25 years

The Swedish NGO Secretariat on Acid Rain was founded in 1982. Much has happened since.

Much has been done, but still plenty to do

Far from target

Climate issue hotter than ever

25 years

Most things can be fixed

Environmental journalist Fred Pearce looks at political development on air pollution, from the 1952 Great Smog in London to the present day and what the future holds.

Page 3 ▶

Much has been done – but still plenty to do

Good progress has been made in improving air quality in Europe. But many problems still await a solution and environmental organizations still have an important role to play.

Page 6 ▶

Requirements ramped up

The big reduction in emissions in Europe that are reported on the following pages have not come about by chance. One of the main reasons has been stricter requirements.

Page 9 ▶

Far from target

Emissions in Europe have fallen considerably over the last 25 years, but further measures are needed to reach targets.

Page 10 ▶

Impact on nature

Acidification has been reduced markedly, but only a slight improvement can be seen in the nitrogen overload.

Page 12 ▶

Climate issue hotter than ever

To meet climate targets, greenhouse gas emissions must be drastically reduced. Many other air pollutants will disappear into the bargain.

Page 14 ▶

After twenty-five years

Over the last year the idea that something must be done to save the environment has sunk into people's consciousness in most parts of the industrialized world. In Europe and North America at least, global warming has become a general subject of conversation.

Exactly what we should do to resolve the problem, and how best to do so, is however not crystal clear. Technology optimists tell us that "necessity is the mother of invention" and the world will be saved by grand technical solutions. Carbon dioxide emissions from coal-fired power plants will "disappear" through carbon capture and storage. Cars and trucks will be powered by electricity from renewable sources of energy – solar, wind, waves and biofuels.

New and improved technology must be part of the solution, there is no doubt about that. But this year's reports by the Intergovernmental Panel on Climate Change (IPCC) make it painfully clear that the trend of increasing emissions must be quickly reversed, preferably before 2015. In other words, we don't have time to wait for technologies that will require many decades before they can be fully implemented.

More energy from renewable sources is a necessity, but we must also learn to be much more efficient (i.e. stop wasting energy and other resources), and be prepared to change habits and behaviour.

Today it is global warming that hits the headlines – twenty-five years ago it was acid rain, at least in Europe. Scandinavia was particularly badly affected, with around 80–90 per cent of acid pollutant depositions being "imported". Acid-sensitive species, including fish, were being wiped out from thousands of sensitive freshwater ecosystems in Norway and Sweden.

To improve awareness and initiate international coordination, a group of Swedish environmentalist associations invited their counterparts elsewhere to join them in a European Acid Rain Conference in Gothenburg in May 1981. One outcome of this conference was the formation of the Swedish NGO Secretariat on Acid Rain in January of the following year, and the start of Acid News.

Since then emissions of acidifying air pollutants have come down, and in some areas ecosystems are slowly recovering. While the air we breathe has become a little bit cleaner, it is still unhealthy or even deadly. Clearly, there is still a long way to go before pollution has been brought down to acceptable levels.

There are still government officials, scientists, environmental journalists, and environmentalists who have been involved in this work for the last twenty-five years. Others may have changed their main occupations, yet still continue to maintain a concern for air quality. But most of those who now work on air quality were not active in the 1980s, or perhaps not even in the 1990s.

For the special anniversary section in this issue of Acid News, we are chronicling the course of events and presenting a broad selection of facts and views on air pollution policy developments over the last few decades.

Hopefully these items will contribute to a better understanding of air quality policy and so lead to more effective ways of attacking the problems of air pollution and global warming in the near future.

Coming issues of Acid News will continue to monitor and comment upon developments of relevance to air pollution and global warming, and we invite contributions from all readers. We would also like to hear what impressions you may have got from Acid News in general and from this special twenty-five year anniversary section in particular.

Christer Ågren

Most things can be fixed

Environmental journalist Fred Pearce looks at political development on air pollution, from the 1952 Great Smog in London to the present day and what the future holds.

Fifty years ago, coal smogs still regularly blanketed Europe's industrial heartlands. London was in shock from an estimated 12,000 deaths during the Great Smog of December 1952.

Twenty five years ago, transboundary acid rain drove the environmental agenda across the continent. The scandal extended from the fishless lakes of Scandinavia to the toxic soils and drooping forests of central Europe.

By twenty years ago, concern had moved on again. This time to the global scale. The world was horrified that emissions of tiny amounts of chlorofluorocarbons (CFCs) from aerosols and refrigerators in Europe and North America could be burning a hole in the ozone layer over distant Antarctica.

And no sooner had the Montreal Protocol been passed, than our concerns returned to a new threat from fossil fuel burning – global warming. This latest concern is fast becoming one of the top issues of any kind on the international agenda for the 21st century.

Air pollution has gone from the local to the global in half a century. For a longtime watcher of this progression, the links between the different concerns are intriguing, and the lessons from earlier crises important for fighting climate change.

Some of the links are obvious. It was efforts to banish the great smogs that helped escalate the acid rain crisis. The sulphur emissions that spread across Europe often came from the new tall-chimneyed power stations built to disperse the emissions that once caused the urban smogs.

More interesting are the similarities in the ways we have responded to the crises. In particular, how the early efforts to fight acid rain and protect the ozone layer have framed how the world has taken on climate change.

Take the role of scientists. I remember atmospheric chemists being troubled by their failure, through the 1970s and early 1980s, to agree a common story about the threat to the ozone layer. It allowed the manufacturers of CFCs to keep going for years. Only luck prevented them destroying the entire ozone layer.

25 years

In the course of time...

1967

Writing in the country's leading daily, Dagens Nyheter, the Swedish scientist Svante Odén reported a gradual increase in the acidity of the precipitation over Europe since the 1950s, with consequent damage to soil and water ecosystems. The following November the Swedish minister of industry took up the matter at a meeting of the OECD, calling for greater attention to the danger of increasing airborne emissions of sulphur and other pollutants.

1972

At the first world environment conference of the United Nations, Sweden presents a report on acidification, in which it laid emphasis on the cross-border nature of the problem. Few countries were however willing to admit that their emissions could be causing environmental damage elsewhere.

1977

Publication of the results of an OECD study that had been set up in 1972 confirmed that sulphur pollution was a cross-border problem. The OECD project later evolved into the Cooperative Programme for Monitoring and Evaluation of Long-Range Transmissions of Air Pollutants in Europe (better known as EMEP).

1979

In November the Convention on Long-Range Transboundary Air Pollution (LRTAP) was signed by more than thirty countries as well as the EC.

1980

Four Swedish environmentalist organizations start a cooperative project for international dissemination of information on air pollution and acidification. The outcome was the establishment of the Swedish NGO Secretariat on Acid Rain in January 1982.

An eight-year research project in Norway confirmed that there had been an increase in the acidity of the precipitation and that there was a connection between acidification and reduced fish stocks.

1981

Reports begin to appear in the West German press of a marked increase in damage to forest trees, which could be attributed to air pollution.

A cost-benefit study produced by the OECD shows that the economic gains of halving West European emissions of sulphur over a period of ten years could be worth as much as six times the costs.

1982

At the Stockholm Conference on Acidification of the Environment, scientists state that if acidification of the surface waters in sensitive areas is to be avoided, the annual depositions of sulphur should be less than 3–5 kg per hectare. Afterwards, West Germany, which had been strongly opposed to any international action, surprised a meeting of environment ministers by urging that all countries should attack air pollution at its sources.

25 years

Most things can be fixed ...

Continued from page 3

The scientists didn't want to repeat that mistake with climate change. And that led directly to the creation of the Intergovernmental Panel on Climate Change (IPCC), whose job was to ensure an agreed scientific consensus to guide policymakers. The drive to reach agreement was driven by veterans of the ozone debacle such as Bob Watson, who subsequently became chair of the IPCC – and is now chief scientist for the British government.

Other scientists moved to global warming from acid rain. And again, many were concerned by their failures in that theatre. In Britain in particular, action to halt acid emissions was held up for almost a decade because government scientific doctrine was dominated by researchers from the chief polluter and denier, the state-owned Central Electricity Generating Board. Independent scientists were determined that should not happen again with climate change, and it is one reason why British climate scientists have often been at the forefront at the IPCC.

Witness too how policy developed. In the 1980s, European governments organised themselves into the "30 per cent club" – a group of nations committed to cutting their sulphur emissions by 30 per cent. This simple formula helped stigmatise those nations, like Britain, who initially refused to join.

Early efforts to fight the carbon emissions causing climate change replicated this formula. Even as nations gathered in Kyoto in 1997, the assumption was that industrial countries would all agree a blanket figure for reducing their emissions. Initially, 10 or 15 per cent was widely discussed, particularly by European delegates. Only during the heat of negotiations did the idea of different countries adopting different targets come to the fore.

Interestingly too, the adoption in Kyoto of the idea of allowing trade in emissions entitlements came from the acid-rain toolkit. The US – which proposed carbon trading before abandoning the Kyoto Protocol after George W Bush became President – had tried it out earlier for controlling sulphur emissions from power stations.

One hopeful lesson from the acid-rain and ozone-hole eras is that agreement on an initial, fairly modest, cut is no impediment to much tougher rules later. Indeed it seems to break the logjam and encourage tougher rules. On ozone, the Montreal Protocol opened the door for tougher agreements in London and Copenhagen. With acid rain, Europe started with 30 per cent cuts, but subsequent agreements have reduced acid emissions by 70-90 per cent. Similar cuts will be needed to halt global warming.

Another cause for optimism is that none of the howls of outrage that cleaning up would be impossibly expensive and damaging to national economies, voiced during all three past pollution crises, have proved correct. Action has always turned out to be painless, and often profitable for the companies involved. Indeed, it is striking how those who want to avoid taking action on air pollution come up with the same excuses every time – and how pathetic those excuses turn out to be.

Even as the Great Smog raged in London 55 years ago, politicians, power companies and their friends in the media all had two reasons for not acting. One: We have always had fogs, they are perfectly natural. And two: Even if we did want to clean up, it would be impossibly expensive. The obvious contradiction between these two claims was rarely remarked on.

But of course the great smogs were not natural. Even unpolluted fogs declined markedly after the smoke that often triggered them was banished. And the transition to smokeless fuels in homes and new out-of-town power stations with smoke filters bankrupted nobody. A few years later, people asked: What was the fuss about? And why didn't we act sooner?

Similarly with acid rain. Back in the 1980s, we were still being told that the rain had always been acid. The sulphur came from the ocean. Or it was in the

"Another cause for optimism is that none of the howls of outrage that cleaning up would be impossibly expensive and damaging to national economies, voiced during all three past pollution crises, have proved correct. Action has always turned out to be painless, and often profitable for the companies involved."

soil all along. How preposterous, cynics said, to blame one country's power stations for another country's dead fish. And anyhow, it would be far too expensive to do anything about it.

All rubbish. Thanks to emissions cuts, our rain is now much less acid. It is taking time for that to translate into revived ecosystems, because accumulated man-made acid persists in European soils. But soils are slowly being flushed clean, the fish are returning, and the main threat to trees is now drought from climate change.

The ozone-hole saga followed a similar narrative. Right up until the Montreal meeting in 1987, the big makers of CFCs, DuPont and ICI, said that the science linking their products to the thinning of the ozone layer was poor. That there had probably always been ozone holes. And that fixing the problem would cripple economies in general and their balance sheets in particular.

The only difference was that the companies knew this was rubbish. They were seeking tactical advantage. So once in Montreal, both announced that they had changed their minds and, by chance, were both just finishing construction of plants to manufacture the substitutes – thus stealing a march of their less fleet-footed competitors.

Which brings us to climate change. Once again, many oil and coal companies and their hired hands in the scientific community insist that climate change is both perfectly natural and in any case, impossibly expensive to fix. Again, the contradiction is barely mentioned.

But also, following the ozone-hole story, there is growing evidence that the cleverer companies know that this is rubbish. Even some oil companies are tentatively repositioning themselves in favour of action on climate change. BP's moniker Beyond Petroleum is a nice example.

Some of this is greenwash. For sure, they haven't stopped exploring for new oil. But there is also huge investment going into new cleaner energy technologies. The two biggest investors in solar power are both oil companies. The smart companies, with the big R&D budgets and high regard for their own entrepreneurial skills, are beginning to see that there is money to be made out of cutting greenhouse gas emissions.

It would be a real optimist who would suggest that, in 50 years time, we might look back on today's climate change crisis in the same way we now look back on the great coal smogs. A receding memory of another problem we fixed without great difficulty. Our civilisation could yet be undone by tipping points in the climate system beyond which there is no recovery.

But it is possible that we might work this out. One thing is for sure, though. There isn't a chance, unless campaigns for action are unleashed on a far greater scale than anything that happened over smogs or acid rain or the ozone hole.

Fred Pearce

Much has been done – but still plenty to do

Good progress has been made in improving air quality in Europe. But many problems still await a solution and environmental organizations still have an important role to play.

Air pollution problems in Europe have not been solved and are nowhere near a solution yet, according to environment researcher Peringe Grennfelt and author Per Kågeson.

"It has become obvious that emission standards and control technology are insufficient to solve these problems in a society in which production and consumption are steadily growing," says Grennfelt.

"The tug of war between environmental interests and industry is continuing," says Kågeson. "The Swedish NGO Secretariat on Acid Rain, the European Federation for Transport and Environment (T&E), the European Environmental Bureau (EEB) and other organizations are needed to maintain environmental pressure on air quality issues."

Although they have different backgrounds, Peringe Grennfelt and Per Kågeson have both been following air pollution issues ever since the problems of acid rain came to light in the late 1960s. Grennfelt is now director of research with IVL Swedish Environmental Research Institute, an independent research body. Kågeson is an author and consultant with a long string of investigative environmental assignments to his name. He is also involved in various ways with the environmental movement, including the Swedish Society for Nature Conservation and T&E.

Solution in sight for vehicle emissions

Grennfelt and Kågeson agree that big advances have been made since the issue of acid rain was put on the political agenda.

"On the whole it's a success story," says Grennfelt. "Acceptance of the need for action has grown with time. In the case of emissions from land-based sources, we generally have the tools we need today. Shipping and to some extent aviation are more problematic."

"The graphs are heading in the right direction, although progress is not as good as it could be," says Kågeson. "Economic growth, increased production and the growth in transport are all pulling in the opposite direction."

Per Kågeson is optimistic about emissions from road vehicles. Regulation is relatively strict in this area and he be-

lieves that a breakthrough in electric hybrid vehicles is not far off, driven by stricter climate requirements and rising oil prices.

"In ten years or so the vehicle emission problem will be largely solved. The big challenges that remain in the case of road transport are to reduce noise and greenhouse gas emissions."

He also points to future tightening of EU air quality standards as an important step forward.

"But the critical factor here will be the extent to which the Commission is able to ensure that limits are observed."

Critical limits – a breakthrough

From the research perspective, the air pollution issue is special in the sense that research has not just identified the problems, but also defined the action that is needed, explains Grennfelt. Formulation of the critical load limits for deposition of sulphur and nitrogen in the late 1980s is the clearest example.

"What was special about critical load limits was that they could be used directly in the political sphere; they could be translated into political goals."

"At the same time the weaving together of research and politics can lead to problems. If research becomes too focused on finding solutions it can lose its role as critical observer.

"The IPCC and today's climate researchers have realized this and are making big efforts to maintain clear boundaries between research and politics. Air quality researchers in the 1980s may not have been quite as aware of the problems involved …"

Nitrogen, climate and particles – areas for future research

Despite 30 years of acquiring knowledge, there are still several big gaps according to Grennfelt. He points out three important areas for research in particular:

- The nitrogen issues are not solved. We don't know how nitrogen in its various forms affects ecosystems. We have a poor understanding of the long-term effects of nitrogen saturation in soils, and of the effects of nitrogen deposition on biodiversity.
- The links between climate change and air pollution. Changes in the climate will affect emissions as well as the transport and deposition of air pollutants. The effects of pollutants on ecosystems will also differ as the climate changes.
- Particles. There is still inadequate knowledge about which particles are harmful and where they come from.

More knowledge – less publicity

Peringe Grennfelt also comments that our growing understanding of air pollution has somewhat paradoxically meant there is less publicity for such issues. Thirty years ago, air pollution research constantly yielded new discoveries and uncovered new links. Research produced news that was widely reported in the media. There was also more scepticism and questioning of findings, which led to a livelier public debate. Today, we have a much better foundation of knowledge, which is also widely accepted. The missing pieces of knowledge that are fitted into the jigsaw are no longer as exciting or dramatic, and there is no longer the same need to question them.

"As a result there is hardly any public debate about air pollution today, and scarcely any media interest," says Grennfelt. "This in turn has led many people to believe that the problems are solved, which they aren't."

Kågeson and Grennfelt both stress the fact that over 300,000 people in Europe are estimated to die prematurely each year as a result of air pollution, according to a survey presented by the EU Commission in 2005.

"As long as this continues we cannot say that the problems are solved," says Per Kågeson. "Air pollution is still a very serious environmental problem in Europe. We can also see that emissions from the rapid growth in shipping are becoming an increasingly severe problem."

When asked if he is less worried about the air pollution situation today than he was 20 or 25 years ago, Grennfelt considers the question for a long time.

"It's easy to forget the massive improvements that have taken place in Europe," he says finally. "I'm naturally pleased with that. But at the same time it has to be said that there is no place on

25 years

1983

The first International Acid Rain Week took place in April, accompanied by a series of awareness-raising activities carried out by environmentalist organizations in several European countries.

Following ratification by twenty-four countries, the Convention on Long-Range Transboundary Air Pollution came into force in March of this year. At the first meeting of the Executive Body, Sweden, Norway, and Finland jointly proposed that countries should reduce their emissions of SO_2 by at least 30 per cent by 1993. Five other countries – Austria, Canada, Denmark, Switzerland and West Germany – gave their support to the proposal.

A proposal for a new directive aimed at reducing emissions of SO_2, NOx and dust from large combustion plants – evidently influenced by West German legislation earlier in the year – is put forward by the European Commission.

1984

Ten countries, now including France, meeting in Ottawa in March, commit themselves to reducing their emissions of SO_2 by at least 30 per cent by 1993. A June meeting of ministers in Munich saw the membership of this 30-per-cent club grow to eighteen.

1985

Environment ministers of EC countries agree on new emission standards for cars, to be introduced in stages over three years, starting in 1988.

By signing the first protocol to reduce emissions under the LRTAP Convention, 21 countries commit themselves to reducing their emissions of sulphur dioxide by at least 30 per cent from 1980 to 1993.

1986

A report published by the Nordic Council in April set down critical loads for sulphur and nitrogen based on scientific evidence. It also gave a definition of critical load.

1986

Basing their claims on the Nordic Council's report, various European environmentalist organizations put forward a call for the reduction of SO_2 and NOx emissions by at least 90 and 75 per cent respectively, adding that emissions of ammonia and VOCs would also have to be cut considerably.

"Santa Claus is beginning to have problems. Just like us he is sawing off the branch he, himself is sitting on". The message on the back of this postcard was part of several campaigns aimed at the UK in the 1980s and early 1990s.

25 years

On a visit to Norway, the British Prime Minister Margaret Thatcher announces that her government intended to take steps to reduce emissions of SO_2.

1988

In a further protocol to the LRTAP Convention, 26 countries agree not to let their emissions of NOx exceed 1987 levels after 1994. The critical load concept is adopted by the Convention, thus making it fundamental to the development of future protocols.

After five years of negotiation, in November the environment ministers of the EC adopt a directive for limiting the emissions of SO_2 and NOx from large combustion plants, known as the LCP directive.

Recognizing the problem of potential global climate change, the World Meteorological Organization and the UN Environment Programme established the Intergovernmental Panel on Climate Change (IPCC). In June, the Toronto Conference on the Changing Atmosphere became the first high-level international meeting to recommend targets for reductions of greenhouse-gas emissions.

1989

In June, the EC environment ministers decide to set stricter requirements for cars. This means that with effect from 1993 all new petrol-engined cars will have to be equipped with catalytic converters.

1989–1990

The turmoil occasioned by political change in Central and Eastern Europe brought a marked lessening of industrial output and a lower consumption of energy, with a consequent reduction in emissions of air pollutants.

1990

Researchers at Stockholm Environment Institute publish an assessment recommending that the temperature rise should be limited to 0.1°C per decade, and that the maximum rise in the mean global temperature compared with the pre-industrial level should not exceed 1.0 to 2.0°C (low and high risk limits).

Legislation on emissions passed in West Germany in 1983 has resulted in almost 200 desulphurization plants coming into operation at power stations with a total electric capacity of 38,000 MW. In addition, power stations with a capacity of more than 30,000 MW have been equipped for selective catalytic reduction (SCR) of NOx emissions.

Times change. In the early 1980s the UK would not even recognize acidification as a problem. But this British stamp from 1992 bears the message "Acid rain kills".

Much has been done ...

Continued from previous page

Earth that is clean – that is unaffected by air pollutant deposition. The problem has not been solved. This is especially evident if you look at what is happening in other parts of the world, such as India and China. The situation there is getting dramatically worse with every year that passes. Emissions from shipping, and to some extent aviation, are also a growing problem."

The climate question

One ground-breaking change in the political sphere over the past year is the breakthrough in the climate issue. Today, the debate about atmospheric emissions focuses almost entirely on greenhouse gases. Kågeson and Grennfelt see this as more of an opportunity than a problem for "traditional" air quality politics.

"On the whole, measures to reduce greenhouse gas emissions have positive effects on air pollutants in general," says Grennfelt.

"As long as the focus of climate work is on reducing energy consumption we have a win-win situation," adds Kågeson. "But if we rush off and invest heavily in switching from fossil fuels to biofuels then we are likely to meet problems with air pollution and with soil use. Large areas in Europe and the Third World are likely to be set aside for energy crops, which will naturally have an impact on food production, biodiversity and other key areas."

It is reasonable that the environmental movement should concentrate on the climate issue now, believes Kågeson. At the same time he hopes that the Secretariat will continue to bring attention to nitrogen oxides, particles and other air pollutants, in addition to the greenhouse gases. The problems, as mentioned, are not yet solved.

Keep on working – and broaden the perspective

Awareness of air pollution issues among authorities and politicians today is far greater than it was when the Secretariat on Acid Rain was formed, reckons Per Kågeson. In that respect the Secretariat, and other environmental organizations, have become less important. Nevertheless there is still a strong need for NGOs[1] as independent pressure groups, even if their primary role is no longer about giving weight to public opinion.

"Environmental policy is still heavily influenced by lobbying," says Per Kågeson. Because of its access to impartial information the EU Commission is fairly resistant to this approach, but at the political level, lobby groups and special interest groups still have considerable influence. In Sweden this is especially true of the automotive industry, led by Volvo and SAAB. There is still a need for strict independent analysis and criticism of political decisions."

Per Kågeson's advice to the Secretariat for the future is simple: Keep on working! He also emphasizes that the Secretariat's role as a source of information will remain central.

"Originally it was the fastest channel for information on these issues. It has continued to be important because everyone knows that it is reliable and independent."

Peringe Grennfelt would like to see the Secretariat take a broader geographical perspective in the future, because of the growing problem of carbon leakage.

"This means that stricter emission control requirements in Europe are leading to production and of course emissions being shifted to other parts of the world. I can understand that the Secretariat does not see it as part of its remit to tackle this problem, but there is a need for someone to do a similar job on other continents as the Secretariat has done and continues to do in Europe," says Peringe Grennfelt.

"Sweden finances an NGO that focuses on European air quality. Perhaps it is time for the EU to finance something similar that operates globally."

Roger Olsson

[1] NGO = Non-Governmental Organisation.

© ANDRÉ MASLENNIKOV

Requirements ramped up

The big reduction in emissions in Europe that are reported on the following pages have not come about by chance. One of the main reasons has been stricter requirements.

European sulphur dioxide emissions are now at low levels compared with the situation 25–30 years ago. Emissions of other pollutants have also fallen.

International agreements, legislation within the EU and national measures have all contributed to this trend.

Since 1979 all European nations (as well as the USA and Canada) have collaborated under the Convention on Long-range Transboundary Air Pollution (CLRTAP). This has led to several international agreements on emission reductions, the latest being the Gothenburg protocol in 1999, which established binding national emission ceilings for four air pollutants: sulphur dioxide, nitrogen oxides, volatile organic compounds and ammonia.

Until the early nineties, EU policy regarding air pollution tended to be fragmented. Today this work is more strategically oriented. A directive establishing national emission ceilings for four air pollutants (the same four as above) was adopted in 2001 and is currently the most important general legislation for improving air quality in Europe.

That same year also saw the launch of the Clean Air For Europe Programme (CAFE), which in 2005 led to the adoption of a thematic strategy on air pollution.

A string of EU legislation also exists to regulate air pollution, including emission requirements for large combustion plants, light and heavy vehicles, as well as limits on the sulphur content of fuels. These controls have been successively stiffened and in many cases have driven technological development forward.

While emissions from land-based sources are gradually falling, those from shipping show a continuous increase. Normally international shipping is regulated by the International Maritime Organization (IMO), which is a UN body, but IMO's handling of environmental issues, including air pollutants, has been characterized by low ambition levels.

Per Elvingson & Christer Ågren

Background information and current news about the LRTAP Convention, European Union, IMO and emissions from international shipping can be found on www.acidrain.org (select "Policy initiatives").

25 years

1991

Twenty-one countries sign the VOC protocol to the LRTAP Convention, most of them with the aim of reducing their emissions by at least 30 per cent between 1988 and 1999.

A strategy to limit emissions of CO_2 and improve energy efficiency is proposed by the EU Commission.

1992

The UN Framework Convention on Climate Change (FCCC) was adopted in May. Although it involves no binding commitments, industrialized countries promise to aim to keep CO_2 emissions below their 1990 levels after the year 2000.

1993

In its Fifth Environmental Action Programme, the European Community states that the long-term objective for acidification is that critical loads should never be exceeded.

1994

The second sulphur protocol to the LRTAP Convention, signed by 26 countries, was the first to use the critical loads approach. Setting separate ceilings for each country, it was expected to more than halve overall European emissions of SO_2 by 2010, in relation to 1980 levels.

1995

Austria, Finland, and Sweden joined the EU.

The EU Council of environment ministers decides to develop a Union-wide acidification strategy with the eventual aim of ensuring that there should be no exceeding of the critical loads. The acidification strategy was adopted by the Commission in 1997.

1996

Completion of the first installation for flue-gas desulphurization (FGD) at a British coal-fired power plant. This cuts emissions from one of Europe's largest coal-fired plants (Drax, 4000 MW_e) by more than 90 per cent, from around 300,000 to between 20,000 and 30,000 tonnes of SO_2 per year.

The EU Commission proposes new exhaust and fuel standards for road vehicles. The proposals are the outcome of several years of collaboration between the Commission, the oil industry and vehicle manufacturers under the Auto-Oil program. The new standards were adopted by the Council in 1998–99.

1997

Revised air quality guidelines are issued by the WHO. These guidelines were subsequently crucial to the setting of limit values in EU directives for air quality.

The first global standards aimed at reducing air pollutant emissions from ships are adopted by the International Maritime Organisation.

EU environment ministers agreed in March that the aim of global climate negotiations should be to strive for reductions in emissions in the industrialized countries by 15 per cent between 1990 and 2010.

25 years

The Kyoto protocol to the Framework Convention on Climate Change is signed by 160 countries. It is expected to bring about a 5.2-per-cent reduction in industrialized countries' emissions of greenhouse gases between 1990 and 2008–2012.

1998

The European Commission presents a proposal for revision of the 1988 directive on emissions of SO_2, NOx and dust from large combustion plants.

In an agreement with the Commission, the car industry promises that average emissions of CO_2 from new cars sold in the EU will not exceed 140 g/km by 2008/09.

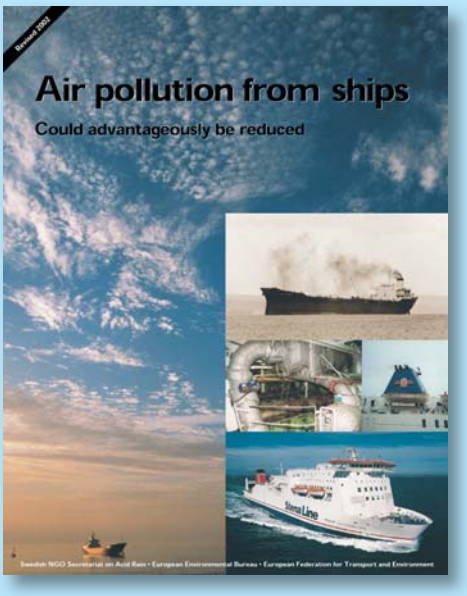
1999

Two new EU directives for air pollution control are adopted. One limits the sulphur content of heavy fuel oil to 1.0 per cent (from 2003) and that of gas oil to 0.1 per cent (from 2008). The other sets new, stricter emission limits – so-called Euro III, IV and V standards – for heavy-duty vehicles, to be introduced in three stages between 2000 and 2008.

The first daughter directive under the 1996 framework directive on ambient air quality is adopted. It covers SO_2, NOx, particles (PM_{10}) and lead.

In June the EU Commission puts forward a proposal for a new directive, adapted to its acidification and ozone strategies, setting binding national emission ceilings for four major air pollutants (the NEC directive).

In Gothenburg, 27 countries sign the Protocol to abate acidification, eutrophication and ground-level ozone, which sets national emission ceilings for 2010 for the four air pollutants. This is expected to bring down overall European emissions of SO_2 by 63 per cent, those of NOx and VOCs by 40 per cent, and of NH_3 by 17 per cent, all from 1990 levels.



Emissions of acidifying pollutants by international shipping attracted growing attention in the 1990s. The Secretariat has published information in eleven languages.

Far from target

Emissions in Europe have fallen considerably over the last 25 years, but further measures are needed to reach targets.

The graphs on the right show European emissions of sulphur dioxide, nitrogen oxides, volatile organic compounds (VOCs) and ammonia, from 1980 until 2005.

What these four compounds have in common is that they are all covered by international agreements to reduce emissions, in the form of the Convention on Long-range Transboundary Air Pollution (the Gothenburg Protocol) and the EU National Emission Ceilings Directive.

European emissions of sulphur dioxide – the most harmful acidifying compound – reached a peak in the last 1970s. Since 1980 they have fallen by just over 75 per cent, i.e. from 53 million tonnes in 1980 to 12.5 million tonnes in 2005.

There are several reasons for this fall. Some countries, such as Germany, have focused deliberately on emission control. In other countries the reduction has come about because it was economically advantageous to switch from coal to gas (UK), or because of a sharp fall or change in the nature of industrial production (several countries in central and eastern Europe).

At the same time as emissions from land-based sources have fallen, emissions from ships in the seas surrounding Europe have increased, since 1990 by more than 50 per cent.

Emissions of nitrogen oxides rose between 1980 and 1990, then began to fall, partly due stricter emission requirements for road vehicles. Over the period 1990–2005 there was a 34-per-cent reduction in emissions from land-based sources, but because emissions at sea rose at the same time the overall effect was a reduction of just 26 per cent.

Of the ammonia emissions in Europe, 90 per cent come from agriculture and these are highest where livestock farming is most intensive. Annual emissions have fallen by a quarter between 1990 and 2005 – from 7.5 to 5.7 million tonnes.

Man-made emissions of VOCs in Europe totalled 14 million tonnes (excluding methane) in the year 2005, which represents a reduction of 42 per cent since 1990. The downward trend is due in part to active measures in many countries, and partly to economic recession and changes in production in the eastern European economies in the early 1990s.

With a few exceptions the countries that make up the EU25 are within sight of their international undertakings for 2010 with regard to sulphur dioxide, VOCs and ammonia (see AN 2/07). Roughly half of them have problems with nitrogen oxides.

The reductions in emissions of pollutants in Europe over the last few decades have resulted in health improvements for people and reduced pressure on ecosystems.

But emission projections up to 2020 prepared under the Clean Air For Europe programme show clearly that existing legislation is totally inadequate to meet the health and environmental objectives of the EU's Sixth Environmental Action Programme (see maps on pp. 12–13).

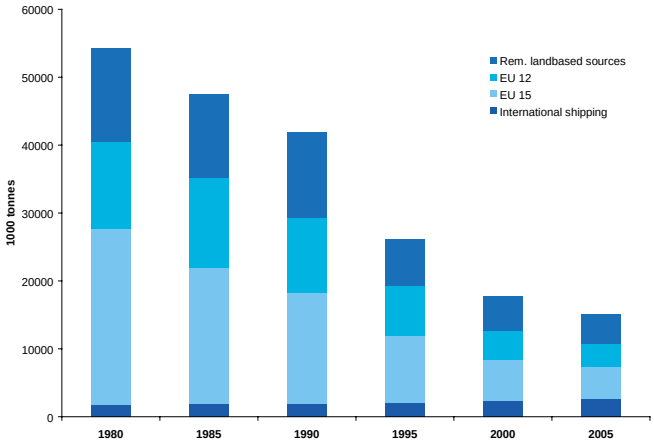
Moreover, unless additional measures are taken, the expected increase in pollutant emissions from international shipping will counteract many of the envisaged benefits of efforts to control emissions from land-based sources.

Per Elvingson & Christer Ågren

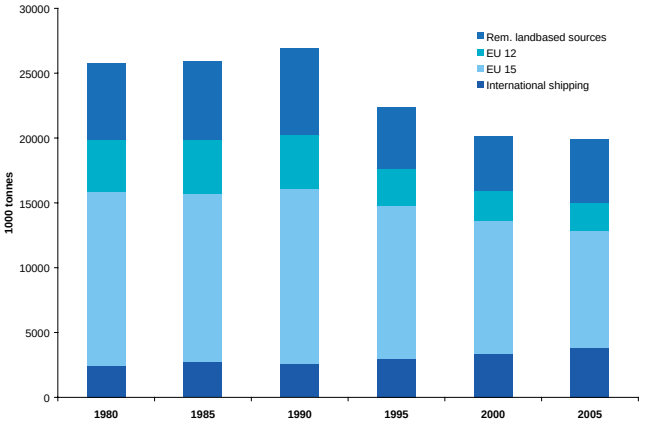
Sources: Table of emissions country-by-country can be found in Acid News 3/07. Data is also available in the EMEP database, http://webdab.emep.int.

25 years

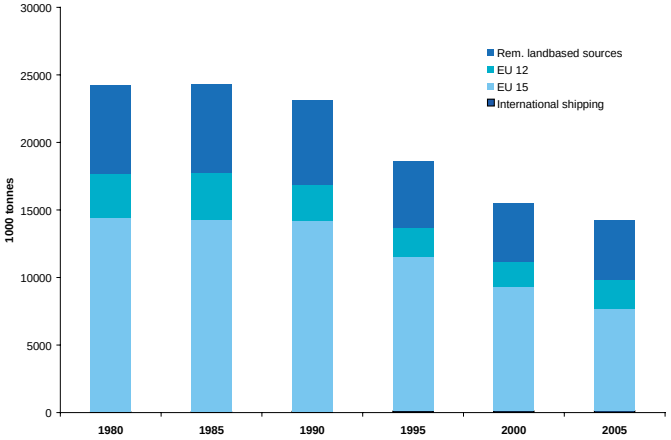
Sulphur dioxide. European emissions 1980-2005 (1000 tonnes).



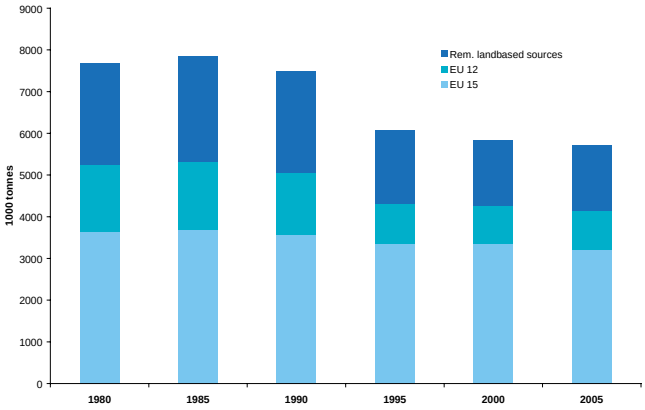
Nitrogen oxides. European emissions 1980-2005 (1000 tonnes).



VOCs. European emissions 1980-2005 (1000 tonnes).



Ammonia. European emissions 1980-2005 (1000 tonnes).



Emissions per capita – EU's top ten

	Sulphur dioxide (kg)	
1.	Bulgaria	117
2.	Estonia	57
3.	Cyprus	55
4.	Greece	48
5.	Malta	45
6.	Romania	34
7.	Poland	32
8.	Spain	28
9.	Czech Rep.	21
10.	Slovenia	21
	Average EU27	16

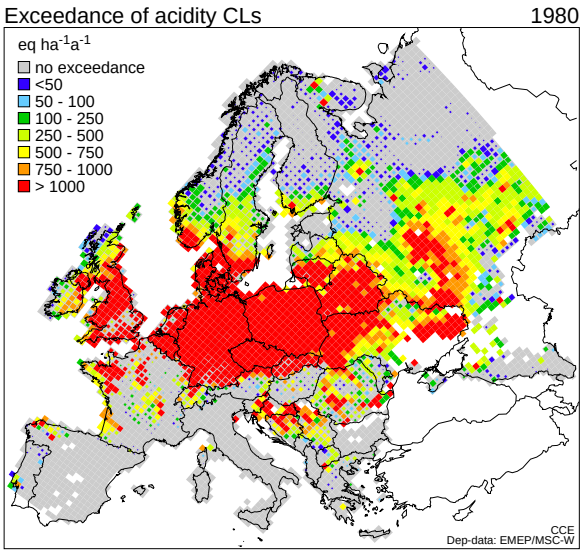
	Nitrogen oxides (kg)	
1.	Luxembourg	63
2.	Denmark	34
3.	Finland	34
4.	Spain	32
5.	Bulgaria	30
6.	Malta	30
7.	Slovenia	29
8.	Greece	29
9.	Belgium	28
10.	Ireland	28
	Average EU27	23

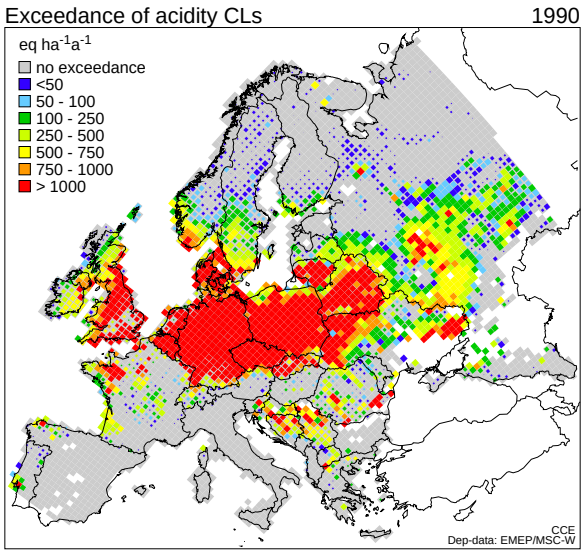
	VOCs (kg)	
1.	Portugal	29
2.	Latvia	28
3.	Estonia	27
4.	Finland	25
5.	Lithuania	25
6.	Spain	24
7.	Greece	24
8.	Poland	23
9.	France	23
10.	Sweden	22
	Average EU27	20

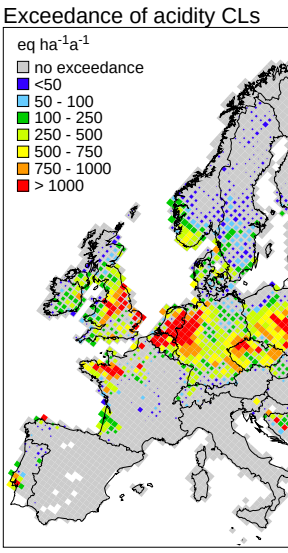
	Ammonia (kg)	
1.	Ireland	27
2.	Denmark	17
3.	Luxembourg	15
4.	Romania	12
5.	France	12
6.	Lithuania	12
7.	Slovenia	10
8.	Spain	9
9.	Poland	9
10.	Netherlands	8
	Average EU27	8

	Particles ($PM_{2.5}$) (kg)	
1.	Cyprus	0.77
2.	Germany	0.74
3.	Netherlands	0.71
4.	United Kingdom	0.64
5.	Czech Republic	0.49
6.	Ireland	0.38
7.	Italy	0.36
8.	Belgium	0.36
9.	Austria	0.32
10.	Spain	0.32
	Average EU27	0.30

Sources: Transboundary acidification, eutrophication and ground-level ozone in Europe in 2005. EMEP Status Report 1/2007. Available at www.emep.int/index_facts.html. Population data taken from Eurostat.







Acidification much better, only slight impro

Critical loads are scientific estimates of the amounts of pollutants that various ecosystems can tolerate without being harmed – sometimes also referred to as the limits on what "nature can tolerate". If pollutant depositions exceed the critical load limit, damage to sensitive ecosystems will by definition occur sooner or later.

The upper series of maps show the extent to which European ecosystems are exposed to more acid deposition than they can tolerate in the long term without damage, i.e. where the critical load limits for acidification are exceeded. The series of maps at the bottom of the page similarly show the eutrophication of terrestrial ecosystems caused by excessive levels of nitrogen compounds. The situation in 1980 is shown on the left, and the expected situation in 2020 is shown on the far right.

The calculations for 2010 and 2020 are based on the assumptions that all 27 EU Member States fully implement emission legislation, the countries that have ratified the Gothenburg Protocol do not exceed their national emission ceilings and that emissions by other countries do not rise beyond current levels. Emissions from international shipping are also assumed to comply with existing legislation. While land-based emissions are expected to fall after 2010, emissions from shipping are assumed to continue rising by around 2–3 per cent each year.

Acidification

It is estimated that the critical limit value for acid deposition was exceeded over approximately 43 per cent, or 1,794,000 square kilometres (km^2), of European ecosystems in 1980.

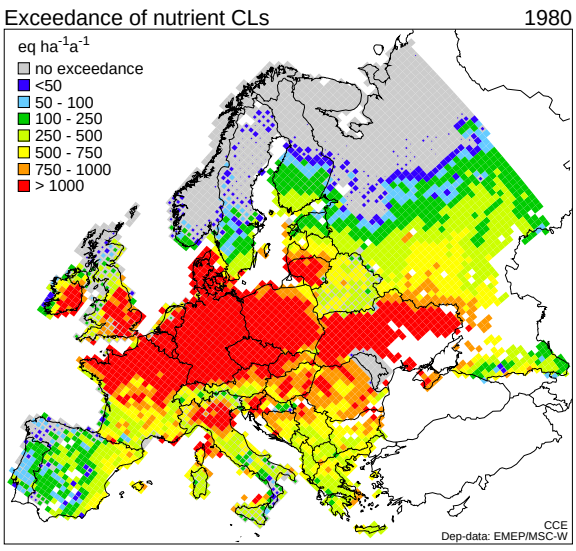
Emissions of acidifying pollutants have fallen since then, however, leading to a significant reduction in both the number of overloaded areas and the extent of overloading in the remaining grid squares over the period 1980–2000. These improvements are expected to continue to 2020, although at a reduced rate.

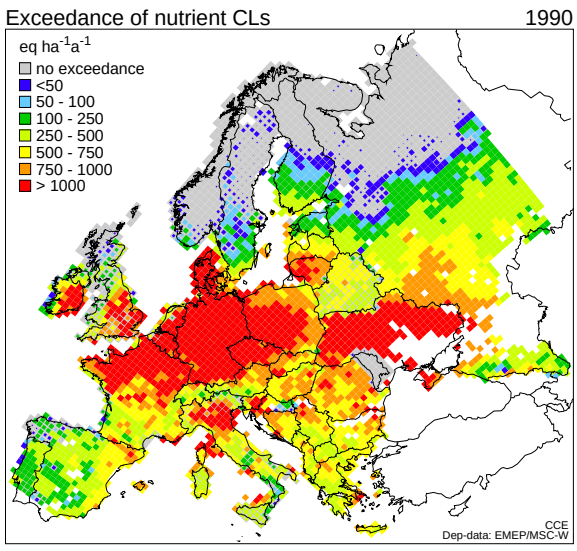
By 2010, the area where critical loads are being exceeded shrink to 333,000 km^2, i.e. less than one fifth of its size in 1980, and by 2020 it is expected to shrink further to 276,000 km^2.

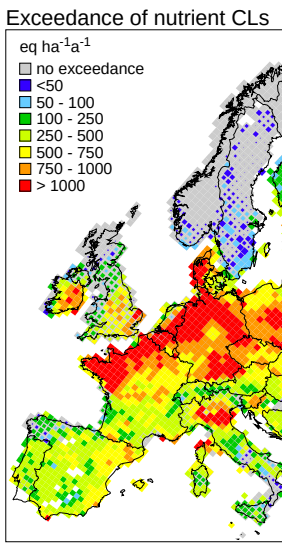
Eutrophication

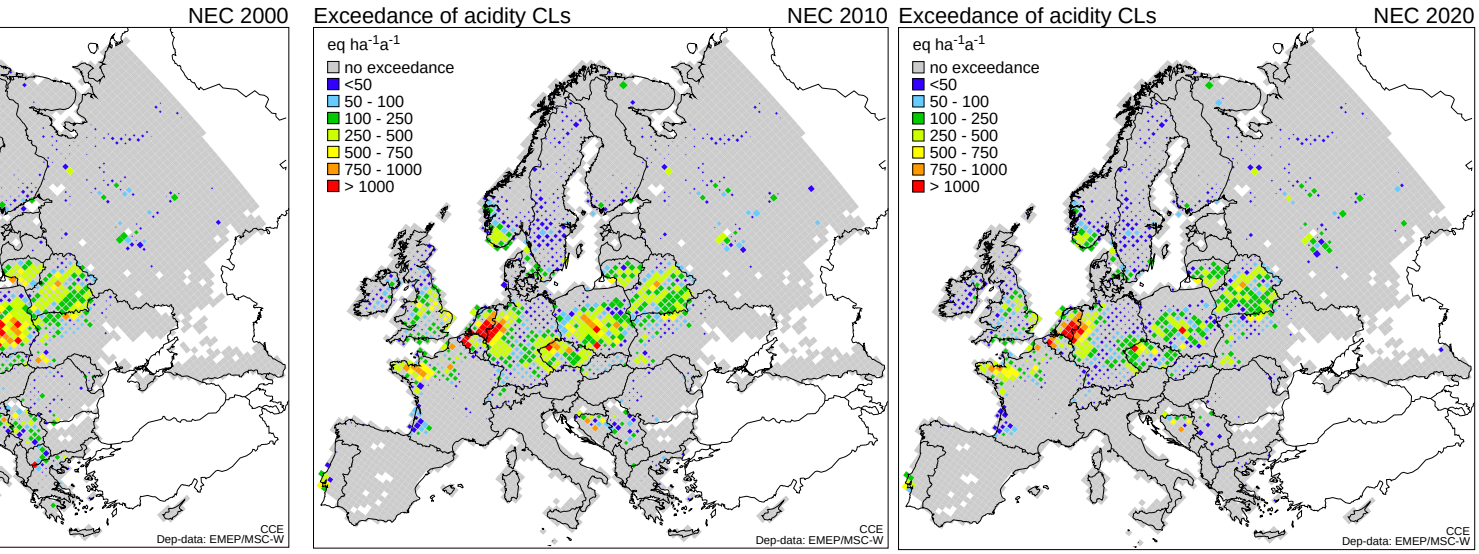
In 1980 the critical loads for nitrogen eutrophication were exceeded over an area of roughly 2.2 million km^2, or 58 per cent of European ecosystems.

Because emissions increased until 1990, the area of exceedance also increased, but since then the situation has improved – although not to the same extent as for acidification. In the year 2000 the critical load limits were still exceeded









ovement in nitrogen overload

over an area of 1.6 million km^2, or 42 per cent of ecosystem areas (the corresponding figure for acidification in the same year was 12 per cent).

According to emission projections based on current legislation, little further improvement is expected in the near future – the area exposed to nitrogen overload will stabilize at around 1.5–1.6 million km^2 up to 2020. This reflects the fact that no dramatic further cuts in Europe-wide (including sea shipping) emissions of nitrogen compounds (NOx and NH_3) are expected to result from existing legislation.

Maps do not reflect reality

One conclusion that can be drawn from the map data is that there is still a great deal to do before we reach the situation where critical loads are not exceeded anywhere – particularly in the case of eutrophication.

EU member states and the countries that have ratified the Gothenburg Protocol have agreed that non-exceedance of critical loads is their long-term goal.

Finally, it is worth stressing that the maps give a snapshot of deposition versus ability to resist at a given point in time – they do not reflect the environmental situation right now. The extent of acidified areas at present most closely resembles the overload map for 1980. Experiments and calculations show that there is a considerable lag, and that the damage that has already been caused by acid rain will persist for decades, and in places for centuries.

Per Elvingson & Christer Ågren

With special thanks to Max Posch, CCE/MNP, Netherlands, for maps and calculations.

Acidification

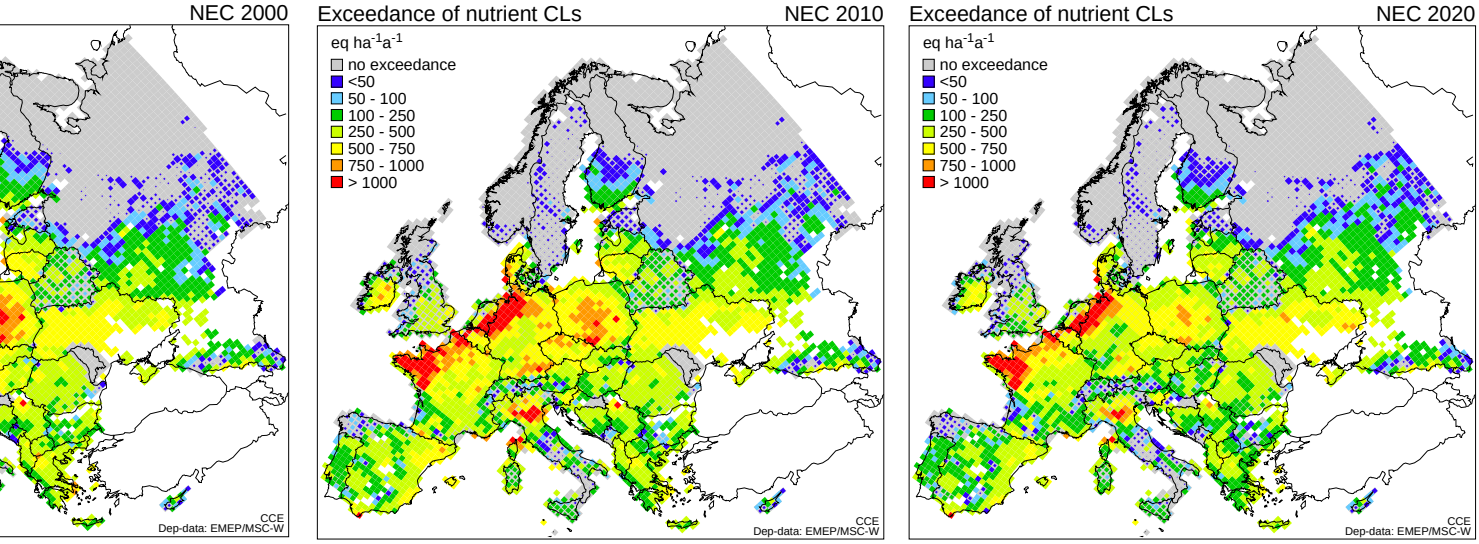
Ecosystem area exceeded (1000 km^2)

	Europe		EU 27	
1980	1794	43%	748	42%
1990	1324	31%	607	34%
2000	493	12%	312	18%
2010	333	7.9%	185	11%
2020	276	6.5%	137	7.7%

Eutrophication

Ecosystem area exceeded (1000 km^2)

	Europe		EU 27	
1980	2226	58%	1094	76%
1990	2286	60%	1089	76%
2000	1605	42%	1016	70%
2010	1558	41%	932	65%
2020	1561	41%	873	61%



Climate issue hotter than ever

To meet climate targets, greenhouse gas emissions must be drastically reduced. Many other air pollutants will disappear into the bargain.

It was back in 1896 that Svante Arrhenius, a chemist and later Nobel prize-winner, published an article in which he stated that emissions of carbon dioxide affect the Earth's climate. But it would take almost a hundred years – until the late 1980s – before the issue became a serious item on the international agenda.

The Intergovernmental Panel on Climate Change (IPCC), a broad gathering of climate researchers from all over the world, was formed in 1988. The panel published its first assessment report in 1990, and this formed an important foundation for the UN framework convention on climate change, which was adopted in 1992. The IPCC's fourth assessment report was issued earlier this year.

Today the climate issue gets more publicity than ever before, and the debate is no longer about *if* the climate is changing, but about how quickly and how much emissions need to be reduced.

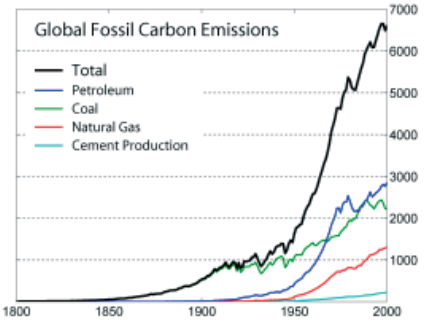


Figure 1. **Global emissions of greenhouse gases**. Million tonnes/yr.

Levels of greenhouse gases in the atmosphere today are well above pre-industrial levels. So far, the temperature has risen by around 0.7°C. But when the climate system reaches equilibrium, a process that takes many centuries, current levels will result in at least a 2°C rise in the average temperature of the Earth. Some of the effects of greenhouse gases are also masked by particles (soot and other pollutants) in the atmosphere.

Global emissions of greenhouse gases are increasing steadily by a few per cent each year, despite intense debate on the need for reductions (figure 1).

Emissions from developed countries were 2.8 per cent lower in 2005 than in 1990, but this is due to big reductions by countries with economies in transition (EIT) over the period 1990–2000. Other countries' emissions rose by 11 per cent between 1990 and 2005, and since the year 2000 emissions from EIT countries have also headed upwards. Turkey accounts for the largest percentage rise during this period, with 74.4 per cent, but in absolute terms the USA was the worst offender of all. Between 1990 and 2005 US annual emissions rose by more than one billion tonnes.

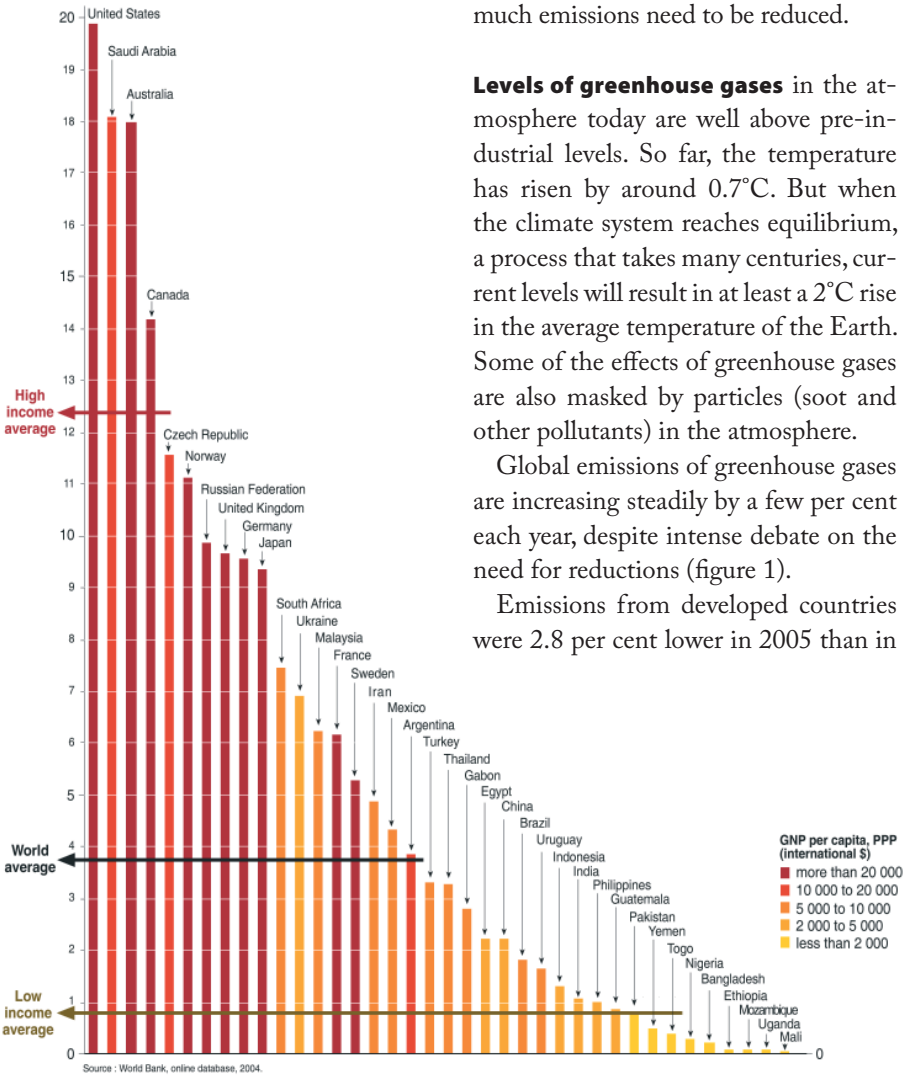
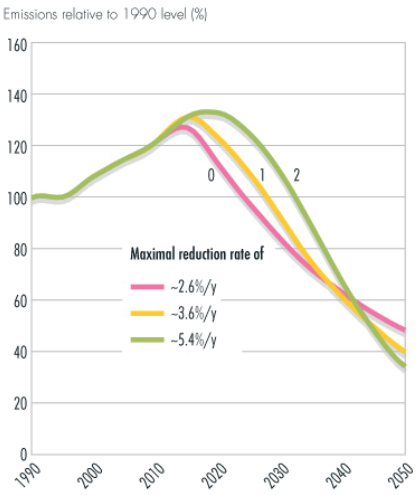


Figure 2. **Emissions of carbon dioxide, tonnes per capita 2002**. *Source*: UNEP/Grid-Arendal.

Most of the greenhouse gases come from burning fossil fuels. Today's industrial nations created the problem and dominate if you look at emissions historically. In recent years, however, emissions from developing countries have risen sharply. The two biggest emitting countries today are the USA and China, which each account for a quarter of global emissions. Looking at emissions per person, the industrial nations are roughly four times as bad as the developing nations. Per capita emissions of carbon dioxide for some selected countries are shown in figure 2.

The EU and a number of other bodies consider that global warming of two

Figure 3. **Emission paths to reach a 400 ppm CO2 equivalent greenhouse gas concentration target** (including CO_2 from land-use change). The longer it takes until emissions start to fall, the greater the annual reductions needed to achieve the target. The risk of the temperature rising more than 2°C increases dramatically if stabilization occurs at higher levels. Graph from UNEP Geo 4-report, based on research by Den Elzen and Meinshausen, 2005.



degrees above the pre-industrial level is the maximum that should be accepted (even this will mean problems for many ecosystems and nations).

If the target is two degrees, global emissions must start to fall within ten years from now (figure 3).

This is naturally a challenge, but also a big opportunity. According to the IPCC, it need not be especially expensive; in fact a long list of measures would actually be profitable as a result of efficiency improvements.

Reducing the use of fossil fuels to meet the climate target will also mean reducing emissions of pollutants such as sulphur dioxide, nitrogen oxides and particles, and hence significant additional benefits in the form of less load on ecosystems and people's health.

Monetary evaluations of these health benefits show that they make up between 50 and 400 per cent of CO_2 mitigation costs. The benefits range from $7 (USA) to several $100/tonne carbon (China). Measures in the domestic sector in developing countries are especially profitable.

In industrial countries with advanced air quality legislation, cost-savings from eliminating the need for air pollution control measures can compensate for a large share of GHG mitigation costs.

These health co-benefits need to be considered in any assessment of mitigation options. They constitute additional local and near-term benefits of measures aimed at global and long-term goals.

In the EU, extensive work is now being done to allocate responsibility between member states for achieving the target adopted by heads of government in spring: Emissions of greenhouse gases must be reduced by 20 per cent between 1990 and 2020, or by 30 per cent if other industrialized countries make the same commitment. A proposal is expected from the Commission in January.

The maps of Europe (figure 4) show estimated loss of statistical life expectancy due to exposure to anthropogenic $PM_{2.5}$ in 2020 under a business-as-usual scenario, compared with one where emissions of greenhouse gases are reduced by 20 per cent, in line with the EU's own target.

Per Elvingson

Further reading and links: Visit our website, www.acidrain.org (select Climate Change).

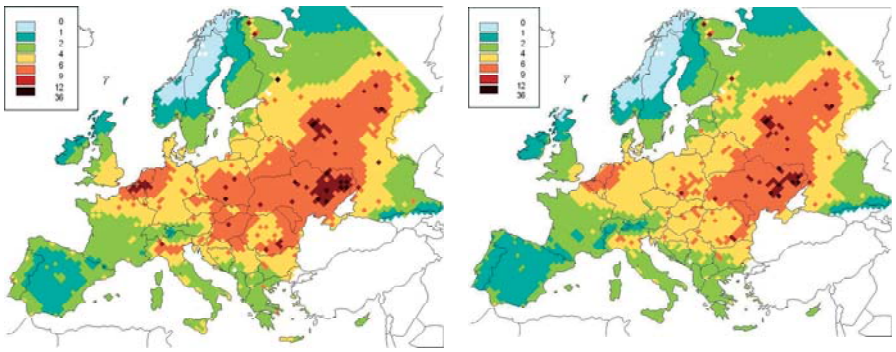


Figure 4. **Estimated loss in statistical life expectancy due to the exposure to anthropogenic PM2.5 in 2020**. On the left, an energy scenario based on national projections, in which greenhouse gas emissions rise by 3 per cent. On the right, one in which emissions are reduced by 20 per cent, in line with the EU target. Maps from Markus Amann, IIASA GAINS model.

25 years

Europe's thirty worst sulphur polluters at the end of the 1990s. The map was produced on behalf of the Secretariat and used to promote debate on a revised directive on large combustion plants in the EU.

2000

A proposal for a European climate change programme is presented by the EU Commission. The Commission suggests setting up a greenhouse gas emissions trading scheme, starting in 2005.

2001

According to the Third Assessment report of the Intergovernmental Panel on Climate Change (IPCC), global temperatures could rise between 1.4 and 5.8 °C over the next hundred years.

According to its Clean Air For Europe (CAFE) programme, presented in May, the European Commission intends to gather all Commission work for improving air quality under one hat. The first major outcome will be a thematic strategy on air pollution to be adopted in 2004.

The directive on national emission ceilings (NEC) and the revised LCP directive (setting stricter emission standards for large combustion plants) are adopted. The NEC directive is expected to cut emissions of SO_2, NOx, VOCs and NH_3 from the 15 EU member states by 76, 51, 60, and 18 per cent respectively, between 1990 and 2010.

At Climate Convention meetings in Bonn and Marrakech, an agreement was finally reached – after four years of negotiating – as to how the Kyoto Protocol should be interpreted.

2002

In its 6th Environmental Action Programme, the EU sets long-term objectives for air quality, acidification and eutrophication, including the stipulation that critical loads and levels should never be exceeded.

An EU strategy on air pollution from seagoing ships was presented by the Commission, including a proposal to regulate the sulphur content of fuel.

2003

After conciliation, a new EU directive is adopted which will lower the sulphur content in fuels (petrol and diesel) for road vehicles, to 50 ppm as from 2005 and then to 10 ppm as from 2009.

The world's biggest experiment in congestion charging began in London in February, and led to overall traffic levels coming down by 15–20 per cent.

25 years

25 years

2004

Representing the largest number of countries ever admitted at one time, Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, and Slovenia acceded to the EU by 1 May.

The CLRTAP Protocol to abate acidification, eutrophication and ground-level ozone (also known as the Gothenburg Protocol) entered into force in May.

Air pollutants, primarily fine particles ($PM_{2.5}$), are responsible for the premature death of some 370,000 persons every year in the EU25, according to calculations produced for the EU's CAFE programme.

2005

The Kyoto Protocol came into force on 16 February. The EU Heads of State backed calls to aim for a 15–30 per cent reduction in greenhouse gas emissions from industrialized countries by 2020. They also endorsed the goal of keeping global temperature rise below 2ºC above pre-industrial levels.

Late implementation and inadequate plans result in many cities in most EU member states not meeting the mandatory air quality standards for PM_{10}.

By revising the directive on sulphur in liquid fuels, EU legislation now sets limits on the maximum allowed sulphur content of shipping fuels used in European sea areas.

Annex VI to IMO's MARPOL Convention, came into force. The IMO's Marine Environment Protection Committee agreed to revise Annex VI, with the aim to agree new and stricter global emission standards for international shipping before the end of 2007.

The European Commission presents its Thematic Strategy on Air Pollution, which sets the level of ambition regarding air quality in the EU until 2020. As part of the strategy, the Commission also proposes a new air quality directive, adding standards for $PM_{2.5}$.

2006

The World Health Organization (WHO) reinforces its air quality guidelines for a number of pollutants and makes them global.

In December new EU passenger cars emission standards for NOx and PM were agreed. The Euro 5 standards become mandatory as from 2009/10, and the Euro 6 standards as from 2014/15.

Allowing greenhouse gas emissions to continue to increase may cost up to 20 per cent of global GDP, according to a report by former World Bank chief economist Nicholas Stern, published on 30 October.

2007

The EU Heads of State agreed that EU greenhouse gas emissions must be cut by at least 20 per cent between 1990 and 2020. Under international agreement the EU undertakes to increase that target to 30 per cent. Moreover, 20 per cent of energy used in the EU in 2020 must come from renewable sources.

Evidence that human activities are causing the planet to warm is now "unequivocal", the IPCC says in its 4th assessment report. To meet the target of 2ºC with a reasonable degree of confidence, emissions in 2050 must be 50–85 per cent below the 1990 level.

25 years

News on air pollution and climate change

The Secretariat's newsletter Acid News is published as a means of keeping attention focused on air pollution, including greenhouse gases, and its attendant problems.

Acid News reports on the environmental and health effects of air pollutants, as well as on the efforts that are being made to control and reduce the emissions.

The magazine is being circulated free of charge, four times a year. To subscribe, either paper copy or electronically, please send an e-mail to acidnews@acidrain.org.

Sex, sulphur and a fishy business

A film with the sub-title "A kind of twisted documentary on acid rain in Scandinavia". Explains air pollution problems in an unconventional way. Produced for the Secretariat by Dockhouse Film & TV AB and shown on Swedish and Norwegian TV. The film won several international prizes and was distributed to environmental organizations all over Europe. 58 min. Available on DVD, single copies free of charge within Europe.

Basic information and latest news

www.acidrain.org is our website address. You'll find Acid News, downloadable copies of our reports, news and a great deal of background information on air pollution and climate change.