14 Combatting “Acid Rain”: Protecting the Common European Sky

Abstract In the late 1960s, Scandinavian scientists asserted that the long-range air pollution was causing serious acidification and that emissions all over Europe would have to be diminished. The prevailing view at the time was that air pollution was a local phenomenon best handled by building high smokestacks, and the major polluting countries were opposed to spending money on protecting areas far away in other countries. This chapter analyses how the discovery of “acid rain” triggered the first international research projects to confirm long-range air pollution and how, in a second phase, international negotiations involving scientists, policymakers, and diplomats resulted in the Convention on Long-Range Transboundary Air Pollution in 1979. Later on, special protocols were adopted, and the signing nations promised to decrease their emissions in accordance with specific goals. Cold War politics played an interesting role in the negotiations and led to an unexpected alliance between Nordic countries and the Soviet Union.

Keywords acidification; LRTAP Convention; Waldsterben; best available technology; critical loads

1 Introduction

On 24 October 1967, the influential Swedish newspaper Dagens Nyheter published an article with a boring title, “The Acidification of Precipitation”.¹ The message, however, was new and radical: air pollution was not only a local but also an international phenomenon. The author, the Swedish scientist Svante Odén, claimed that “there is a more or less permanent cupola of polluted air over Europe”.² Sulphur dioxide, he wrote, being emitted in large quantities by power plants and industries burning sulphurous coal or oil all over Europe, was being transported through the air over vast distances and transformed into sulphuric acid through chemical processes in the atmosphere. Odén further

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argued that when rain or snow brought the airborne sulphuric acid down, usually in places far away from where the emissions had taken place, it lowered the pH values in streams and lakes (see figure 1). In Sweden and Norway, this in turn contributed to the drastic decrease of fish populations in many lakes that had recently been observed by fishery experts. Moreover, he predicted that increasing acidity would reduce the future biological productivity of forests and of cultivated land, particularly so in the Nordic countries, where soils were especially sensitive to acidification.³

![Figure 1: This map accompanied Odén's article in the Dagens Nyheter and had the following caption: “A map of the pH of precipitation over Europe in 1962. Note the acidic finger that extends up over the Baltic”.](image)

By publishing his findings in a leading daily paper, rather than a scientific journal, Odén was able to immediately attract attention to his alarming message far beyond the academic community. Officials at the newly established Swedish
Environmental Protection Agency (SEPA) became very concerned, whereas industry representatives questioned his findings, fearing that the government might respond by taxing sulphur emissions. SEPA, recognizing the international dimension of acidification, or acid rain as it was called, searched for a suitable arena in which the issue of acid rain could be launched. At the time, the Organization for Economic Co-operation and Development (OECD) was one of the few environmentally active intergovernmental bodies, and in February 1969, SEPA introduced the acidification issue at a meeting of the OECD’s Air Quality Committee. There, Odén’s scientific findings encountered considerable scepticism because they challenged a politically convenient scientific consensus. One by one, the air quality experts present “stood up and explained that, outside an inner zone of only a few kilometres, sulphur emissions were no problem”, as the SEPA representative, Göran A. Persson, later recalled.⁴

The predominant view among scientists and experts at the time was that air pollution was a local phenomenon. The atmosphere was seen as a giant diluting machine, offered by nature for free. Most experts viewed the building of tall smokestacks as the most effective measure to deal with air pollution. They argued that sufficiently tall stacks led to an effective dispersion of sulphur and other pollutants, rendering their concentrations harmless before they hit the ground.⁵ Odén seriously questioned this prevailing consensus, arguing that the atmosphere must rather be seen as an efficient transport infrastructure capable of redistributing pollutants from industrial regions to faraway places elsewhere in Europe. His view reflected an emerging ecological conception of the earth as a cohesive biosphere – as Barry Commoner was to phrase it in 1971 – where “everything is connected to everything else” and “everything has to go somewhere”.⁶ Put differently, Odén claimed that Europe had a common sky. The political implication was clear: the problem of air pollution would have to be addressed on an international level.

This chapter analyses how the “discovery” of acid rain gradually led to an understanding of the transnational character of air pollution. This in turn triggered international negotiation involving scientists, policy-makers, and diplomats, resulting in the Convention on Long-range Transboundary Air Pollution (hereinafter LRTAP Convention), signed in Geneva in 1979.⁷ This convention did not impose any legal obligations on the signing nations, but it established an international regime for further negotiations, leading to the formulation and adoption of a number of so-called protocols. The countries signing these later protocols promised to fulfil concrete goals on decreasing emissions, and these protocols thus contributed to a joint international protection of the common European sky from pollution. Hardly surprising, a number of countries in
North-Western Europe were the main drivers of the process, though at times in an unexpected cooperation with the Soviet Union.

Before delving into these international processes from the late 1960s and onwards, I will first give a brief background of how air pollution had been understood until then.

2 The Era of the Chimney

In the eighteenth and nineteenth centuries, the combustion of coal in the industrial towns and regions of Europe grew rapidly, and, as a result, the air became increasingly polluted. By the late nineteenth century, many industrial regions in Europe were suffering from chronic air pollution, to which, astonishingly, the inhabitants became more or less inured. In fact, the pollution only became evident on those few rare occasions when it was greatly minimized for one reason or another.

One such hiatus occurred in January 1923, when the Ruhr district was occupied by French troops because Germany had failed to pay its war reparations according to the terms of the Treaty of Versailles (1919). The German workers went on strike, and industrial production in the entire Ruhr ground to a sudden halt. As a result, the sky over the Ruhr cleared up for the first time in many decades. The harvests that summer were much more bountiful than normal, trees grew faster than ever before, and housewives did not have to scrub their homes twice a day. However, the strikes led to an economic crisis, with hyperinflation and mass poverty – especially among the families of the strikers. Therefore, it was a relief for the population in the Ruhr district when the strikes were called off in September. When production resumed, the “normal” smoke came back, and it was in fact seen as a blessing.⁸

The unexpected clearing of the sky during the long strike had very clearly demonstrated the gravity of the air pollution, and in 1924 an official committee was set up to investigate its effects. One of its main conclusions was that it was not the visible smoke and ash but rather the invisible sulphuric acids that were the most damaging pollutants. However, the committee could not identify any feasible measures for reducing these emissions and concluded “that the battle against air pollution by large industries seems to have little chance of success”. Instead, it proposed adaptive measures like the planting of species of deciduous trees that are more resistant to sulphuric acids.⁹

The rather laconic attitude of this committee was typical of the way air pollution was treated in many heavily polluted industrial areas of Europe and elsewhere until the mid-twentieth century. Air pollution was seen as an almost
inevitable side effect of the industrial production that provided employment and prosperity to the very people that were most affected. This is not to say that there was no resistance at all. For example, in Manchester, in England’s industrial heartland, an elite group of urban reformers were pursuing investigations of air pollution as early as the second half of the nineteenth century. However, it was not able to muster enough political support to get laws enacted that would curb emissions.\(^{10}\) One of the reformers was a chemist, Robert Angus Smith, who systematically investigated the content of rainwater in and around the city of Manchester in the 1850s and 1860s. He emphasized the detrimental effects of sulphur emissions, and in an extraordinary book entitled *Air and Rain: The Beginnings of a Chemical Climatology* (1872), he actually first used the term “acid rain”.

The only feasible strategy for coming to grips with the most dangerous health effects of air pollution seemed to be the building of ever-higher smokestacks.\(^{11}\) When gases and particles were emitted into the atmosphere at high altitudes, winds dispersed them across the surrounding landscape, thereby reducing the concentrations of hazardous substances – or so it was believed – to levels that were no longer harmful.

### 3 The “Killer Smog”

However, even if industries built tall smokestacks, innumerable household furnaces still emitted pollutants. Occasionally this produced dangerous smog. In December 1952, London faced a combination of cold weather, intensive use of furnaces, and an absence of wind, generating very high concentrations of smoke particles in the city. Four thousand people lost their lives. This tragedy contributed to a change in British perceptions of air pollution. In response to the “killer smog”,\(^{12}\) the parliament passed the Clean Air Act (1963), introducing severe restrictions for smoke emissions in heavily polluted areas. In “smoke control areas”, households and industries could only use “smokeless furnaces”, being forced to switch from coal to electricity, gas, or low-sulphur oil.\(^{13}\)

The Clean Air Act was a first step towards a new paradigm for reducing air pollution developed by newly professionalized environmental experts. In this paradigm, dedicated energy systems such as electricity, gas, and district heating played a key role. These systems converted “dirty” fuels into user-friendly and fairly clean energy carriers and then distributed them via a specially designed physical network. Large plants, in which the combustion process could be carefully controlled and the amount of pollutants reduced, accomplished this conversion. The remaining smoke was emitted through high chimneys. Many European
countries began applying this new approach to reduce pollution starting in the 1950s. Furthermore, new environmental protection agencies were established to enforce these laws. By the 1960s, similar kinds of national measures had been taken in most of the industrialized countries of the West. The focus was primarily on mitigating the deleterious public health effects of air pollution.¹⁴

Until the late 1960s, air pollution was thus seen as a local issue that could be handled by national authorities. However, it was appreciated that large industrial plants located near national borders could easily be a source of serious transborder pollution. In the 1930s and 1940s, there had been a spectacular conflict of this kind in the western part of North America. A huge lead and zinc smelting plant located in the little town of Trail, Canada, a few kilometres from the US border, was identified as the source of the heavy pollution experienced across the border by farmers in the state of Washington. The American farmers protested vigorously and succeeded in mobilizing the high-level support of President Franklin D. Roosevelt, who wrote a letter of protest to his colleague, the prime minister of Canada. The two governments set up a special arbitration tribunal. In its final decision, in March 1941, this tribunal proclaimed a general principle:

No state has the right to use or permit the use of its territory in such a manner as to cause injury by fumes in or to the territory of another or the properties of the persons therein, when the case is of serious consequences and the injury is established by clear and convincing evidence.¹⁵

In accordance with the principle, the Canadian government took on the responsibility of ensuring that the Smelting Company in Trail reduced its effluent burden and financially compensated the US farmers that had been affected by the pollution.¹⁶ This general principle, known as the Trail Smelter Convention, became famous in international law and was brought to the fore in Europe 30 years later, as will be described below.¹⁷

4 Putting Acid Rain on the International Agenda

Today, when the perception of air pollution as an international problem has become almost self-evident, it may be hard to understand how controversial the claim of large-scale transborder air pollution was in the late 1960s, as the reactions of the experts in the OECD’s Air Quality Committee to Odén’s findings demonstrate. At that time, the building of high smoke stacks was seen as an easy and effective measure to solve the problem of air pollution. It was based on a percep-
tion of the atmosphere as a more or less limitless sink.\textsuperscript{18} Were this conception to be abandoned, new abatement technologies would clearly be needed, and this might lead to high costs for many power companies and industrial firms. However, in spite of its scepticism, the OECD committee did in fact appoint an expert group to take a closer look at the Swedish data.\textsuperscript{19}

Swedish government representatives also presented the findings on acid rain at the meetings with Nordic neighbour countries, which, according to Odén's research, were also strongly affected by imported acid rain. Not surprisingly, the message got a much warmer reception than at the OECD, and the Nordic Research Council decided to initiate a joint research programme to investigate the acidification issue further. This Nordic research team contacted the expert group appointed by the OECD, and together they made plans for undertaking a more ambitious survey. In April 1972, the OECD adopted this plan and decided to initiate the so-called Co-operative Technical Programme to measure the long-range transport of air pollutants. Eleven Western European countries – Austria, Belgium, Denmark, Finland, France, the Netherlands, Norway, Sweden, Switzerland, the UK, and West Germany – agreed to participate.\textsuperscript{20}

Meanwhile, the Swedish government continued to look for international arenas to promulgate the issue of acidification, arenas that also included the Eastern European countries. A very attractive option had appeared in December 1968, when the General Assembly of the United Nations (UN) voted to convene the United Nations Conference on the Human Environment, later held in June 1972. Sweden offered to host the conference and was thus able to influence the agenda. The Swedish government prioritized the issue of acid rain and appointed an expert group to prepare a study on the subject. The group was chaired by Professor Bert Bolin, Sweden's leading meteorologist, and also included Odén as member. In 1971, it presented its report: \textit{Air Pollution Across National Boundaries: The Impact on the Environment of Sulphur in Air and Precipitation}, based on research conducted in the previous year. In this report, the concept of “transboundary air pollution” was launched, and it was demonstrated that the large-scale dispersion of sulphur over Europe had a certain tendency towards the east and north-east due to the prevailing winds. The authors emphasized that the transboundary character of air pollution had political implications and that “adjacent countries intervene in each other’s economies through the effects of atmospheric pollutants”.\textsuperscript{21}

However, the report's reception at the conference was somewhat of a disappointment to the authors and the Swedish government. Although the report and its findings were strongly supported by Norway and the other Nordic countries, which had in the meantime also discovered acidification in their environments, the large majority of the participating European countries saw the acidification
problem as mainly a Nordic problem, linked to the lime-deficient soils in this region, which were incapable of buffering the acids. They did not want to impose expensive restrictions on their own power plants and industries to protect fish and forests in the Nordic countries.\(^2\) Another disappointment for the conference organizers was occasioned by the long shadow of the Cold War. The Eastern European countries (apart from Romania) boycotted the conference in solidarity with the German Democratic Republic, whose delegates had been refused visas by the Swedish government.\(^3\)

That said, the conference was quite successful in other respects. It led to the establishment of the United Nations Environment Programme and to the adoption of a declaration of principles, the UN Stockholm Conference Declaration (1972). Particularly important was Principle 21 in this declaration:

States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction.\(^4\)

In the fall of 1972, this principle, with its roots firmly planted in the Trail Smelter arbitration, was also adopted by the Eastern European countries in a session at the UN in New York.\(^5\)

5 Joint Research Projects

A number of international research projects to monitor long-range air pollution were carried out in the 1970s. In 1973, the above-mentioned OECD survey was launched with eleven countries participating, under the leadership of Sweden and Norway. Data about emission, dispersion, and deposition of pollutants (primarily sulphur and sulphur acids) were collected from the whole of Western Europe. By 1977, the OECD was able to publish a final report that indeed confirmed the scope and severity of transboundary air pollution.\(^6\) Parallel to this study, other organizations, in particular the United Nations Economic Commission for Europe (UNECE), also initiated projects to monitor and map air pollution that now also included scientists from Central and Eastern European countries. Gradually these various efforts coalesced, and the UNECE took the lead in establishing the ambitious Co-operative Programme for Monitoring and Evaluation of the Long-Range Transmission of Air Pollutants in Europe (also known as the European Monitoring and Evaluation Programme, EMEP).\(^7\)
These research projects brought together researchers from many countries and from numerous fields like meteorology, chemistry, limnology, forestry, geology, computer science, mathematical modelling. The set of scientific specialties here reflects the complex and comprehensive nature of the pollution processes involved, yet gradually a common view of transboundary air pollution and its environmental effects developed. The researchers also built up mutual trust; they became an “epistemic community” in the field of air pollution, to use a concept coined by the American political scientist Peter Haas. A particularly important aspect of these scientific efforts was the development of sophisticated mathematical models of the geographical flows of pollutants and the chemical transformations to which they were subject. In the 1950s and 1960s, access to more and more powerful computers had enabled meteorologists to develop mathematical models of atmospheric systems for weather forecasts, and these models could also be applied to pollution studies in order to make the air pollution threats “visible” to the public. The meteorological institutes in Stockholm and Oslo had been leading centres in this research, and it is not surprising that these institutes came to play key roles in the EMEP and OECD programmes. 

Research from the 1970s confirmed the long-suspected asymmetrical character of the acidification problem. Long-range air pollution did not spread evenly in all directions but according to the prevailing wind patterns, thus primarily in eastern and north-eastern directions (due to the rotation of the earth). This finding implied an asymmetry: while some countries, notably the Nordic countries, were net importers, others were net exporters of pollutants. This asymmetry was aggravated by the fact that some of the net importing countries had soils with low lime content, which made them more vulnerable to acidification.

Even if scientists from different European countries were gradually able to reach a consensus about the extent and the nature of the acidification, its asymmetrical character made it an extremely difficult political problem. The net importing countries called for the introduction of efficient measures to diminish the emissions, while the net exporting countries had few incentives to impose extra costs on their polluting industries. What complicated the matter even more was that the net exporters were big and powerful nations like Germany, Great Britain, and France, whereas some of the main net importers, like the Nordic countries, were fairly small, at least in terms of inhabitants and political power. Other major net exporters like Poland, Czechoslovakia, and Bulgaria, situated on the other side of the Iron Curtain, were, from a Nordic perspective, even less susceptible to influence. A political deadlock seemed almost inevitable. However, political developments on a high level, far removed from environmental politics, would ultimately break this deadlock.
6 Pollution and Cold War Politics

In the mid-1960s, after the Cuban missile crisis brought the world to the brink of nuclear war, the two superpowers embarked on the road to a lasting détente. The major symbol of this détente process was the Conference for Security and Co-operation in Europe, which was in session from 1973 to 1975 with the participation of the USA, Canada, and 33 European countries, including the Soviet Union. The end result was the Helsinki Final Act (1975), entailing an agreement to cooperate in three areas, or “baskets”: armaments control, human rights, and economic affairs. The third basket includes a sub-basket about cooperation on environmental issues. However, it subsequently turned out to be very challenging to make any progress in the three main areas. Both superpowers were reserved about arms control, the East was not inclined to promote human rights, and economic cooperation also proved difficult to achieve. But both sides were still eager to have something come out of the Helsinki agreement, and when the Soviet Union proposed cooperation in the environmental arena, the Western countries responded positively (see also chapter 10 by Laakkonen and Räsänen). Both sides expected negotiations in this area to lead to rather undemanding obligations, and the UNECE was chosen as a convenient arena.

Soviet policy-makers and experts looked for suitable environmental issues and identified the problem of acid rain as an interesting issue. They knew that this was of great concern to the Scandinavian countries. Moreover, Soviet scientists had undertaken a preliminary study that revealed that the Soviet Union was also a major net importer of air pollution. The study indicated that acid rain caused annual losses of more than USD 150 million to Soviet agriculture. At the beginning of 1978, the Norwegian minister of environmental protection, Gro Harlem Brundtland, was invited to Moscow. Upon arrival, she argued for an international convention on the reduction of sulphur emissions, and to her surprise, she met with sympathy from her hosts. This led to an alliance between Norway and the Soviet Union aimed at organizing such a convention within the framework of the UNECE.

Subsequent negotiations in Geneva were thus characterized by what, from a Cold War perspective, could only be seen as an unholy alliance between Norway and the Soviet Union. However, from an environmental perspective, taking into account the asymmetrical character of acidification, it was an alliance between two net importers of pollution. The Soviet Union promised to “take care of the position of other socialist countries during the negotiations” – as Valentin Sokolovskiy, the chief Soviet negotiator, put it – while Norway agreed to agitate for a convention in the West. Norway, in close cooperation with its Nordic neigh-
bours, was able to exert a kind of moral pressure on the Western European countries. Norway’s case was supported by the final OECD report from 1977, which confirmed what the Scandinavians had been arguing for a decade: large-scale transborder air pollution was indeed taking place in Europe and was causing severe environmental damage in many parts.

The Nordic countries aimed at a convention with binding commitments for reducing sulphur. This, however, encountered tough opposition from many Western European countries, which believed that they did not have any domestic acidification problem and were not prepared to take on the costs of reducing their emissions. Opposition collapsed when the Nordic countries dropped the demand for reduction commitments. Great Britain and France agreed to a non-committing convention, and the most stubborn holdout, West Germany, finally succumbed to pressure from all the other countries. The Soviet Union kept their promise about convincing their allies, and in November 1979, the LRTAP Convention was agreed upon and signed by representatives from 33 countries. Most European countries signed the treaty, as did the USA and Canada.

Even if the convention did not impose any binding obligations on the signatory countries, its adoption could still be seen as an important first step for handling long-range transboundary air pollution. The preamble of the convention – referring to Principle 21 of the UN Stockholm Conference Declaration and the guiding principle of the convention, formulated in Article 2 – states that

> The Contracting Parties, taking due account of the facts and problems involved, are determined to protect man and his environment against air pollution and shall endeavour to limit and, as far as possible, gradually reduce and prevent air pollution including long-range transboundary air pollution.

Most importantly, the convention established an international regime for further negotiations: it formulated a set of rules and created an organizational structure with the Executive Body, comprising government officials from the signatory countries, that would meet once a year, and a permanent secretariat. In addition, a number of ad hoc work groups, research programmes, and task forces were set up, which provided the growing epistemic community of researchers and experts on air pollution with a stable transnational platform. Finally, the convention secured the continuation of the monitoring and evaluation programme for air pollution, the EMEP. However, the participation in this regime by countries in Eastern and Southern Europe was not very enthusiastic in its early years. In particular, in Eastern European countries, environmental problems were not among the official priorities, and they felt forced into the convention by the Soviet Union. After a period of initial obstruction, these countries gradually took part
in the regime by submitting air pollution data, sharing knowledge, and participating in various task forces.\textsuperscript{37}

7 Waldsterben and Tote Board Diplomacy

In the spring of 1982, ten years after the UN conference on the environment, Sweden hosted a conference on the topic “Acidification of the Environment”. At this conference, the German biochemist Bernhard Ulrich presented a study arguing that 1,000,000 hectares of forests in Central Europe were at risk of acid deposition, with 100,000 hectares already dying. The phenomenon of Waldsterben (dying forests, see chapter 7 by Hölzl/Oosthoek) was particularly pronounced in Germany’s Black Forest, according to Ulrich.\textsuperscript{38} These findings had an enormous impact in West Germany, where the Green movement was gaining political momentum and where, since the days of romanticism, the forest was enjoying an important place in national mythology and self-images.\textsuperscript{39} In October 1982, a new federal government was installed with conservative leader Helmut Kohl from the Christian Democratic Union (CDU) as the new chancellor. Under pressure from the media and the growing Green movement —its parliamentary wing, the Green party, secured seats in the West German parliament for the first time in 1983 — the new government took a new stance towards long-range air pollution and began to support the Nordic countries in their struggle for concrete actions to reduce emissions. The CDU — far less in thrall to the coal industry and its trade unions than the former Social Democratic government had been — was (and still is) closely linked to powerful rural, agricultural, and forest interest groups, like the German Forest Conservation Society (Schutzgemeinschaft Deutscher Wald).\textsuperscript{40}

It was not only the concern for the health of German forests but also the possibility of a technological fix that led the new government to change its tune. New technology for flue gas desulphurization (FGD) at large power plants was becoming available and affordable. In the 1970s, the Japanese industrial sector had made great advances in this technology in order to satisfy the Japanese government’s strict environmental policies. In the early 1980s, a few German companies were successful in advancing FGD technology further to the point that reducing sulphur dioxide emissions up to 95 per cent could be achieved at power plants fired by coal or fuel oil. In a familiar pattern, the cost of the new technology decreased as production volumes increased. By 1983, the German government was able to get the parliament’s approval for a law — though highly unpopular in the utility sector — that made FGD compulsory for large power plants.\textsuperscript{41}
With West Germany as a new ally and with affordable and efficient technological options at hand for decreasing emissions, there seemed to be few obstacles to a decisive advance in the war against transboundary air pollution. At a meeting of the Executive Body of the LRTAP Convention in 1983, representatives from four Nordic countries proposed an amendment to the convention in the form of a protocol aiming at a 30 per cent reduction of sulphur dioxide emissions by 1993, using emission levels in 1980 as a basis. They received support for their proposal from Germany, Switzerland, and Austria – which all had domestic Green movements concerned about Waldsterben – and from Canada and the Soviet Union. The Soviet Union argued for a 30 per cent reduction of transboundary fluxes rather than of total emissions, as this would imply that it would not have to reduce emissions in parts of its country that did not affect other European countries. These nine countries, soon known as the 30% Club, were a minority of the convention members. In particular, the USA and the UK argued that there was no scientific justification for the 30 per cent target. The Executive Body was thus unable to agree on a joint protocol.

However, the 30% Club continued to exert pressure on the other countries, in particular by organizing two high-level conferences in 1984, first in Munich and then in Ottawa, presenting new data on environmental degradation caused by acidification. As a result, more and more countries joined the club, and when the Executive Body met in 1984, 20 of the 33 convention members were in favour of a binding protocol on reduction of sulphur emissions. According to Article 12 in the LRTAP Convention, amendments have to be adopted by consensus, and 13 countries were still refusing to reduce their emissions. A deadlock seemed inevitable. However, eventually an elegant diplomatic solution was found and agreed upon. Those countries that were willing to reduce their emissions should be allowed to sign a protocol that would be binding only for its signatories, while the other members of the convention were not restricted by it. Accordingly, 21 countries signed the Protocol on the Reduction of Sulphur Emissions at the following Executive Body meeting in 1985, which was held in Helsinki to commemorate the tenth anniversary of the Helsinki Final Act. The signing of this protocol was a significant step forward for the 30% Club, even though it meant that free riding by some countries was officially accepted: a number of big net exporters of sulphur like Czechoslovakia, East Germany, Greece, Poland, Spain, and the UK – none of which had signed the protocol – could continue to emit sulphur as usual.

However, the members of the 30% Club insisted in what can be called “naming and shaming” diplomacy. The political scientist Marc A. Levy used the metaphor of a tote board to describe this. A tote board is a device often used in the USA for charity fundraising, and it shows how much different parties have do-
nated for a certain cause. By making the size of these contributions visible to all on the tote board, incentives are created for increasing donations. The sulphur protocol worked like such a tote board. It clearly demonstrated which countries were willing to “donate”, or cut emissions in this case, and which were not. Governments that did not sign were free to allow their citizens and industries to discharge effluents without limit, but in doing so, they ran afoul of their own domestic Green movements and suffered a kind of ostracism from the community of the “compliant” countries. The tote board mechanism also put pressure on countries that had signed the protocol but failed to comply, inasmuch as the monitoring of emissions made their failure public.

Thus, even though the sulphur protocol had no material sanctions for non-compliance, it could still exert considerable moral pressure on members and on non-members alike. An important tool for this tote board diplomacy was the impartial monitoring of emissions and subsequent public reporting under the aegis of the EMEP. In 1984, the signatories to the LRTAP Convention approved an annual budget to secure the long-term financing of EMEP monitoring activities, which suggests that the EMEP was seen as “the backbone” of the convention.

Through the monitoring activities of the EMEP, scientists were able to demonstrate that a number of other substances besides sulphur dioxide caused severe transboundary air pollution. Nitrogen oxides contributed to acidification, too, and so-called volatile organic compounds produced “summer smog”, not least in Germany. In the following years, additional protocols for other pollutants were prepared and ratified: nitrogen oxides (NO and NO₂) in 1988, volatile organic compounds in 1991, a second one for sulphur in 1994, heavy metals in 1998, and a “multi-effect” protocol in 1999. As with the sulphur protocol, signing these additional protocols was not mandatory for members of the LRTAP Convention. Nevertheless, partly because of the tote board mechanism, over time more and more countries signed the various protocols. With all these protocols and a growing number of countries signing them, the LRTAP Convention became considerably stronger.

8 Best Available Technology versus Critical Loads

The first sulphur protocol is a short and simple document of only four pages and bereft of appendices. The central sentence in the document states, “The Parties shall reduce their national annual sulphur emissions or their transboundary
fluxes by at least 30 per cent as soon as possible and at the latest by 1993, using 1980 levels as the basis for calculation of reductions.⁴⁸ There are no specifications of how these reductions should be achieved. This was left to the signatory governments. The later protocols gradually became more complex and included appendices aimed, on the one hand, at stipulating technical means for reducing emissions and, on the other hand, at reducing the ecological impacts of emissions. Since 1994, the protocols have also called for an implementation committee to oversee implementation of the measures and compliance by the signatories.

In the 1990s, a controversy emerged within the epistemic community between advocates of a technology-oriented approach based on the concept of best available technology and an effect-oriented approach based on the concept of critical loads.⁴⁹ The technology-oriented approach was developed first. It was rooted in a long-standing UNECE tradition, dating back to the mid-1960s, of working parties in which technical experts exchanged views and information on technologies for abating air pollution. In the 1960s, the agenda was still limited to local air pollution. In the mid-1980s, this tradition was revived within the LRTAP Convention in the form of the Task Force on Abatement Technologies, which was established in preparation for the nitrogen oxides protocol in 1988. In 1991, the task force was upgraded to become the permanent Working Group on Abatement Techniques, and in addition, a number of expert groups were set up to review abatement techniques of many different kinds – with a particular emphasis upon operational experiences and costs. The work of all these groups was essential for most of the protocols that were developed in the late 1980s and onwards.

The technology-oriented approach had a strong impact on the nitrogen oxides protocol signed in 1988, which was considerably more complex than the protocol signed three years earlier. The protocol itself is eight pages long and has a 16-page technical annex, which forms an integral part of the protocol. The signatories took on a twofold obligation: to ensure that their total emissions in 1994 would not exceed their emissions in 1987 and to apply emission standards based on the “best available technologies which are economically feasible”.⁵⁰ The technical annex specifies what the best available technologies are, and this annex was to be regularly updated to keep pace with technological developments.

While most of the sulphur effluents were discharged by large power plants and factories where FGD could be applied, the nitrogen oxides emissions tended to come from cars. This brought catalytic converters to the forefront of negotiations about the nitrogen oxides protocol. Catalytic converter technology had been developed in the USA for reducing nitrogen oxides emissions from cars.
in response to the increasingly stringent standards for automobile emissions, notably in California. Some technical experts saw converters as the crucial best available technology for reducing nitrogen oxides emissions from cars, whereas others thought they were too expensive and thus not economically feasible. The British, French, and Italian car manufactures lobbied their governments to avoid emission standards based on converters, while the German and Swedish car manufacturers did the opposite. The latter had an important stake in the US market and were thus familiar with the technology they had to apply in cars for exports to the USA. However, this did not carry the day, and the upshot was that the new nitrogen oxides protocol did not require the introduction of converters and could therefore aim only at a freeze on emissions. But, in parallel to the signing of the actual protocol, 12 countries (only from Western Europe) publicly pledged a 30 per cent reduction in nitrogen oxides by 1998, a feat that could only be accomplished by introducing catalytic converters on a large scale.\(^5\)

The controversies around catalytic converters and other abatement technologies led some countries to question a purely technology-oriented approach. They argued that this approach conferred undue benefits on producers of clean technologies and ignored not only different capacities for implementation but also the differential ecological effects of emission reductions. Therefore, they advocated an effect-oriented approach based on the concept of critical loads as a complement or alternative to the technology approach.\(^5\)\(^2\) The concept of critical loads was developed by Nordic scientists in the 1970s and 1980s. The concept refers to the vulnerability of a specific ecosystem to pollutants. The critical load is the maximum quantity of pollutants that an ecosystem can tolerate without being irrevocably damaged. Proponents of the critical loads approach argued that the most cost-effective way of reducing air pollution in Europe was to replace the ongoing pursuit of uniform reductions in all countries by differentiated reductions based on the dispersion patterns of different kinds of emissions and the differential sensitivity of ecosystems in various parts of Europe.\(^5\)\(^3\) This approach thus addressed the asymmetrical character of long-range air pollution.

To become relevant for policy purposes, the concept of critical loads had to be buttressed with complex computer models – models that could produce an integrated assessment of the deposition of pollutants over various parts of Europe based on different scenarios for future emissions. Such a model, called Regional Acidification Information and Simulation (RAINS), was developed in the late 1980s at a scientific institution that is interesting in itself: the International Institute for Applied Systems Analysis (IIASA).\(^5\)\(^4\) The establishment of the IIASA was the outcome of a bridge-building initiative intended to reduce East-West tensions by creating a common research institution in the expanding field of systems analysis. It was established in 1973 by scientific institutions in 12 countries
(it was thus non-governmental) from both sides of the Iron Curtain and was located in Laxenburg, in neutral Austria. IIASA’s research focused primarily on making global models in different domains like energy, agriculture, and forestry.

In the early 1980s, IIASA initiated a project on transboundary air pollution, which culminated in the RAINS model, designed for simulating air pollution in Europe. More specifically, the model’s aim was to estimate the long-term environmental impacts of different emission control policies for all of Europe at a resolution of 150 km x 150 km. The model has six modules for each pollutant to be studied: emissions and costs of reducing them, atmospheric transport and deposition, soil acidification, lake acidification, groundwater sensitivity to acidification, and forest sensitivity to acidification. With this comprehensive model, colour maps could be produced illustrating how different emissions scenarios would affect ecological systems in different parts of Europe. The IIASA scientists later also developed a user-friendly version of the RAINS model, which allowed policy-makers to test the environmental effects of different emission reduction strategies.⁵⁵

The RAINS model thus provided a sophisticated science-based tool for developing efficient reduction policies, and in the late 1980s, an effect-oriented approach became institutionalized within the LRTAP Convention regime.⁵⁶ The Task Force on Integrated Assessment Modelling was set up, and the negotiations for the second sulphur protocol, adopted in 1994, were primarily based on an effect-oriented approach together with a technical approach. Now the basic obligation for the signatories was to ensure “that the depositions of oxidized sulphur compounds in the long term do not exceed critical loads”. In addition, the signatories promised to “make use of the most effective measures for the reduction of sulphur emissions”.⁵⁷

This protocol has five appendices, the first two addressing environmental effects and the latter three addressing abatement technologies. When negotiating this protocol, the negotiators discovered a pragmatic advantage to the effect-oriented approach, namely that politically it allowed for more room for manoeuvre. Countries that had been reluctant to sign earlier protocols requiring uniform reductions for fear that they would be too costly could now be offered more lenient terms with lower reduction targets or longer time limits.⁵⁸ This seems to be one reason why the protocols were signed by ever more countries in the 1990s.

The focus on the environmental effect approach was even more prominent in the negotiations in the second half of the 1990s, leading to the so-called Gothenburg Protocol, which was signed in 1999. This protocol was of a new kind, based on a “multi-pollutant/multi-effect” strategy. The aim of the protocol is to “reduce emissions of sulphur, nitrogen oxides, ammonia and volatile organic compounds that are caused by anthropogenic activities and are likely to cause
adverse effects on human health, natural ecosystems, materials and crops – due to acidification, eutrophication or ground-level ozone”. The protocol is thus a complex and multifaceted agreement based on simulations made with the RAINS model. However, for some countries, the emission reduction requirements were rather modest, and it seems as if a certain political manoeuvring was in place in order to get as many countries as possible to sign the protocol.

9 The Effectiveness of the LRTAP Convention

Under the auspices of the LRTAP Convention, delegates from the signatory countries were able to negotiate and agree upon a whole series of agreements, or protocols, in which the signatories agreed to reduce their emissions and to introduce different kinds of measures and policies. Furthermore, the number of countries that have signed these protocols have increased over time. It is also clear that the emissions of many pollutants have decreased rather substantially since 1979, when the convention was established. For example, from 1980 to 1989, the total emission of sulphur dioxide from all the Eastern and Western European countries that had signed the LRTAP Convention decreased by 23 per cent. However, there was a marked difference between the signatories and non-signatories of the sulphur protocol. The former cut back their emissions by an average of 29 per cent, whereas the latter achieved no more than an eight per cent decrease. The period between 1980 and 2000 witnessed an overall reduction of sulphur emissions in Europe by nearly 70 per cent. In the decade between 1990 and 2000, emissions of nitrogen oxides and of volatile organic compounds were reduced by 25–30 per cent, lead by 60–70 per cent, and mercury by 50 per cent. According to assessments made with the RAINS model, since 1980 these reductions have also markedly increased the area of ecosystems that receive less than the critical load of different pollutants.

Does this mean that the LRTAP Convention has been effective in coping with transboundary air pollution in Europe? This is a difficult question to answer. On the one hand, this convention has often been considered as a very successful example of international environmental cooperation. It clearly has raised public awareness of air pollution in most European countries and thereby has fostered a readiness to enact and implement legal emission standards. It also has facilitated the emergence of an epistemic community of scientists and technical experts that has acquired a thorough scientific understanding of pollution processes. Many countries have also introduced specific legislation to enforce emission cutbacks, for example by taxing emissions or making the use of abatement technologies like FGD or catalytic converters compulsory. Furthermore, by the mid-
1990s, the dynamism of the LRTAP Convention had influenced the European Union, which in 1997 adopted its own Acidification Strategy, based on the RAINS model. The European Union had more effective tools at its disposal to enforce compliance with its strategy than the LRTAP Convention had. Taken as a whole, therefore, it can be argued that the convention has been an effective form of organization in the struggle to decrease emissions.

On the other hand, it can be argued that many of the emission cuts were outcomes of processes that had little to do with environmental policies, and they would have taken place without the convention in any case. The energy sector was the largest emitter of sulphur, and while it succeeded in lowering its emissions substantially, its cutbacks were not motivated primarily by environmental concerns but by the adoption of more efficient and profitable process technologies. One such change was the shift to North Sea oil, which became the energy source of choice for Western Europe in the 1980s, not least for security reasons. This oil had much lower sulphur content than that from the main Arab suppliers, and its use thus decreased sulphur emissions. Another change was a switch from coal and oil to other energy sources. The 1970s and 1980s saw a rapid increase in the consumption of natural gas in most European countries, both in the East and in the West, and as natural gas contains almost no sulphur, this also led to substantial reductions of sulphur emissions. Norway and the Soviet Union became the two largest suppliers of natural gas. In the late 1970s, both countries promoted aims to expand their sales of natural gas to the European continent, and it is not unlikely that this shared interest motivated their unholy alliance against acid rain.

Furthermore, many European countries, both in the East and West, built nuclear power plants in the 1970s and 1980s. Oftentimes the decisions to build these plants had been taken long before the LRTAP Convention came into force. But when the nuclear plants were commissioned, they partly replaced fossil fuel plants and thus reduced emissions. Additionally, the sharp hike in oil prices starting in the mid-1970s provided strong incentives for introducing more energy-efficient technologies in Western European countries. In combination with lower economic growth, this led to lower increases in energy consumption than expected and thus lower emissions. Finally, in Eastern Europe, the dramatic decline in industrial production after the political transitions in 1989 resulted in major reductions in emissions. Again, this development was not driven by environmental policies.

In a number of cases, it can thus be argued that the reduction of emissions had little to do with efforts made by the LRTAP Convention. But this is too simplistic, I believe. The convention contributed to a new mindset among many European policy-makers and politicians regarding environmental issues. Though
few politicians were prepared to accept high costs for reducing emissions, they were willing to exploit windows of opportunity for legislating emission cutbacks made possible by developments in other fields. A very important window of opportunity emerged when eight Central and Eastern European countries wanted in the mid-1990s to become members of the European Union. They were compelled to agree to the union’s much stricter environmental policies as a condition for membership.

10 Concluding Reflection

It is not so surprising that large-scale, transborder air pollution was first discovered in Europe, given the high degree of industrialization combined with the small size of most of its countries. Given the resistance from influential emitting industries, the opposing interests of countries that were net exporters and net importers of sulphur emissions, and the deep political divisions of the Cold War, much more extraordinary is the way that this discovery was handled by scientists, politicians, diplomats, and policy-makers. To an informed observer in the early 1970s, it must have seemed very unlikely that international agreements in the form of conventions and protocols on transborder pollution would be reached within a decade and that these agreements would contribute to substantial decreases in emissions in the following decades. For sure, the lowering of emissions was slower in Eastern Europe. Heavy industry occupied an almost sacred place in the official culture of communist societies, and this led to the delayed installation of regulations to control air pollution. It was only after 1989 that more substantial reductions of emissions occurred in these countries.

How can we understand this achievement? There were three main factors involved. One of them was the increasing knowledge of the environmental consequences of long-range transboundary air pollution, thanks to the continued monitoring and modelling activities within EMEP. On the basis of these findings, many net exporters discovered that their own environments were also affected and that emission cutbacks would benefit them too. A second factor was the development of relatively inexpensive technological fixes for end-of-pipe emission control and simultaneously a large-scale introduction of substitute technologies that could eliminate sulphur emissions from power plants, in particular nuclear power and natural gas. The third factor, finally, was politics. In the late 1970s, striving towards a détente of the Cold War led the Soviet Union and Norway to form an unholy alliance in pursuit of the LRTAP Convention. In the following decades, European integration politics also played a role. When the countries in Western Europe developed ever-deeper economic and political relations, they be-
came increasingly interdependent. Even countries lacking any intrinsic environmental motive to cut back on their toxic emissions could be swayed to do the “right thing” by other countries that were evidently frustrated and saw themselves as victims of these emissions. In addition, domestic politics played a role in many countries. An emerging Green movement asserted growing political influence in many Western European countries in the 1980s and, to a lesser degree, in Eastern Europe in the 1990s.

The story in this chapter may be a source of optimism to those who are frustrated by the ongoing international negotiations on climate change as it demonstrates that it was possible in the past to reach international agreements leading to substantial reductions of emissions. Moreover, much of the working mode developed under the LRTAP Convention was transferred to the United Nations Framework Convention on Climate Change (1994), and international collaboration among scientists has increased the knowledge about climate change very rapidly. However, climate change is a particularly hard nut to crack because, unlike for acid rain, potential solutions via technological fixes are neither readily available nor cheap, even if the fast growth of wind power and photovoltaics is promising. At present (fall of 2020), the political conditions are extremely unfavourable for international environmental collaboration, but this can hopefully change for the better, like the fall of the Berlin Wall did in in the 1990s. Moreover, a growing Green movement and an increasing realization in broad sectors of society of the effects of climate change in terms of devastating storms and fires will most probably increase the political pressure from below. Finally, the combatting of acid rain shows that to achieve coordinated action among many heterogeneous countries and actors it is necessary to have endurance and purposefulness as well as understanding of and respect for differences in conditions among countries.

Notes

9 Ibid., 52 (own translation).
13 Brimblecombe, Big Smoke, 161–78.
14 Uekötter, Von der Rauchplage zur ökologischen Revolution, 349ff.
16 Ibid., 68–85; see also Rebecca Bratspies and Russel Miller (eds.), Transboundary Harm in International Law: Lessons from the Trail Smelter Arbitration (Cambridge UK: Cambridge University Press, 2006).
18 Water was also considered according to a similar perception, with rivers, large lakes, or seas being seen as sinks that could make emissions harmless, see Joel Tarr, The Search for the Ultimate Sink. Urban Pollution in Historical Perspective (Akron, Ohio, 1996), chapter 1.
20 Ibid., 107–108.
22 Lundgren, Acid Rain on the Agenda, 288.


31 Gunnar Sjöstedt, “Special and Typical Attributes of International and Environmental Negotiations”, in International Environmental Negotiations, 32.


34 Ibid., 10.

35 The USA and Canada have been members of the UNECE since its establishment in 1947. That air pollution could cross the boundary of these two countries was demonstrated already in the 1930s through the conflict that led to the Trail Smelter arbitration, see above. The LRTAP Convention was thus an instrument for handling their air pollution controversies as well.

36 See the UNECE website.

37 Jean-Paul Hettelingly et al., “Air pollution effects drive abatement strategies”, in Sliggers and Kakebeeke, Clearing the Air, 68.


43 Ibid., 155–157.

Levy, “European Acid Rain”, 77, 93–94.

Describing EMEP as “the backbone” is a common expression in the literature on LRTAP.

All protocols and their signatories can be found on the UNECE homepage.


Ibid., 129.


Ibid.


Levy, “European Acid Rain”, 114.


Jean-Paul Hettelingh et al., “Air pollution effects drive abatement strategies”, in Sliggers and Kakebeeke, Clearing the Air, 77–78.


Jörgen Wetttestad, Clearing the Air. European Advances in Tackling Acid Rain and Atmospheric Pollution, (Hampshire: Ashgate, 2002), chapter 5.

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