Modelling

The Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP) provides sound scientific support, particularly in the areas of emission inventories and projections, atmospheric monitoring and modeling, and integrated assessment. EMEP also evaluates current and new emission scenarios, including their long-term costs and economic benefits. These results help countries negotiate obligations and abatement strategies for the pollutants addressed by the Convention. They are also used by policymakers to develop and implement national air pollution control measures and actions across regions.

# Assessing the Impacts

## Human Health

Nearly all of the pollutants covered under the Convention have been linked to adverse health outcomes. From disproportionately higher rates of asthma to an increased risk of cancer, the health impacts of air pollution pose a threat to humanity regardless of age, gender or location.

The Convention addresses these risks through the Joint Task Force on Health, a joint programme of the Convention's Executive Body and the World Health Organization, scientists, and researchers working in the field. Through research and analysis, the Joint Task Force helps the Convention to incorporate the latest findings on health impacts into its policies.



## Rivers and Lakes

The acidification of freshwater systems is caused by sulphur emissions and nitrogen deposition. A higher acidity in these systems has been found to be detrimental to species and ecosystems causing visible changes in fish populations and migration patterns.

The Convention addresses these concerns through the International Cooperative Programme on Assessment and Monitoring of the Effects of Air Pollution on Rivers and Lakes, which monitors and assesses acidification of rivers and lakes, providing policymakers with the data required to establish effective targets.



## Agriculture and Vegetation

The potential for damage to vegetation by air pollution in many areas of Europe, the Caucasus, Central Asia and North America are high and the annual economic costs may be considerable. The Convention supports researching the underlying science for assessing vegetation effects through several of its International Cooperative Programmes, including those on vegetation, forests, and modeling and mapping. These are responsible for analysing research data (or providing research data) so the Convention can better understand the risks and find effective solutions.



## Historic and Cultural Monuments

Studies of materials have indicated the costs of atmospheric corrosion influenced by acidifying pollutants. Air pollution can also damage calcareous stones, medieval glass and metals found in historic and cultural monuments. The preservation of these structures is the major focus of the International Cooperative Programme on Effects on Materials, including Historic and Cultural Monuments. The group evaluates trends in corrosion and soiling due to air pollutants.





## A Hemispheric Approach: North America

North America has benefited greatly from the U.S. and Canadian participation in the Convention. Its strong science and modelling have shown how other countries impact North America's environment, particularly in vulnerable northern areas. Canada and the United States implement the Convention's provisions through bilateral agreements: cooperating on long-range transport of air pollutants under the 1991 Canada-U.S. Air Quality Agreement, the Great Lakes Binational Toxics Strategy, and under the Commission for Environmental Cooperation and the Border Air Quality Strategy, launched in January 2003.

Canada and the US implement the Convention's provisions through domestic and bilateral programs, including the 1991 Canada-US Air Quality Agreement, the Great Lakes Binational Toxics Strategy, the Border Air Quality Strategy, and the Commission for Environmental Cooperation. For heavy metals, wide-ranging domestic programmes in both countries have established emission standards for sources that emit mercury, cadmium and lead compounds. Both countries are committed to working together to better understand the relationship between air pollution and health, with collaborative efforts also under way between the U.S. Health Effects Institute and the European Union.

In addition, the Convention's Task Force on Hemispheric Transport of Air Pollution (HTAP) utilizes its network of scientific researchers to further understand the link between the Europe and North America, with respect to transboundary air pollutants.



## An Integrative Approach: Central Asia and Eastern Europe

Until recently, the five countries of Central Asia had not been involved with the work of the Convention. In recent years, however, Kazakhstan and Kyrgyzstan became Parties to the Convention and have indicated their intention to become more involved with its work and protocols. Tajikistan, Turkmenistan and Uzbekistan have also shown an interest in becoming Parties to the Convention and certain of its protocols. UNECE has a particular interest in assisting Central Asian countries in their future development, and a United Nations-funded project will be helping to develop emissions reporting, pollution monitoring and clean-coal combustion technology in the Central Asian subregion.

While most nations in Eastern Europe have signed the Convention, they have had difficulty in ratifying and complying with the pollutant targets set out by the Convention's protocols. In response to this concern, the POPs, Heavy Metals, and Gothenburg Protocols are being revised and will include more flexibility with their targets, with the aim of helping these nations replace outdated technology and successfully meet the Protocols' goals.



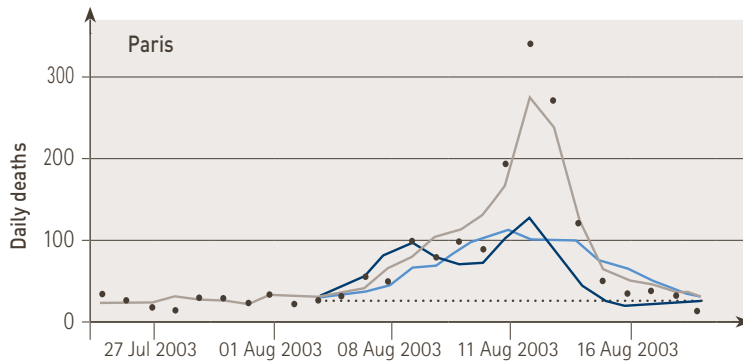


# The Climate Change Factor

Climate change and air pollution are major environmental problems, and their impacts reach far beyond national boundaries. Both problems can only be solved if emission reductions are carried out over large areas, which underlines the need for extensive international cooperation.

Air pollution and climate change strongly overlap in terms of emission sources, primarily the combustion of fossil fuels and livestock farms. Thus, measures to abate air pollution and greenhouse gases tackle the same sources. The challenge is to bring climate change and air pollution policy together, using a multi-substance and multi-effect approach that builds on the same integrated science.

The graph below highlights this link, as record-breaking temperatures combined with the presence of ozone, during the 2003 summer heatwave in Paris, resulted in a significant increase in the daily number of deaths. In response to this concern, the Convention's Gothenburg Protocol is a step in the right direction. The multi-substance approach is a model for potential policies that would reduce pollutants the Convention covers, which are linked to climate change.



- Max Min
  - Full model
  - Ozone
  - Actual deaths
  - ... None
- MaxMin curve = mortality effect of temperature  
Ozone = mortality effect of ozone  
Full model = combined effect  
None = background mortality without heat wave

Daily reported and modelled mortality in Paris related to heat and ozone exposure during the 2003 heat wave. *Source: Dear et.al. 2005.*



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moving forward

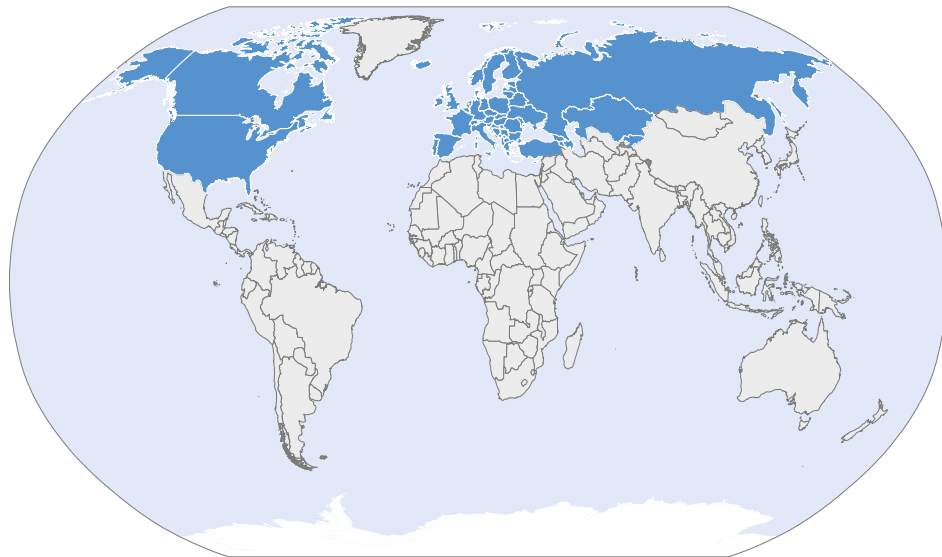


.....> For 30 years, the Convention on Long-range Transboundary Air Pollution has been a consistent voice in the fight against air pollution. As it moves forward, the Convention has already initiated negotiations for stricter pollutant targets for 2020, and has also developed aspirational targets for 2050. It is continuing to engage both Eastern European and Central Asian countries by providing them with the relevant capacity-building tools to join and comply with the Convention's protocols. The Convention recognizes the importance of working in an integrated manner to combat climate change, and has initiated dialogue with international organizations to explore synergies and solutions.

Realizing the transnational impact of air pollution, the Convention plans to further its global cooperation by providing technical assistance and guidance to other regional United Nations commissions (for Asia, Latin America and Africa), as the fight against air pollution goes global.



The Convention on Long-range Transboundary Air Pollution has been ratified by 51 countries, making it one of the most regionally inclusive and successful United Nations environmental agreements.



[www.unece.org/env/lrtap](http://www.unece.org/env/lrtap)

### The Protocols of the Convention on Long-range Transboundary Air Pollution (CLRTAP)

- The 1999 Protocol to Abate Acidification, Eutrophication and Ground-level Ozone
- The 1998 Protocol on Persistent Organic Pollutants (POPs)
- The 1998 Protocol on Heavy Metals
- The 1994 Protocol on Further Reduction of Sulphur Emissions
- The 1991 Protocol concerning the Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes
- The 1988 Protocol concerning the Control of Nitrogen Oxides or their Transboundary Fluxes
- The 1985 Protocol on the Reduction of Sulphur Emissions or their Transboundary Fluxes by at least 30 per cent
- The 1984 Protocol on Long-term Financing of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP)

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