NO. 5, DECEMBER 1992

Acid News

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

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CZECHOSLOVAKIA

Environmental policy reform

IN NOVEMBER 1989, just after they had rid themselves of the Communist regime, the people of Czechoslovakia were inclined to put the environment second only to human rights among the issues to be faced. Now the environment ranks only sixth or seventh in the popular estimate. Both for politicians and the public the main interest is money.

That at least is Josef Vavrousek's view. Up to July 1992, Vavrousek had been federal minister of the environment in Czechoslovakia, but in that month the federal environmental committee, which had been responsible for the planning of policy and legislation and the coordination of international relations in the environmental sphere, was disbanded by a joint decision of the Czech and Slovak republics. Since they also decided to cut down the number of federal ministries to five – for foreign affairs, defence, the interior, finance, and the economy – there was no longer a seat for a minister of the environment. Interim responsibility for environmental matters of concern to the whole former country was put in the hands of the deputy prime minister, Jan Macek.

This development can be seen as a part of the preparations for a splitting up of the federal republic. Some of the duties of the former federal committee have now been taken over by the ministries of the environment for the two new republics.

Just previously a thorough reform of environmental policy had taken place in Czechoslovakia and the program for environmental protection that was adopted in 1991 may be summarized as follows:

☐ Application of the polluter-pays (PPP) and user-pays (UPP) principles, the former to be introduced gradually. It is thought inevitable that government subsidies will be needed to enable some enterprises to deal with environmental problems arising from the policies of the former regime.

☐ Environmental impact assessments to be required before making new investments.

☐ A gradual approach to European Community environmental standards.

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Acid News

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

ACID NEWS 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 fullfill 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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Editor: Christer Ågren

Published by: The Swedish Society for Nature Conservation

Printed by: Williamssons Offset, Solna

ISSN 0281-5087

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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EDITORIAL

Between ourselves

HAVING PUBLISHED Acid News for about ten years, and now entering on a broader stage of development, we considered the time had come to get more personally in touch with our readers – to find out how useful this publication was, and in what ways, and how it might be improved so as to enhance that usefulness.

This summer we therefore started sending out a circular, country by country, asking for readers' views. The response has so far been most gratifying. Many constructive suggestions have been received which will help the editors in making Acid News a more effective as well as a more readable publication. We shall also be helped in this by the clearer idea that the replies have given us of the uses that recipients make of Acid News.

Although we can hardly hope to reply personally to all readers who have sent in comment, we shall be doing so in all cases where it has seemed particularly called for, and in the meantime we take this opportunity to thank all those who have so generously responded.

Air pollution affects great numbers of people in those parts of the world – Europe and North America in particular – to which the information in Acid News is primarily directed. Individuals may see the effects in different ways – through worsening health, despoiling of the environment for recreation, the destruction of favourite beauty spots and beloved monuments – and many are now engaged in some way or other in organizations for the protection and conservation of the environment. Many, too, are engaged directly or indirectly through their professional occupations, as scientists, administrators, consultants, teachers, politicians, journalists, or officers of environmentalist organizations.

The field is indeed wide, but there are natural limits to the distribution of a publication such as Acid News. At present we print 5000 copies of each issue, and our mailing list comprises about 4000 names. We also send bundles of copies to various organizations which in turn distribute them to local environmentalist groups and individuals. We know, too, that many recipients either hand on their copy to others or otherwise spread the information contained in it.

But if we are to be effective in spreading, through Acid News, information on political developments, scientific research, and the activities of environmentalist NGOs, we need news from all kinds of sources. So whenever you come across any item of general interest concerning not only air pollution directly, but also allied matters such as energy and transportation, do write or send us a copy.

A secondary intention in sending out a circular was to amend and update our mailing list. Since the newsletter is distributed free of charge, names are being added continuously as requests come in. They are removed either because we are asked to do so, or because copies have been returned, usually on account of a change of address. We thus have to rely on readers to keep us informed of changes. In several cases the replies to the circular contained suggestions for new recipients, which are always welcome.

Finally, let me assure those readers who have wondered: Acid News is printed on paper that is *not* bleached with chlorine.

CHRISTER ÅGREN

We would also like to thank our various contributors and especially the photographers who have made their copyrighted matter freely available, and we take this opportunity to wish them and our readers a happy and prosperous New Year.

Continued from front page

☐ A decentralizing of environmental policy and turning it over to the regions.

☐ Increased use of financial incentives in the way of charges, fines, taxes, etc.

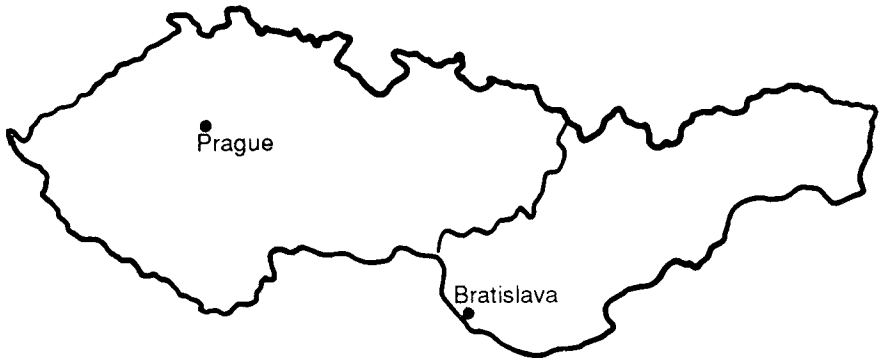
Despite having undergone a marked recession, with a GDP 15 per cent lower in 1991 than it was in 1990, Czechoslovakia has managed a considerable increase in environmentally directed investments. In 1991 the total of such investments amounted to the equivalent of $400 million, or 1.5 per cent of the country's gross national product. Between 1985 and 1990 it had only been 0.6 per cent.

According to World Bank estimates the total investment need will run to anything between $50 and $100 billion. In any case no radical improvement of the Czechoslovakian environment will be possible before the end of the century without foreign assistance.

The problem to which both the authorities and the environmentalists would give priority is that of air pollution. In a 1991 estimate, the enormous emissions of pollutants are said to have caused 41 per cent of the forest trees to be noticeably damaged, and 6 per cent to be either hopelessly damaged or already dead. Although the emissions of sulphur dioxide have lately been reduced, it does not seem likely that it will be possible to achieve the 30-per-cent reduction by 1993, from 1980 levels, that Czechoslovakia had undertaken to make in signing the UN ECE sulphur protocol.

In annexes to a federal clean-air act that was passed in 1991, the two republics have set down new standards for imissions and emissions, together with increased charges and fines for allowing emissions. Breaking the law on environmental protection can bring fines up to Kc10 million (or about $2 million).

"The power plants in the Czech republic will have make their emissions of sulphur dioxide conform to the new standards at the latest by 1996. Those that do not will be shut down," says Michael Trezzi, who manages international relations at the Czech ministry of the environment.



According to Vladimir Novotny, head of the air pollution section at the same ministry, the republic's strategy for cleaner air may be summarized thus:

☐ Changing the structure of industry.

☐ Reducing the output of electricity.

☐ A more efficient use of energy.

☐ Increased use of natural gas.

"It will be especially necessary," says Novotny, "if air pollution is to be reduced, to diversify the ways of producing energy, so as to lessen the dependence on coal."

Especially necessary to lessen the country's dependence on coal

The Czech authorities are now seeking ways of making the work towards cleaner air more effective in the most polluted areas. One idea is to form air-quality management authorities composed of representatives of local government and local environmentalist organizations as well as of the most important industrial and power interests in the area. Such bodies would be responsible for monitoring air pollution and taking the necessary measures whenever the concentrations of pollutants should become excessively high. They should also develop long-term, cost-effective strategies for cleaner air.

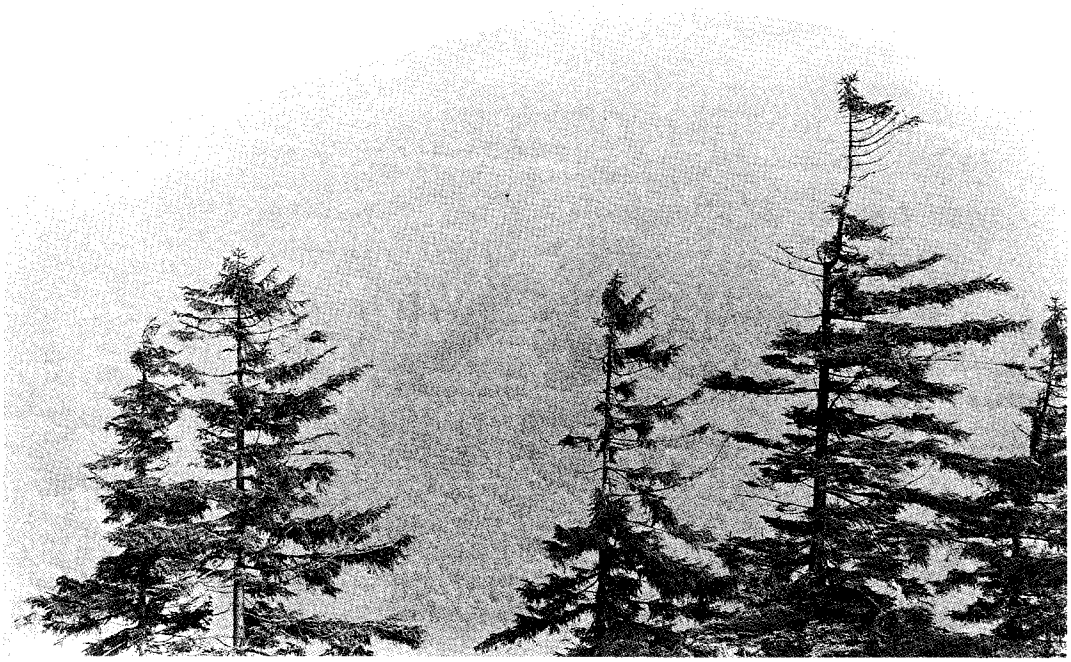
To bring down the emissions of sulphur dioxide, which are now running at about 2.5 million tons a year, the authorities want to see advanced flue-gas desulphurization (FGD) equipment installed at power plants fired with lignite and with a long remaining lifetime. The plant that seems likely to be the first to be so equipped is one at Prunerov in northern Bohemia, which is among the ten worst polluters in Europe. Last July the state energy corporation signed an agreement with the Gottfried Bischoff company of Germany for cooperation in installing FGD at Prunerov I. A study for a similar project at Prunerov II is being paid for by PHARE, the Poland-Hungary Aid for Restructuring Economies which is now being coordinated by the European Commission and has been extended to all the countries of eastern Europe.

It has been calculated that the average cost of bringing a Czechoslovakian power plant with a capacity of 400 MW_e up to European Community standard would be $200 million – or half of the total allotted to environmental investment in 1991.

One of the most important aims is to bring down the peak concentrations of sulphur dioxide during peri-

On the following pages

ods of inversion. The problem is especially serious both in Prague and in northern Bohemia where the concentrations can be so high as to threaten human health. One way to deal with it might be to stockpile coal with a low sulphur content for use when the weather conditions are particularly unfavourable. It will also be important to reduce sulphur emissions from residential heating, which is mostly by small stoves, either through increasing the use of gas or brown-coal briquettes or by installing central heating.



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Bringing down the emissions of air pollutants to acceptable levels will call for radical measures throughout the energy sector. The energy consumption per unit of output is 3-5 times higher in Czechoslovakia than the average in the OECD countries. Firing techniques are antiquated, and one-third of the plants are more than twenty years old – in other words, in need of replacement.

The federal government has indicated an intention of raising energy prices so as to make them reflect the cost to the environment. It also wants to abolish the subsidies for transporting coal, to differentiate coal prices according to quality, and close down unprofitable mines.

The overall consumption of coal is expected to fall by at least 20 per cent in the near future. On account of increased exports of energy-consuming products, on the other hand, the demand for coal may actually increase in some trades, such as steelmaking and chemical production. Coal use may also increase if Russia should further reduce exports of oil and natural gas, or demand an abnormal increase in the price of these forms of energy.

The coal deposits are concentrated to northern Bohemia, where they consist of brown coal, and Ostrava further east, with hard coal. At current rates of extraction they can be expected to last for 30-50 years.

At present the only other source of energy of any consequence, besides coal, is nuclear power. There are two power stations in operation, at Jaslovske Bohunice and Dukovany, each with reactors of Russian VVER design. Although not of the same type as Chernobyl, they are nevertheless considered to have a very poor margin of safety, and projects to improve safety are being financed through the PHARE program both for these plants and two new ones that are being built at Temelin and Mochovce.

Opinion in Czechoslovakia is divided as to the future of nuclear generation. Whereas the Czech ministry of the environment and the republic's environmentalists are against it, members of the former federal environmental committee were for it. One of the environmentalist organizations that is actively opposing it is Ekowatt, which besides its anti-nuclear activities is engaged in promoting renewable energy sources.

As regards air pollution from road traffic, the main problem is the age of the vehicles. Czechoslovakian cars are among the dirtiest in Europe. The number of imported cars is certainly increasing, and new vehicles have to be equipped with catalyzers and conform with Community standards. But because the car fleet is being renewed so slowly, and there will doubtless be a considerable increase in traffic, it is unlikely that there will be any decrease in emissions before 1997-2000 at the earliest.

There are however measures that are planned for reducing emissions in the transport sector, including a lower tax for vehicles with catalyzers, and also a lower tax on lead-free petrol than on leaded. There is to be improved inspection and control of motor vehicles, and improvements in mass transport (some municipalities that had done away with trolley buses are already considering reintroducing them). The sulphur content of petrol and diesel oil may be reduced, too, through capital investments in refineries.

MAGNUS ANDERSSON

Magnus Andersson is a freelance writer specializing on environmental matters and Eastern Europe in particular.

Coal consumption (million tons)

	Lignite	Hard coal
1937	17.4	16.7
1987	100	28
1990	82	22

Sulphur-dioxide emissions (000 tons)

1950	900
1970	2450
1980	3100
1988	2800
1990	2443

NO_x emissions (000 tons as NO_2)

1985	1127
1989	950

Source: Czechoslovakian report to UNCED, Rio de Janeiro 1992.

Drawn-out negotiations

THE PERIOD COVERED by the present international agreement for reducing emissions of sulphur dioxide is now coming to an end. Signed by twenty nations, it called for a 30-per-cent reduction by 1993, calculated from 1980 levels. Negotiations for a new agreement have now been going on for about a year, the aim being to have one ready for signing by November next year.

The present agreement, known as the Sulphur Protocol, dates from 1985, and is an annex to the UN ECE Convention on Long Range Transboundary Air Pollution of 1979. Since such agreements only come into force after they have been ratified by a specified number of countries – a procedure that usually takes at least two years – a new one should have been signed already last year. But as things stand, there will now be some years without any agreement.

In fact this does not matter very much, since the executive body for the Convention had already decreed in 1989, regarding the sulphur protocol, that "The obligation for the Parties to reduce their national annual sulphur emissions or their transboundary fluxes by at least 30 per cent as soon as possible and at the latest by 1993, using 1980 levels as a basis for calculation of reductions, means that reductions to that extent should be reached in that time frame and the levels maintained or further reduced after being reached."

Since the signing of the present protocol it has been agreed that new ones should be based on the critical-loads concept. The eventual aim is to reduce emissions to such an extent that the critical limits for depositions and concentrations of airborne pollutants will not be exceeded.

Negotiations are going on in the Working Group on Strategies, using the mapping of critical loads that is also being carried out continuously under the Convention (see Acid News 1/92, pp 12-13).

Getting down to below the critical loads will require a very great reduction of emissions, and so for practical reasons the aim is to arrange it in stages over a lengthy period. An attempt will be made to set a ceiling to the emissions allowed to each country. The requirements will thus differ from case to case – according, among other things, to the sensitivity of the areas that will be affected by the emissions and to the cost-effectiveness of the reductions.

The various possibilities can be evaluated by using a computer model, such as RAINS (Regional Acidification Information and Simulation), fed with data on the emissions, transport, and deposition of sulphur, as well as on the cost of any proposed measure.

Changes in the emissions of sulphur dioxide in Europe between 1980 and 1990 (in per cent)

Parties to the Sulphur Protocol	
Liechtenstein	–75
Austria	–75
Germany, f. West	–71
Sweden	–67
France	–62
Norway	–61
Denmark	–59
Netherlands	–56
Finland	–55
Switzerland	–51
Belgium	–50*
Hungary	–38
Russian Fed.	–38
Italy	–37**
Luxembourg	–33***
Ukraine	–28
Germany, present	–23
Czechoslovakia	–21
Canada	–20
Belarus	–14**
Germany, f. East	+12
Bulgaria	+22*
Non-parties to the Sulphur Protocol	
Spain	–30
Ireland	–24
Portugal	–23**
United Kingdom	–23
Poland	–22
USA	–9
Iceland	0***
Romania	–
Yugoslavia (former)	+14
Greece	+25***
Europe total	**–28**

* 1989, ** 1988, *** 1985

Source: **Strategies and Policies for Air Pollution Abatement: 1992 Review**, UN ECE 1992.

A prime matter of contention, besides that of agreeing on national ceilings for emissions, is whether technical requirements are to be binding, or merely recommendations. This concerns chiefly the emission standards for combustors and the maximum sulphur content of fuel oil. Germany, supported by France, the Netherlands, Switzerland, and Austria, has proposed binding requirements both for existing and future plants. Some other countries, including Italy, Hungary, Finland, Sweden, and Denmark, would have binding requirements, but only for plants yet to be built.

An alternative put forward by Great Britain would allow each country to decide for itself how the required reductions are to be achieved. Technical standards might be included in the protocol, although only in the form of recommendations. Among the countries that appear inclined to such a solution are Spain, Poland, Norway, and Ireland.

Other matters requiring solution include the possibility of having paragraphs in the protocol on the use of financial instruments, on joint implementation, and burden sharing. That last concerns possible agreement on economic and technical aid to other countries, especially in eastern Europe.

The next meeting of the Working Group on Strategies is scheduled to take place at Geneva during the first week in March, with further meetings in May and August. Failure to reach agreement on a protocol during 1993 would appear to mean yet another year's delay – and so delay with the revision of the NO_x protocol, which was signed in 1988 and runs to 1994, since that is also in the hands of the Working Group.

CHRISTER AGREN

* UN ECE stands for the United Nations Economic Commission for Europe, which embraces all the countries of Europe as well as the United States and Canada. The Convention on Long Range Transboundary Air Pollution was set up in 1979 and came into force in 1983. There are thirty-four signatory countries.

Effects of the protocol

A HALVING of the concentrations of ozone above a 75 ppb limit will be the main beneficial effect, at the close of the nineties, of the international agreement to reduce emissions of volatile organic compounds (VOCs). Yet the agreement will, on the whole, fail to bring the concentrations down to below the critical levels, according to a recent study* in which modelling has been used in an attempt to determine the actual effectiveness of the agreement.

The ozone levels above which damage to vegetation occurs will be greatly exceeded even after implementation of the protocol.

Here the reference is to the VOC Protocol to the UN ECE Convention on Long Range Transboundary Air Pollution, from November 1991. Most of the twenty-two signatories have undertaken to reduce their emissions of VOCs by 30 per cent between 1988 and 1999. See Acid News 4/91.

The computer model used for the study was that developed by the EMEP, the European program for the monitoring and evaluation of the long-range transmission of air pollutants. This shows the connections between the emissions of air pollutants, principally VOCs and nitrogen oxides (NO_x), climate, and the formation of tropospheric ozone.

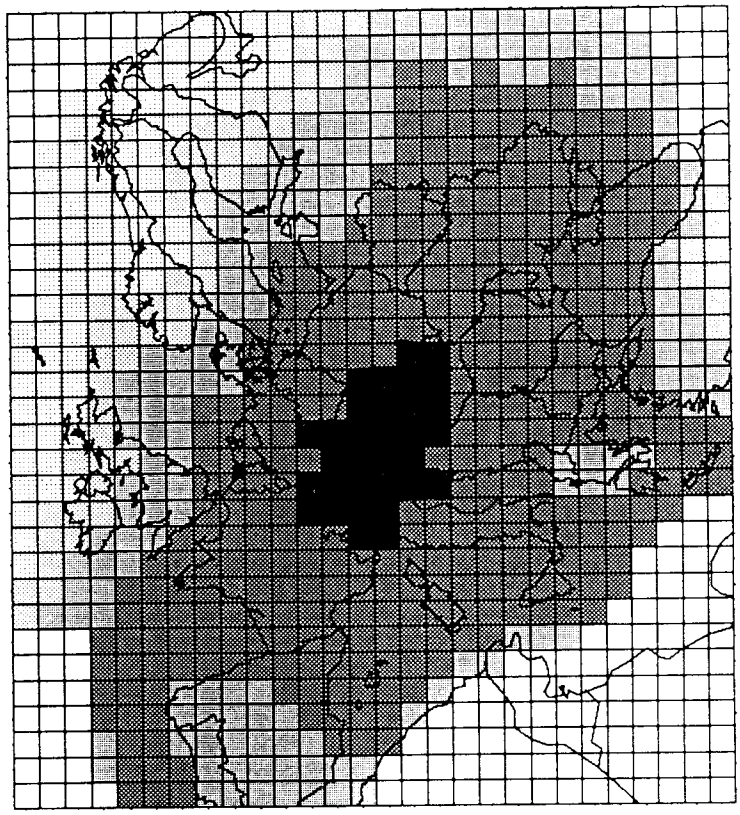
The model was run for the period from April to September 1989, both with and without the reductions agreed under the VOC protocol. The resulting changes in ozone concentrations are shown as a) the monthly average of daily maximum levels, b) the ppb-hours over 40 ppb, and c) over 75 ppb (parts per billion; 1 ppb ozone is equal to 2 micrograms of ozone per cubic metre of air).

A great difficulty in assessing the effects of the protocol was the totally inadequate reporting of emissions from most countries. By agreement within the ECE all countries have to report their national emissions of VOCs, man-made and excluding methane. But many have not sent in any reports at all, others have included methane, and some have failed to distinguish between anthropogenic and natural emissions. Only one country complied properly and fully with data for 1989, the base-year chosen for the calculations.

So as to be able to carry out the study, the researchers made certain assumptions regarding the proportions of natural emissions and methane in the available data. They also used emission data from outside sources, and occasionally had to make estimates of their own.

It appeared that a reduction of

Map showing the extent (number of ppb-hours) by which the 40-ppb base level was exceeded, according to model calculations, in different parts of Europe during the period from April to September 1989.



VOC emissions according to the protocol would not have any great effect on the long-term mean levels of ozone. They would be 4-8 per cent lower in northwestern Europe, but only 1-4 per cent lower elsewhere.

The principal aim of the protocol was however to bring down the occurrence of episodes with peak levels of ozone, and the model showed that in this respect it would be more successful. The greatest improvement would be a reduction of the number of ppb-hours in excess of 75 ppb – amounting to 40-60 per cent over the greater part of Europe.

The number of ppb-hours in excess of 40 ppb is calculated to drop by 15-20 per cent in northwestern Europe, by 5-15 per cent in the rest of western Europe, and 5 per cent or less in the East. Particular interest attaches to the excess of ozone above 40 ppb, because this has been proposed as the base level for determining the critical levels for ozone.

As the critical exposure level for ozone, the UN ECE Task Force on Mapping has suggested a cumulative exposure during daylight in the course of a growing season of 300 ppb-hours above the 40-ppb baseline. Objections have however been raised to this as being too high (see Acid News 3/92, pp 9-11).

Since the proposed critical level is for daylight exposure, while the model takes into account exposure throughout 24 hours, no comparison is possible between the two. The model exaggerates the excess by a factor of about 3, which is taken into account in the following.

It appears from the study that the proposed critical level of 300 ppb-hours above 40 ppb is already being greatly exceeded over practically the whole of Europe, and that it will continue to be exceeded even after implementation of the VOC protocol. Bringing down concentrations to below the critical level will require a very large reduction of the emissions both of NO_x and VOCs in Europe.

CHRISTER AGREN

***The effects of the VOC protocol on ozone concentrations in Europe**. By D. Simpson and H. Styve. EMEP MSC-W Note 4/92. Obtainable from Meteorological Synthesizing Centre-West, The Norwegian Meteorological Institute, P.O. Box 43-Blindern, N-0313 Oslo 3, Norway.

CALIFORNIA

Valuing the health benefits of clean air

ATTAINING air pollution standards in the Californian South Coast Air Basin may save 1600 lives a year, according to a research paper* published in *Science* earlier this year. Estimates of the total annual economic gain from meeting the national ambient-air quality standards (NAAQs) for ozone and particulate matter (PM_{10}) in the basin range from \$5.0 to \$21.5 billion, with \$9.8 billion as the best estimate, according to the article. The benefits to health of meeting the standard for ozone alone would be \$1.2 billion to \$5.8 billion, with a best estimate of \$2.7 billion.

Attaining standards for ozone and particulates would result in large annual benefits

The research group assessed the health effects due to ozone and PM_{10} in the basin and found that on an average each of 12 million residents of the area experienced ozone-related symptoms on up to 17 days per year and faced an increased risk of death in any year of 1 in 10,000 as a result of elevated exposure to particulate matter. To place this result in perspective, in California the risk of death in a motor-vehicle accident in 1987 was 2 in 10,000. Ozone-related symptoms include sore throat, mild cough, headache, chest discomfort, and eye irritation.

The authors say that the air quality in the basin is the worst in the United States with respect to PM_{10}, ozone, and nitrogen dioxide. Attaining the NAAQs "will require pervasive, technology-forcing emission controls in addition to changes in lifestyle." Because society places great value on reducing even a small risk of premature death, the potential gains from attaining the NAAQs for PM_{10} are large. The annual benefits would range from \$2.9 billion to \$14.9 billion, with a best estimate of \$6.4 billion. The annual value for reducing days of restricted activity in the basin (days missed from work, spent in bed, or otherwise measurably constrained because of the effects of air pollution) was estimated by the researchers to be more than \$775 million.

An implication of the study's findings is that benefit estimation "has not reached the maturity that policy makers would like and cannot yet provide definitive answers to difficult economic questions," say the authors. There is also much that is not included; for example, no value is ascribed in the study to improvements in visibility, to protection of materials or to vegetation, or to the prevention of chronic lung disease.

"Some questions are inherently political; although we settle on a mid-range value of life, a broader range is provided, reflecting our belief that political process must decide which value is appropriate." The authors present calculations putting the value of a statistical life variously at \$1.8 million, \$4 million, and \$9.2 million (in 1990 dollars).

The available information shows that important benefits, including the preservation of lung function, are not yet quantifiable in dollars and that current benefit calculations are likely to be underestimates, say the authors, and add: "We conclude that it is prudent to continue pursuing a policy of attainment for the ozone and PM_{10} NAAQs in Southern California."

Adapted from an article by Michael P. Walsh in **Car Lines**, No. 3, May 1992.

*** Valuing the health benefits of clean air**, by Jane V. Hall, Arthur M. Winer, Michael T. Kleirman, Fredrick W. Lurmann, Victor Brajer, and Steven D. Colome. Science, vol. 255, February 14, 1992.

Corrosion of materials

AIRBORNE POLLUTANTS, in particular sulphur dioxide and nitrogen oxides, are contributing to the destruction of our cultural monuments, both of stone and metal. And in this case there are no critical limits below which no damage will occur. In fact every single acid molecule constitutes a threat.

An official UK program of research into the effects of air pollution on building materials recently concluded that sulphur dioxide remains the main cause of damage to stone in the more polluted areas of Britain, and that it is also an important factor in steel corrosion.

The study involved the exposure of slabs of limestone and sandstone (both widely used as building materials), as well as samples of several metals, at twenty-nine sites representative of different "pollution climates" in Britain.

All of the unsheltered stone slabs lost weight during their exposure at a rate varying between 0.11 and 1.22 per cent per year. A 1 per cent weight loss translates into a surface recession of about one millimetre every 30 years. Statistical analyses of the results showed that acid rain, the dry deposition of acid gases, and rainfall explained 65-75 per cent of the weight losses.

Corrosion rates in mild steel were about 50 μm per year in industrial environments and 30-40 μm/year in city centres, falling to 21 μm a year at a remote rural site. The higher rates will have an economic significance, for they will mean increased repair costs for building owners and occupiers. Statistical analyses showed that rainfall and annual average concentrations of sulphur dioxide and nitrogen oxides could explain most of the variation in corrosion rates from one part of the country to another. Long-term SO_2 levels were again, as with stone, the dominant cause of destruction in the more polluted areas.

The experiments will continue until 1995. The data already obtained are however considered sufficiently robust for use in producing "damage functions" to predict material damage at different levels of pollution. These will be used to prepare maps showing where damage to building materials is likely to remain a problem once current reduction programs have been fully implemented. Together with critical-load maps for damage to soil, water, and vegetation, caused by acid deposition, they will help to put pressure on decision makers to pursue further reductions of emissions.

Source: **ENDS Report**, No. 211, August 1992.

A greener parliament

THE UK HOUSE OF COMMONS begins the new parliamentary session a good deal greener than it was before the general election. An opinion poll has revealed that a large majority of MPs would support a more radical environmental program than the government's – and that newly elected MPs are greener than their predecessors.

This is what appeared from interviews with 123 MPs. Included in the sample were seven Cabinet Ministers, eleven members of the Shadow Cabinet, and more than 50 new MPs.

The interviewees were asked to rate on a score of ten each of ten questions. A score of seven was taken to mean "high priority." Support was strongest for the proposition that acid emissions from power stations should be abated by means of the best available technology – 88 per cent giving this question high priority. Three-quarters of the sample also favoured a target to cut carbon-dioxide emissions by 20 per cent by 2005 through energy-efficiency programs.

Support of the use of market mechanisms to curb pollution was surprisingly low, being given high priority by only 33 per cent of the sample. Market mechanisms are likely to be a major theme of the British government's environmental policy over the next few years.

Source: **ENDS Report**, No. 212, September 1992, with reference to **Changing environmental course?** from WBMG Environmental Communications, Suite 312, Linen Hall, 162-168 Regents Street, London, England W1R 5TB.

Vanishing trout

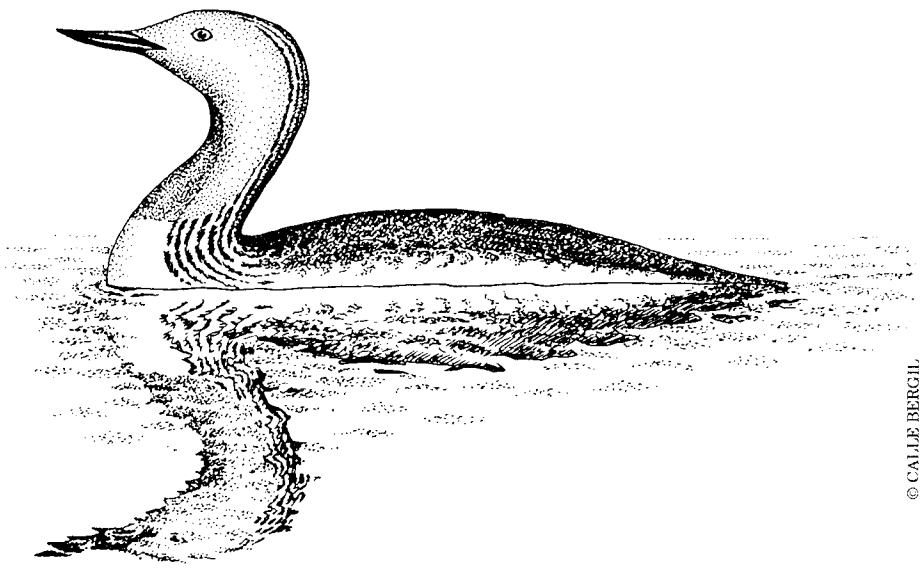
ACID RAIN and droplets in clouds, as well as extensive planting of conifers, have combined to banish trout from many Welsh streams, according to a long-term study of the catchment of the Llyn Brianne reservoir in west Wales.

Conifer needles that have captured acid droplets from mists and low cloud aggravate the effect of acid rain. And drainage ditches in forest plantations ensure that the acid water often runs off directly into streams, killing fish before the soil can neutralize it.

Although the acidification can be neutralized by liming the surrounding hillsides, there are fears, to be investigated in a follow-up study, that this may result in damage to the ecology of local wetlands.

Modelling studies suggest that around Llyn Brianne reductions of between 30 and 50 per cent in the acidity of rainfall will be necessary to prevent further acidification of soils and streams, and that only a 60 to 90 per cent reduction would allow the recovery of fish populations, river invertebrates, and fishing birds such as dippers.

Source: **New Scientist**, August 15, 1992



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Divers also affected

Recently some of the highest concentrations of mercury that have ever been recorded in a bird species in Sweden – not excluding those of the disastrous sixties – have been found in red-throated divers on the southwestern side of the country.

These divers often nest beside small, naturally fishless lakes, fetching their food, mostly fish, from other lakes in the neighbourhood. Acidification has however killed off the the fish in many of those lakes, and so reduced the divers' living space. Now on top of this it has been found from analyses of unhatched eggs that the concentrations of mercury in them were so high as to endanger reproduction. Mercury becomes more mobile in the ecosystem as acidification increases.

"There can be no doubt about the connection between the high concentrations of mercury and lake acidification," says Mats O.G. Eriksson, scientist at the Environmental Protection Agency. "Many of the lakes in southwestern Sweden have become acidified, and in one county in particular, Älvsborgs län, the population of red-throated divers has become halved since the thirties."

Source: **Svensk Jakt**, No. 2, 1992.

Publications

Climate change: Designing a tradeable permit system (1992)
The framework convention on climate change signed in Rio contains a commitment by participating countries to work toward reductions in their emissions of greenhouse gases. In a market-based approach, the most-often-discussed options for this are tradeable permits and taxes. This report contains technical papers presented at a workshop on tradeable permits, organized by the OECD. A second volume discussing the use of taxes will also be published.

£18, 282 pp. Published by OECD, 2 rue André Pascal, F-75775 Paris cedex 16, France.

Can nature survive global warming? (1992)
For many years, national parks and other types of protected areas have formed the cornerstone of attempts to conserve natural ecosystems and species. Geographical boundaries offer however no protection against climate change. This discussion paper from WWF International, written by Chris Rose and Phil Hurst, provides a popular review of scientific information on the potential worldwide effects of climate change on ecosystems and species.

60 pp. Available from WWF International, CH-1196 Gland, Switzerland.

Burning questions (1992)
A conference report edited by K. V. Ramani, Peter Hills, and Grace George. The subtitle of this book is "Environmental limits to energy growth in Asian-Pacific countries during the 1990s." It addresses a wide range of energy and environmental issues, both in the form of technical analyses and statements from the standpoint of national governments in the region.

375 pp. Published by the Asian and Pacific Development Centre, Pesiaran Duta, P O Box 12224, 50770 Kuala Lumpur, Malaysia.

Mercury in soil – distribution, speciation and biological effects (1992)
Prepared by four Scandinavian scientists, this report contains a review of the international literature on mercury in soils, and on the effects on microbial and biochemical processes as well as on species diversity of soil biota. Comment is given on the problem of assessing "critical" or maximum allowable concentrations of mercury in topsoils.

90 pp. Published by the Nordic Council of Ministers (Nord 1992:3). Can be ordered from Allmänna förlaget, S-106 47 Stockholm, Sweden.

EMEP report 1992

ARE THE EMISSIONS of air pollutants diminishing? The yearly reports from the EMEP provide an important check on the way signatories to international agreements are fulfilling their obligations, as well as on the general effect of such agreements. They are also useful in the development of new agreements based on the critical loads concept.

The current EMEP report* shows that the emissions of sulphur declined in Europe during the eighties, while those of nitrogen oxides increased. Between 1980 and 1990 sulphur emissions fell by 7.2 million tons, or just over 26 per cent. During the same period the emissions of nitrogen oxides increased by 1.1 million tons, or 5 per cent. Ammonia emissions are also recorded, but the incompleteness of the underlying data makes it impossible to discern any clear trend.

Emission data, based on official figures supplied by each country, have been assembled by the EMEP since the late seventies (Table 1). Together with data from field measurements of concentrations and fallout, meteorological data and advanced mathematical calculations are used to describe the transformation and deposition of pollutants as they move about in Europe.

In 1990 the EMEP computer model was revised and also improved. The emission data was, for example, expanded so as to cover the areas of sea and include emissions from shipping in international trade, as well as the natural emissions of sulphur from the seas (NAT). As a result, the contributions of sulphur and oxidized nitrogen from indeterminate sources (IND) – that is, depositions that cannot be attributed to any known source of emission – have become substantially reduced.

Especially in the case of western Europe, a considerable proportion of the deposition still comes under IND. This is probably because of a combination of emissions from outside Europe (for instance from North America), of European emissions that have been under way for more than 96 hours (the time limit for modelling of so-called trajectories), and emissions from natural sources. Another recent report** from the EMEP shows that 70 per cent of the unidentified depositions of sulphur come from European sources, while 25 and 5 per cent come from North America and northern Asia respectively.

The emissions from international shipping include those from traffic in the Atlantic (ATL), the North Sea (NOS), and the Baltic (BAS). Traffic in the Mediterranean and the Black Sea is on the other hand not covered at all. According to EMEP, the data on emissions from ships is still incomplete, probably conveying an underestimate of the actual emissions. The data on natural emissions of sulphur from the sea (in the form of dimethyl sulphide) is said to be an estimate based on crude assumptions.

It is noted in the report that very few countries include emissions of

Continued on page 12

Table 1. Emissions of sulphur and nitrogen oxides.

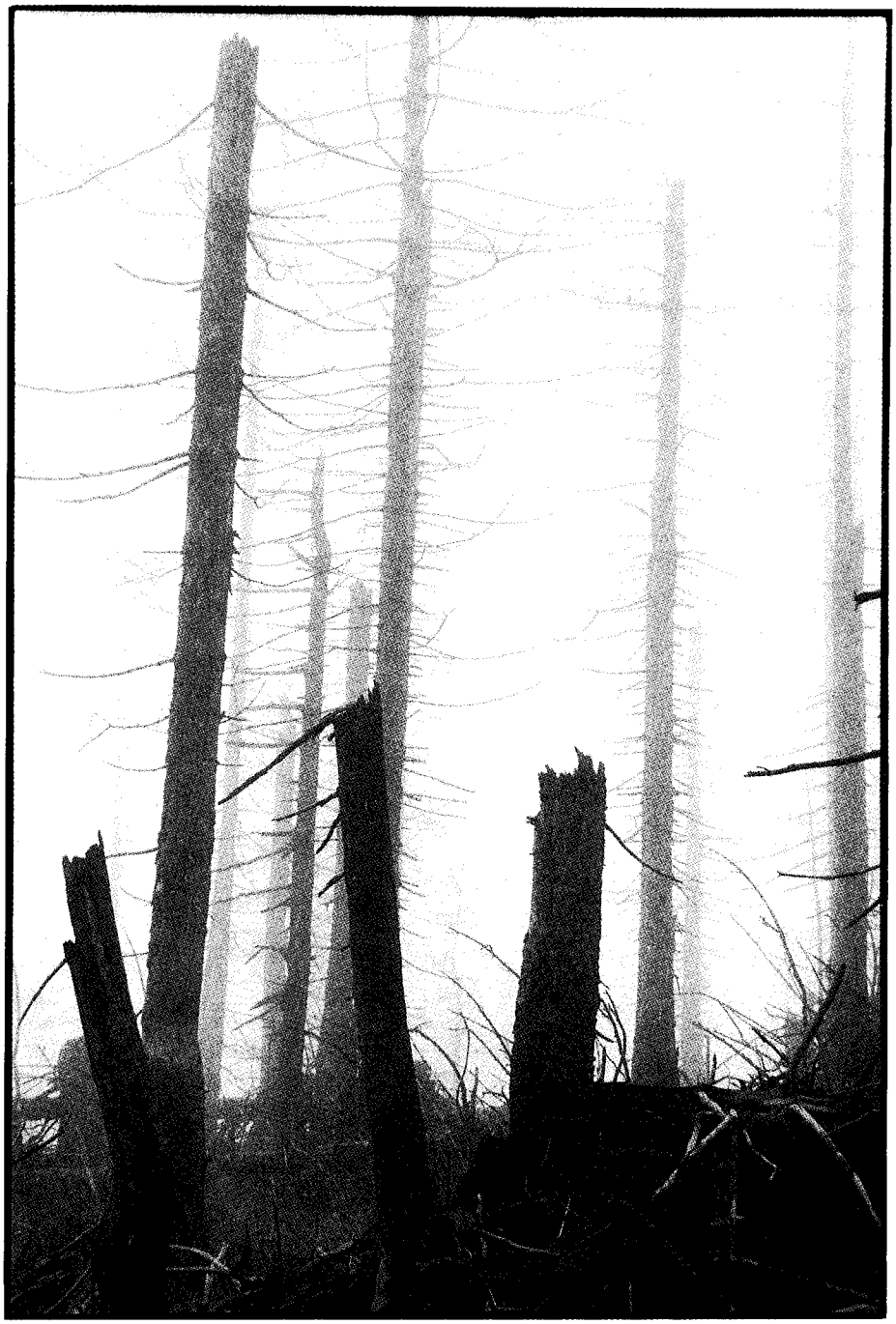
		Sulphur (1000 tons)		Nitrogen oxides (1000 tons as NO_2)	
		1980	1991	1980	1991
Albania	AL	[25]	[25]	[9]	[9]
Austria	AT	195	49*	233	209*
Belgium	BE	414	210*	442	300*
Bulgaria	BG	517	515*	150	150*
Czechoslovakia	CS	1550	1282*	1204	1122*
Denmark	DK	224	133*	241	254*
Finland	FI	292	128*	264	290*
France	FR	1669	603*	1823	1742*
Germany, f. East	DD	2132	2621*	630	705*
Germany, f. West	DE	1597	501*	2980	2707*
Greece	GR	200	250*	746*	746*
Hungary	HU	816	505*	273	238*
Iceland	IS	3	3*	13	12*
Ireland	IE	111	84*	73	135*
Italy	IT	1900	1203*	1480	1755*
Luxembourg	LU	12	5*	23	15*
Netherlands	NL	233	119*	548	529*
Norway	NO	71	33*	181	212*
Poland	PL	2050	1605*	1500*	1280*
Portugal	PT	133	106*	166	142*
Romania	RO	900	900*	[390]	[390]
Spain	ES	1625	1095*	950	950*
Sweden	SE	257	102*	398	373*
Switzerland	CH	63	31*	196	184*
Turkey	TR	138*	199*	[175]	[175]
Soviet Union[1]	SU	6400	4465*	3167	4407*
United Kingdom	GB	2441	1916*	2442	2690*
Yugoslavia	YU	650	740*	350	420*
Remaining area	REM	[256]	[256]	[100]	[100]
Int. trade, Baltic Sea	BAS	[36]	[36]	[80]	[80]
Int. trade, North Sea	NOS	[87]	[87]	[192]	[192]
Int. trade, rem. Atl.	ATL	[158]	[158]	[349]	[349]
Int. trade, Mediter.[2]	MED	[6]	[6]	[13]	[13]
Int. trade, Black Sea	BLS	n o d a t a			
Biogenic sea emis.	NAT	[362]	[362]	[0]	[0]
Sum		**27523**	**20330**	**21781**	**22875**

The table shows national official data received at the ECE secretariat up to April 3, 1992 for sulphur, February 6, 1991 for nitrogen oxides. Data estimated by MSC-W/CCC are given in square brackets.

* Interpolated data (no data have been officially submitted).
[1] European part of former USSR within the EMEP area of calculation.
[2] Data for the vicinity of Gibraltar only.

Environmental Factsheet
No. 1, December 1992

FOREST DAMAGE IN EUROPE



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What surveying shows

NATIONAL INVENTORIES of the scale and distribution of forest damage have been carried out in some countries in Europe since 1983. Since 1986 most countries have coordinated their surveys on the basis of a system devised within the framework of the International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests, under the Executive Body of the UN ECE Convention on Long Range Transboundary Air Pollution. A task force headed by Germany is responsible for the detailed planning and coordination.

The sixth European-wide coordinated assessment of damage under

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The Environmental Federation in Sweden
The Swedish Society for Nature Conservation
The Swedish Anglers' National Association
The Swedish Youth Association for Environmental Studies and Conservation
World Wide Fund for Nature Sweden

this program was made in 1991. Of the twenty-seven countries involved, twenty-four carried out studies both of conifers and broadleaved trees, while three confined their surveys to conifers only.

More than 160 million hectares were surveyed, representing about three-quarters of the total forested area of Europe. For various reasons in 1991 the state of the forest was not assessed in Byelorussia, the Ukraine, Latvia, Bulgaria, Turkey, and Croatia.

The method used is to assess sample trees for damage in accordance with the following five-class system:

Class 0	0-10% defoliation	none
Class 1	11-25% "	slight
Class 2	25-60% "	moderate
Class 3	60%– "	severe
Class 4	100% "	dead

Defoliation intensity is employed as a means of showing the trees' general state of health. Some countries combine defoliation and discoloration of needles and leaves in their judgements.

It is difficult however to determine just when a tree is to be regarded as damaged. From experience gained during the last three years of the survey work it has now been concluded that a loss of foliage of up to 20-25 per cent is not necessarily a sign of deteriorating vitality. Conifers regulate the amount of their foliage according to the availability of moisture or nutrients or as a response to favourable or unfavourable weather conditions. Also broadleaved trees that have lost foliage as a result of late frost or insect attack may replace part of the loss with new leaves or compensate for it without showing any reduction of growth.

Consequently Class 1 defoliation is considered more as an early warning stage than an indication of reduced vitality.

In Table 1 the extent of defoliation is shown in the ranges moderate to severe (Classes 2-4) and slight to severe (1-4). In the full report, ratings are shown for different species and age groups of the coniferous and broadleaved trees. In 1991 18.5 per cent of the total of broadleaved were in defoliation classes 2-4, while the corresponding figure for conifers was 24.4 per cent.

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The following reports on damage to individual species refer to the 1990 surveys, the information for 1991 not yet having been published.

OAK TREES (*Quercus robur*) more than 60 years old were found to have suffered in particular. In the former East Germany, for instance, 83 per cent of the older trees were

Table 1. Intensity of defoliation in 1991, in per cent of the trees affected. For all tree species, unless marked * for conifers only.

	Moderate to severe (Classes 2-4)	Slight to severe (Classes 1-4)
United Kingdom	56.7	94.0
Poland	45.0	90.8
Czechoslovakia	41.3	75.9
Denmark	29.9	58.5
Portugal	29.6	52.5
Estonia*	28.0	65.0
Russia*	26.0	67.2
Germany	25.2	64.2
Lithuania	23.9	75.4
Luxembourg	20.8	44.2
Norway	19.7	50.6
Hungary	19.6	51.7
Liechtenstein	19.0	68.0
Switzerland	19.0	68.0
Belgium	17.9	56.6
Netherlands	17.2	47.5
Greece	16.9	48.2
Italy	16.4	41.6
Finland	16.0	35.5
Slovenia	15.9	37.1
Ireland*	15.0	46.2
Sweden	12.0	45.3
Yugoslavia	9.8	25.2
Romania	9.7	38.4
Austria	7.5	45.4
Spain	7.3	35.7
France	7.1	23.6

classified as moderately to severely damaged (Classes 2-4). In Czechoslovakia and the United Kingdom the percentages were 63 and 55 per cent respectively.

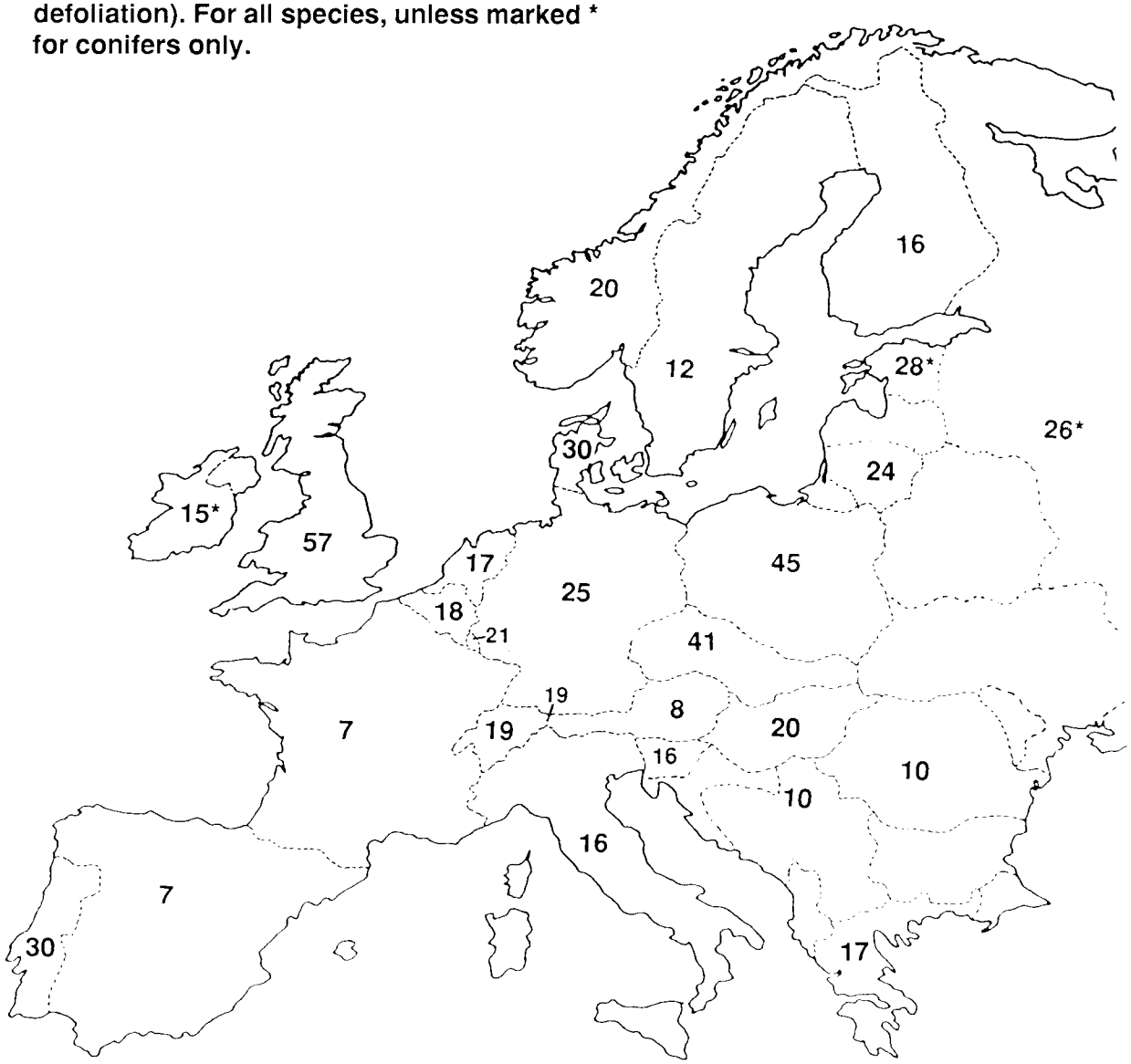
CORK OAK (*Quercus suber*) was the species showing the greatest defoliation, 42 per cent of the trees placing in Classes 2-4.

COMMON BEECH (*Fagus sylvatica*) have suffered particularly in East Germany, Byelorussia and the UK, where 67, 54 and 53 per cent of trees more than 60 years old were moderately to severely damaged.

Also as regards NORWAY SPRUCE (*Picea abies*), trees over 60 years old were considerably more defoliated than younger ones, and in several countries more than 25 per cent of such trees were placed in Classes 2-4. In Byelorussia and Denmark the proportion was over 60 per cent.

FIR (*Abies alba*) still remains the most affected species in Central Europe. In Poland 77 per cent of the

Intensity of defoliation 1991. Percentage of trees in defoliation Classes 2-4 (>25 per cent defoliation). For all species, unless marked * for conifers only.



fir trees over 60 years of age were found to be moderately to severely defoliated. In the 1989 annual report it was said that in Bulgaria the trees had died in 25,000 hectares of a total area of fir forest of 30,000 hectares.

SCOTS PINE (*Pinus sylvestris*) 60 years and older were most badly affected in Byelorussia and Latvia, 61 per cent of the trees falling into Classes 2-4.

From 1990 to 1991 the number of all sample trees with a defoliation greater than 25 per cent increased from 20.8 to 22.2 per cent, which means that the number of trees considered as damaged has risen by nearly 7 per cent within a year.

The results, when seen over the whole period of the surveys from 1986 to 1991, reveal great variations from one year to another (Table 2). This is as might be expected, since the various factors affecting the vitality of the trees – drought, wind, frost, air pollution, etc. – will vary greatly from year to year. In general it can be said that aged trees and trees standing on high ground will be the worst affected. But recent studies indicate that considerable defoliation is now increasingly occurring in younger stands as well.

One should also bear in mind that an average figure for a whole country may, for instance, conceal severe damage in the mountain regions, while the lowland forests are still in a good shape. Several thousand hectares of forest on mountain tops in Czechoslovakia, Germany, and Poland are among the most heavily affected.

Although in general a six-year period will not permit any far-reaching conclusions, there seems to be an definite trend in eastern Europe, where there has been a great increase in the reported damage. Some of this increase may of course be due to more careful surveying, as well as to the lifting of censorship. The air-pollutant load of eastern Europe is however extremely high. As for the West, marked increases in damage have been noted in the United Kingdom and Portugal. In other countries there are no clear trend either way.

As the table and map indicate, ailing forests are to be found to a greater or lesser extent in all the countries of Europe, and it is generally agreed that the direct and indirect effects of air pollution are a major cause of the widespread damage.

Table 2. Results from forest-damage surveys 1986-1991. Percentage of trees in Classes 2-4 (defoliation >25 per cent).

	1986	1987	1988	1989	1990	1991
Austria	4.6	3.6	3.6	4.4	9.1	7.5
Belgium						17.9
- Wallonia	–	9.0*	11.0*	16.6	19.1	
- Flanders	–	12.5	10.4	11.6	8.3	
Bulgaria	8.1	3.6	7.4	24.9	29.1	–
Byelorussia	–	–	–	67.2 R	54.0	–
Czechoslovakia	16.4	15.6*	27.4	33.0	46.6	41.3
Denmark	–	23.0	18.0	26.0	21.2	29.9
Estonia	–	–	9.0R	28.5*	20.0*	28.0*
Finland	8.7*	12.1	16.1	18.0	17.3	16.0
France	8.3	9.7R	6.9	5.6	7.3	7.1
Germany						25.2
- former East	–	–	13.8	16.4	35.9	
- former West	18.9	17.3	14.9	15.9	15.9	
Greece	–	–	17.0	12.0	17.5	16.9
Hungary	12.0	6.0R	7.5	12.7	21.7	19.6
Ireland	–	0.0*	4.8*1	13.2*	5.4*	15.0*
Italy	1.02	–	–	9.11	14.8	16.4
Latvia	–	–	–	–	36.0	–
Lithuania	–	–	3.0R	21.5	20.4	23.9
Liechtenstein	19.0	19.0	17.0	11.8	7.1*	19.0
Luxembourg	4.9	7.9	10.3	12.3	–	20.8
Netherlands	23.4	21.4	18.3	16.1	17.8	17.2
Norway	12.0*2	17.8*R	20.8*	14.8*	17.2	19.7
Poland	4.6	–	20.4	31.9	38.4	45.0
Portugal	–	–	1.3	9.1	30.7	29.6
Romania	–	–	–	–	–	9.7
Russia	–	–	–	–	–	26.0*
Slovenia	–	–	–	22.6	18.2	15.9
Spain	13.4	12.6R	7.0	3.3	3.8	7.3
Sweden	2.1	5.6*	10.6	12.9*	16.2	12.0
Switzerland	13.0	15.0	12.0	12.0	17.0	19.0
Ukraine	–	–	–	1.4R	6.4	–
United Kingdom	–	22.0	25.0	28.0	39.0	56.7
Yugoslavia	23.0*	9.5	10.0R	–	–	9.8

* Conifers only.
R Regional survey
1 Only trees <60 years assessed.
2 1985 survey.

Further reading: **Forest Damage and Air Pollution**. Annual report of the forest-damage survey in Europe, prepared by the International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests, within the UN ECE Convention on LRTAP. The information here is based on the report for 1990 and a summary for 1991.

* The Convention on Long Range Transboundary Air Pollution under the United Nations Economic Commission for Europe (ECE) was signed in November 1979 and entered into force in March 1983. For further details see Environmental Factsheet No. 2, available from the Swedish NGO Secretariat on Acid Rain, Box 245, S-401 24 Göteborg, Sweden.

Table 2. Provisional estimate of sulphur budget for Europe. Average for 1990-91. Total (dry + wet) deposition of sulphur. Unit: 100 tons sulphur per year.

	AL	AT	BE	BG	CS	DK	FI	FR	DE	GR	HU	IS	IE	IT	LU	NL	NO	PL	PT	RO	ES	SE	CH	TR	SU	GB	YU	REM	BAS	NOS	ATL	MED	BLS	NAT	IND	SUM
AL	41	0	0	22	8	0	0	2	11	18	11	0	0	29	0	0	0	8	0	16	2	0	0	1	6	2	36	2	0	0	0	0	0	2	64	285
AT	0	124	20	2	293	4	0	77	484	0	70	0	1	211	1	8	0	132	0	12	9	2	12	0	16	42	86	1	1	4	2	0	0	3	156	1774
BE	0	0	408	0	13	1	0	116	110	0	1	0	2	2	2	30	0	10	0	0	6	0	0	0	2	107	1	0	0	13	2	0	0	3	43	874
BG	4	2	2	1284	56	1	0	5	74	34	70	0	0	26	0	1	0	62	0	360	1	0	0	8	128	9	134	1	0	1	0	0	0	4	202	2472
CS	0	24	26	7	3264	9	2	62	1387	1	300	0	2	48	1	12	0	545	0	50	6	2	2	0	46	66	85	1	2	6	2	0	0	4	210	6168
DK	0	0	10	0	24	150	1	14	142	0	2	0	2	1	0	9	2	34	0	1	2	6	0	0	8	112	1	0	5	10	1	0	0	4	54	596
FI	0	0	6	0	39	20	384	10	150	0	7	0	2	2	0	5	5	106	0	5	2	48	0	0	423	59	4	0	14	4	1	0	0	13	328	1640
FR	0	5	190	1	126	8	0	1963	570	0	26	0	11	265	6	53	0	76	10	12	313	2	16	0	14	409	43	4	1	46	40	0	0	38	675	4908
DE	0	19	278	1	901	54	2	488	9587	0	46	0	12	97	10	138	2	352	2	12	42	7	22	0	48	561	22	0	8	52	10	0	0	22	518	13329
GR	8	1	2	210	24	0	0	6	32	490	26	0	0	33	0	1	0	28	0	96	3	0	0	20	62	6	48	6	0	0	0	0	0	8	238	1350
HU	0	17	7	11	285	2	0	18	223	2	1334	0	0	70	0	3	0	160	0	121	4	1	1	0	45	17	236	1	1	2	0	0	0	2	146	2712
IS	0	0	1	0	0	0	0	2	4	0	0	5	1	0	0	1	0	2	0	0	0	0	0	0	1	15	0	0	0	0	1	0	0	12	48	94
IE	0	0	4	0	4	0	0	8	22	0	0	0	180	0	0	2	0	2	0	0	3	0	0	0	0	110	0	0	0	2	9	0	0	13	68	429
IT	2	18	20	14	172	4	0	153	321	14	110	0	1	3182	1	8	0	111	4	32	63	1	20	1	22	106	269	24	1	4	4	0	0	22	570	5226
LU	0	0	3	0	1	0	0	10	8	0	0	0	0	0	8	1	0	1	0	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	4	38
NL	0	0	101	0	16	2	0	66	194	0	2	0	3	2	0	179	0	12	0	0	4	0	0	0	2	203	0	0	0	20	2	0	0	4	50	866
NO	0	0	20	0	40	39	12	26	197	0	6	0	9	2	0	16	70	69	0	6	6	27	0	0	110	314	3	0	6	19	7	0	0	36	386	1425
PL	0	12	60	10	1098	54	7	92	3145	1	180	0	4	40	2	36	2	5294	0	80	10	16	2	0	230	205	77	1	16	18	4	0	0	12	525	11232
PT	0	0	0	0	1	0	0	6	4	0	0	0	0	2	0	0	0	0	238	0	110	0	0	0	0	8	1	2	0	0	21	0	0	6	64	466
RO	3	6	6	146	254	4	2	14	280	14	356	0	0	61	0	4	0	270	0	2824	3	2	0	12	390	21	375	1	1	2	0	0	0	4	376	5432
ES	0	0	15	0	16	2	0	108	78	0	2	0	4	44	0	6	0	12	111	0	2896	0	1	0	1	96	10	18	0	6	46	3	0	28	420	3929
SE	0	1	25	0	77	120	60	32	372	0	12	0	6	2	0	22	26	165	0	20	4	280	0	0	168	260	6	0	24	20	5	0	0	27	433	2156
CH	0	3	12	0	33	2	0	97	120	0	8	0	1	173	1	5	0	18	0	1	16	0	82	0	2	36	10	0	0	2	2	0	0	2	81	708
TR	1	1	2	102	32	1	0	4	48	50	35	0	0	13	0	1	0	47	0	110	2	1	0	567	297	7	28	4	0	0	0	0	0	15	718	2088
SU	2	18	78	126	989	122	234	119	2188	22	502	0	9	89	2	50	12	2632	1	844	16	98	2	64	18418	392	237	1	60	31	7	0	0	62	5354	32782
GB	0	0	39	0	26	6	0	74	142	0	2	0	66	2	0	25	1	24	1	1	17	2	0	0	10	5018	1	0	1	45	26	0	0	36	230	5797
YU	15	26	12	165	294	4	1	42	362	32	408	0	1	386	0	6	0	210	0	198	16	2	2	3	63	35	2422	8	1	3	2	0	0	12	506	5236
REM	0	1	5	10	24	1	0	40	49	16	12	0	1	100	0	2	0	14	7	8	102	0	1	2	4	30	24	626	0	2	4	1	0	24	666	1776
BAS	0	40	105	2	170	298	158	64	1030	0	26	0	8	8	1	38	10	601	0	17	10	182	0	0	436	350	12	0	123	30	5	0	0	38	507	4272
NOS	0	2	219	0	172	130	4	352	912	0	17	0	59	12	2	256	30	154	2	5	43	24	1	0	40	3726	8	0	20	296	40	0	0	140	664	7321
ATL	16	2	112	0	106	42	58	368	598	0	13	11	234	18	2	62	35	131	212	5	1470	34	2	0	516	2006	8	3	8	70	672	0	0	1250	3551	11515
MED	45	20	42	306	345	8	2	333	568	534	264	0	4	2330	1	19	0	273	24	276	829	3	8	129	172	162	651	346	2	12	16	2	0	182	2192	10148
BLS	1	2	2	126	97	3	12	4	98	18	53	0	0	12	0	2	0	125	0	264	0	2	0	139	996	12	36	0	1	1	0	0	0	26	652	2685

Table 3. Provisional estimate of oxidized-nitrogen budget for Europe. Average for 1990-91. Total (wet + dry) deposition of nitrogen. Unit: 100 tons nitrogen per year.

	AL	AT	BE	BG	CS	DK	FI	FR	DE	GR	HU	IS	IE	IT	LU	NL	NO	PL	PT	RO	ES	SE	CH	TR	SU	GB	YU	REM	BAS	NOS	ATL	MED	BLS	NAT	IND	SUM
AL	1	1	0	2	3	0	0	4	4	16	2	0	0	18	0	0	0	3	0	2	0	0	0	0	2	2	7	0	0	0	0	0	0	0	20	92
AT	0	42	14	0	82	4	0	90	274	0	9	0	1	101	1	19	1	40	0	2	3	3	22	0	6	30	15	0	1	5	2	0	0	0	61	832
BE	0	0	27	0	5	1	0	66	59	0	0	0	2	1	1	24	0	4	0	0	2	0	1	0	1	56	0	0	0	8	2	0	0	0	17	276
BG	1	4	1	30	22	2	0	6	28	38	14	0	0	17	0	4	0	22	0	46	0	1	0	2	41	6	23	0	0	1	0	0	0	0	56	366
CS	0	26	19	1	254	8	2	74	368	2	36	0	2	34	2	28	2	118	0	8	2	6	6	0	17	50	18	0	2	7	2	0	0	0	80	1172
DK	0	0	6	0	7	18	1	16	58	0	0	0	2	1	0	16	3	9	0	0	0	5	0	0	4	80	0	0	2	6	2	0	0	0	21	260
FI	0	1	6	0	23	23	120	16	90	0	2	0	2	2	0	14	16	50	0	1	2	66	0	0	92	54	1	0	12	6	2	0	0	0	108	711
FR	0	8	72	0	48	6	0	833	374	0	5	0	8	120	4	74	2	26	8	2	123	4	24	0	5	230	10	1	1	32	44	0	0	0	252	2316
DE	0	18	133	0	206	31	3	466	1547	0	8	0	11	52	9	216	8	92	2	2	17	14	34	0	20	366	5	0	6	48	12	0	0	0	214	3532
GR	1	2	1	14	10	1	0	8	14	160	6	0	0	24	0	2	0	12	0	17	2	0	0	6	26	6	10	2	0	0	0	0	0	0	79	399
HU	0	20	4	2	76	2	1	22	88	3	64	0	0	50	0	7	0	50	0	16	2	2	2	0	14	12	40	0	1	2	0	0	0	0	48	532
IS	0	0	1	0	0	0	0	4	6	0	0	2	1	0	0	3	1	0	0	0	0	0	0	0	0	16	0	0	0	1	1	0	0	0	29	70
IE	0	0	2	0	2	0	0	10	16	0	0	0	18	0	0	5	0	1	0	0	2	0	0	0	0	52	0	0	0	2	8	0	0	0	28	150
IT	0	24	13	2	62	3	0	193	174	20	19	0	1	618	1	18	1	36	2	7	34	2	30	0	8	37	52	4	1	5	4	0	0	0	197	1570
LU	0	0	1	0	0	0	0	6	4	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	1	18
NL	0	0	24	0	4	2	0	43	84	0	0	0	2	1	0	54	1	4	0	0	2	1	0	0	1	104	0	0	0	10	2	0	0	0	20	362
NO	0	1	16	0	21	32	12	42	142	0	2	0	9	1	0	40	58	32	0	2	4	38	0	0	18	250	1	0	6	19	8	0	0	0	154	908
PL	0	18	42	1	391	42	9	120	754	1	30	0	4	30	2	80	8	516	0	14	4	32	6	0	74	286	18	0	12	20	4	0	0	0	184	2472
PT	0	0	0	0	0	0	0	7	4	0	0	0	0	2	0	1	0	0	40	0	32	0	0	0	0	6	0	0	0	0	16	0	0	0	37	150
RO	0	10	4	12	89	4	2	18	98	18	58	0	0	42	0	9	1	88	0	144	2	4	1	2	108	15	58	0	1	2	0	0	0	0	108	898
ES	0	2	10	0	8	2	0	122	58	0	1	0	2	34	1	14	0	4	57	0	414	1	2	0	0	68	4	4	0	6	44	3	0	0	180	1042
SE	0	2	19	0	34	72	52	44	228	0	2	0	6	2	0	51	50	60	0	2	2	143	1	0	62	210	2	0	17	22	5	0	0	0	160	1250
CH	0	4	8	0	12	0	0	100	88	0	1	0	0	56	1	11	0	5	0	0	6	0	32	0	1	24	2	0	0	3	2	0	0	0	31	386
TR	0	2	1	8	14	1	0	6	20	62	8	0	0	9	0	2	0	20	0	21	1	1	0	76	136	5	7	0	0	0	0	0	0	0	258	661
SU	0	32	60	16	392	126	210	170	946	30	93	0	8	72	2	125	40	882	1	126	7	186	10	26	3456	316	58	0	58	38	8	0	0	0	1532	9026
GB	0	0	15	0	10	6	0	69	89	0	0	0	34	2	0	30	3	10	1	0	8	4	1	0	6	645	0	0	1	22	22	0	0	0	92	1073
YU	2	34	10	14	104	4	1	56	158	34	68	0	1	238	1	14	1	76	0	34	8	3	6	1	21	24	165	2	2	4	2	0	0	0	160	1244
REM	0	2	4	2	12	1	0	64	28	26	3	0	1	66	0	6	0	6	4	3	45	1	2	1	2	24	8	39	0	2	4	1	0	0	360	718
BAS	0	3	31	0	54	90	59	75	390	0	4	0	8	6	1	74	22	114	0	3	4	118	2	0	84	238	2	0	28	26	5	0	0	0	156	1596
NOS	0	4	66	0	48	42	4	218	384	0	3	1	38	6	2	152	26	42	2	0	17	24	2	0	14	1135	2	0	6	70	34	0	0	0	234	2580
ATL	0	4	70	0	51	40	32	333	452	0	3	8	87	12	2	130	78	52	40	1	185	45	6	0	54	1044	2	0	8	64	264	0	0	0	1526	4593
MED	2	26	24	22	98	6	2	318	211	296	37	0	2	638	1	35	2	74	12	41	168	6	14	22	76	92	96	27	2	10	13	1	0	0	652	3028
BLS	0	2	2	6	20	2	2	4	25	18	8	0	0	12	0	2	0	32	0	28	0	2	0	20	242	7	6	0	1	1	0	0	0	0	144	584

Explanation of the tables

The two-letter country codes are given in Table 1. To find the contribution from other countries to a certain country, follow the horizontal row starting from the relevant country code on the far left. To find the contributions from a certain country to other countries, follow the vertical column starting from the relevant country code at the top. REM signifies contribution to and from the part of the domain for deposition calculations which is not covered by European countries. IND signifies the part of the calculated depositions which cannot be attributed to any known emission sources by the present models.

Fuel efficiency program

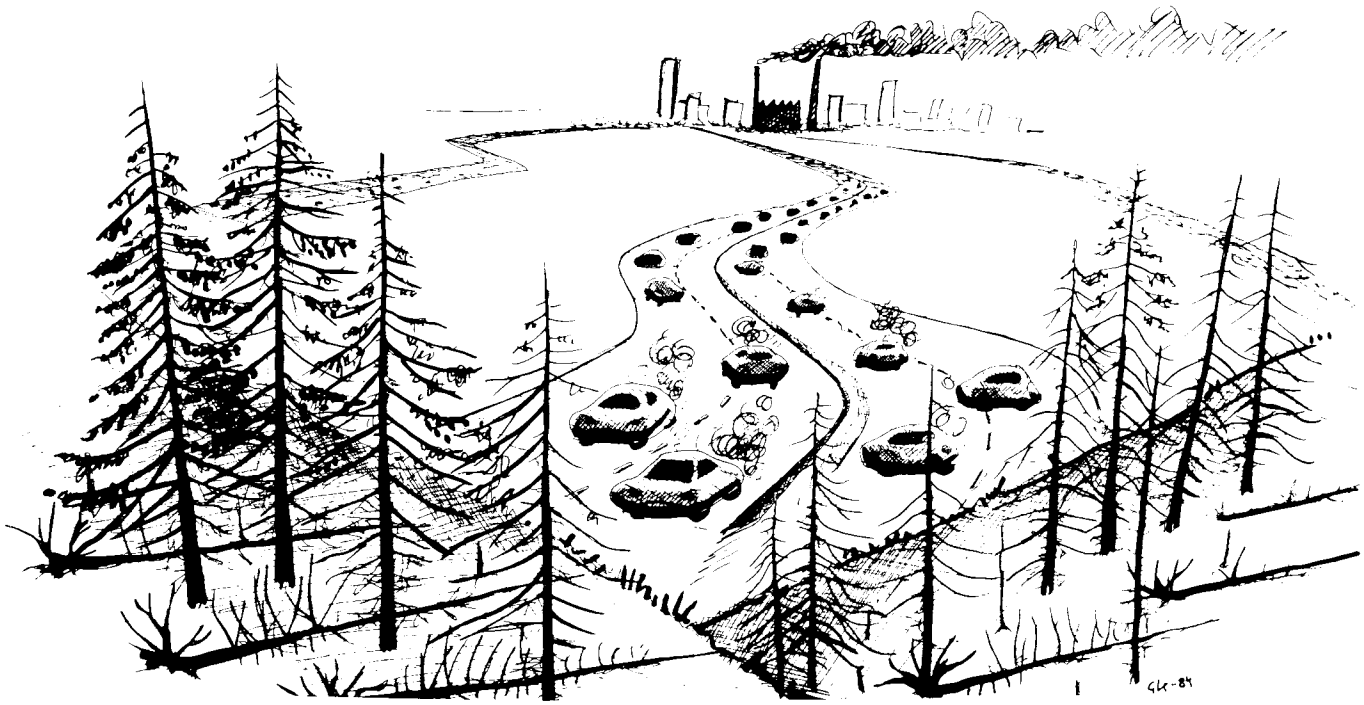
AT A MEETING on August 31 the French and German ministers for the environment agreed to launch a new program to improve the fuel efficiency of motor vehicles in their respective countries. The aim is to have cars that will, by the year 2005, consume on an average 0.5 litres of petrol per 10 kilometres, compared to the current averages of approximately 0.7 and 0.9 litres per 10 km in France and Germany. The environment ministers also called upon the industry to produce 100-per-cent recyclable cars within five years.

Following the meeting, French carmakers argued that several factors were working against such improvements, these including more-stringent emission and safety standards (the latter adding weight) and customers' demands for options such as air conditioning.

As recently as two years ago the German carmakers promised to reduce emissions of carbon dioxide by 25 per cent by 2005. At a seminar in Salzburg last September however Hartmut Weule, head of research at Daimler-Benz, the largest German maker, insisted that there would instead be a rise of 10 per cent during that period. As reasons he gave ever larger engines, heavier vehicles, and more cars on the road.

This statement from Hartmut Weule will doubtless produce repercussions at the ministry of the environment in Bonn. The German car manufacturers' undertaking to reduce emissions was one of the chief reasons why the Minister for the Environment Töpfer had hitherto refrained from imposing any general measures on motoring.

Sources: Michael P. Walsh, **Car Lines**, September 1992, **Ny Teknik**, No. 38, 1992.



EMEP Report 1992

Continued from page 12

nitrogen oxides from ferries and shipping on inland waterways or from offshore installations. Since such emissions may be relatively large for some countries, it is important that they should henceforth be included in official emission data.

Every year the EMEP presents information on emissions, transports (exports and imports), concentrations, and depositions of sulphur and nitrogen pollutants. The latest available data on exports and imports of sulphur and oxidized nitrogen compounds can be seen in Tables 2 and 3. Since variations in weather and air currents can cause relatively large annual differences in the transports of air pollutants, the values shown in the tables are averages for 1990 and 1991.

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EMEP. Abbreviation for European Monitoring and Evaluation Programme (officially the **Co-operative Programme for Monitoring and Evaluation of Long Range Transboundary Air Pollution**). It was started in 1977 and is carried out under the UN ECE Convention on Long Range Transboundary Air Pollution.

* The data shown in the tables is from the EMEP MCS-W Report 1/92, entitled **Calculated Budgets for Airborne Acidifying Components in Europe, 1985, 1987, 1988, 1989, 1990 and 1991**. It can be had from The Norwegian Meteorological Institute, Box 43-Blindern, N-0313 Oslo 3, Norway.

** **Contributions to sulphur background deposition over Europe: Results for 1988.** By Leonor Tarrasón. EMEP/MSC-W Note 5/92. Available from the same address as above.

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SHIPPING

Call for a curb on emissions

SHIPPING is an energy efficient mode that could in many cases provide a good substitute for transportation over land. The pollution aspect still remains, however, and in a joint address to the Nordic Council of Ministers the various Scandinavian societies for the conservation of nature have proposed that their countries should start taking measures to deal with it without further delay.

Sweden and Norway have been especially active within the International Maritime Organization (IMO), a United Nations body, in urging such measures. The nature conservation societies takes the view however that the Scandinavian countries should not wait for a new annex to the MARPOL convention (see Acid News 1/92, p.16) to come into force, but should take unilateral action. They could do this either by setting special requirements for vessels that regularly enter Scandinavian ports or by imposing environmental charges that could be paid simultaneously with the harbour dues.

The societies see no reason for waiting until the annex has been ratified and finally come into force, probably at the earliest around 1995. They point out that if the manufacturers of anti-pollution equipment are to go on developing their products, they will need to see a market as soon as possible.

If the emissions of sulphur are to be reduced, there will have to be restrictions on the sulphur content of fuel oil. It has been agreed in the shipping committee of the Helsinki Commission (HELCOM) that the Scandinavian countries are to enter into bilateral agreements to restrict the sulphur content to 1.5 per cent. The conservation societies consider this to be insufficient, and propose a maximum of 0.5 per cent, and that their countries should immediately start making agreements among themselves to this end.

Various technical solutions are also available for reducing the emissions of nitrogen oxides from ships. The conservation societies take the view that every possible means should be used to reduce these emissions, provided it does not cost more per kilogram than similar measures for vehicles and stationary plant ashore. They suggest that this could be done by combining an emission charge with the harbour dues. The charge could subsequently be made part of an international system involving an environmental index for all shipping – as is being urged within the IMO by Sweden and others.

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Further publications

National acid precipitation assessment program (1991)
This integrated assessment report from NAPAP, the national acid precipitation assessment program, gives a summary of the causes and effects of acidic deposition in the United States and a comparison of the costs and effectiveness of alternative emission control scenarios.

520 pp. Available from the NAPAP Office of the Director, 722 Jackson Place, NW, Washington, D.C. 20503, USA.

Lichen sensitivity and air pollution (1992)
A literature review of major papers on about 250 lichen species in the northern hemisphere. Gives in tabular form the estimated sensitivity values to various pollutants, transformed into a unified ten-degree scale.

72 pp. Report 4007. Obtainable from the Swedish Environmental Protection Agency, Information department, S-171 85 Solna, Sweden.

Ambio No. 5, 1992. Special issue: Critical loads in Nordic countries
In this special issue of Ambio, Nordic estimates of critical loads have been compiled and compared with those from other parts of Europe and North America.

Single copies of the magazine can be ordered from Ambio, Box 50005, S-104 05 Stockholm, Sweden.

Skogsutsikter (1992)
In this book Per Elvingson reviews the state of the European forests and the problems of air pollution, while also taking a look into the future. Details the extent of forest damage, the sources of the pollution that is causing it, and considers possible solutions.

164 pp. Swedish only. Published by Institutionen för Miljövård, Göteborgs Universitet, Medicinaregatan 20B, S-413 90 Göteborg, Sweden.

Mark- och floraförändringar i sydsvensk ädellövskog (1992)
By Ursula Falkengren-Grerup. A résumé of the research carried out at the University of Lund on changes in soil and flora in primary broadleaf woodlands in South Sweden. Reveals extensive acidification of the soil, as well as changes in the incidence of fungi and vascular species that are in part ascribable to depositions, both acid and eutrophying.

96 pp. In Swedish (summary and figure captions in English). Published by the Swedish Environmental Protection Agency, Information Department, S-171 85 Solna, Sweden.

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NORWAY

Attack on nitrogen oxides

NORWAY IS ONE of the countries that have undertaken to reduce their emissions of nitrogen oxides by 30 per cent by 1998. The Norwegian pollution inspectorate (SFT)* recently put forward a package of measures for achieving this at an estimated cost of 1040 million kroner. Exhaust-gas cleaning for ships, motor vehicles, and the gas turbines on oil platforms was among the chief proposals, although they also included a more efficient use of energy and a changed pattern of transportation.

Of all the various proposals, it seems the only one that is likely to be realized this year will be exhaust controls for light trucks. The introduction of five other measures that was supposed to take place now – including campaigns for driving so as to keep down fuel consumption and promoting the use of electric vehicles – will be delayed. But as the SFT points out, the longer the time allowed to elapse before the necessary measures are introduced, the more vigorous will they have to be to achieve the 30-per-cent goal.

Although the cost of the proposed package of measures may appear high, there is much to be said on the side of the argument that the gain to society – in the way of improvements to health and less damage to the environment – will be many times greater. According to an estimate of the central bureau of statistics (SSB),** the marginal cost of emitting 1 kilogram of nitrogen dioxide is 89.80 kroner. Bringing down the Norwegian emissions by 30 per cent would result in an annual overall reduction of 81,000 tons. Multiplied by 89.80, that amounts to a social gain of 7273 million kroner – or seven times the cost.

A marginal cost of 89.80 kroner assumes a general level of air pollution that does not differ very much from the present one. With less air pollution, the marginal cost will also be lower. There are on the other hand several effects that are not included in the calculations – such as that of ozone on health and vegetation – so the conclusion in regard to social gains should in essence be valid.

Of the gain of 89.80 kroner per kilogram of nitrogen dioxide, as much as 88.90 kroner is attributable to effects on health (especially as regards respiratory troubles). The health effects are considered to take place only in thickly populated areas. The gains in the forms of less damage to forest and fewer fishkills are put at 0.6 and 0.3 kroner. Since these figures may however be uncertain, the statistical office intends to reexamine them jointly with the pollution inspectorate. As regards air pollution, the SFT had shown in a previous study that improving the air in Oslo at a cost of 200 million kroner would give a fourfold gain.

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* Statens Förorensningstillsyn
** Statistisk Sentralbyrå

Based on articles in **Natur & Miljö Bulletin**, No. 14 and 15, 1992. The SSB estimates appear in a report entitled **Miljökostnader i makroperspektiv**, A. Brendemoen, S. Glomsröd & M. Aaserud, 1992. Rapport 92/17, which is obtainable from Statistisk Sentralbyrå, P.b. 8131 Dep., N-0033 Oslo, Norway.

Big German gains

HEAVY INVESTMENTS have resulted in a marked reduction of the emissions of sulphur and nitrogen oxides from power plants in what used to be West Germany. Since 1984 more than DM20 billion has been spent on equipment for desulphurization and denitrification of the flue gases, and on low-NO_x burners. Similar steps are now being taken for reducing emissions in the former East Germany.

These efforts were sparked off by growing awareness of the effects of air pollution on the environment, especially in the form of forest damage, which became a cause for alarm at the beginning of the eighties. One consequence was the Ordinance on Large Combustion Plants of 1983, which set emission standards for existing as well as new installations.

The governing principle in the German cleaning-up program is that *Stand der Technik*, state-of-the-art technique, shall be generally applied. This in turn derives from the principle of anticipatory action (*Vorsorge*) as found in the Federal Imission Control Act. In its practical interpretation it means that emissions from all sources shall be reduced to a degree that is technically reasonable.

The installations that are subject to licensing under the Imission Control Act are all plants with a certain emission relevance. All boilers, for instance, with a thermal capacity of more than 1 megawatt (MW) require licences both for their construction and operation.

Implementation of the emission standards was effected at large combustion plants (>50 MW_{th}) within a period of about six years during the second half of the eighties. The changes in emissions resulting from the application of the standards, which are shown in Table 1, may be seen in Table 2.

Following unification, the West German rules are now being applied in the East as well. New plants have to meet the standards from the start, and existing ones must either be retrofitted within an interim period – usually extending for five years – or be shut down.

The application of the West German requirements is expected to lead to the emissions of sulphur from combustion plants in the East being reduced by 95 per cent, and those of nitrogen oxides by 37 per cent. The restructuring and retrofitting program is expected to be largely completed during the second half of the nineties.

Power plant emissions of sulphur dioxide decreased by 88 per cent

The first commercial installation for flue-gas desulphurization in West Germany came into operation in 1977 at a coal-fired power plant in Wilhelmshaven. The method, which had been described as early as 1880 by a German named Clemens Winkler, was first put to practical use at Battersea power station in London early in the nineteen-thirties. It was only in the 1970s that any general application started, and then mostly in Japan and the United States. Modern FGD methods are so effective that more than 95 per cent of the sulphur dioxide in the flue gas is eliminated.

By the end of the 1980s power plants in Germany with a total electric capacity of about 38,000 megawatts (MW_e) had been retrofitted for flue-gas desulphurization. Today there are close on 200 FGD installations in operation in that country.

There is a variety of methods for flue-gas desulphurization. The most used process, both in Germany and elsewhere, is wet scrubbing with limestone. This has in fact captured more than 90 per cent of the FGD market. Here the end product is gypsum. The aim of the German law is to prevent emissions simply being moved over from one medium (air) to another (soil or water), requiring that the end product shall find commercial use.

Other FGD systems that are being used here and there include the spray dry scrubbing, the Walther, and the Wellman-Lord processes. There are marketable by-products from the two latter in the form of sulphuric acid, elementary sulphur, or ammonium sulphate.

More recently combined processes have appeared in which the nitrogen oxides and the sulphur dioxide are removed simultaneously. Among these are the active coke and the Desonox systems, of which the first is being used at two German power stations, and the other at one. The end product in each case is sulphuric acid.

Virtually all of the 1.8 million tons of FGD gypsum that was produced at coal-fired stations in Germany in 1989 was used in making plaster, gypsum plasterboards, or cement and concrete. The gypsum from lignite-fired plants is usually deposited in opencast mines together with the waste water and the combustion residues. Much of the 1.2

Table 1. Standards for the emissions of sulphur dioxide and nitrogen oxides from stationary combustion plants for the generation of power and heat.

Capacity (MW_{th})	Maximum permitted emissions (mg/m^3) Solid fuel	Liquid fuel	Gaseous fuel
Sulphur dioxide			
>300	400*	400*	35
100-300	800	680	35
10-100	1000	850	35
<10	2000	1700	35
Nitrogen oxides			
>300	200	150	100
50-300	400	300	200
1-50	500	450	200

* At least 85 per cent desulphurization rate.

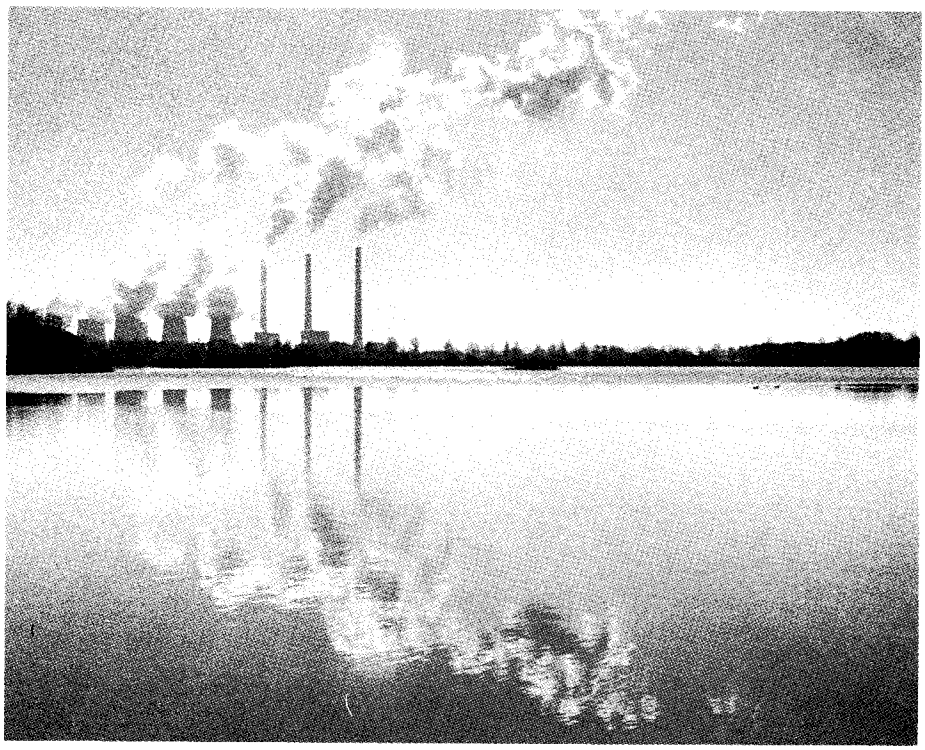
million tons produced in 1989 could however have been used, say, for building material, and it is expected that by 1995 up to 80 per cent of the lignite FGD gypsum will find some use or other.

The most effective of the commonly used methods for reducing the emissions of nitrogen oxides from combustion is SCR, selective catalytic reduction. This has an efficiency of up to 90 per cent. Ammonia is injected into the flue gas in the presence of a catalyst (usually titanium-oxide based) to reduce NO and NO_2 to nitrogen gas and water. Combining SCR with special firing techniques, such as low-NO_x burners, can raise the efficiency to more than 95 per cent. The method was developed in Japan, where it began to be used towards the end of the seventies.

The first SCR plants to operate on a commercial scale in Europe were installed in Germany in 1985. By the end of 1990, German power stations with a total electric capacity of more than 30,000 megawatts (MW_e) had been equipped for selective catalytic reduction, and there are now some 140 SCR installations in operation in the power sector alone.

More than 90 per cent of the SCR capacity has been installed at coal-fired plants, but only 2 per cent at those burning lignite. This is because the emission limit for NO_x of 200 milligrams per cubic metre (mg/m^3) of flue gas can be met at lignite power plants simply by modifying the method of combustion, which is not possible at coal plants. Five of the SCR installations are at oil-fired plants.

Apart from the employment of selective catalytic reduction, modifications have been made in the firing technique at German combustors with a total thermal capacity of 150,000 MW. There is also a further 3000 MW_{th} with cleaning by ten SNCR installations – selective *non*-catalytic reduction.



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Jänschwalde, near Cottbus in eastern Germany, the second largest lignite-fired power station in the country, is now being retrofitted for flue-gas desulphurization.

From a survey made by the Federation of German Electric Power Companies (VDEW), it appears that sums amounting to DM14 billion have been invested by the public utilities in retrofitting FGD at power plants. The investment in SCR is estimated to have been DM5 billion, and in combustion modification DM2 billion. Installing the equipment provided work for 300,000 people (in terms of man-years), and 1000 have found permanent jobs in its subsequent operation.

The local site-specific conditions for retrofitting have resulted in a great variation in cost at different plants. In the case of electricity generation the additional cost has been calculated to be about DM 0.015 per kilowatt-hour for desulphurization and DM 0.010 for NO_x reduction. Since only about half of the country's power is generated in coal and oil-fired plants with flue-gas cleaning, the average increase in electricity prices is likely to be no more than DM 0.013/kWh.

The average costs of reducing the emissions of pollutants are estimated to be DM2.3 per kilogram for sulphur dioxide and DM2.7 for nitrogen oxides.

As a result of the cleaning program, there has been a marked reduction of the emissions from large combustion plants. The emissions of SO_2 from power stations are estimated to have decreased by 88 per cent, and those of NO_x by 74 per cent. Between 1980 and 1990 the overall emissions of sulphur in West Germany dropped by 71 per cent, but those of nitrogen oxides by only 12 per cent (see Table 2).

A comparison of the actual depositions and concentrations of air pollutants with the scientifically supported critical loads shows that the latter are still being exceeded in a great part of the country. Bringing the imissions down to below the critical loads will require a still further reduction of emissions both in Germany itself and in those countries that export pollution to Germany.

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Article based primarily on a paper entitled **Technologies to clean up power plants**, by Bernd Schärer, Umweltbundesamt, Berlin.

Table 2. Emissions of sulphur dioxide and nitrogen oxides in the former West Germany, 1980-1990. Thousands of tons.

	SO_2			NO_x		
	1980	1985	1990	1980	1985	1990
Power plants, district heating	1900	1500	320	800	760	340
Industry	870	570	410	400	300	250
Households and others	340	230	130	140	140	110
Traffic	110	85	80	1600	1750	1900
Total	**3200**	**2400**	**940**	**2950**	**2950**	**2600**

A market distorted

THROUGHOUT THE 1980s the rise of monetarist economic ideologies in the UK and the US, together with moves to extend the influence of the so-called free market principles controlling aspects of the European Community, imbued energy policy with market-based notions. Deregulation became the watch-word, leading to a situation where short-term costs and a desire for high returns on investment became the principal influence on investment in the energy sector. These took priority over longer-term considerations such as energy security, technological, social and economic development and, of course, environmental protection.

This went so far in the UK that, in 1982, the then minister for energy, Nigel Lawson, stopped further work on energy forecasts within his ministry on the basis that the market rather than the government was the suitable "mechanism" to determine how to meet future demand for fossil fuels and/or electricity. Public fuel utilities were privatized, giving an opportunity to establish competitive markets driven, in theory, by the needs of the consumer where once there had been monopolies serving the wishes of the government.

The plans for the Internal Energy Market within the EC draw much from this UK experience of deregulation and privatization. Open access to grids and pipe networks (though only for very large users) would transcend national boundaries in a pan-EC free-for-all. Short-term price takes over priority from long-term cost.

In the last few years it is fair to say that, in some industrialized countries at least, a longer-term planning perspective has returned, e.g. in the Netherlands, Denmark, and Germany (through its Enquete Commission), driven by apparent concern about the environmental impacts of the use of fossil fuels and electricity, most notably the threat of global climate change.

However, in most cases the free market ideology remains predominant. For example, in planning for controls on emissions of carbon dioxide, governments have tended not to drop back into technocratic mode of the 1960s and 1970s and chase after particular technologies. Instead, there has been much talk of how to meet the environmental targets using market-based instruments, such as carbon or energy taxes. Witness the priority given within the European Community to analysis of the carbon/energy tax proposal. Yet, as we shall see, this simplistic reliance on market mechanisms is based on a fundamental misunderstanding of the energy "market."

Any arrangements which favour supply-side over end-use may be considered distortions of the market

The primary implication of this situation for the proponents of sustainable energy scenarios is that there is probably little point in presenting our results in a "technocratic mode." If we expect government to develop programs to support renewable energy technologies merely because we say they are "cleaner" than other energy-supply technologies, we are more than likely to be on a hiding to nothing. We have to be more sophisticated than that because such expectations do not take into account the current political reality as outlined above.

Starting from here – redefining the energy market

If those are the forces shaping politicians at present, how then do they translate into influences on the people who actually invest in our energy infrastructure – from those few people who decide to build certain types of power station to every householder deciding what type of light-bulb to buy?

Friends of the Earth has recently published a detailed study of these influences and their impacts on the emissions of carbon dioxide as analyzed for the UK. The study does shamelessly borrow from free market economic ideology the notion that, with perfect competition, complete knowledge amongst all players and "rational" behavior, the "market" will allocate resources efficiently. It uses that, the predominant driving force in energy policy in at least the UK, as its starting place.

However, the study highlights the fact that the "market" at which government policy is currently directed – the so-called "energy market" – is actually not the relevant one to consider. The relevant market is the "market" in *energy services*, since energy services, when it comes down to it, are what we demand – warmth, illumination, mobility, cooling, etc. Of course, the provision of these energy services requires delivered energy, but the amount of delivered energy required depends on the efficiency with which that energy is converted into the desired level of energy service (which itself is dependent on the efficiency of the technologies or buildings or processes involved).

Accept this argument and, in a perfectly operating market in energy services, the measures to improve efficiency of end-use technologies, buildings or processes should be able to compete on equal terms with the supply of delivered energy. Therefore any regulations, fiscal regimes, informational imbalances, institutional or structural arrangements which favour supply-side over end-use may be considered distortions of the market.

To identify the extent of distortion in the operation of the perfect market in energy services, the Friends of the Earth study extends analysis that we undertook three year ago. The first step is to model the market as if it was perfect. This can be represented by assuming that all people investing in the market do so with common financial criteria, or at a common discount rate. As many readers will find familiar, if each technology which can deliver energy

services can be costed on these terms (relative to the "business-as-usual" scenario), it is possible to build a "least-cost curve" for delivering energy services and, in this particular case, for doing so whilst cutting carbon-dioxide emissions. The result of our analysis of measures outside the transport sector is shown in Figure 1.

From this least-cost curve in Figure 1, it is clear that the market in energy services does not currently allocate the UK economy's resources efficiently between the different options; there are several technological options for improving the efficiency of fossil fuel and electricity end-use which are cheaper to implement (i.e. they lie below the horizontal axis on the curve than the options which the "market" can currently be expected to deliver.

While Figure 1 may represent the perfect outcome of a perfect market in energy services (and that includes large cuts in emissions of carbon dioxide at a lower cost than business-as-usual), it in no way represents the current reality facing consumers seeking to meet their demand for energy services. In reality, investments in different energy services are made by different kinds of investors facing different problems with different profit motives and thereby, in effect, different discount rates.

The analysis was therefore taken a stage further to reveal this "investor's perspective" of the market in energy services. More realistic discount rates of 25-30 per cent have been applied to industrial investments and a higher level of 40-50 per cent applied to measures undertaken in the domestic sector. Centralized power stations are still assessed at 10-per-cent rate of return, but more decentralized options such as co-generation stations and renewable energy technologies have slightly higher rates. For the particular case of energy efficient lighting, a rate of 120 per cent was used.

The resulting cost curve is shown in Figure 2. It can only be considered illustrative of the investor's perspective, since the discount rates used are not based on carefully collected empirical data. Nevertheless, it is revealing. All of the options lie above the horizontal axis.

In other words, from the investor's perspective, all of the "alternative" options open to supply a demand for energy services are perceived as having a net cost, often quite high when compared against what the market is intent on offering them. These options do not appear "economic" to the investor compared with accepting (and paying for) the "traditional" supply of fossil fuel and electricity. This helps to explain, in economic terms, why options which are cost-effective for the nation's economy (those below the axis in Figure 1) are being ignored in practice by individual investors – they do not perceive them as cost effective. It also explains why, in most studies of the role of carbon taxes, very high increases in energy prices are needed to stimulate action from investors.

This, however, is the world in which energy policy must act. The disparity between Figures 1 and 2 represents the extent of failure of the market in energy services to meet demand in the most cost-effective manner. The question then is to understand the influences which distort the investor's perspective.

The Friends of the Earth study does this at some length. Its focus is obviously the UK, so many of the features distorting the market are

Figure 1. Least cost curve for UK carbon dioxide abatement options (by the year 2005: 10 per cent common discount rate).

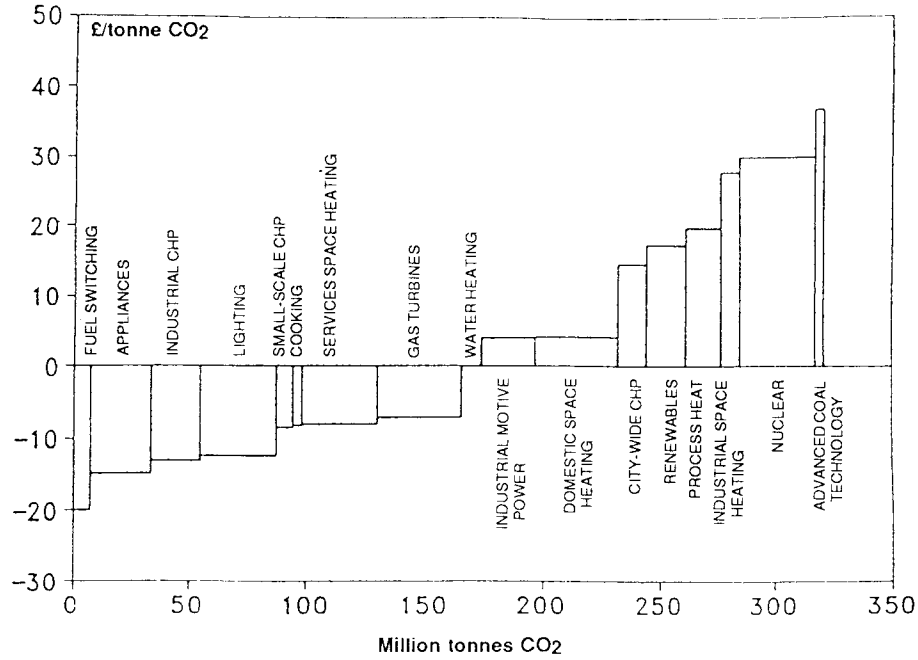


Figure 2. Investor's perspective of UK carbon dioxide abatement options (by the year 2005: various discount rates).

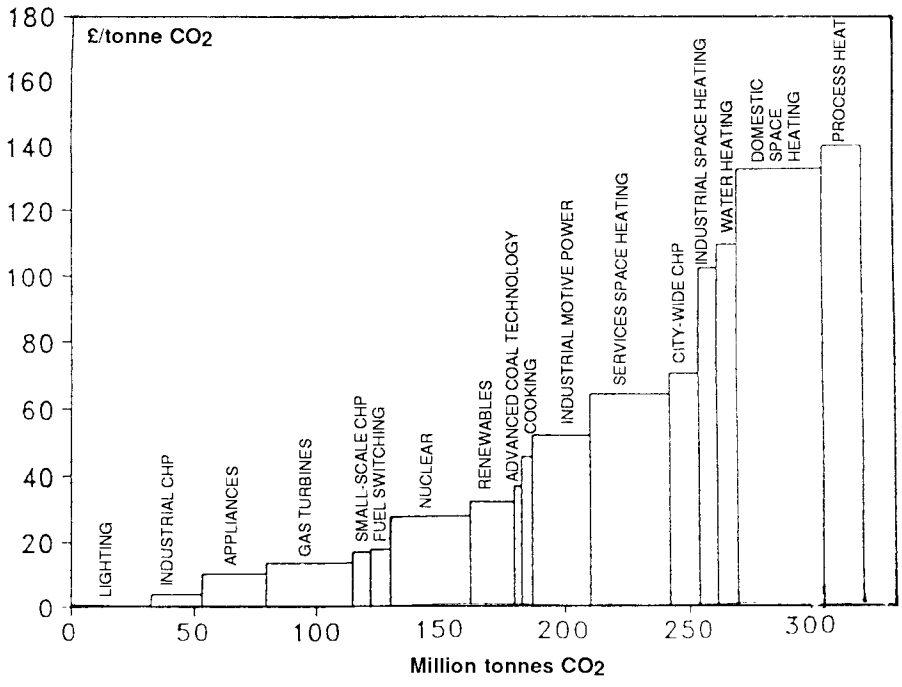
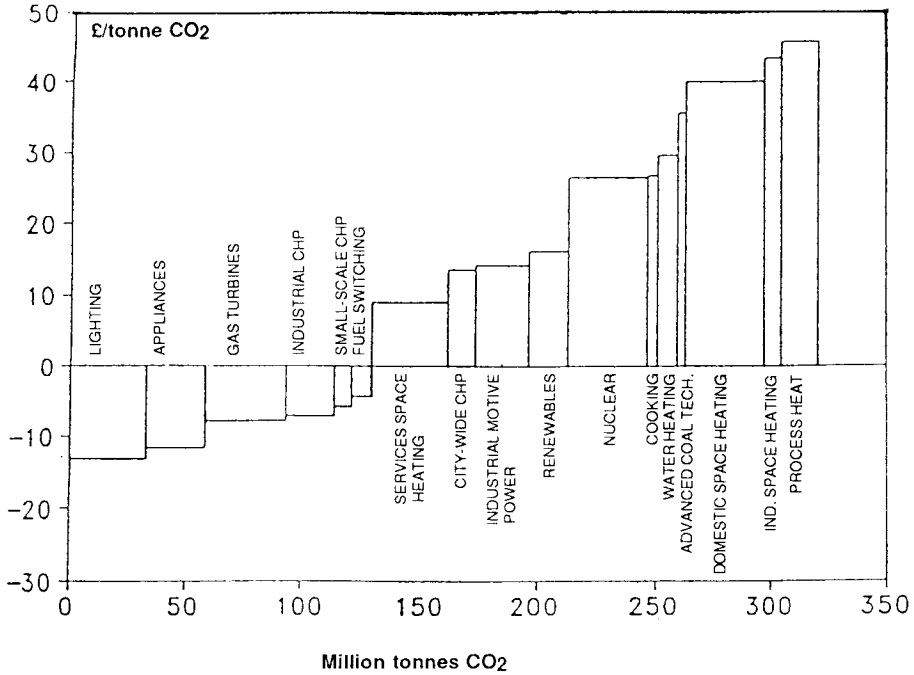


Figure 3. Investor's perspective of UK carbon dioxide abatement options following the application of regulatory and informational measures (by the year 2005: various discount rates).



particular to that nation. However there are undoubtedly some common threads which can be summarized. For example, we found, as others have before,

- ☐ a bias in the regulations controlling the prices charged by the electricity and gas companies which favours increased energy sales rather than energy conservation;
- ☐ an imposition of a purchase tax (VAT) on energy efficient products but not on energy supply;
- ☐ a poor availability of capital for cost-effective investments in energy efficiency improvements in low-income households, small businesses, and the public sector;
- ☐ a split incentive for investment in energy efficiency improvements between the owner of a building who is responsible for investment in the building fabric (and therefore its energy efficiency) and the occupiers who pay the bills (and therefore receive any savings on bills resulting from such investment).
- ☐ a low level of public awareness and a generally poor provision of information, advice, education, and training in the efficient use of energy.

Figure 2 is shorthand for the impact of these "distorting" influences.

The report then examines the range of policy measures and mechanisms available to alter the distorted perspective, highlighting the value of each measure in reducing each market distortion. On the basis that there are regulatory, fiscal, institutional and informational distortions in the market for energy services, it will be no surprise that regulatory improvements, fiscal incentives, institutional reform, and information programs all feature as promising measures to be adopted.

Giving politicians a clear view of what they have to do

By attempting to predict the impact of such measures on investors' choices, it is possible to draw up a cost curve which represents the investor's perspective after restructuring the market through the introduction of least-cost planning goals, appliance and building efficiency standards, information campaigns and so on. This is shown i Figure 3. In so doing, it was assumed that the measures would go some way towards removing the distortions by the year 2005, but by no means remove the whole problem. There was an attempt, albeit superficial, to take into account some level of inertia in the market as it currently is.

As we concluded when launching the report in August 1992, the results of this study are unambiguous; the UK government has both the onus and the opportunity to provoke substantial cuts in emissions of carbon dioxide whilst improving economic efficiency. However, without fresh action, the government will perpetuate market distortions which misdirect energy sector investment and encourage excessive emissions.

Conclusions – getting us to where we want to be

The details of Friends of the Earth's policy recommendations are less important here than the value of this analysis to our understanding of how we might alter current energy policy in the UK. By taking as a starting point the politician's current policy understanding we hope to have turned it towards the direction we believe policy should be heading. By using modelling techniques and terms with which politicians are familiar, we hope to have begun to alter the way in which they consider what policy measures are needed and how to enact them. By seeking to be clear about how much we believe each policy can achieve, we hope we have given politicians a clear view of what they need to do in the next few years of their short term of office in order to set up the chance of attaining that sustainable energy future in thirty or more years' time.

It is early stages in terms of the level of detail in the analysis. Nevertheless, I believe that is does start to put us in a position where we can demonstrate not only that there exists the possibility of an environmentally sustainable future, but also that we have a well mapped-out, practical route which starts from where they are now and goes to where we know we need to be.

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The article is a part of a lecture held at Alternative World Energy Conference, Madrid, September 19-21, 1992.

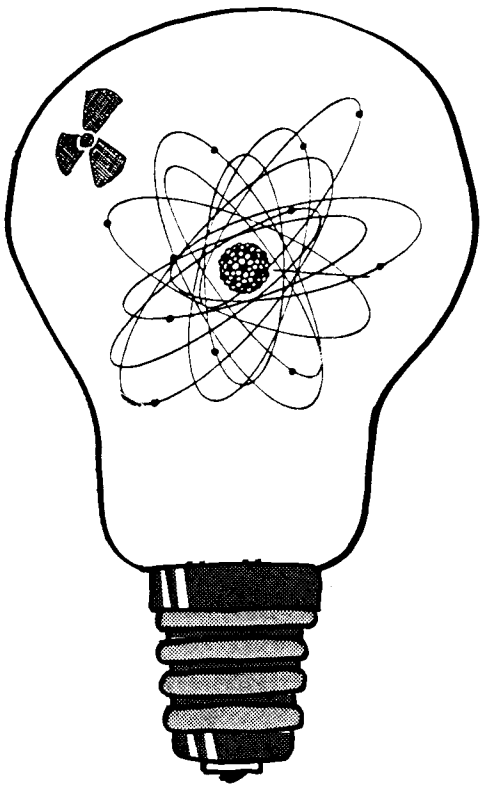
* **Efficiency without tears: "No-regrets" energy policy to combat climate change**. By T. Jackson, 1992. Available from Friends of the Earth, address as above. £11.

600 million light bulbs

= 40 nuclear reactors

IT WOULD BE POSSIBLE to close down the most dangerous nuclear reactors in eastern Europe without needing to replace any of them – simply by exchanging 600 million incandescent light bulbs for compact fluorescent lamps (CFLs). That, at least, is the opinion of Dr Arthur Rosenfeld and his colleague Dr Evan Mills of the Lawrence Berkeley Laboratory in California. According to the two scientists, who have themselves developed some of the technology, CFLs offer incredible savings.

Global sales of CFLs amounted to more than 120 million units in 1991, and are doubling every few years. These lamps, which are similar in size to normal incandescent lamps, provide the same amount of light but consume only one-fourth as much energy. They last 8-10,000 hours, or as long as 8 to 12 ordinary light bulbs.



"Each compact fluorescent lamp saves about 50 watts of peak power, so we'd need 600 million of them (1.5 lamps for each of the region's 400 million inhabitants) in order to turn off the electricity associated with the 40 most dangerous reactors," explains Dr Rosenfeld. "The proposed 600 million CFLs are only three year's current worldwide production. The wholesale cost of about $5 billion would be well below the estimate of $8 to $10 billion needed to upgrade some of the dangerous nuclear plants."

According to Dr Rosenfeld's calculations the lamps last on an average five years, and would save consumers about $5 billion a year on their electricity bills. This assumes however that the countries of central and eastern Europe will continue to raise electricity prices so as to bring them up to about 10 cents per kilowatt hour, making them comparable to those in western Europe. "The first year's savings of $5 billion would pay for the second generation of lamps, or better yet, for factories to manufacture them more cheaply in the region," he says. "Subsequently, the $5 billion per year could be ploughed into economic development."

The advantages do not end here. Rosenfeld maintains that a new generation of long fluorescent tubes offer the possibility of another 10 per cent saving in office buildings and factories. A further saving of 10 to 20 per cent could be achieved by using these lamps in combination with efficient, flicker-free electronic ballasts. Cleaning dusty fixtures and inserting aluminium reflectors behind the lamps could bring the total savings up to 50 per cent, with a three year payback.

Adapted from an article in **Tomorrow Magazine**, No. 3, 1992. Published by Tomorrow Media, Kungsgatan 27, S-111 56 Stockholm, Sweden.

US MOTORISTS

Not paying their way

AMERICAN MOTORISTS are in reality heavily subsidized. Car taxes and duties only cover 60 per cent of the cost of maintaining the highway system, nine-tenths of the rest being paid out of federal and state taxes. That supplement amounts every year to about $29 billion of the $71 billion that goes to the upkeep of the road network. Car owners do not have to pay a cent for such things as traffic policing or ambulance services – nor do they have any economic responsibility for the consequences of car driving in the way of damage to the environment and road accidents.

Another example of where motorists do not pay the real costs may be seen in the enormous free parking spaces around shopping centres. The ground cost for these is calculated to pile up to $85 billion a year, although this is recouped by storekeepers taking higher prices for their goods – to the detriment of those who do not shop by car. Employees also get free parking space, which in the US federal capital is reckoned to cost $2000 a year for each employee.

Correcting the situation through taxes on gasoline, which might be a way of dealing with the problem, would be politically difficult in the United States, where the price of motor fuel has always been very low compared with other industrialized countries, being only about a third as high as that, say, in Sweden.

Source: **The going Rate: What it really costs to drive**. J.J. MacKenzie, R.C. Dower, D.D.T. Chen, Report for World Resources Institute, Washington DC.