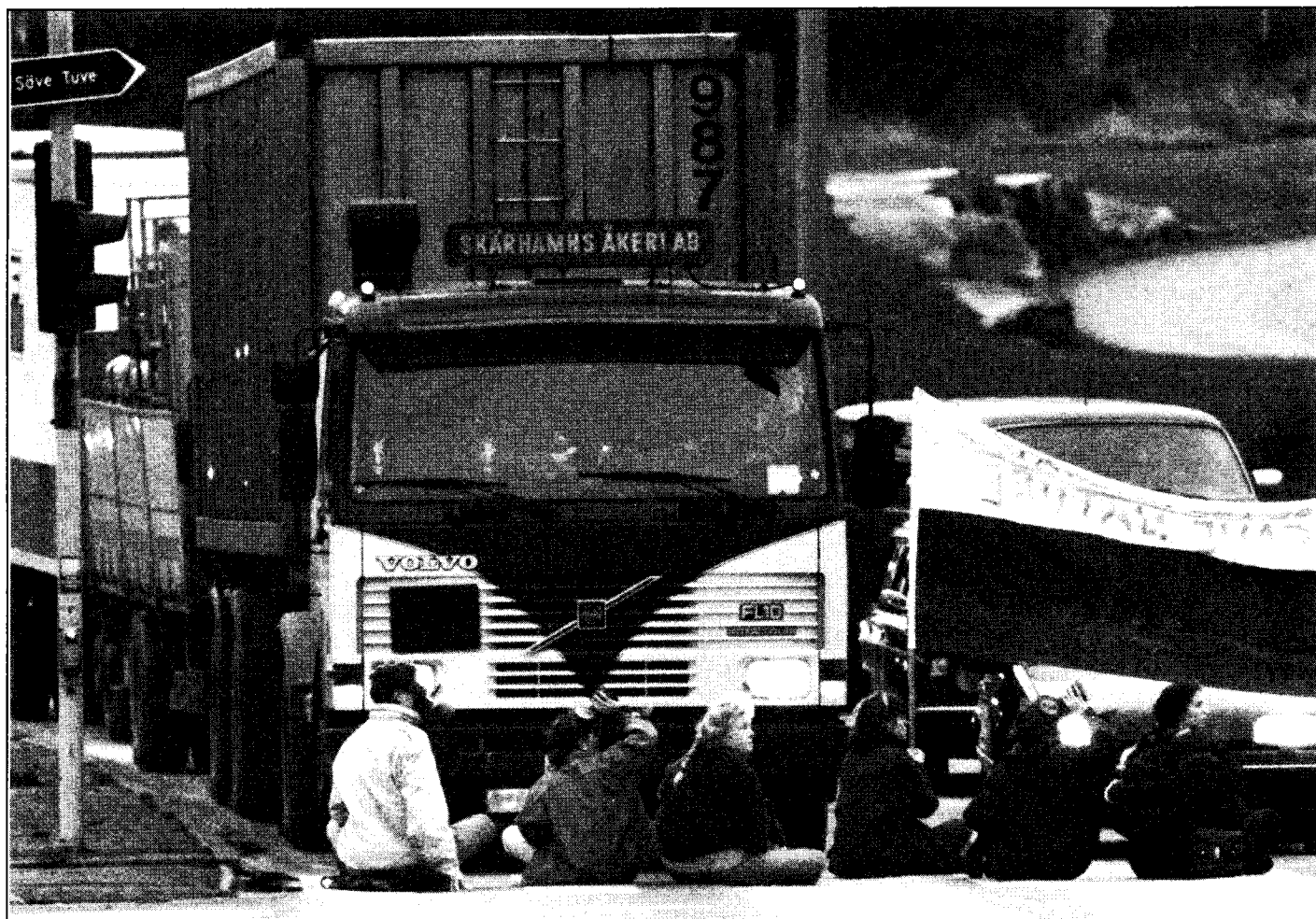


Acid News

NO. 1, MARCH 1992

A Newsletter from the Swedish and Norwegian NGO Secretariats on Acid Rain



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ROAD TRAFFIC

Enough is enough

PUBLIC PROTEST against increasing air pollution from road traffic and aircraft continues to grow all over Europe. Highly visible demonstrations have been taking place from the Baltic region down to the Alps, and widespread lobbying and public actions are being made ready to counteract the threat that is looming over the whole continent.

On October 25, 1991, environmentalist groups including Robin Wood in Germany and Children of the Earth in Czechoslovakia blocked the main roads crossing the border between Germany and Czechoslova-

kia in protest against the increase in truck traffic. To underscore a demand for switching freight carrying from the roads to the railways, a group at Waldhaus had even managed to place a 14-metre-long locomotive on the highway. In this case the demonstrations had been arranged to coincide with a meeting of European transport ministers in Prague.

A Pan-European Transport Conference had been called simultaneously by NGOs to formulate a declaration to the ministers. This demanded an environmentally in-

clined transport policy which, with the critical-load concept as a basis, would take in a full assessment of the social, economic, and environmental costs of future infrastructural projects.

During an International Traffic Day on November 15, 1991, environmentalist groups gathered in sixty-five cities in thirteen European countries to protest against air pollution from traffic and the construction of new motorways, circular routes around cities, and large bridges. Under the slogan of "Not

Continued on page 3

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Acid News

A newsletter from the Swedish and Norwegian Secretariats on acid rain.

ACIDNEWS is a joint publication of the two secretariats, whose aim is to provide information on the subjects of acid rain and the acidification of the environment.

Anyone interested in these problems is invited to contact the secretariats at either of the addresses below. All requests for information or material will be dealt with to the best of our ability.

In order to fulfill the purpose of Acid News, we need information from everywhere – so if you have read or heard about something that might be of general interest, please write or send a copy to:

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THE SECRETARIATS

The Swedish NGO Secretariat on Acid Rain is supported by the following environmental organizations:

- The Environmental Federation (Miljöförbundet)
- The Swedish Anglers' National Association (Sportfiskarna)
- The Swedish Society for Nature Conservation (Naturskyddsföreningen)
- The Swedish Youth Association for Environmental Studies and Conservation (Fältbiologerna)
- World Wide Fund for Nature Sweden (Världsnaturfonden WWF)

Address and telephone: see above.

The Norwegian Secretariat, "The Norwegian Clean Air Campaign," is organized by five non-governmental organizations concerned with the environment:

- Nature and Youth (Natur og Ungdom)
- The Norwegian Forestry Society (Det Norske Skogselskap)
- The Norwegian Association of Anglers and Hunters (Norges Jeger- og Fiskeforbund)
- The Norwegian Society for Conservation of Nature (Norges Naturvernforbund)
- The Norwegian Mountain Touring Association (Den Norske Turistforening)

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A matter of concern

WITH GLOBAL THREATS to the environment such as the greenhouse effect and the thinning of the ozone layer claiming so much attention, the more regional problems of acidification and forest decline have tended to recede into the background.

It is quite in order that the global problems should be recognized and taken seriously, and the strategies and programs for dealing with them should naturally be given a high priority. But since the environmental authorities and environmentalist organizations both have limited resources at their disposal, a contradiction seems to have arisen between the claims of the global and the regional environmental problems that revolve on atmospheric chemistry. In many cases the result has been a lower priority for the regional.

The problems are nevertheless still with us. The acidification of soil and water is still going on, forests are still being damaged, as are buildings and the historic monuments that in general comprise our heritage. Health also continues to suffer from the emissions that cause acid rain. Although there has been some progress in curbing these emissions, the problem is far from being solved. Rather are the phenomena intensifying and spreading farther afield. Mostly in question are the pollutants sulphur dioxide, oxides of nitrogen, volatile organic compounds, and ammonia.

While there is a definite tendency in Europe for the emissions of sulphur dioxide to diminish, the pace is far too slow and the reduction targets have been set far too low and too far off in time. The emissions of nitrogen compounds, both oxides and ammonia, appear to be still on the increase. Although for the moment there is no clear trend as regards VOCs, there should at least be some reduction of emissions during the nineties as a result of more stringent control of vehicle exhausts.

The fact remains, however, that as long as the concentrations and depositions of these pollutants – along with secondary formations such as ozone – stay above the criti-

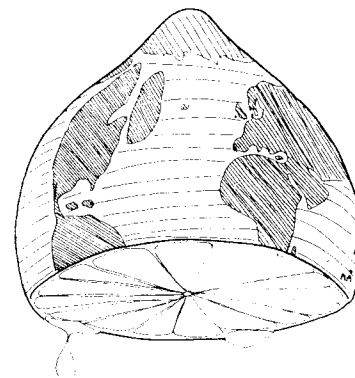
cal levels, so long will the damaging effects continue.

The possibilities for bringing about rapid reductions of emissions certainly exist. It is just the will to take the necessary steps that is often lacking. Greater awareness of the harm caused by air pollution, both among the public and among politicians, is needed if there is to be any real progress. The economic consequences in particular will have to be made clearer. There are for instance calculations indicating that if the steady acidification of the soil starts to affect forest growth – as it may be expected to do in Scandinavia within only a few decades – the losses may run to billions of kronor a year.

Although the economic aspect must obviously be an important consideration for the decision makers, there are also other weighty arguments in support of a rapid and sizeable reduction of emissions. The fact, for example, that in the course of only a few decades we have used up a great part of the soil's store of the nutrients that are available to plants is definitely not compatible with the concept of a sustainable society. Neither is the present steady impoverishment of flora and fauna, nor the damage to our cultural heritage, which has also been given too little attention.

It is for reasons such as these that the regional problems of air pollution, such as acidification, must be brought back into the political arena. An intensification of activity on the part of environmentalist organizations and other concerned groups could be highly important as a means of hastening this urgently needed process.

CHRISTER ÅGREN



Continued from front page

one more metre of motorway" some of the protests were also directed against the International Road Federation, which had recently presented a plan for building 20,000 kilometres of new motorway in Europe before 2010.

Here the day of action had been coordinated by EYFA, the European Youth Forest Action. In Budapest, where even the minister for the environment took part in the demonstrations, people started painting the city's first bicycle lanes on the roads. In Copenhagen the target was the ravaging of national monuments by air pollution, and in Tartu, Estonia, the protests aimed at the pollution caused by the city's obsolescent bus fleet were accompanied by a demand for improved public transportation. Demonstrators in Brno, Czechoslovakia, blocked the entire inner city for four hours.

One of the main streets in the centre of Göteborg, on the west coast of Sweden, was likewise obstructed by more than hundred activists a couple of weeks later, on December 3. Such protests have been taking place regularly in Göteborg during the last months, often causing open conflict with motorists. In some cases the demonstrators have been arrested and sentenced to quite heavy fines.

It is notable that according to a fresh report from the Environmental Protection Agency, Sweden will not be able to attain the aim, set by parliament in 1985, of reducing its emissions of nitrogen oxides by 30 per cent (from 1980) by 1995. The main reason: greatly increased road traffic.

Increasing transport of freight by road through Austria was the reason for 250 people from the Tirol stopping traffic at Kufstein/Kiefersfeld on the German-Austrian border on January 18, 1992. Transit traffic has been a subject of much public debate both in Austria and Switzer-

land on account of the negotiations between EFTA and the EC for a closer alignment of policy (see Acid News 2/91). The transit agreement that was finally signed on October 21 last year fails however to satisfy environmentalists in either country.

For one thing, that agreement does not envisage any reduction in through truck traffic, but rather an increase. Moreover it makes no

Transportation should pay its full social costs

mention whatsoever of transiting passenger cars. In the Tirol, for instance, it is estimated that 50 per cent of the emissions of air pollutants emanates from tourist vehicles passing through the region. While it does, on the positive side, include schemes for improving the two countries' railway systems, there is no commitment to do anything about the lines leading to Switzerland and Austria from the surrounding EC countries – which would be an important presupposition if road freighting through the Alpine region is really to be reduced.

Environmentalist organizations are however now stepping up lobbying activity towards the Community as well. The European Federation for Transport and the Environment (T&E) is for instance working on several projects for lobbying the Commission. One that is of importance in 1992 will be to demand of industry and politicians in Europe that transportation should pay its full social costs. The T&E is now preparing a major report on the way these costs should be calculated and internalized.

Further public actions in protest against the increase in road traffic

and air pollution that are being planned for this spring will concentrate on the emissions of carbon dioxide and the contribution of the various modes of transportation to global warming. An appeal will be made to the governments of Europe to take the negotiations for a UN Climate Convention more seriously, and to prepare for concrete reductions of the emissions of carbon dioxide from the transportation sector as well. During the action days special attention will be drawn to the marked increase in air traffic in Europe.

The action days are scheduled to take place on April 20-21, coinciding with International Earth Day, and also on May 15. It is expected that all environmentalist groups will be preparing activities for those occasions.

REINHOLD PAPE

T&E was launched in 1990 as an umbrella organization to represent organizations, now numbering twenty, that are campaigning for a more environmentally inclined approach to the problem of transportation in all countries of Europe. For more information contact T&E Secretariat, 17 George Street, Croydon, England CR0 1LA.

A Climate Convention is supposed to be an outcome of the UNCED meeting in Rio de Janeiro, Brazil, in June. See Acid News 4/92.

For Earthday activities contact:

Earthday International
Box 38946, 794 Fort Street,
CA-Victoria, British Colombia
Canada V8W 3N2
Phone: (604)743-7121
Fax: (604) 743-3353

For activities during International Traffic Action Day May 15, 1992 contact:

European Youth Forest Action
Postbox 566
NL-6130 AN Sittard
The Netherlands
Phone: 31-46-513045
Fax: 31-46-522709

On the following pages

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Opportunities for saving

THE RESTRUCTURING of industry in eastern Europe offers great possibilities of energy saving, enabling the emissions of air pollutants such as sulphur and carbon dioxide to be cost-effectively reduced. Investments leading to improved efficiency in the use of energy in eastern Europe would be a means of lessening the pollution load both there and in the West. In other words, it should be in the interest of the western European countries to support the process of economic restructuring in the East.

An analysis of the way changes in the economic and energy systems of eastern European countries can affect general policies for the reduction of acid rain has recently appeared in a report* from IIASA, the International Institute for Applied Systems Analysis based in Austria.

For the purposes of the analysis IIASA has employed two scenarios, the one for reference, representing the latest available governmental energy projections for the year 2000, and the other anticipating a transition from centrally planned to market economies. The projections in the first, which date back several years and therefore mostly reflect

the expectations of former governments, presuppose an increase in total primary energy demand in eastern Europe of almost 30 per cent between 1985 and 2000.

According to that scenario, energy intensity in industry would increase by an average of 8 per cent, from 4.5 to 4.86 petajoules per million DM of

West's self-interest to ensure the success of restructuring

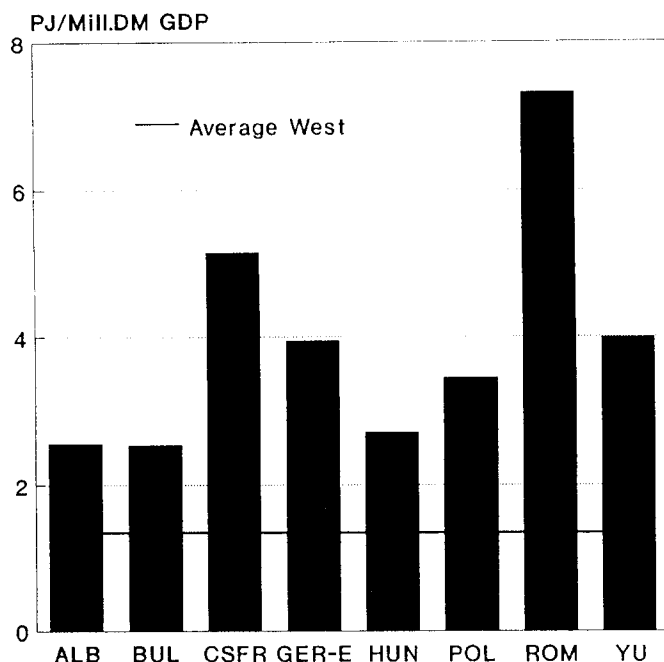
gross domestic product. In comparison, the level in western Europe in 1985 was 1.25 petajoule. This enormous difference is due to the poor performance of the existing technical equipment in eastern Europe, with its low energy efficiency, combined with a high share of energy-intensive heavy industry.

The energy consumption of the transport sector in the East, in terms of petaj/DM1m of gross domestic product, was about 10 per cent higher (in 1985) than in west-

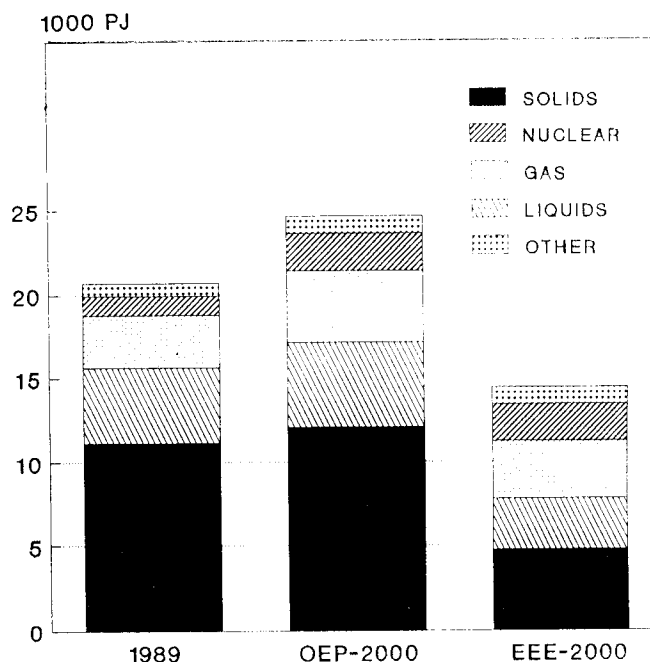
ern Europe, and is expected to increase by 10 per cent by the year 2000. In 1985 the consumption of energy for domestic use was about equal in East and West, or 34 terajoules per capita per annum. An increase of 10 per cent by 2000 was forecast for eastern Europe.

The second scenario assumes the transformation of industry towards more advanced production processes and less energy-intensive activities, resulting in a gradual approach to the average western European levels of 1985 in the overall energy intensities in the East. In the case of industry, it is assumed that only about half the changes that will be necessary for reaching the 1985 levels of western Europe will have been implemented by the year 2000.

The sulphur emissions that result from the application of the two scenarios are shown in the table. Under each of the scenarios two levels of emissions are shown. The first represents the "no control" case, with no measures for the reduction of emissions applied at the sources of fuel combustion, indicating the upper range of emissions. The second shows the emissions that would remain after the application of all the



Industrial energy intensities in eastern Europe, 1985.



Eastern energy use according to the scenarios.



Energy use for transportation is relatively higher in eastern Europe than in the West, but tramways are a particularly energy-efficient mode.

control technologies that are now commercially available.

Instead of increasing by 10 per cent, as in the OEP scenario, the emissions would be reduced by about 25 per cent with the EEE scenario. The maximum achievable reduction would be 93 instead of 78 per cent. Similarly, improvements in energy efficiency would have a positive effect on the emissions of CO₂. Instead of a 17-per-cent increase by 2000, as in OEP, with the EEE scenario the eastern European emissions of CO₂ would decline by 23 per cent, as compared with 1985.

During the last year maps were published showing the critical loads for acid deposition over Europe. The achievement of the low deposition levels that will be required if the critical loads are not to be exceeded would call for a marked reduction of emissions in a great part of Europe – and in some countries almost zero emissions. Consequently these loads are not considered when setting short-term policy targets in international negotiations. In the negotiations for the next sulphur protocol under the UNECE Convention on Long Range Transboundary Air Pollution, interim target loads will be used instead.

By last autumn, when the present IIASA report was being produced, target loads, in some cases preliminary, had been specified by ten European countries. Using the RAINS model, the reductions of emissions have been spread over the various countries so as to permit achievement in the most cost-effective manner. The model shows that attainment of the target loads that have so far been specified will entail a general reduction of emissions in Europe by a good 70 per cent. As a result of decisions so far taken, the reduction is likely to be less than 30 per cent.

For most eastern European countries the EEE scenario implies a con-

siderable reduction of emissions. This in turn means that some western countries will not need to reduce to the same extent. For the whole of Europe the overall cost of reducing emissions would be 44 per cent lower in the EEE case than in the OEP scenario, or DM34 billion per annum instead of 61 billion. The report also gives the abatement costs for each country according to each scenario, both in money and as a per cent of their gross domestic product.

As demonstrated by the model, improvements in efficiency would not only lead to lower abatement costs within any country applying measures to that effect.

As shown by the international optimization model approach that is used in the RAINS model, such measures might also have a benefit elsewhere by lowering the requirements on other countries.

In other words, the improvement of energy efficiency in eastern Europe could permit a considerable decrease in abatement efforts in the West. It should thus be a matter of vital self-interest for the West to ensure the success of the East's restructuring process. The considerable cost savings might in fact provide the motivation for western countries to engage in that process. They could at least use the difference in abatement costs between the two scenarios as a base for financial support to eastern Europe, and still retain a cost saving as compared with the "no control" case.

In both cases the efficient control of emissions from large combustion plants is an absolute necessity. Increased energy efficiency will on the other hand mean that fewer large power plants will be needed, and thus there would be a lower amount of emissions to be abated.

CHRISTER ÅGREN

*** Economic Restructuring in Eastern Europe and Acid Rain Strategies.** By M Amann et al. Available from the publisher, IIASA, A-2361 Laxenburg, Austria.

The analysis was carried out with the RAINS computer model developed by the Institute (Regional Acidification INformation and Simulation).

Sulphur emissions (in kt SO₂) for countries of eastern Europe for 1985, and for two energy scenarios.

	1985	OEP Scenario ¹		EEE Scenario ²	
		I	II	I	II
Albania	121	167	41	78	38
Bulgaria	1070	1555	236	152	11
Czechoslovakia	3150	2513	708	1743	114
Germany (East)	5360	5048	1158	3892	431
Hungary	1404	1529	580	1018	128
Poland	4300	4165	749	3427	425
Romania	1800	3261	313	2544	232
Yugoslavia	1500	2393	321	1093	124
SUM	18705	20631	4106	13947	1503
Change	–	+10%	-78%	-25%	-93%

¹ Official Energy Pathway

² Energy Efficiency in Eastern Europe

Investments and controls

"WEST GOES EAST: Opportunities or Pollution Transfer" was the title of a conference held in Sofia, the Bulgarian capital, on January 18-20, 1992, and arranged by Ecoglasnost (Friends of the Earth Bulgaria) and the European Coordination of Friends of the Earth (CEAT). In a statement issued beforehand, the organizers had noted that the economies of Central and Eastern Europe needed input from the West in the form of technological, management, and marketing know-how, as well as capital.

The environmentalist organizations in the central and eastern European countries would, it went on, have no objections in principle to such a development, provided it was subject to a strict environmental policy.

The purpose of the conference was to ventilate the problems that western investments in the area might give rise to, from the point of view of the environment. Attending were more than 100 representatives of environmentalist groups from central, eastern, and western Europe, and among the subjects of lectures and debate were:

- Environmental criteria for western commercial activities in Central and Eastern Europe.
- Strategies for getting early and sufficient access to information concerning the commercial activities of western companies and assessing their potential environmental effects.
- The quality and usefulness of the self-regulatory agreements of western industry (codes of conduct, responsible care programmes, etc.).
- A network for cooperation between environmentalist organizations as a means of giving them influence over the quality of western commercial investments.

Eleven national reports which were presented at the

conference helped to give an understanding of the issues at stake. Unfortunately there are already many examples of western investments in eastern Europe with an adverse environmental effect.

The broad conclusions of the conference were summarized by agreement of the participants as follows:

1. There is an urgent need in the region for stringent national environmental legislation, effective

monitoring and enforcement, and a robust regulatory system.

2. We, like the European Community, recognize the need to ensure that western firms act in advance of such legislation. The basis for this must be the acceptance of public accountability through information provision and public participation in decision making. As a minimum western firms must operate at the same environmental standards as they do in the west.

3. It is essential that governments, firms, NGOs address the issue of environmental impact of western investment in central and eastern Europe.

4. It is vital that environmental NGOs work together more effectively on the issue of foreign investment.

The "Sofia Statement" from the conference makes concrete recommendations as to how NGOs, governments in Central and Eastern Europe, western firms, and western governments and international institutions should implement these general conclusions. It was e.g. decided to set up an NGO network to monitor developments.

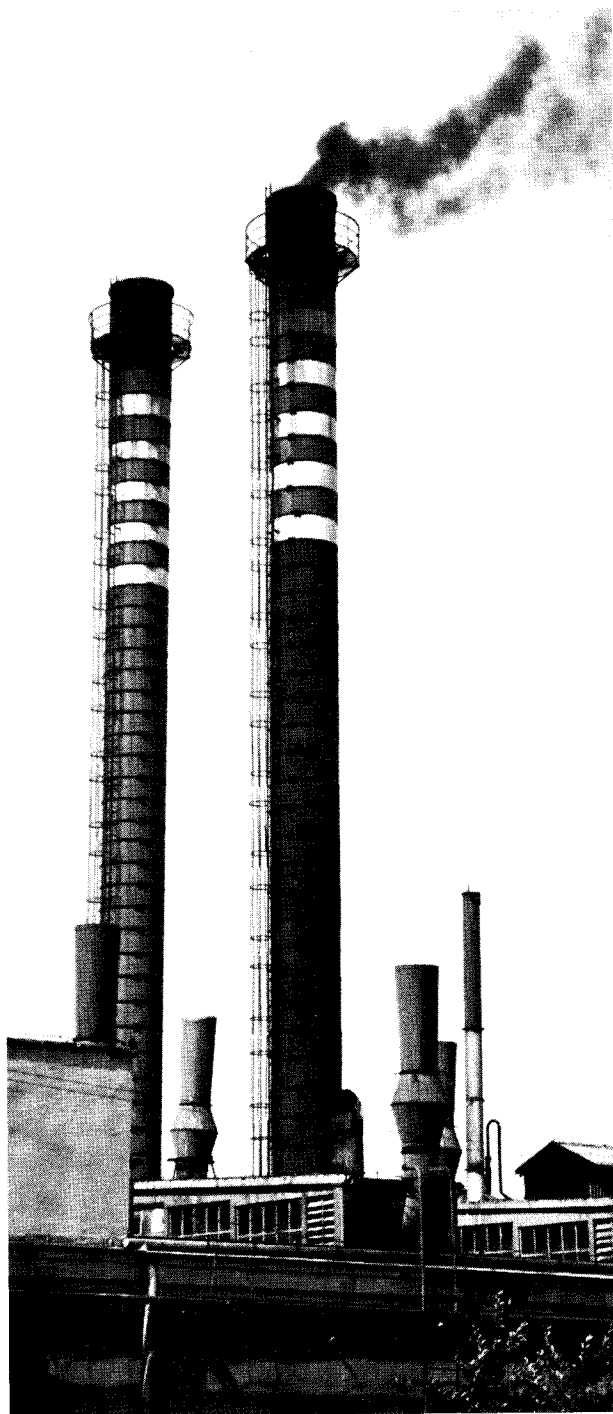
A detailed report from the conference can be obtained from CEAT, the focal point for the network is the Slovakian Society for the Conservation of Nature (SZOPK), and the Ecological Studies Institute in London is planning to publish a newsletter on the matter of western investments in eastern Europe.

REINHOLD PAPE

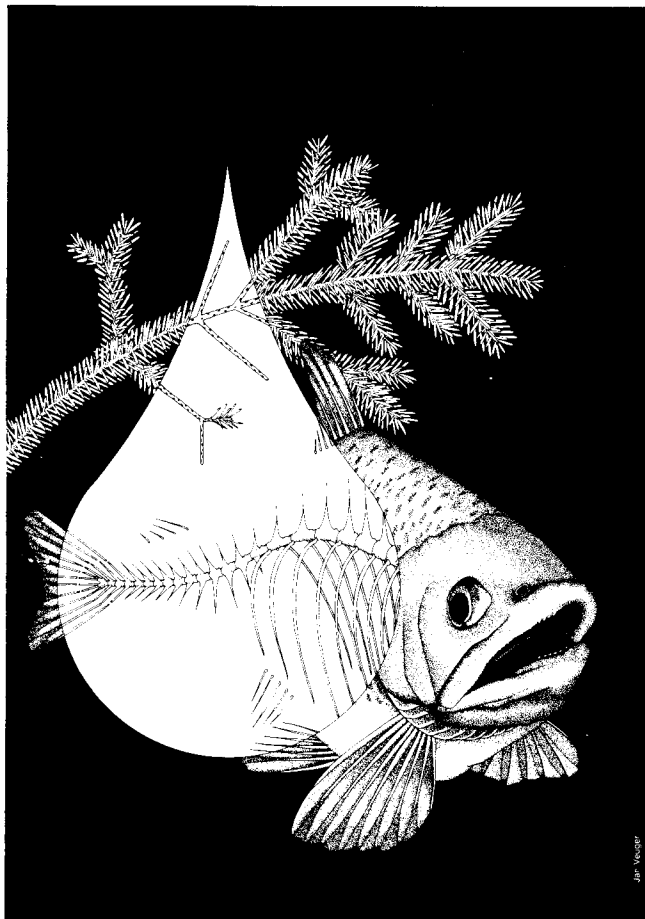
European Coordination of Friends of the Earth, CEAT, 19 rue Blanche, B-1050 Brussels, Belgium

Slovakian Society for Conservation of Nature, Gorkého 6, CS-811 01 Bratislava, Czechoslovakia

Ecological Studies Institute, 49 Wellington Street, London WC2E 7BN, Great Britain



An ABC of acidification



© JAN VEUGER

The ability of soils in Sweden to ward off acidification is nearing an end. Unless emissions of acidifying pollutants are quickly and substantially reduced, the acidification of soils and waters can only become intensified.

BECAUSE OF AIR POLLUTION, close on 14,000 lakes are now distinctly acidified in Sweden – and about 4000 of them very badly so, which means that the pH value of the water has fallen by more than 0.6 units. And a rapid further deterioration will ensue if acid deposition continues at the same rate as today – it being estimated that after only a few decades the number of acidified lakes will have risen to 34,000.

The country has something like 85,000 lakes with a surface of more than one hectare – and the facts mentioned have been revealed in a recent survey* covering some 4000 that had been selected at random. The new survey is in effect a follow-up of a similar one carried out in 1985, the findings of which have however only been published in Swedish.

The cause of acidification is to be found in man-made emissions to the atmosphere, primarily of sulphur and nitrogen oxides. Such pollu-

tants can be carried along by the winds for thousands of kilometres before being deposited on soil or water. While still in the atmosphere the sulphur dioxide becomes transformed into sulphuric acid, hydrogen ions and sulphate ions, and the nitrogen oxides to nitric acid, hydrogen ions and nitrate ions.

As shown by data from EMEP, the European monitoring program, almost 90 per cent of the sulphur and nitrogen compounds that are deposited over Sweden come from abroad, the countries contributing the most being Germany, Britain, and Poland.

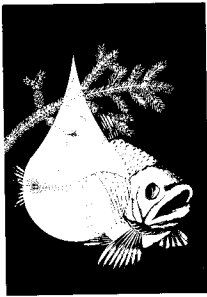
From analyses of the precipitation over Sweden it can be seen that the concentrations of sulphate ions were on the increase during the sixties and reached a maximum in the seventies, and had then gone down in line with the reduction of sulphur emissions both in Sweden and on the continent. Today the sulphate concentrations are about 30 per cent

lower than they were twenty years ago in south-central Sweden. In other parts of the country the decline has been somewhat less.

The lowering of sulphate levels has not however been accompanied by a reduction in the concentrations of hydrogen ions. The pH values of rain and snow are consequently just about as low as they were in the seventies. The explanation is to be found primarily in a continued increase in the emissions of nitrogen oxides. The proportion of nitric acid in the precipitation has increased, while that of sulphuric acid has fallen. Fully one-third of the acid depositions over southern Sweden are now made up of nitric acid.

EFFECTS ON SOIL

Practically all lakewater originates in precipitation, and there is thus a clear connection between the chemical composition of the rain or snow and that of lakewater. But most of the rain and snow falls over land,



and the water only reaches a lake after having first passed through the soil. While in the soil it undergoes various chemical reactions, causing

changes in its composition.

A slow natural and mainly biological process of soil acidification has been taking place in Scandinavia ever since the retreat of the great ice sheet some 10-15,000 years ago. Over the last century however acidification has increased apace as a result of human activities, with fuel burning and forest practices as prominent causes. During a few recent decades alone the supply of acid from airborne pollutants has had a greater acidifying effect on the soil in southern Sweden than all the biological processes, including those due to forestry, have had in the same space of time.

It has been calculated that the soil-acidifying effect of airborne pollutants is twice as great in southern Sweden as that of forestry. In the northern two-thirds of the country, where the acid deposition is considerably less, the effects are about equal.

Acidification reduces the ability of the soil to neutralize further additions of acid. Ion exchange is one of the processes by which neutralization takes place. Humus substances and clay particles capture hydrogen ions (for instance from sulphuric acid) and give off instead base cations to the water as it seeps through the soil. Although this acidifies the soil, it improves the pH value of the water. At the same time base cations of potassium, calcium, and magnesium are leached out of the soil. Since 1950 the forest soils in southern Sweden have lost about half of their store of calcium and magnesium ions. Deficiencies of magnesium, for example, can produce a nutrient imbalance, and they are thought to be among the causes of forest decline in Europe.

The weathering of silicates and other minerals provides another neutralizing process, but one that takes place slowly. As a result the concentrations of aluminum ions in the soil water increase, especially when the pH of the mineral soil has fallen below 4.4. Increased concen-

trations of aluminum in the soil water can result in damage to trees' roots, and aluminum ions that are leached out into lakes and streams can become transformed and so toxic to organisms such as fish.

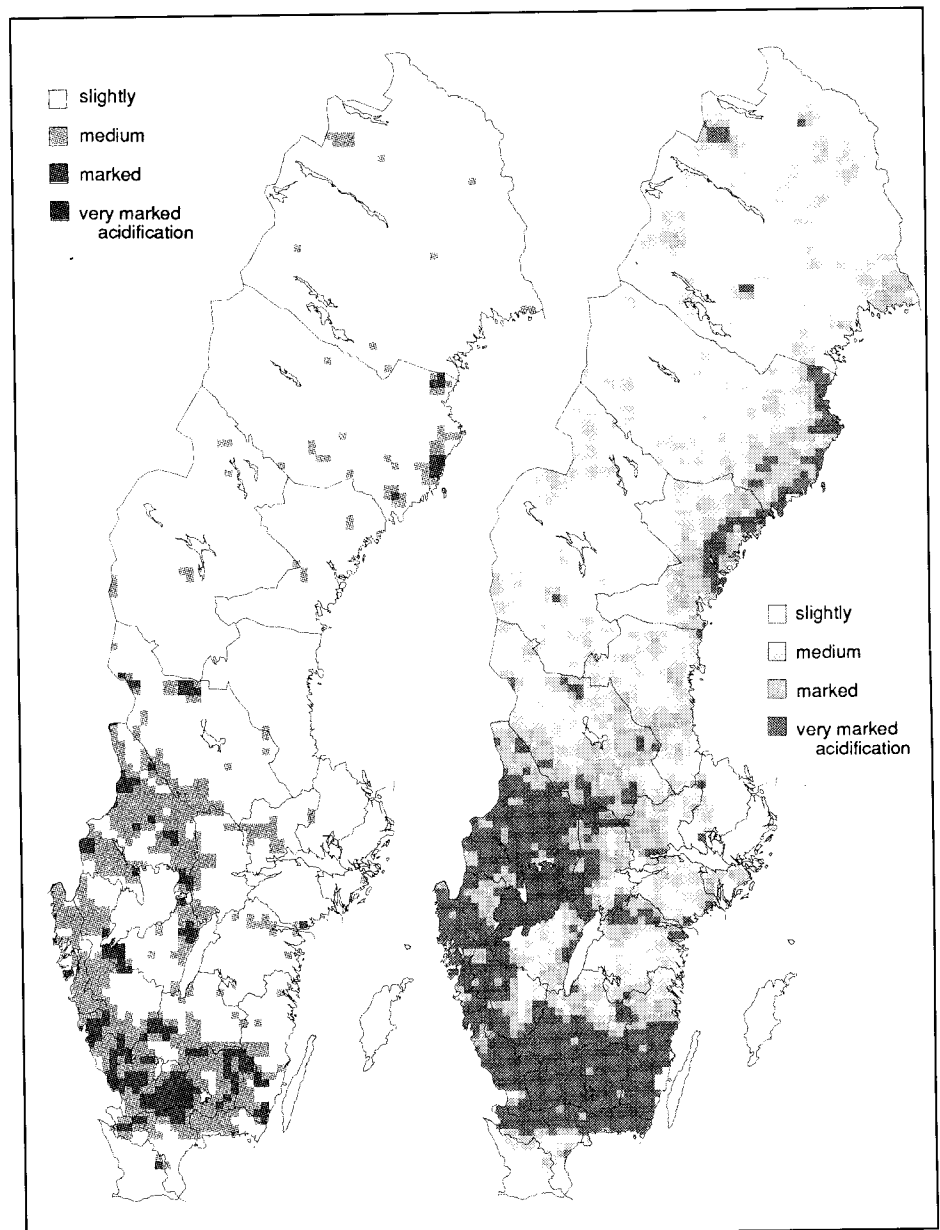
The buffering processes of ion exchange are of relatively short duration. Should acid depositions continue at the present rate, the store of base cations in forest soil will have become practically exhausted within a few decades.

CRITICAL LOADS

The amount of acid deposition that various types of soil will manage to neutralize in the long run – the so-

called critical load – will depend on the mineral weathering rate. The critical load may be defined as the greatest superaddition of a certain pollutant an ecosystem can support without suffering damage in the long term. The additions of acid substances should therefore not take place at a rate exceeding that required for weathering in the soil to neutralize them.

In areas with very slow-weathering baserock, such as quartzite, the rate of weathering – and thus the neutralizing ability – corresponds to less than 20 milliequivalents of hydrogen ions per square metre (meq/m^2) a year. This equals a de-



Maps show an alarming picture of the rate at which acidification will proceed in Sweden if nothing is done to stop it. Left, the extent of lake acidification today. Right, as it will be in a few decades if emissions of sulphur are not still further reduced.



Even frogs are affected. Both field and laboratory trials have shown that acidified waters increase frogspawn mortality and affect the development of tadpoles.

position of max. 3 kilograms of sulphur per hectare per year – provided that sulphur is the only acidifying agent.

In Sweden the bedrock consists for the most part of granite and gneiss. In such case the critical load lies between 20 and 50 meq/m² or 3-8 kg sulphur per hectare and year. According to previous surveys, the annual depositions of sulphur over forest land in southern Sweden amount to 20 to 30 kg per hectare, and in the south-central parts of the country to 10-20 kg/ha.

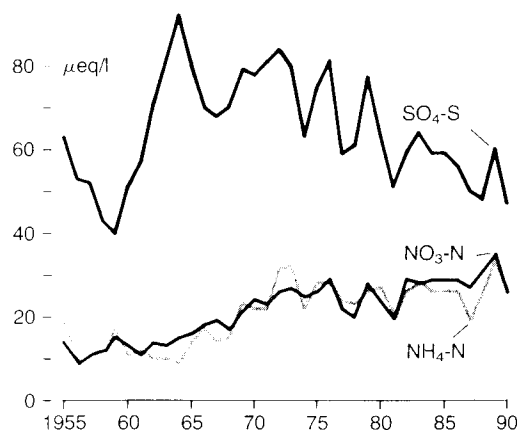
THE ROLE OF NITROGEN

Nitrogen compounds, too, can contribute to acidification. Nitrogen occurs in precipitation both as nitrate ions and in a chemically reduced form as ammonium ions. The latter arise from the emissions of ammonia, the role of which in acidification is related on pages 14-15. If the nitrate ions are taken up by the roots of plants, the accompanying hydrogen ion is neutralized through the plant giving off a hydrocarbonate (HCO₃⁻) or hydroxide ion (OH⁻) in exchange for a nitrate ion. Since there is usually a deficiency of nitrogen (in relation to other nutrients) in terrestrial ecosystems, most of the nitrate that is deposited in Sweden is still

being absorbed by the vegetation.

Of late the supply of nitrogen has greatly increased as a result of anthropogenic emissions of nitrogen oxides to the atmosphere. When the fallout has become so great that the vegetation can no longer absorb it, a condition of nitrogen saturation arises. An increase in the outflow of nitrogen, mainly in the form of nitrate, then follows. Since no neutralization occurs, the nitrate depositions also contribute to acidification. When the ground is frozen in winter,

Sulphur and nitrogen concentrations in precipitation over central Sweden.



After having increased substantially for many years, the sulphate concentrations in precipitation over Sweden are now falling, while the levels of nitrate and ammonium show no such tendency.

too, the nitrate ions cannot get to the roots of the plants, and in the thaw the nitric acid is transported unneutralized to lakes and streams where it also adds to the acidification.

Almost all the water in a lake has flowed into it after having fallen as precipitation on land. The soil's neutralizing ability is therefore an important factor in lake acidification. The acidification of the soil itself leads to increased concentrations of aluminium and heavy metals in the lakewater.

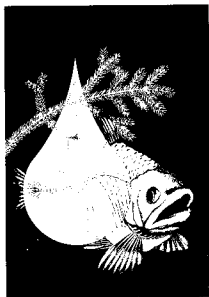
BIOLOGICAL EFFECTS

Acidification has extensive biological effects in lakes. For one thing the diversity and number of aquatic species diminishes, resulting in a greatly changed ecosystem. When the pH value of the water is over 6, for instance, there will normally be 30 to 80 species of phytoplankton. As the pH gets lower, the number falls rapidly, so that in the most acidified lakes only 5-10 species will remain. Among the sensitive animal species are snails, mussels, crustaceans, and certain species of fish. Some of these may be affected even before the pH has dropped below 6.

Nationwide surveys had previously been carried out in Sweden in 1972, 1975, and 1985. The results are however not altogether comparable, since the lakes were not always the same, and the methods of analysis likewise tended to be changed. If one disregards the effects of liming, it will be seen

however that there has been little change in acidification status since the early seventies. From the end of that decade the concentrations of sulphate in the water have fallen, while those of nitrate have increased. In southwestern Sweden the ratio of nitrate to sulphate shows the contribution of nitrate to lake acidification to be approaching 20 per cent.

The lower concentrations of sulphate must be due to reduced emissions of sulphur both in Sweden and abroad. There are two reasons why the acidification situation has nevertheless not improved. On the one hand depositions have not, for meteorological reasons, decreased to the same extent as emissions. On



the other the acidification of the soil is still going on, so that its store of base cations is being reduced and its neutralizing capacity is declining.

This state of affairs will continue as long as acid depositions exceed the critical loads.

Although the acid deposition is much less in the northern than in the southern part of the country, the brooks and lakes of the mountain region have been hard hit by acidification. This is because acid accumulates in the snow during the winter and is suddenly released in the spring melt. As reported in *Acid News* 4/91 (p 13) these acid surges have a marked effect on flora and fauna.

MORE OR LESS ACID

A low pH is not in itself a sufficient criterion for classifying a lake as acidified, since some lakes are naturally acidic. On the Environmental Agency's scale, water is "slightly" acidified if its average alkalinity has not fallen by more than 25 per cent since preindustrial times. Alkalinity is a measure of ability to neutralize – to resist acidification. It is expressed in microequivalents (μeq) of hydrocarbonate ions per litre of water.

As means of determining the degree of acidification, alkalinity is a more reliable measure than the pH, since a lake's pH value can, for natural reasons, vary considerably during the year, whereas the alkalinity will remain much more stable. Only when the alkalinity has fallen so low as to be unmeasurable is there any reason for a recourse to the pH method for determining acidification.

Acidification is regarded as "medium" if the alkalinity has fallen by 25-50 per cent, as "marked" if the fall is 50-75 per cent, and "very marked" if more than 75 per cent. It is regarded as serious only if it has worsened or threatens to worsen the conditions of life for plants, animals, or humans. When the alkalinity of a lake has dropped below 50 $\mu\text{eq/litre}$, the pH value will seldom be more than 6. Around and below that value a drop of 0.3 or more units

will have a perceptible effect on fauna and flora.

The historical changes in alkalinity have been estimated by computer modelling, which also separates the acidifying effect of sulphur and nitrogen. The outcome of these calculations is that 13,700 of the country's lakes have become acidified from depositions of sulphur and nitrogen. The degree of acidification in 5000 of them is accounted as medium, as marked in 4700, and very marked in 4000. This means that in rather more than 17 per cent of Sweden's lakes, acid depositions have caused an impoverishment of flora and fauna.

Studies of the benthic fauna in streaming waters have revealed a complete absence of species that are sensitive to acidification on stretches totalling some 120,000 kilometres. That is about 40 per cent of the length of all the rivers and streams in Sweden.

LIMING

In 1977 Sweden started a five-year trial program for liming lakes, and during that period some 1,100 were treated. Since then the amount of liming has increased. In 1990 the government allocations amounted to 170 million kronor, and to date altogether about one billion kronor has been spent on liming. A further 100-150 millions has been made available by local authorities, fishermen's associations, and others, since government funding usually covers only about 85 per cent of the costs. The government does on the other hand also provide money for

restoration, chiefly for restocking vanished species. All effort so far has however been far from sufficient to entirely counteract the effects of acid deposition.

Liming is done chiefly by spraying powdered limestone (CaCO_3) directly onto the water from specially built rafts, although helicopters may also be used in particularly inaccessible places. Since lakewater is continually being renewed, the effect can only be of limited duration, and the liming has to be repeated, usually every other or every third year.

In the case of some, often small, lakes where the water renewal is exceptionally rapid, the lime may be applied to surrounding wetland instead of directly to the water. The method does however have disadvantages. It calls for greater applications of lime, and may have an adverse effect on the vegetation of the wetland. The advantages are that it has a relatively long-lasting action, and holds back the leakage of metals from the soil to the lake.

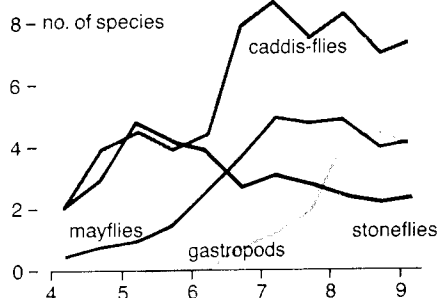
Automatic dosing machines, of which there are several main types, are used for liming streams.

All liming of lakes is carefully monitored. It appears that in 85 per cent of the cases, liming has been successful – in other words, the alkalinity of the water has been made to exceed 50 $\mu\text{eq/litre}$. Without liming, the number of acidified lakes would have been several thousand more than the present 13,700.

The biological effect has been almost entirely positive. The number of species of fish, bottom fauna, and plankton has increased, as well as the total production and biomass of fish generally. The concentrations of metals such as mercury in fish has lessened, and but for liming about 40 per cent of the total production of wild salmon would have been lost. Also lost would be 50-100 million kronor a year from retail sales of freshwater salmon, crayfish, etc.

Attempts at estimating the recreational value of fishing in terms of money seems to indicate that people are prepared to let salmon fishing cost up to fifteen times the market value of the catch – so that in this respect liming may be said to be "rescuing" several hundred million kronor a year. There is also a value in the retention of

Number of species at different pH values.



Acid waters generally support a limited range of species. The diagram shows the average number found at the sites studied, in relation to the pH of the water.



© MARK EDWARDS

The liming of wetlands can result in appreciable changes in the vegetation. Especially sensitive are sphagnum mosses, which can be killed off even by moderate doses of lime. Here is a recently limed wetland in southwestern Sweden.

acid-sensitive species of animals and plants that cannot be priced.

THE FUTURE

It is uncertain how long it would take, if emissions were to cease, for freshwater systems to regain their normal chemical and biological status. The chemistry of the soil and its capacity for recovery will be decisive. The soil's store of base cations would gradually be built up through the inflow from weathering and from the atmosphere – a process that may be assumed to need several decades. On the other hand it is

clear that unless the emissions of acid air-pollutants are radically cut down, there will be a decided increase in the number of acidified lakes and streams in Sweden.

The Environmental Agency's computer model shows that if acidification is only to be prevented from getting worse, a reduction of 50 per cent from today's emissions will be needed. Only after a reduction of 75 per cent can any long-term improvement be expected. Even then, nearly 12,000 lakes would still remain acidified in Sweden, according to the model.

If emissions were stopped completely, the lakes and streams would gradually revert to their preindustrial level of acidity. The soil has however suffered a lasting impoverishment and a reduction of its neutralizing capacity, which in the worst event will not be restored until after the next Ice Age.

CHRISTER ÅGREN

***Acidification and liming of Swedish Freshwaters. Monitor No. 12.** Obtainable from the publisher, the Swedish Environmental Protection Agency, Information Department, S-171 85 Solna, Sweden.

Often far exceeded

ACID IS BEING deposited in amounts that are damaging to the environment over three-quarters of Europe. In some central and northwestern parts of the continent the depositions are twenty times higher, if not more, than the ecosystems can withstand without becoming damaged – twenty times more, that is, than the so called critical loads. Forests, soils, and surface waters will inevitably be affected.

In a report entitled *Mapping Critical Loads for Europe*, the Rijksinstituut voor Volksgezondheid en Milieuhygiene (RIVM) of the Netherlands has presented a series of maps showing the critical loads for acidity, sulphur, and nitrogen. The data on which they are based comes from the national reports of thirteen countries, and these reports are printed separately in an annex. Where national data was lacking, European soil data had to be used instead, for assessing the critical load of acid for forest soils.

The areas most sensitive to acid – that is, with the lowest figures for critical load – are seen to be in Scandinavia, the northern parts of the former Soviet Union, and parts of Britain and Ireland. The map in Figure 1 shows critical loads measured as the amount of acid (expressed as acid equivalents per hectare per year) that can be absorbed, neutralized, by

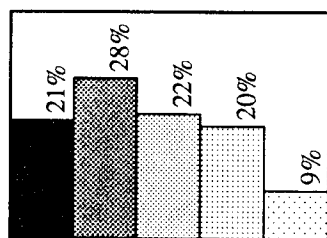
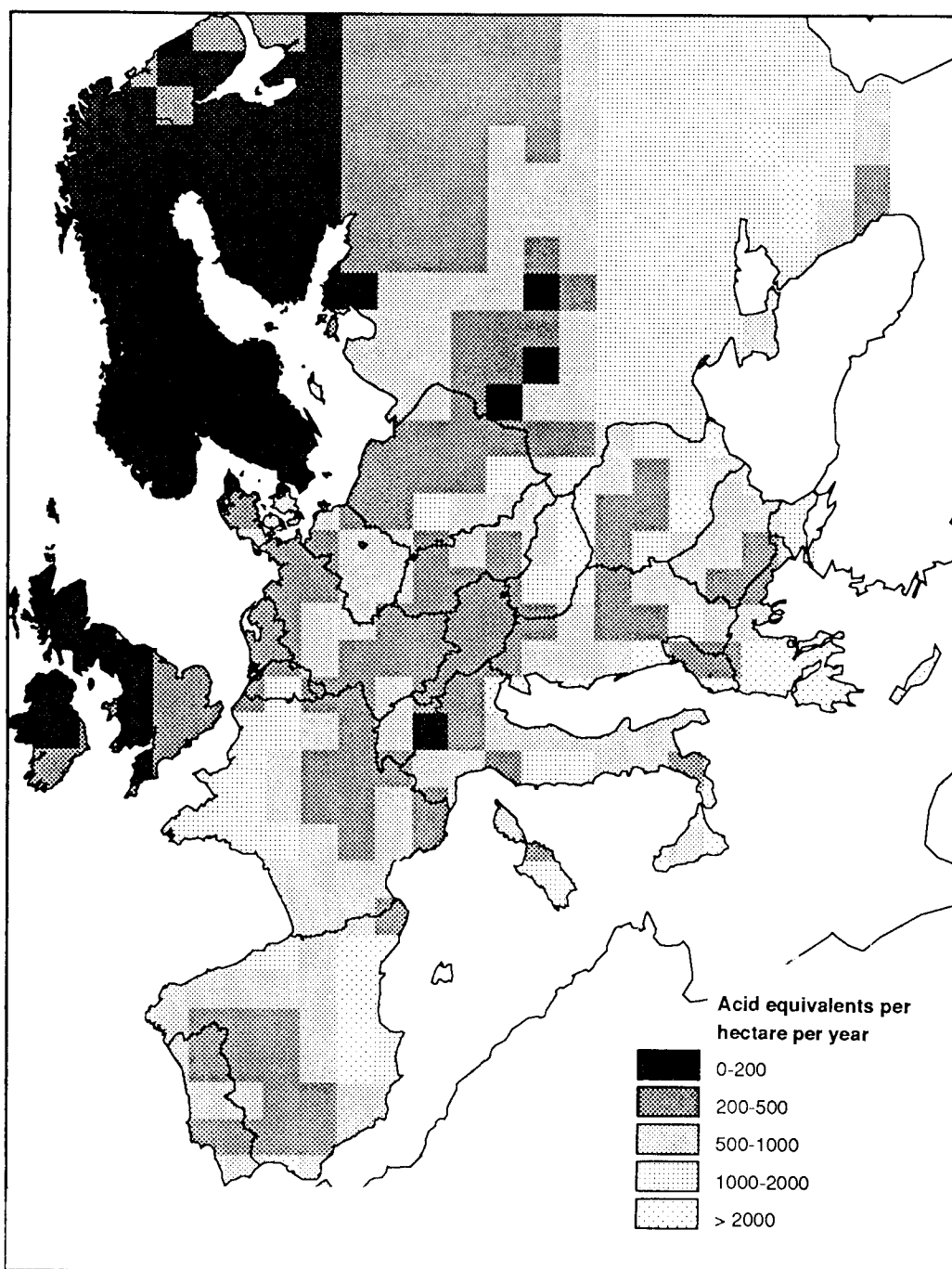
the soils without causing long-term harmful effects to the ecosystems. The critical loads data have been aggregated to 150x150 km grid squares by constructing cumulative distributions of critical loads for every grid cell.

The 1-percentile map reflects the upper bound of the range of critical loads in each grid cell which covers 1 per cent of the grid cells' area. In

theory this means that if the input of acid does not exceed the amount indicated by the colour of the grid cell, 99 per cent of the area in the grid cell will be protected from acidification. If a higher percentile were used (say 5), a similar reckoning would show fewer ecosystems being protected.

The maps showing the critical loads for sulphur were compiled

Figure 1. Critical loads measured by the amount of acid that can be absorbed by the ecosystem without harmful effects (1-percentile map).



Distribution of classifications.

from the critical-load maps for acidity by applying a fraction computed from actual acid deposition. Those with critical loads for nitrogen were developed in similar fashion by applying the aforementioned fraction, together with data on the uptake of nitrogen by vegetation.

The procedure for mapping and the methods used for calculating critical loads are described in more detail in the report.

To show where depositions exceed the critical loads, the current levels of acid deposition have been set against the critical loads of the

maps. When mapped in absolute terms, the excess appears the greatest (more than 2000 acid equivalents per hectare a year) in central and northwestern Europe – in some parts twenty times higher than the critical load (Fig 2). As mentioned, too, the critical loads are now being exceeded in something like 75 per cent of Europe.

The report has been produced by the RIVM Coordination Center for Effects, which assists the work relating to environmental effects that is being carried on under the UNECE Convention on Long Range Transboundary Air Pollution. Scientists

from fifteen European countries were involved.

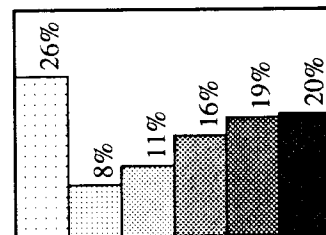
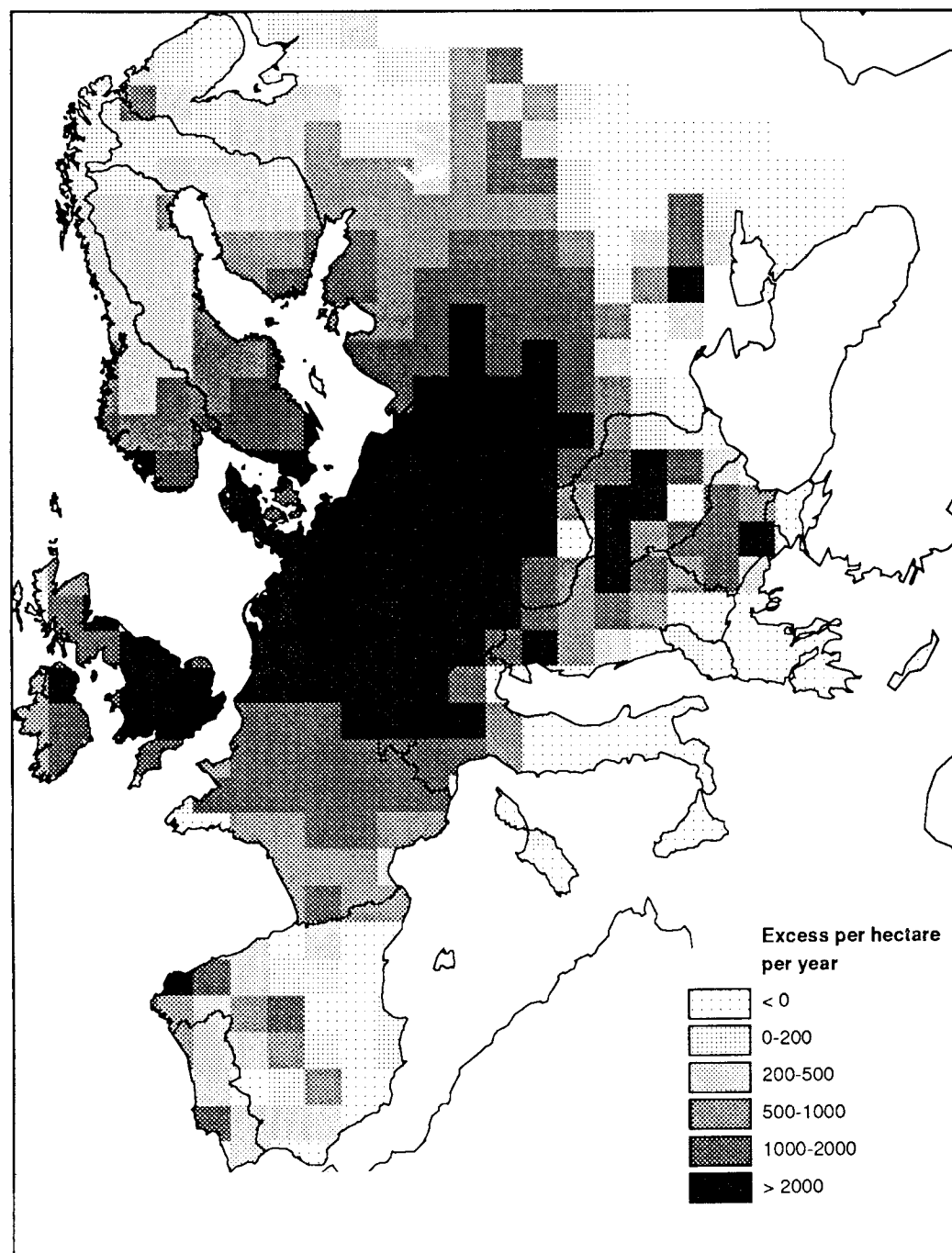
The maps are intended for use in the working out of new international agreements, under the convention, for reducing emissions of sulphur and nitrogen. Using the critical loads approach also entails employing computer models for the transport and deposition of pollutants.

By identifying the areas in which pollution needs to be reduced if it is to come down to critical-load levels – or, for a start, at least to approach them – schemes can be developed for reducing it in the most cost-effective manner. It is expected that an all-European abatement strategy, based on this concept, will lead to international agreements under which countries may have differing obligations to reduce emissions.

CHRISTER ÅGREN

The above report can be obtained from the Coordination Center for Effects, RIVM, P.O. Box 1, NL-3720 BA Bilthoven, The Netherlands.

Figure 2. Extent to which acid depositions exceed critical loads, shown in acid equivalents per hectare per year (1-percentile map).



Distribution of classifications.

Lower speeds

AT THEIR COUNCIL MEETING on December 17 in Brussels, the EC Transport Ministers reached a compromise on the proposed directive for installing speed restrictors on heavy road vehicles, both trucks and intercity buses, from the mid-1990s. Disagreement has previously centred on the actual limits that were to be imposed. The political agreement that has now been reached stipulates 85kph for trucks and 100kph for buses. It does however admit a leeway of 5kph, which means that trucks could travel at 90kph and buses at 105kph.

The Directive will be applicable from January 1, 1994, for new vehicles and from January 1, 1995, for vehicles registered between 1988 and 1994. While road safety has been proclaimed to be the prime motive for this move, it can also lead to environmental gains at a low cost. Lower speeds mean less fuel will be consumed, and so the emissions of carbon dioxide will also be lower – as will the noise and the emissions of nitrogen oxides.

The Directive is expected to be formally adopted during the March 1992 meeting of the Council.

Source: **Europe Environment**, January 7, 1992.

...less smog

NINE OF THE NORTHEASTERN states in the US are to adopt the same stringent environmental regulations for road vehicles as California, thus going beyond the federal rules. These states are New York, New Jersey, Pennsylvania, Massachusetts, Virginia, Maryland, Delaware, New Hampshire, and Maine.

They may later be joined by Washington DC and three more states in the northeast. In an area with a third of the US population there would then be strict controls on the amounts of smog-forming hydrocarbons and nitrogen oxides that vehicles may emit. Further possible requirements would call for a successive increase in the number of vehicles running on natural gas and methanol, as well as a certain proportion of electric vehicles.

Source: **Ny Teknik** 1991:47.

The problem of ammonia



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GREAT ENVIRONMENTAL problems can arise from emissions of ammonia in places where there is intensive agriculture. The main source is livestock farming, although contributions also come from nitrogen fertilizers and industrial activities.

In two recent studies* by IIASA, the International Institute for Applied Systems Analysis, new emission factors for livestock farm-

ing provided by Dutch scientists have been used in an assessment of European emissions. For the whole of Europe, including the European parts of the former USSR, the total emissions of ammonia are estimated to have been 8 million tons in 1980 and 8.1 million in 1987. See table. Calculations for 2000, based on official projections and extrapolations, give a figure of 8.6 million tons,

which would mean an increase of 8 per cent over 1980.

Emissions are expected to stabilize in northern Europe, but to rise in the southern and eastern parts of the continent. The IIASA report emphasizes however that in many cases the calculations are based on uncertainties. For some countries the divergence may be anything from 5 to 40 per cent, on account of inadequate reporting.

There is also considerable uncertainty as regards the costs for reducing emissions. As might have been expected, the greatest potential for big reductions at a low cost is to be found in countries practicing intensive agriculture. There it is a matter primarily of cutting down the nitrogen content of feedstuffs and spreading manure in such a way as to minimize the escape of ammonia. Many countries are considered capable of reducing emissions by 30 per cent at little or no cost.

In places where farming is less mechanized the cost will be great even for small reductions. On the other hand the emissions of ammonia are assumed to be less of a problem in such areas. The maximum feasible reduction for Europe as a

whole is put at 40 per cent. The associated costs would be DM67bn per annum. To date the only countries to have actually decided on reductions are the Netherlands and Sweden.

The question then remains as to whether money should be spent on reducing the emissions of ammonia or of nitrogen oxides in order to curb the load of nitrogen on the environment. The most cost-effective ways of reducing the depositions of nitrogen over Europe will be analysed in a third report from IIASA which is due to appear shortly. In the course of 1992 a new version of the Institute's RAINS computer model will be ready, embracing ammonia in addition to sulphur and nitrogen oxides.

PER ELVINGSON

* **Past and future emissions of ammonia in Europe (SR-91-01) and Costs of controlling ammonia emissions in Europe (SR-91-02)**, both by Ger Klaassen. Obtainable from IIASA, A-2361 Laxenburg, Austria.

Further reading: **Enviro Magazine** No. 9 (1990), published by the Swedish Environmental Protection Agency, S-171 85 Solna, Sweden. Also **Acid News** No. 3, 1988.

Ammonia emissions, estimates by country (kton NH₃)

	1980	1987	2000
Albania	25	27	33
Austria	79	79	80
Belgium	102	105	90
Bulgaria	122	120	141
CSFR	200	197	191
Denmark	116	103	81
Finland	56	49	39
France	679	650	637
Germany (f. West)	529	533	541
Germany (f. East)	228	239	176
Greece	88	100	125
Hungary	156	155	161
Ireland	128	128	156
Italy	359	366	371
Luxembourg	5	5	5
Netherlands	224	239	209
Norway	37	47	31
Poland	570	528	476
Portugal	66	65	62
Romania	297	340	422
Spain	251	317	409
Sweden	66	59	59
Switzerland	64	60	52
Turkey	532	476	414
United Kingdom	482	492	509
USSR	2288	2446	2935
Yugoslavia	214	217	218
Europe	7961	8143	8620

FACT FILE

CONCENTRATIONS must be relatively high if ammonia in gaseous form is to have direct effect in the way of damage to vegetation. The problem is most likely to arise in agricultural areas with intensive livestock farming.

The indirect effects are geographically more widespread. In Europe ammonia constitutes about half of the anthropogenic emissions of nitrogen to the atmosphere. The remainder consists of nitrogen oxides with transportation in various forms and combustion plants as the main sources. Effects on the natural environment depend on the combined input of nitrogen oxides and ammonia.

The critical loads for nitrogen deposition are now being exceeded in most of Europe. Nitrogen in the form available to plants is normally in deficiency in natural ecosystems, and the large man-made oversupply can give rise to a number of unnatural effects.

RISK OF FOREST DAMAGE. Trees become stressed by an imbalance between nitrogen and other nutrients. Mycorrhiza fungi, which in many cases

ensure an important part of the plant's uptake of nutrients and water, are adversely affected.



© CALLE BERGIL

CHANGES IN VEGETATION. Species favoured by nitrogen increase at the expense of other, often endangered species, that are unable to compete.

RISK OF LEACHING. Saturation occurs when the nitrogen supply exceeds the ability of the vegetation to absorb it. The surplus can then leach out into the surface and ground water. This adds to

the problems of overfertilization of coastal waters and unacceptable concentrations of nitrate in drinking water. Saturation has already come about in areas with a high loading of nitrogen, such as the Netherlands, North Germany, Denmark, and South Sweden. Leaching is likely to become an ever more serious problem, as saturation occurs over ever widening areas.

SOIL ACIDIFICATION. Ammonia can, in certain circumstances, also have an acidifying effect on soil, surface water and ground water. Gaseous ammonia (NH₃) reacts in the atmosphere with acids, forming ammonium ions (NH₄⁺) and so increasing the pH value of the precipitation. After deposition to the ground the ammonia ions can either be taken up by the vegetation or nitrified, transformed to nitrate. If the nitrates so formed are leached out, the result will be a marked acidification of the soil. Leaching becomes a problem, on the one hand because of saturation, on the other because of the low or non-existing ability of plants to take up nitrogen in winter.

Pollutants in fuel oil

ONE TENTH of the man-made emissions of sulphur is estimated to come from shipping. Increasingly stringent requirements for fuel oil on land have led to ever worse qualities being used at sea, where there are still no requirements at all.

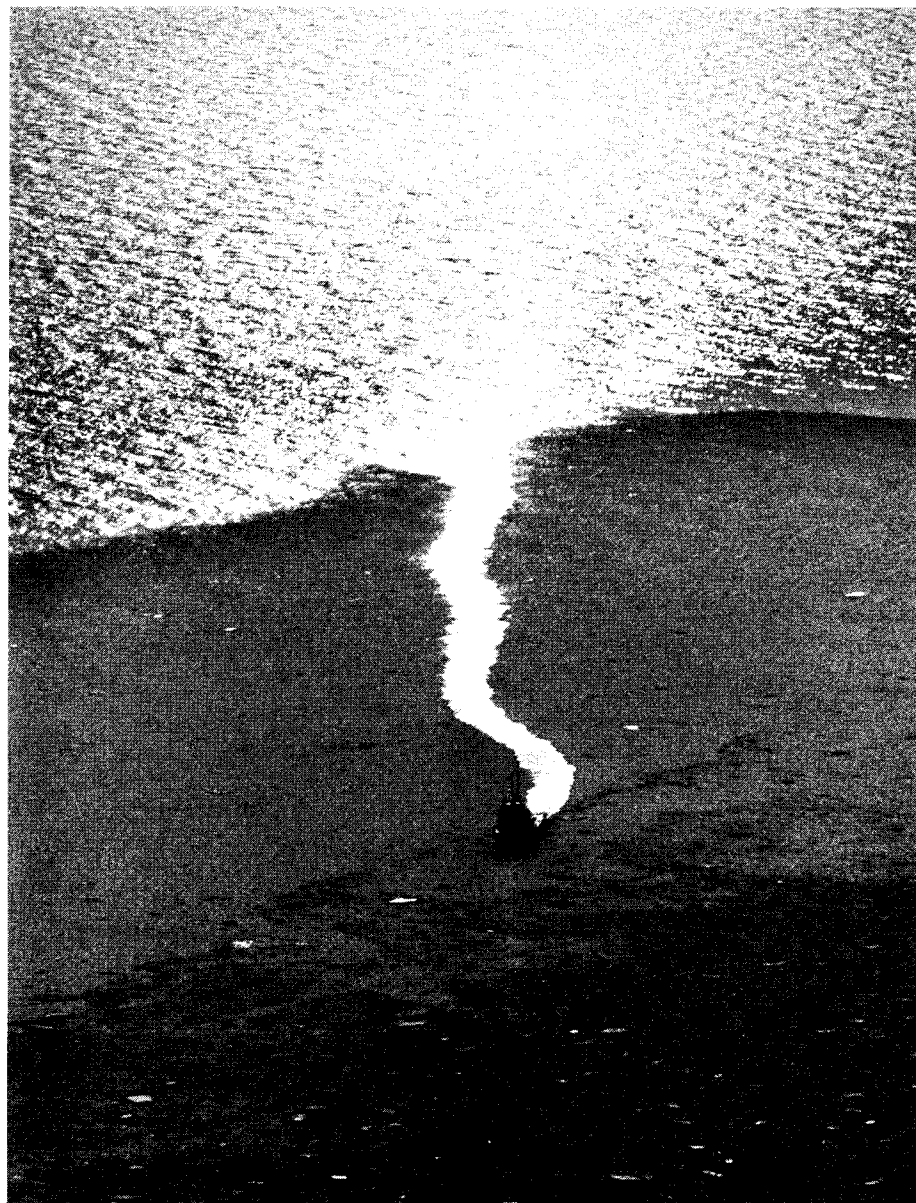
On the international bunker market, oil is often sold with a sulphur content of 5 per cent. In comparison, the sulphur content of fuel for use on land in Sweden may not exceed 0.8 per cent. Moreover, waste oil that is classified as environmentally hazardous is sometimes mixed with ships' bunkers.

It has now been agreed among the littoral states represented on the Helsinki Commission (HELCOM) that from January 1, 1993, the mixing of waste oil with bunkers shall be prohibited in the Baltic. These countries have moreover undertaken to have made, at the latest by 1995, bilateral agreements to limit the sulphur content of bunker oil to 1.5 per cent.

These same countries are now presenting a common front within IMO, the International Maritime Organization, which is a UN organ, for getting the Baltic rules accepted as international standard.

At the IMO meeting last November a Marine Environmental Protection Committee was appointed, with instructions to work out a draft annex under the MARPOL Convention, which is the principal global instrument for regulating pollution from ships. This annex is to include regulations for controlling emissions of air pollutants, limiting the sulphur content of fuel oil, and prohibiting the admixture of chemical wastes.

Hitherto the IMO has mostly concerned itself, in regard to the environment, with the matter of oil spills from ships. Now however it is also considering demands for a halving of ships' emissions of sulphur and a reduction of those of nitrogen oxides by 30 per cent by the year 2000. Within the IMO the opposition to international environmental rulings comes mainly from countries that sell oil with a high sulphur content, as well as those with big merchant



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fleets sailing under flags of convenience.

A proposal that is being mooted in IMO by the Baltic littoral countries would set up an environmental index for all shipping. This would take into account the vessel's energy efficiency and its equipment for cleaning exhaust gases, as well as other characteristics affecting the environment. By differentiating the harbour dues, for instance, individual countries could then give advantage to the more energy-efficient and "cleaner" ships, thus stimulating the development of types that are better from the environmental

point of view and making it worthwhile for owners to install exhaust-cleaning equipment on existing vessels.

Pressured by local opinion, most of the owners of sea-going ferries operating from Swedish ports have lowered the sulphur content of their fuel oil to 0.5 per cent. This has eliminated about 6000 tons of sulphur that would otherwise have been emitted to the atmosphere in the course of a year. Further progress in this direction will however call for wider international agreement.

PER ELVINGSON

Possible improvement

AN ECONOMIC SOLUTION to ships' air pollution problems may lie in a metal box filled with sand. The method has been used for some time to eliminate emissions of volatile organic compounds from industrial plants. In essence it involves a so-called combustion exchanger containing a bed of sand which is heated up to 1000°C by an electric element. The exhaust gases are pumped in and pass through the sand, where they are burnt. The emissions of VOCs are thereby reduced by more than 90 per cent. The heat from the process also helps to keep the sand hot.

By injecting ammonia or urea into the exhaust gases the nitrogen oxides can be transformed into nitrogen gas and water. Full-scale tests have shown that by this means the emissions of nitrogen oxides can

be reduced by at least 65 per cent. The advantage of the method in its application to ships is that the cost of the combustion exchanger is only about a quarter of that for selective catalytic cleaning equipment and that it operates independently of the temperature of the exhaust gases. The latter is important because the emissions of all kinds of pollutant vary greatly with the engine load.

Emissions of sulphur and carbon dioxide are however not affected. The sulphur can best be reduced through more stringent requirements for its content in fuel oil, and carbon dioxide can only be dealt with by using energy more efficiently, as for instance by reducing the speed, or possibly turning to non-fossil fuels which do not, in balance, add to the pollution.

More than expected

THE EMISSIONS of nitrogen oxides from oil rigs must be at least twice as great as previous estimates. In 1988 those from the Norwegian oilfields were calculated to be 12,000 tons per annum. After examining the matter more carefully, however, and taking into account the flares, turbines, and other machinery on the rigs, the Norwegian environmental authorities have come to the conclusion that in that year the emissions of NO_x were more like

30,000 tons. Oil production has subsequently increased, and in 1990 the emissions were found to be 35,000 tons, or 16 per cent of the total Norwegian emissions of nitrogen oxides. Since the previous estimates were only based on general international information, it may be assumed that oil rigs on the whole emit nitrogen oxides in much greater quantity than it has been thought.

Source: *Natur & Miljö Bulletin*

Clamping down

THE CALIFORNIA Air Resource Board, which is the state authority, wants to bring in control of the emissions of air pollutants from shipping. Meteorological data has shown that emissions from ships 160 km out at sea can have a distinct effect on air quality over land. Of the total emissions of nitrogen oxides and sulphur dioxide in the state of California, shipping is responsible for 10 and 37 per cent respectively.

Among the changes that may be expected are standards for new types of marine engine. Existing engines may have to be converted for fuel injection, which reduces emissions of nitrogen oxides and is not too expensive or difficult to install. Burning fuel with less sulphur is another way of cutting down emissions of sulphur and nitrogen oxides, and moreover does not require changes in the ship's machinery.

DENMARK

Action in the capital

IN COPENHAGEN there is to be free parking for electric cars, according to a decree of the city fathers aimed at improving the quality of air in the Danish capital.

The city has already made 5000 bicycles available on loan, in the same manner as luggage trollies at airports and railway stations. The twenty kroner needed to detach a bicycle from the rack can be recovered when it is put back, after as a long time as the borrower pleases. The bikes have been given a special appearance so as to prevent them being purloined. Eight big companies are sponsoring the scheme with a million kroner each, being allowed in return to put their logos on the machines.

FRANCE

Trains beating the airline

THE FRENCH TGV TRAINS are steadily taking more travellers away from the domestic airline Inter Air. During the ten years in which the TGV service has been operating on the Paris-Lyon route, the number of passengers carried by the airline has halved. In fact 92 per cent of the passenger traffic is now by TGV train.

Since 1990, when TGV services started between Paris and Bordeaux, the number of train travellers has more than doubled. At the same time car travel has noticeably diminished, while the total number of people being transported between these two cities has actually increased.

Inter Air is already having to meet competition from TGV trains on half of its routes, and in twenty years all its routes, except for that to Corsica, will be exposed to it. If the cross-Channel route is ready as scheduled for operation in 1993, London-Paris will be affected in the same way.

Source: *Les Echos*, October 4, 1991.

Controversial fuel

THE TWO BRITISH power-generating blocs are proposing to convert some of their large oil-fired plants for the use of a fuel called Orimulsion, which is a bitumen-in-water suspension that will give high emissions of sulphur. The fact that they have no intention of installing equipment for flue-gas desulphurization (FGD) has however led to a controversy with H. M. Inspector of Pollution.

Orimulsion, which comes from the Orinoco Belt in eastern Venezuela, contains up to 2.9 per cent of sulphur. Since it has a lower heat value than oil, in terms of emissions that would be the same as oil with a 4-per-cent sulphur content. Trials with the new fuel have already been carried out at three large power stations, and both of the generating companies, National Power and PowerGen, have applied for permission to use Orimulsion in their plants on a large scale.

They both claim that they will not need to fit FGD when burning the new fuel, despite the fact that it would reduce the amount of sulphur emitted by at least 90 per cent. They maintain that it would suffice to keep within the quotas that were set for their power stations as a unit under the national emission-reduction plan issued by the government in 1990. The extra amounts of sulphur emitted would, they say, be compensated by burning less coal.

According to the Environment Protection Act of 1990, in all cases where integrated pollution control is applicable, the "best available techniques not entailing excessive costs" (BATNEEC) are to be used. The Inspector of Pollution considers that conversion from oil to Orimulsion constitutes a "substantial change," and therefore the new emission standards should apply. That would mean using FGD or some similar cleaning technique.

A problem of interpretation has arisen because PowerGen had applied for trial firing with Orimulsion before the present law came into force. Its application concerned the two power plants Ince B in Cheshire, with a capacity of 1000 megawatts, and Richborough in Kent, 340 MW. In Kent its Isle of Grain plant, 2680 MW, was also held to be in line for conversion. National Power's application for the complete conversion of its Pembroke power station was however handed in after the law had come into force. The emissions from that plant, with a capacity of almost 2000 MW, would amount with the new fuel to about 200,000 tons of sulphur dioxide a year.

Orimulsion is also coming up for possible use in the United States and Canada. There however it is taken for granted that flue-gas desulphurization is to be a part of the package. It is said that the cost of installation will be offset by the savings gained through the use of Orimulsion, which is considerably cheaper than oil.

CHRISTER AGREN

UK

Bikes better

IF MORE PEOPLE in Britain could be encouraged to "get on their bikes," air pollution could be significantly reduced, and half of all the trips by car could be eliminated – according to a study published in January by the Cyclists' Touring Club (CTC), Britain's largest cycling organization.

Road traffic is responsible for a considerable part of the emissions of air pollutants in the United Kingdom: for 50 per cent of the nitrogen oxides, 37 per cent of the volatile organic compounds, and 20 per cent of the carbon dioxide. Of all the car journeys undertaken, 61 per cent are for less than five miles. If only the people using the car for short trips were to take to cycling, air quality would be greatly improved.

The study was carried out for the cycling club by Earth Resources Research (ERR), environment consultants. It posits that by creating a safe cycling network, restraining car use, and generally encouraging cycling, its share of "non-walk" jour-

neys could be made to increase from 4 to more than 40 per cent. This has already been achieved in cities such as Delft in the Netherlands.

Part of the financing of the study was provided by the Southampton City Council, which is planning its urban transportation on the lines of "People first, cars second."

Bikes not fumes. Available, price £8.00, from the CTC, Cotterell House, 69 Meadow, Godalming, Surrey, England GU7 3HS.



BELGIUM

Good try

THE BELGIAN BRANCH of Greenpeace was recently ordered to remove the posters it had placed on billboard car advertisements, saying "Cars are harmful to the environment." They had been put on billboards all over the country in January, at the time of Brussels motor show.

The Belgian Federation for the Car and Bicycle Industry had brought a lawsuit against Greenpeace in the Brussels courts, with the result that the organization was ordered to rectify the damage within sixty hours. According to Mr Deleuze, head of Greenpeace Belgium, the organization has asked several of the political parties to introduce a draft bill in parliament requiring all ads for cars to carry the warning text "Cars are harmful to the environment." Says Mr Deleuze: "We would like cars to have the same future as tobacco, in other words, a bleak one. It would be a good thing for our lungs."

Source: **Europe Environment**, January 21, 1992

Noteworthy publications

Environmental publications from the Netherlands

There are two quarterlies published by the authorities in the Netherlands on matters concerning the environment that can be obtained free of charge.

Change, dealing with the climate from various political and scientific aspects. Apply to Kluwer academic publishers, Bioscience division, P.O. Box 17, NL-3300 AA Dordrecht, The Netherlands.

Environmental News from the Netherlands, with articles on national environmental policy and research in the Netherlands. Obtainable by application to The Secretariat of the Department of Information and International Relations, Ministry of Housing, Physical Planning and Environment, P.O. Box 20951, NL-2500 EZ The Hague, The Netherlands.

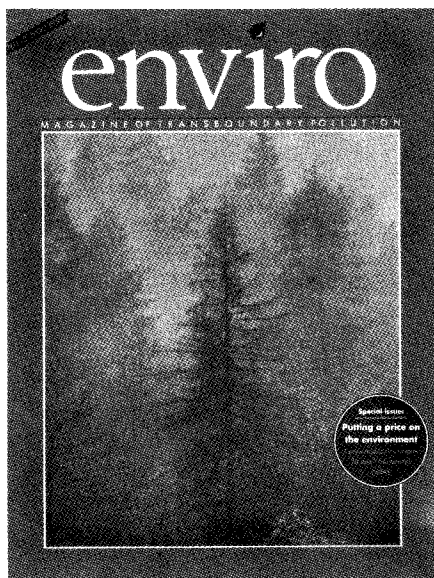
Environmental Policy: How to apply economic instruments (1991)

In the field of environmental policy, economic instruments can be a powerful market-based complement to direct regulations. Here are presented guidelines developed by OECD for the practical application of economic instruments for dealing with air, water, waste, and noise pollution. They target economic sectors such as energy, transport, agriculture, and industry that have a major impact on the environment. 130 pp. Obtainable from the publisher: OECD, 2 rue André Pascal, 75775 Paris Cedex 16, France.

Experience from the CFC phaseout (1991)

Sweden has adopted a phaseout plan for CFCs in nine areas where they are ordinarily used, and this report describes experience so far in its application. It

also attempts to determine what problems remain, how they can be solved, and what the chances are of fulfilling all the aims of the plan. 48 pp. Published by the Swedish Environmental Protection Agency, Information Department, S-171 85 Solna, Sweden.



Economic Instruments in practice

Enviro is a magazine published twice yearly by the Swedish Environmental Protection Agency. The November 1991 issue is devoted entirely to the subject of economic instruments as a part of environmental policy.

The subtitle of the publication (formerly *Acid Magazine*) is Magazine of Transboundary Pollution. Among the matters dealt with in previous issues are sulphur emissions (No. 8), nitrogen

(No. 9), Swedish plans for environmental action (No. 10), and toxic organic compounds in the Baltic Sea (No. 11). Requests to be put on the mailing list, as well as for back numbers – all free of charge – should be addressed to the Swedish Environmental Protection Agency, Information Department, S-171 85 Solna, Sweden.

Clean air around the world (1991)

A reference book for which specialist organizations from twenty-seven countries have compiled up-to-date information concerning their national air-pollution problems, monitoring systems, and regulatory frameworks. The contributing bodies are all members of the International Union of Air Pollution Prevention Associations, and the countries they represent range over a wide spectrum of economic and industrial development. There are also two special chapters giving the views of the United Nations and the European Community. 500 pp. Price £32.00 incl. postage. Obtainable from the National Society for Clean Air and Environmental Protection, 136 North Street, Brighton, England BN1 1RG.

Effects of acidification on bird and mammal populations (1991)

By M.O.G. Eriksson. A review of the literature from North America and Europe, principally Scandinavia. The author sees a relation both in time and space between the decline of several bird species and either lake acidification or forest damage. Further research is said to be needed to determine the actual connection. 76 pp. Published by the Swedish Environmental Protection Agency, Information Department, S-171 85 Solna, Sweden.

Coming events

The rational Use of Energy and the Environmental Benefits. Strasbourg, France. April 1-3, 1992.

Organized by the Watt Committee on Energy, which is an independent energy think-tank based in Britain, this conference will concern the adoption of technologies leading to a more rational use of energy by industrial and commercial undertakings as well as in households. Should be seen against the background of standards harmonization within the European Community. Enquiries and applications to register

should be addressed to VDI-GET, Frau A. Bohnen, Postfach 101139, 4000 Düsseldorf, Germany. Tel. +49-211-6214 583.

Urban Air: Emissions, human exposure and risk identification. Stockholm, Sweden, June 1-3, 1992.

A conference that is being organized by the Urban Air Project at the Center for Nutrition and Toxicology, Karolinska Institute. For details contact: Center for Nutrition and Toxicology, NOVUM, S-141 57 Huddinge, Sweden. Fax. +46-8-779 58 13, tel. +46-8-746 00 83.

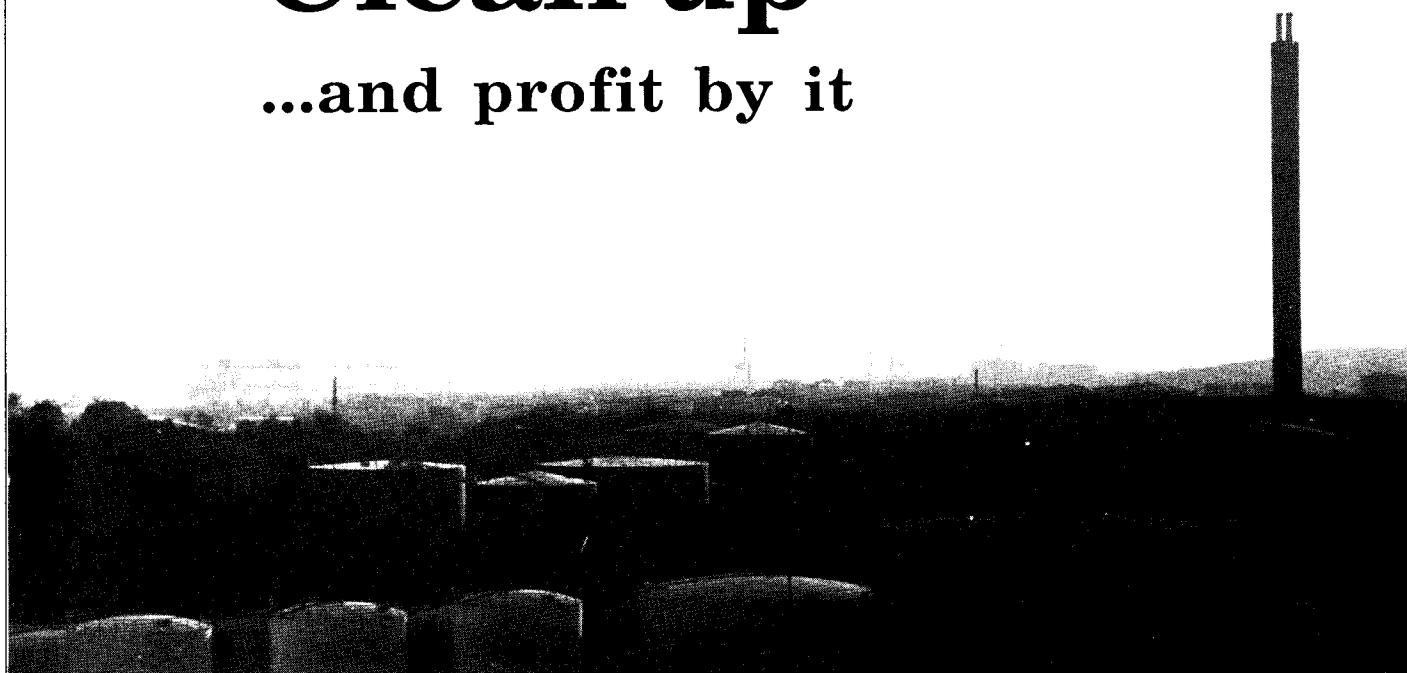
Impacts on terrestrial ecosystems. Bad Dürkheim, Germany, June 14-18, 1992.

The aim of this conference is to assess the state of knowledge concerning climate change, to discuss its effects on biological processes in terrestrial ecosystems, and determine future needs for research.

Further information from the organizers: Elsevier Science Publishers, Conference Department, Mayfield House, 256 Banbury Road, Oxford, England OX2 7DH.

Clean up

...and profit by it



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FROM BERKELEY, California, comes the startling suggestion that the European Community's emissions of CO₂ could, by the year 2020, be reduced by 60 per cent without any cost in the end to society. Those who say this are a group of researchers at the university there, who will shortly be publishing a study of the possibilities which has been carried out with the financial support of the Netherlands government.

Within the Community it has been agreed that emissions of carbon dioxide shall have been frozen in 2000 at 1990 levels, after which reductions are to start. Scientists are on the other hand broadly unanimous that global emissions will have to be at least halved. But if the right to emit were to be distributed equally among the people on this planet, it would mean that the EC countries would have to bring their emissions down by 75-80 per cent from today's levels.

In probing the possibilities, the Berkeley researchers have envisaged three different situations, called scenarios. The basis from which they have proceeded is the present state of affairs in France, Italy, the former West Germany, the Netherlands, and Great Britain.

The first scenario accepts business as usual, with emissions follow-

ing the official forecasts for energy use. The increase of CO₂ would then be 23 per cent from 1985 to 2020.

As a first alternative to this the researchers have selected the most profitable measures to promote the efficient use of energy. The consequence would be a reduction of each household's bill for energy by ECU 670 a year by 2020, compared with what it would have been under business as usual. The emissions of CO₂ would moreover be 30 per cent below the 1985 figure.

The other alternative presupposes the application of energy efficiency measures aimed at bringing about the greatest possible reduction of CO₂ emissions. They would then be 60 per cent lower than in 1985, and yet the cost of energy will still be somewhat lower than in the case of business as usual.

The proposition that measures to reduce carbon-dioxide emissions

would either cost nothing or would actually be profitable rests on the fact that using energy efficiently would result in less energy being used compared with today. The more costly methods for its conversion would also no longer be necessary – with lower emissions and a lower price as a result.

The question then is why, if it would so often be profitable, there is no noticeably spontaneous move towards a more efficient use of energy. The explanation lies largely in the imperfections of the market, including a perverse system of regulations which favours the big suppliers, as well as differences in the need for a quick return between households, industry, and the suppliers of energy. There are however possibilities for increasing consumer influence, such as differentiated taxes on vehicles according to fuel consumption, and labelling electrical appliances for efficiency.

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Changes in energy use and emissions of carbon dioxide by 2020, compared with 1985 levels. Source: IPSEP.

	Energy use	CO ₂
Business as usual	+21%	+23%
Lowest-cost scenario	-33%	-30%
Max. effect scenario	-40%	-58%

Buying insurance against greenhouse risks: A least-cost approach to climate stabilization. To be published by IPSEP, International Project for Sustainable Energy Paths, 7627 Leviston Ave., El Cerrito, CA 94530, USA.