NO.2, JUNE 1991

Acid News

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

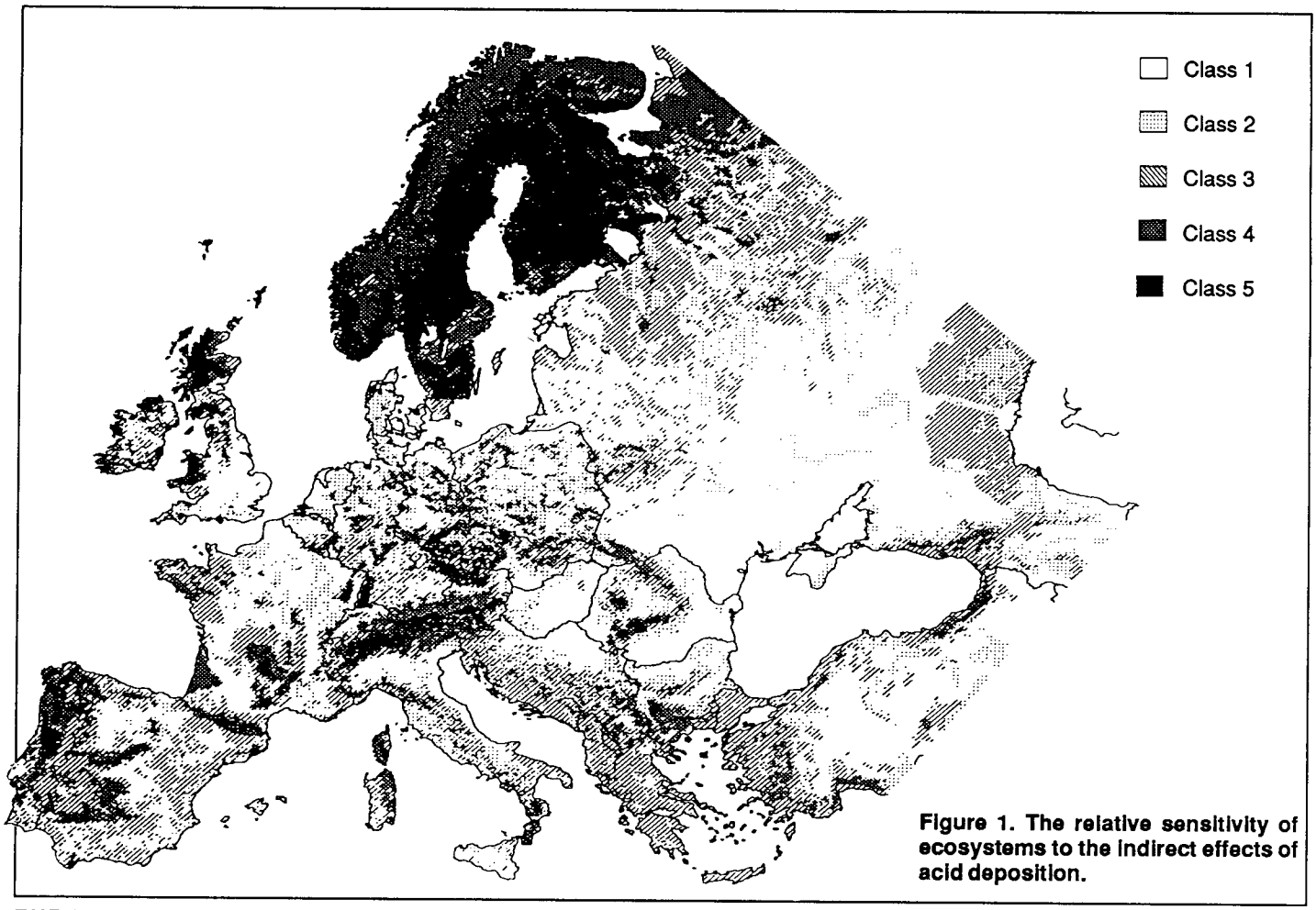


Figure 1. The relative sensitivity of ecosystems to the indirect effects of acid deposition.

EUROPE

Sensitive ecosystems

THE AREAS MOST sensitive to acidification in Europe are in Scandinavia, the mountainous parts of central and southern Europe, and on the western sides of the British Isles. This can be seen from a report* recently published by the Stockholm Environment Institute.

The institute has worked out a means for determining the various regions' sensitivity by correlating data on four basic factors: bedrock, soil types, land use, and precipitation. The rock and soil types, and the vegetation associated with land use, have been classified according to their relative sensitivity to acid deposition. Consideration has thus been taken not only to the sensitivity as such, but also to other factors influencing the acidification process.

Areas with bedrocks of a slow weathering type, such as granite and gneiss, will be more sensitive to acidification than those with faster weathering types such as limestone. The rocks have been arranged according to sensitivity in five categories.

Soils are divided into two categories according to their ability to resist acidification (buffering capacity). Among the four categories for vegetation, coniferous forest is considered to be most likely to increase site sensitivity, followed by rough grazing and heath land, and then decidous forest. Arable and rich grazing lands are, on account of the normal application of lime and fertilizer, assumed to be least sensitive.

Areas with an annual rainfall exceeding 1200 mm are put in a higher category of sensitivity than those with less. This is because high rainfall increases the leaching of base

Continued on back page

The Swedish NGO Secretariat on Acid Rain
Box 245
S-401 24 Göteborg, Sweden
Phone: +46-31-15 39 55

The Norwegian Clean Air Campaign
Postbox 94
N-1364 Hvalstad, Norway
Phone: +47-2-78 38 60

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:

The Swedish NGO Secretariat on Acid Rain
Box 245
S-401 24 Göteborg, Sweden
Telephone: 031-15 39 55
Telefax: 031-15 09 33
Editor: Christer Ågren
Published by: The Swedish Society for the Conservation of Nature
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 the Conservation of Nature (Naturskyddsföreningen)
- The Swedish Youth Association for Environmental Studies and Conservation (Fältbiologerna)

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)

The Norwegian Clean Air Campaign
Postbox 94
N-1364 Hvalstad, Norway
Telephone: 02-78 38 60
Telefax: 02-90 15 87

EDITORIAL

Let us be there

© ANDERS ÅGREN

NON-GOVERNMENTAL organizations, NGOs, have now been excluded from the process of developing an environmental charter for the ECE sphere. According to the draft presented by a group of European experts, the charter would ensure public accesss to environmental information and make it possible for all who are interested to participate in a practical manner in the making of decisions concerning environmental matters.

These issues are of vital interest to environmental NGOs, and it is highly important for them to be able to participate in this process, even if only as observers. It is thus remarkable that they should be excluded from the procedure. In this case the move to exclude came, curiously enough, from the Netherlands, although it appears to correspond to a general wish of the European Community.

Several environmental NGOs have official observer status at the United Nations, which means that they have the right to be present at, but not actively participate in, meetings organized by UN bodies. Their role in these cases is to keep informed, to note the attitudes of the various countries, as well as often acting as lobbyists, with the possibility of exerting some influence on the proceedings. In general this may be described as a watchdog function.

Some countries may of course regard the NGOs' presence as vexatious – especially if they are among those who would prefer not to publicly reveal their true attitude.

By various means the environmental NGO observers have been repeatedly excluded from meetings, or part of meetings, of the UN ECE Convention on Long Range Transboundary Air Pollution, as for instance during the discussion of protocols for NOx and VOCs.

Seeing that negotiating positions and agreements are often determined in closed inofficial get-togethers prior to the official meeting, it seems astonishing that some countries should think it necessary to go further and prevent NGOs even from attending the official ones.

Retainment of NGO participation at the most elementary level, that of observer status, is the least that can be asked. Allowing freedom to speak at meetings, as well as abolishing the almost ubiquitous "restricted" stamp on documents, would open the way to still more fruitful participation – and in turn give enhanced prestige to these activities.

Other salutory effects of greater openness would probably be a speeding up of the deliberations and better results from international cooperation in regard to the environment. Governments that really wish to see results from such cooperation should therefore take energetic steps to facilitate the participation of environmental NGOs in the proceedings of the various bodies.

CHRISTER ÅGREN

New standards agreed

COMMUNITY ENVIRONMENT ministers agreed, on March 18, on new emission standards for heavy diesel-driven vehicles. The new standards are largely identical with those originally proposed by the EC Commission in May 1990.

These standards (see table) are to be applicable in two stages – in the first initially for all new engine models from July 1, 1992, and then for all new engines from October 1, 1993. Particulate limits will, in this first stage, differ according to the size of the engine, the requirement being more stringent for engines with an output greater than 85 kW.

Commercial diesel emission standards in the EC, in grams per kilowatt-hour, based on the European 13-mode test cycle (ECE R49).

	Current	Stage I	Stage II
NOx	15.8	9.0	7.0
HC	2.6	1.23	1.1
CO	12.3	4.9	4.0
Part.			
< 85 kW	–	0.63	0.15
>85 kW	–	0.36	0.15

The standards of the second stage will apply to new engine models from October 1, 1995, and to all new engines from October 1, 1996. This is one year earlier than was originally proposed.

The Commission has also announced that later this year it will be presenting a proposal for a lowering of the sulphur content of diesel fuel to 0.05 per cent. The aim is primarily to make it easier to meet the more stringent second-stage requirement for particulates.

In connection with the tightening of the emission standards the ministers agreed to permit individual member countries to employ fiscal incentives to promote sales of vehicles that comply with the standards ahead of the deadlines laid down – with the provision that the incentives should not exceed the extra cost of engineering vehicles to the new limits. This follows a previous ruling of the same kind for passenger cars.

The requirements of the second stage, to be generally applicable in the autumn of 1996, largely coincide with the US standards coming into force in 1994. Since they are based on a more advanced test cycle, however, and will include durability as well as requiring a guarantee from the manufacturer, the American standards will in fact be stricter. See AN 1/91, pages 9-11.

In June the Swedish parliament will be debating a law on tightened emission standards for heavy diesel vehicles. The proposed requirements are similar to those of USA-94 and EC-96, although more stringent as regards hydrocarbons and carbon monoxide. The intention is that they shall be applicable to 1996 year models, which in fact will mean an introduction in the autumn of 1995. Included will be a durability requirement.

CHRISTER ÅGREN

Correction: The limit for particulates in the Swedish standard, applicability starting with the 1993 year models, should be 0.4 g/kWh, not 0.7 g/kWh as given in the table on page 10 of AN 1/91.

© ANDRÉ MASLENNIKOV

On the following pages

Projecting car emissions

IN THE COMING decade, the emissions of nitrogen oxides from private cars in Poland may almost double, and those of carbon dioxide increase by about 70 per cent. These are among the conclusions of a study* carried out by Earth Resources Research on behalf of WWF International.

The ERR institute has developed a computer model for projecting future emissions of air pollutants from road vehicles. Among the factors taken into account are for instance:

- Vehicle technologies in use, taking into account fuel types, vehicle efficiencies, and abatement technologies.
- The mix of vehicles in the total stock, and the rate of change of mix as determined by vehicle operating lives, rate of purchase, and stock growth.
- Road network conditions, including average speeds and degree of traffic congestion.
- Total demand for travel in motor vehicles.

In the specific case study of Poland it was assumed that the average annual distance travelled by each car will rise from 7,000 to 10,000 kilometres between 1990 and 2010. In the same time period the total number of cars in the country is projected to double, from five to ten million cars. This will then be equal to around 250 cars per thousand people, which will still be less than current ownership levels in western Europe, where they are typically between 300 and 400 cars per thousand and are still rising.

In projecting future emissions of nitrogen oxides three scenarios have been developed with different rates of introduction for new vehicles entering the Polish car stock, including the proportions of new vehicles meeting differing emission standards in each year.

It is assumed in Case A that sales of catalyzer-equipped cars (meeting the EC standards for 1993 year models) will start around the middle of the nineties, and that by the year 2000 they will amount to about 70 per cent of new-car sales.

In Case C, representing the most optimistic of the three scenarios, it is assumed that the sales of catalyzer vehicles will have already started this year, and that from 1996 all the new cars will be equipped with catalytic converters. The assumptions for the B scenario lie about halfway between those of Cases A and C. The results of the various scenarios for NO_x emissions are illustrated in Figure 1.

Three scenarios have likewise been developed to project future fuel consumption in private cars. Case A represents a business-as-usual scenario, reflecting current European averages and trends in fuel economy. Cases B and C are increasingly optimistic in regard to the proportion of new cars entering the stock and to the average efficiency of those vehicles. The last would imply a continuing high fuel-cost regime, probably coupled with fiscal incentives to the takeup of fuel efficient cars, and with stringent fuel-use standards.

The resultant fuel consumption as projected by the ERR model may be seen from Figure 2. In this, the weight of fuel is presented as petroleum equivalent, so the growth rate presented will be closely representative of the increase in the expected emissions of carbon dioxide. As can be seen from the figure, car fuel use is predicted to at least treble over the next thirty years.

The conclusion from this study is that a package of measures aimed at the transport system as a whole will be necessary if the environmental effects of road transport are to be limited. Any policy that concentrates solely on the application of "clean" technologies to new vehicles will be environmentally insufficient.

CHRISTER ÅGREN

***Factors influencing NO_x and CO_2 emissions from road traffic in Central and East Europe**, by Malcolm Fergusson, Earth Resources Research, 258 Pentonville Road, London, England N1 9JY.

Figure 1. Projected NOx emissions (thousand tons/year) from cars in Poland.

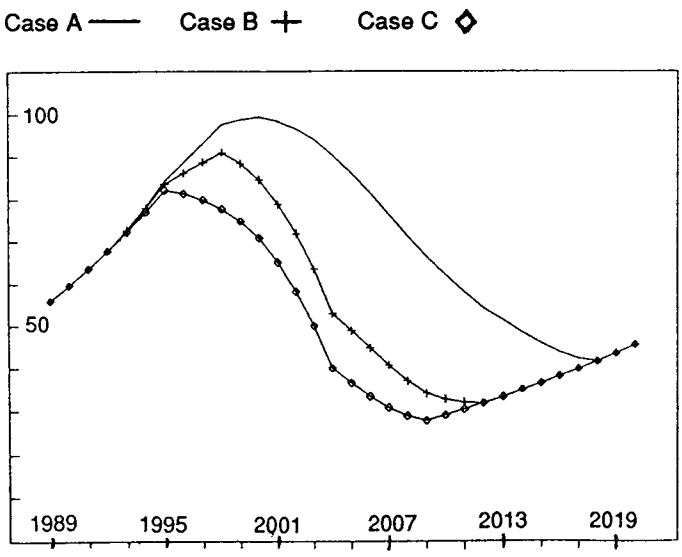
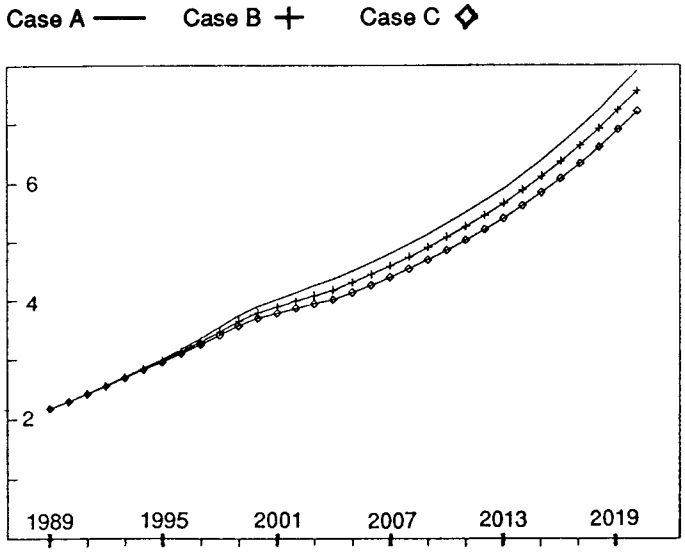
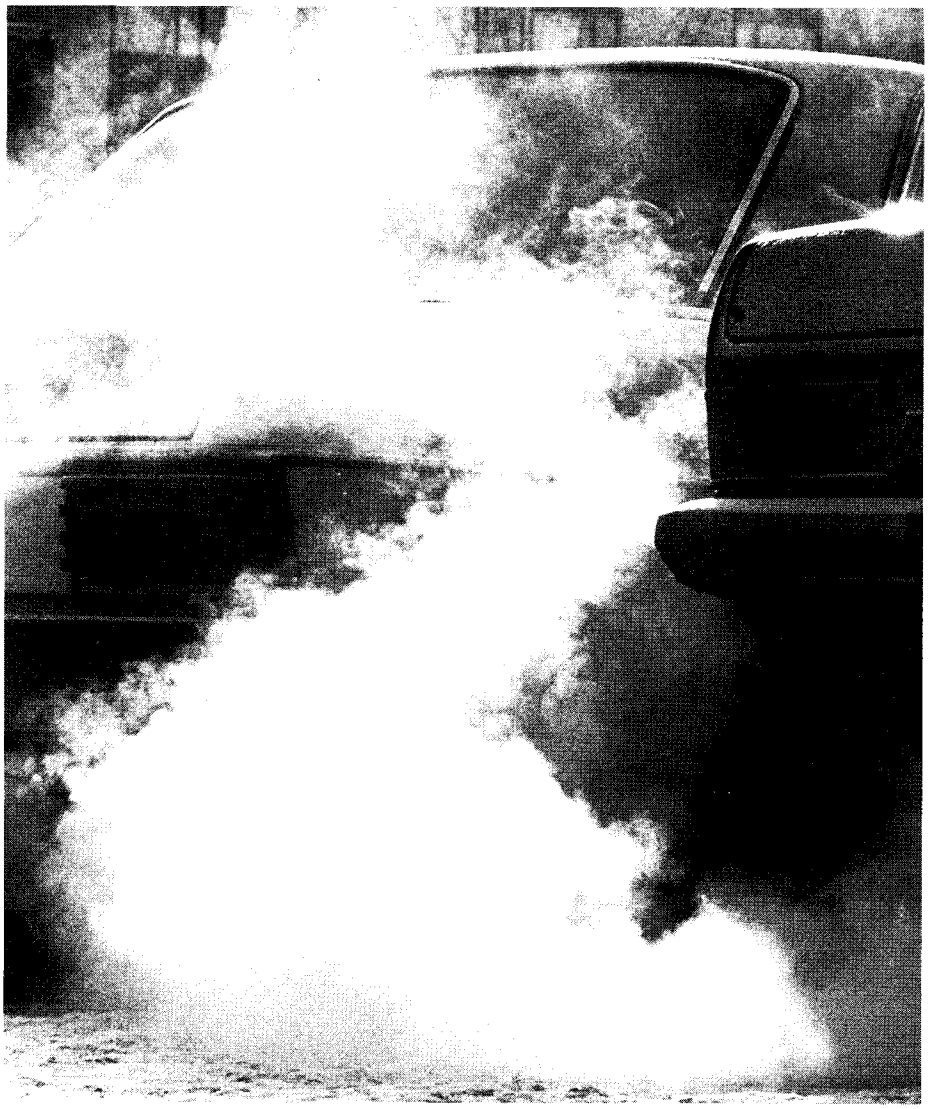


Figure 2. Projected fuel use (million tons/year) in cars in Poland.





Cats for all EC cars

ON DECEMBER 21 the environment ministers of the European Community moved as expected to bring the emission standards for medium and large cars into line with those already agreed for small ones in June 1989. Thus requirements will now be the same, and will start to apply at the same time, for all new cars. In effect this will mean that all models will have to be fitted with three-way catalytic converters. New models will have to conform from July, 1992, and all new cars from January 1, 1993.

The ministers further agreed that a decision should be taken, at the latest during 1993, on more stringent Stage 2 requirements which should become obligatory in 1996. It was also agreed that the member countries should be permitted to use fiscal incentives to promote sales of cars meeting these second-stage standards as soon as they had been agreed.

The new EC conformity-of-production limits, coming into force in 1992/93, are 3.16 g/km of CO, 1.13 g/km of NO_x and HC combined, and 0.18 g/km of particulates. According to the European Environmental Bureau, the combined limit values for HC and NO_x will permit emissions that are 30 per cent higher than they would be with the USA 1983 standards. The emissions of particulates will be twice as high.

Even last year Denmark had demonstrated displeasure with the new EC standards, by unilaterally decreeing application of the USA 83 requirements as from October. This open defiance of common market rules has still not led to any steps on part of the Community.

CHRISTER ÅGREN

ITALY

Cleaner cars earlier

FIAT ANNOUNCED in February that starting in January 1992 catalytic converters will be fitted as standard on most new Italian-made cars. The decision, which is based on an agreement between Fiat and the Ministry of the Environment means in effect that the European Community rules on auto emissions, adopted in December 1990, will be implemented one year early in Italy.

The agreement on speeding up the catalytic-converter program is part of a package of measures undertaken by Fiat and the Italian government. The package includes research and development programs as well as legislative changes and various financial incentives.

The measures include the retrofitting of cars registered since January 1988. Converters will be specified for each model on the road so that a 50 per cent reduction in emissions will be achieved in every case. A three-year program will moreover be launched by the ministry to subsidize the purchase of filters to reduce emissions from buses less than ten years old that are mainly used in urban routes.

Fiat will carry out research programs supported by Environment Ministry funding. The first three projects are: a system to provide instant information for the general public on pollution levels in Rome, a study of exhaust-gas emission levels in Rome, and research into the technical feasibility of making vehicles with particularly low emission levels.

Source: **M P Walsh, Car Lines,** March 1991.

"Worldwide, more than one new car is produced every second. Spend the night in bed and when you wake up the next morning 30,000 new cars will have been made while you were asleep. In 1989, world car production topped 35 million vehicles a year."

Source: **Mad Car Disease,** Greenpeace UK.

Easier may mean harder

THE FORMULATION OF an international agreement for limiting the emissions of volatile organic compounds (VOCs) was again discussed at a meeting in Geneva at the end of January*. While there is still some uncertainty and lack of agreement on a number of points in the coming document – which will primarily be directed at reducing episodic high concentrations of tropospheric ozone – it seems that the Working Group of the ECE is nevertheless agreed on certain critical aspects.

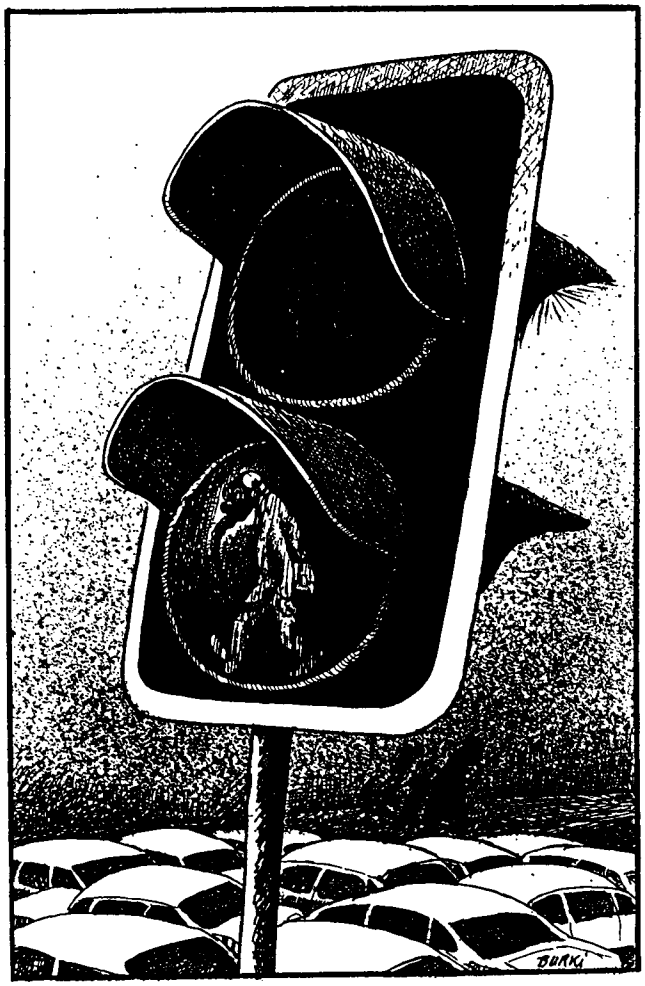
- The agreement shall at the outset, for instance, provide for reductions in two stages (after the model of the NOx protocol of 1988), with the second incorporating the critical load concept. Negotiations for detailing this second stage are to start within six months of the protocol's coming into force (which usually means two or three years after signing).
- The essential aim of the first stage will be to bring about a reduction of the national emissions of VOCs by 30 per cent from the end of the eighties to the end of the nineties.
- The signatories shall, within two years of the protocol's coming into force, have introduced emission standards for new stationary and mobile sources. No precise levels or techniques are prescribed. Instead there will be recommendations in two technical annexes.

In the current draft of the basic obligations of the protocol individual countries are allowed great flexibility, so as to enable them to sign without committing themselves to exactly similar measures in all cases.

In the following the figures in parenthesis represent proposals or alternatives that have been put forward but not yet agreed upon.

The draft starts by laying down that the annual emissions of VOCs are to be reduced by at least (30) per cent by (1997, 1998, 2000), using as a basis (1990, 1987) levels. For some countries however the possibility is left open of confining a corresponding reduction to certain specified areas – so-called tropospheric ozone-management areas – within their countries. This would be allowable only if the VOC emissions from these areas alone contribute to the concentrations of ozone in other countries.

The possibility is moreover provided for certain countries to undertake only to freeze emissions, using the same base and target years as above. This would apply to countries whose annual emissions of VOCs are less than (500,000) tons, and (20) kilograms per capita, and (5) tons per square kilometre. Since reports on VOC emissions have still not come to the ECE from all the countries that are signatory to the convention on transboundary air pollution, it is however difficult to estimate how many will be affected by this ruling.



Smog.

© BURKI

The protocol will thus, in this draft version, mean some countries committing themselves to a reduction of at least 30 per cent in about ten years, while others will be allowed to increase their emissions for a time, only having to bring them down to levels not exceeding today's somewhere around the year 2000.

This "flexible" approach, allowing countries to sign while making highly variable committments, can well give rise to problems, as for instance regarding interpretation. It will make it difficult to determine what exactly any country has committed itself to, and whether it is actually living up to what appear to be its committments.

In consideration of the absolute necessity to reduce emissions of VOCs in order to protect both humans and the natural environment (see AN 4/90, pp 6-7), the protocol as now drafted is clearly inadequate.

According to plan, a final meeting of the ECE Working Group on VOCs to agree on the form of the protocol is to take place in Geneva on June 3-7. In view of all that remains unsettled after two-and-a-half years of negotiations, it seems not improbable that there will have to be yet another meeting in the autumn if this document is to be ready for signing at the meeting of the Executive Body of the Convention in November.

CHRISTER ÅGREN

*The fifth meeting of the **Working Group on VOCs**, set up in 1988 by the Executive Body of the UN ECE Convention on Long Range Transboundary Air Pollution to arrive at an agreement, or protocol, for limiting the emissions of volatile organic compounds. The original expectation had been that a protocol would be ready for signing in the course of 1990, but the aim now is to have it ready this year. The UN Economic Commission for Europe (ECE) embraces all the countries of Europe as well as the United States and Canada.

FRANCE

To improve efficiency

THE LEADING FRENCH car manufacturer, Peugeot, has decided to launch a program to reduce the fuel consumption of cars to an average of 6 litres per hundred kilometres by the year 2000 – provided that other European carmakers do the same.

According to Peugeot, this program will involve costs of about FF 2.5 billion over a seven year period. Two major priorities will be to make cars lighter and to increase the efficiency of petrol and diesel engines. As this is expected to result in an increase in the price of cars of 3 to 5 per cent, Peugeot wants all European manufacturers to agree to this program, to avoid price discrepancies.

Source: **European Environment Fortnightly**, No 363, 1991

GERMANY

Tax on emissions and noise

AUTOMOBILE TAXES in Germany soon may be based on how cleanly and quietly a car performs, instead of on its engine size, as is current practice.

The German government has decided that future auto taxes should contain several components. Carbon dioxide emissions, as an indirect measure of fuel efficiency, would be one of the taxable elements. Emissions of traditional pollutants such as carbon monoxide, nitrogen oxides, and hydrocarbons would comprise the second part of the levy. Noise levels would constitute the third. For diesel automobiles, particulate emissions would also be included in the tax equation.

The structure of the tax has not yet been determined, but it is expected that the CO_2 component will constitute a substantial proportion of the tax. Draft legislation is not expected until late in the year, and if approved the tax would probably go into effect in 1993.

Source: **M P Walsh, Car Lines**, March 1991

ESTONIA

Trucks worst

IN ESTONIA petrol-driven trucks are mostly responsible for the air pollution arising from road traffic. Freight carrying accounts for more than half of the total vehicle mileage, which in this Baltic country amounts to about 5 billion kilometres a year.

As estimated by the Technical Research Centre of Finland, the emissions from road traffic amounted in 1989 to 173,000 tons of carbon monoxide, 59,000 tons of hydrocarbons, 30,000 tons of nitrogen oxides, 3200 tons of sulphur dioxide, 2300 tons of particulates, and 100 tons of lead. Of the country's total emissions of nitrogen oxides, 57 per cent came from road vehicles.

Almost all the vehicles on Estonia's roads have been made in the Soviet Union. Since there is no reliable data on their emissions, and the fuel is of greatly varying quality, certain assumptions had to be made regarding the emission coefficients for the various types of vehicle.

Car ownership is still relatively low in Estonia, being about a third as high per head as in western Europe. Although a large number of cars are now being imported from the West, most of them are dilapidated and emit large amounts of air pollutants. A continued increase in road traffic is to be expected, and with it an increase in the emissions of pollutant.

Source: **Nordic Road & Transport Research**, No. 1, 1991.

Publications

Acid Politics (1991)
By Sonja Boehmer-Christiansen and Jim Skea. Illustrates the various factors governing the environmental policy process, by examining the attitudes and reactions to the acid rain problem in Great Britain and West Germany. Also compares the differing organization and structure of the environmental protection system of the two countries. 296 pp. Price £39.50. Obtainable from the publisher: Belhaven Press, 25 Floral street, Covent Garden, London, England WC2E 9DS.

The Dirty Man of Europe (1990)
The author, Chris Rose, makes a critical analysis of British environmental policy, and describes how Britain, rather than getting cleaned up, is becoming dirtier. Published by Simon & Schuster. Price £8.99, plus £2.35 for postage. Obtainable from International Book Distributors, 66 Wood Lane End, Hemel Hampstead, England HP2 4RG.

Light Vehicles and Cleaner Air (1990)
Report describing the means available for further lowering of exhaust and evaporative emissions from passenger cars and light-duty trucks. Proposals for new Swedish emission requirements are also presented, as well as an overview of the consequences of such proposals. 74 pp. Price 74 kronor. Available from the publisher: The Swedish Environmental Protection Agency, Information Department, S-171 85 Solna, Sweden.

Critical Loads to Surface Waters in Fennoscandia (1990)
This report describes how critical loads for acid deposition to surface waters in Norway, Finland and Sweden are calculated and mapped. 40 pp. Obtainable from the publisher: The Nordic Council of Ministers, Store Strandstraede 18, 1255 Copenhagen K, Denmark.

Mad Car Disease; Britain's Road to Environmental Ruin (1991)
Report describing the crisis of British transport policy, including the various environmental effects of traffic on roads. Obtainable at a price of £5 from the publisher: Greenpeace UK, Canonbury Villas, London, England N1 2PN.

Acid Emissions from Stationary Plant: Reopening the Debate (1990)
By Jim Skea. An elaborate report on the British acid rain policy, with particular emphasis on emissions from large combustion plants. 80 pp. Price £15. Obtainable from the publishers: Friends of the Earth, 26-28 Underwood Street, London, England N1 7JQ.

Relaxing pollution control

IN A SET OF guidance notes for the UK's power stations issued in February by Her Majesty's Inspectorate of Pollution (HMIP), the previously proposed stringent new limits on the emissions of nitrogen oxides (NO_x) were set aside in favour of the much laxer EC standard contained in the 1988 Large Combustion Plant Directive.

The proposed new standards, which were included in an earlier draft of the guidance notes, would have been likely to force the application of more advanced cleaning technologies, such as selective catalytic reduction (SCR), at new coal-fired power stations. This technology is already in successful use in several countries, most notably in Germany and Japan, but has yet to be installed in the United Kingdom.

According to Greenpeace UK, the pressure to drop the new standards appears to have come from the soon-to-be privatized generating companies, which were concerned at the cost of meeting the stricter limits.

Under Part 1 of the Environment Protection Act, passed last November, HMIP was given a strong mandate to enforce stricter UK pollution control – independently of government or industry influence – by implementing the concept of Best Available Techniques Not Entailing Excessive Costs (BATNEEC). The decision to drop the stricter NO_x standards for new power stations is, according to Greenpeace UK, the first clear breach of the Inspectorate's duty to ensure that BATNEEC is applied.

"This sets an extremely bad precedent for the future of pollution control under the new Environment Protection Act," said Andrew Tickle, Greenpeace's acid rain campaigner, "It is quite clear that as soon as the pressure of the generating companies and the government came to bear on HMIP, the inspectorate caved in."

In April, Friends of the Earth UK accused the chief pollution inspector of HMIP of defective interpretation of the new pollution laws and of a failure to develop an open and even-handed process. FoE claims that the Chief Inspector has provided minimal information regarding his interpretation of BATNEEC, despite a requirement by the Department of the Environment that BATNEEC is to be "applied in a transparent, rational and consistent way."

© CHRISTER ÅGREN

"As the first of its kind, this Process Guidance Note represents a crucial test of the Chief Inspector's interpretation of one of the central principles in the Environmental Protection Act. The pollution clean-up requirements have been watered down, setting the scene for the wholesale compromise of the government's new pollution laws," said Fiona Weir, air pollution campaigner at FoE.

According to recent reports by IEA Coal Research,* the SCR technology has proved itself capable of reducing emissions of nitrogen oxides by 80-90 per cent with high reliability. Furthermore, the cost differential between SCR and low-NO_x burners, which cut emissions by less than half of this amount (usually by 25-40 per cent), has narrowed substantially since the mid-1980s.

On the world scene, some 150,000 MW of coal-fired capacity has been fitted with low-NO_x burners, while a further 43,000 MW has been equipped with SCR systems. In Germany alone, since 1985 more than 30,000 MW of coal-fired capacity has been fitted with SCR.

CHRISTER ÅGREN

*__NO_x control installations on coal-fired plants__, and __Systems for controlling NO_x from coal combustion__. Each available for £85 from IEA Coal Research, Gemini House, 10-18 Putney Hill, London, England SW15 6AA.

ACID RAIN

Damage will continue

A TENTH OF THE British countryside is condemned to decades of acid rain damage. This will, according to Friends of the Earth, be the result of the government breaking its commitment to protect vulnerable environments.

Official maps show that by the year 2005 environmental damage to extensive parts of Wales, Scotland, the West Midlands, the Peak District, the Lake District, and Northumberland will continue. This is after the clean-up measures required by the EC Large Combustion Plants Directive and by new UK pollution laws have been implemented.

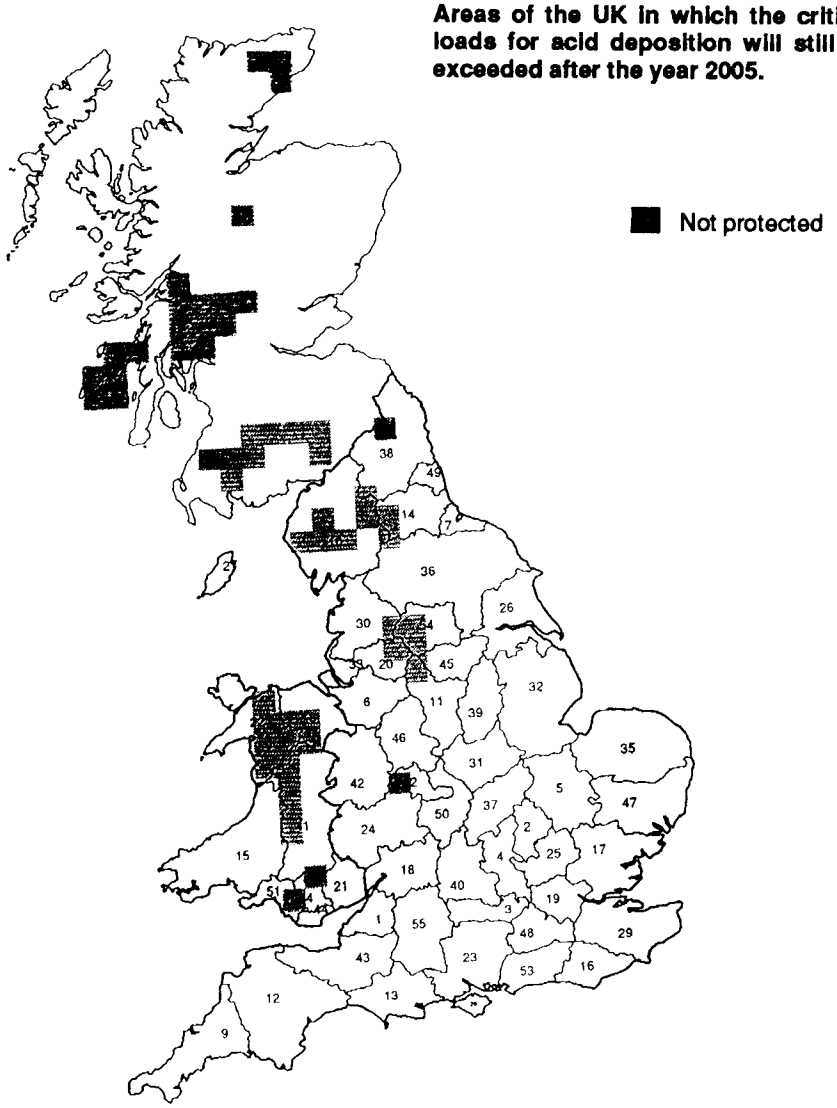
For 8 per cent of the UK surface area, soils will be subject to sulphur deposition in excess of critical loads (the levels of pollution that can be tolerated without adverse environmental effects.)

The two electricity generating companies, National Power and PowerGen, intend to fit only three power stations with flue-gas desulphurization (FGD) equipment. In order to protect sensitive areas in Britain, additional power plants would have to cleaned up. Friends of the Earth has identified eight plants as priority power stations to be equipped with FGD. These are large and relatively new plants, which contribute to sulphur deposition on the sensitive areas that need protection.

Recent research shows that emissions of sulphur dioxide would have to be cut by over 80 per cent in order to stop acid rain damage and to allow the recovery of acidified surface waters in the UK.

CHRISTER ÅGREN

Areas of the UK in which the critical loads for acid deposition will still be exceeded after the year 2005.



GROUNDWATER

Threatened by acidification

ACIDIFICATION IS tending to cause an increase in the concentrations od aluminium and other potentially toxic metals in the groundwater in the British Isles – as may be seen from the findings of an investigation recently carried out by the British Geological Survey (BGS).* This revealed zones of acidified groundwater with abnormal concentrations, mostly of aluminium, but also of metals such as zinc, copper, and nickel.

***Trace element occurrence in British groundwaters.** Obtainable from the British Geological Survey, Keyworth, Nottingham, England NG12 5GG.

BUILDINGS

Great saving from reduction of pollution

IN BRITAIN BILLIONS of pounds for the repair and maintenance of buildings could be saved if concentrations of sulphur dioxide were reduced by 30 per cent, according to an estimate of ECOTEC consultants made on behalf of the Ministry of the Environment.

The savings over a 30-year period would, they say, probably amount to £9.5 billion, but might be as much as £17 billion, if only modern buildings are considered. A reduced need for repairs to historic monuments might bring a further saving of £80-160 million. The economic gain from avoiding damage to the latter should however be much higher than the cost of repairs. By taking into account the willingness-to-pay of visitors to historic buildings, ECOTEC puts the gain at £1.9 billion.

The cost of reducing SO_2 concentrations by 30 per cent would in all probability be lower than the potential savings as decribed above. Such a reduction would moreover mean less damage to soil, groundwater, surface water, vegetation, and humans.

Consider what you need

SWEDEN COULD REDUCE its overall emissions of carbon dioxide by at least 10 per cent by 2010, as compared to the level of 1986, according to a study by Thomas B. Johansson, at the Department of Environmental and Energy Systems Studies at the University of Lund. This could be achieved solely through improved energy efficiency and the use of renewable energy resources.

The following acount of the study is taken from an article by Deborah MacKenzie which appeared in the New Scientist earlier this year.

The writer notes that its positive conclusion results from using a simple, yet innovative, approach – like that of an ordinary householder who might think it normal to estimate needs, list the various ways of filling them, then adopt the cheapest options. But the energy business does not work that way today.

According to Professor Johansson, government planners typically assess how energy demand has grown alongside economic growth. Then, for an economy forecast to grow a certain amount, they predict that a corresponding amount of extra energy will be needed. They then build the plants required to generate the energy.

The alternative, says Johansson, is to plan your power supply in terms of the services you need, considering the possibility of making existing energy go further, as well as simply generating more power. The point is to provide "hot showers, cold herring" and whatever else electricity users want, rather than power for its own sake.

It may not be possible now to reorganise the power industry to sell services, rather than energy, but it is at least possible to plan in terms of the uses to which the energy must be put. The planner can then show how to meet those needs, either by generating more power, or by using existing supplies more efficiently, for the least cost. Least cost might mean less money required to install equipment or buy fuel. On the other hand it might mean less CO_2.

That is the analysis Johansson has done for Sweden. The results show that Sweden can spend less than it now expects on district heating and electricity, and still cut CO_2 emissions by 35 per cent from these sectors by the year 2010 (see figure).

In Sweden, if there are no increases in energy efficiency, the electricity demand in 2010 will be for 194 terawatt-hours (TWh) of energy – half as much again as today's demand. (Each TWh is 1000 million kilowatt-hours, kWh.) But with electricity prices expected to increase 50 per cent by 2010, the extra cost of power should, in itself, lead consumers to increase their own energy efficiency. Johansson calculates that efficiency will increase enough in this way to allow the demand for electricity to be met by only 140 TWh.

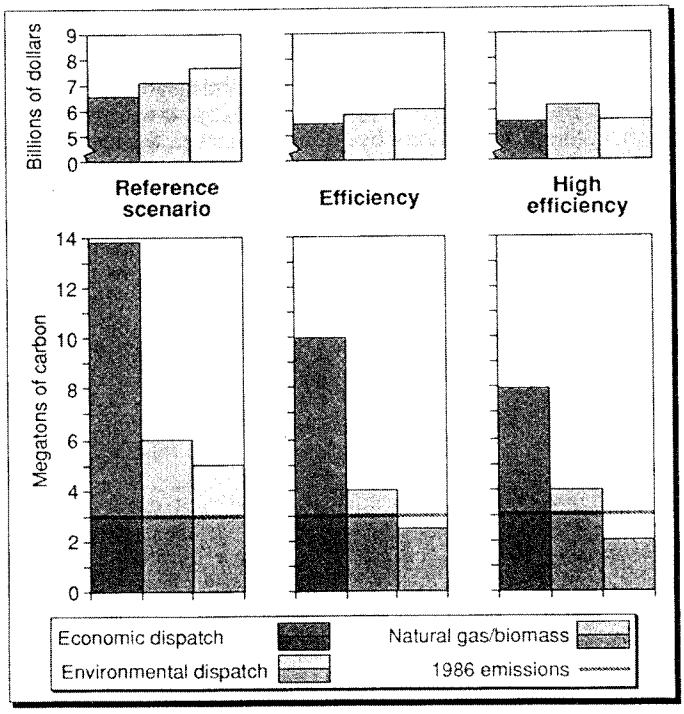
The government can, however, promote a more extensive adoption of efficient technology than would be achieved by relying on such market forces. Methods could include imposing efficiency standards, allowing tax concessions for efficient appliances and replacing electric space heating, common now in Sweden with its abundant electricity, by more efficient heat pumps and fuel.

If such measures lead to replacement of all today's inefficient equipment, as it wears out, by the most efficient equipment now on the market, Sweden will need only 111 TWh of electricity in 2010, rather than 140 TWh. If consumers adopt energy-efficient equipment currently in the research and design stage as well, Sweden can meet its electricity needs with 96 TWh by 2010 – a drop in power requirements of one-third. This, says Johansson, is the benefit of calculating energy requirements in terms of need, rather than supply. Increased efficiency can be taken into account.

The environmental impact of such increase in efficiency, however, depends on how you generate the power. Johanssons's team has calculated the effect of different energy mixes, used at different levels of efficiency. One energy mix simply chose the cheapest options for supplying energy – using entirely coal, oil and natural gas. Another chose energy sources that minimized the production of CO_2.

The solution that produced least CO_2 used no coal, some oil and gas, but substantial biomass, a renewable fuel that does not increase the net amount of CO_2 in the atmosphere.

Vattenfall, the Swedish energy board, estimates that Sweden already has 50 TWh per year of unused biomass power, chiefly the branches, bark, sawdust, and other residues from the forest industry. To this Johansson's team added another 40 TWh per year that Sweden could produce from energy plantations of fast-growing trees intended only as fuel. They calculated the energy, and costs, that would result if the wood were used to fuel highly efficient cogenerating power stations, where both the electric power generated



© KJELL-ARNE LARSSON

by steam, and the waste heat, are used. They rounded off the environmental scenario by including the 3 TWh of wind power that Vattenfall thinks could be installed in Sweden by 2010.

The team then calculated the costs, both in money and CO_2, of each energy mix at three different levels of efficiency: efficiency improved only by market forces, adoption of all commercially available efficient technology, and using efficient technology now in the planning stage.

Not surprisingly, the more energy efficiency was included, the cheaper energy became. More surprisingly, there was little difference in price between scenarios that optimized costs, and those that optimized CO_2. All the options came out filling Sweden's energy needs at a cost of between $5.5 and $7 billion per year, or from 2 to 2.9 cents per kWh. Electricity in Sweden now costs 2.8 cents per kWh.

The real surprises were in CO_2 production under each scenario. If the basic source of power was fossil fuel, no amount of efficiency was enough to reduce CO_2 emissions from the electricity and heating sectors to the 1986 level of 11 million tons per year – equivalent to 3 milion tons of carbon. (Note: The Swedish parliament decided in 1988 to keep national carbon emissions at or below the 1987 level.) Even with maximum efficiency, this plan, although otherwise the cheapest, produced 7.6 million tons of carbon per year (see figure).

But even by relying on biomass, Sweden will not meet its targets unless overall energy needs are reduced by efficient technology. Maximum use of biomass, plus market-driven energy efficiency, still produced 5 million tons of carbon per year. Using commercially available, efficient technology in the plan using biomass, carbon emissions drop to 2.7 million tons. The target can be exceeded, with carbon emissions falling to 1.9 million tons, if the most efficient technology that researchers can imagine is adopted.

Johansson's team tested a third energy mix that did not achieve the target of stabilizing CO_2 emissions. This was a halfway house in which Sweden used no coal, and only its existing biomass, without the energy plantations. The rest came from natural gas. Gas is promoted in some countries, including Britain, as a way to reduce emissions from fossil fuels, because it generates less CO_2 per unit of energy produced.

In Johansson's model, this option produced lower emissions, but they were not low enough. It produced 3.8 million tons of carbon per year, even with the highest levels of energy efficiency.

The difference between the cost of energy under these low-CO_2 scenarios and the costs of the other plans gives the cost of achieving Sweden's CO_2 target. The plan that produces the least CO_2 costs less than than simply letting market forces prevail, because its high level of energy efficiency saves enough money to pay for the investment needed to switch to biomass production.

Johansson estimates that under such a plan Sweden would gain $40 for every ton of carbon it does not produce but would have produced under market forces alone. But this would not be the cheapest option.

Carbon emissions in the cheapest plan are less than under market forces, thanks to the efficient methods it uses. But they are far too high to meet Sweden's target. The difference in cost between the cheapest scenario and the plan that produces least CO_2 is $102 for each ton of carbon not released. This may be taken, says Johansson, as the cost to society of adopting an energy policy which minimizes CO_2, versus one that minimizes costs.

The introduction by the Swedish government of a tax on carbon emissions in 1991, at a rate of $150 per ton of carbon, should generate the extra revenue needed to pay the higher cost of replacing nuclear energy with biomass, compared to replacing it with fossil fuels.

New Scientist
February 16, 1991
By permission

Energy and the environment

IN A REPORT entitled Energi 2030, a group of researchers from Norway, Sweden, and Denmark have presented the findings of a study to see how these countries could reduce emissions of pollutants arising from the use of energy to levels compatible with environmental goals during the next forty years.

The study proceeds from the assumption that to avoid an increase in the greenhouse effect, a global reduction of emissions by 80 per cent will be required for carbon dioxide. On a basis of equal sacrifice, this would mean 90 per cent for the Scandinavian countries.

As regards sulphur dioxide and nitrogen oxides, the goal should be to reduce emissions to levels where the depositions would no longer harm the most vulnerable of the Scandinavian ecosystems.

Like Johansson and his associates in Lund (pp 10-11), the Energi 2030 group rejects the traditional way of assessing the demand for power as a paralleling of economic growth, measuring it instead in terms of the need for services. Their conclusion is that the current level of services can be maintained while using much less energy than is consumed today. Efficiency is thus again the keyword – although an increasing use of renewable energy resources will also be necessary, especially in Sweden and Denmark.

The possibilities of saving energy were studied on the basis of a survey covering 140 sample items. Among these were nine kinds of domestic appliance, nine types of dwelling, fourteen industries, and twenty-four means of transportation, in addition to energy supply sources. In each case the present average energy efficiency was compared with that obtainable from the use of the best current prototype technology (the latter being named EFT, the acronym for "efficiency improving technology" in Norwegian, the language of the report).

In the case of industry it turned out that energy consumption could be reduced by 40-50 per cent through the application of EFT, and that a reduction of 60-70 per cent would be attainable in the domestic field. Since improvements are also possible on the supply side, the total savings would be still greater.

The three scenarios that were set up all assumed that the current EFT would be in general use by 2030. Only housing had to be exempted, since most of the buildings would still be there in forty years, and low-energy solutions require new kinds of construction.

Calculations showed that in Norway and Sweden the same per capita level of energy services could be maintained in 2030 with less than 50 per cent of today's energy consumption, while Denmark could manage with under 30 per cent. This would presuppose technological improvements to EFT levels and certain structural changes in the transport sector.

With the further technical improvements in efficiency of 10-15 per cent assumed for various sectors in subsequent scenarios, energy consumption could be brought down to 40 per cent of current levels in Norway and Sweden, and to 20 per cent in Denmark. Apart from population developments, the difference is due to the fact that Denmark has much to gain by phasing out energy-wasting power plants fired with coal.

Under critical loads yet same services

Such general reductions will however not suffice for the attainment of environmental aims. It will also be necessary to replace fossil fuels with renewable energy resources. In Norway already more than half the energy comes from such resources, so a 50-per-cent reduction of consumption can be achieved without their further use. Since there is relatively little use of renewable energy in Sweden, and still less in Denmark, there will on the other hand have to be greater recourse in these countries to bio-energy, solar, and windpower.

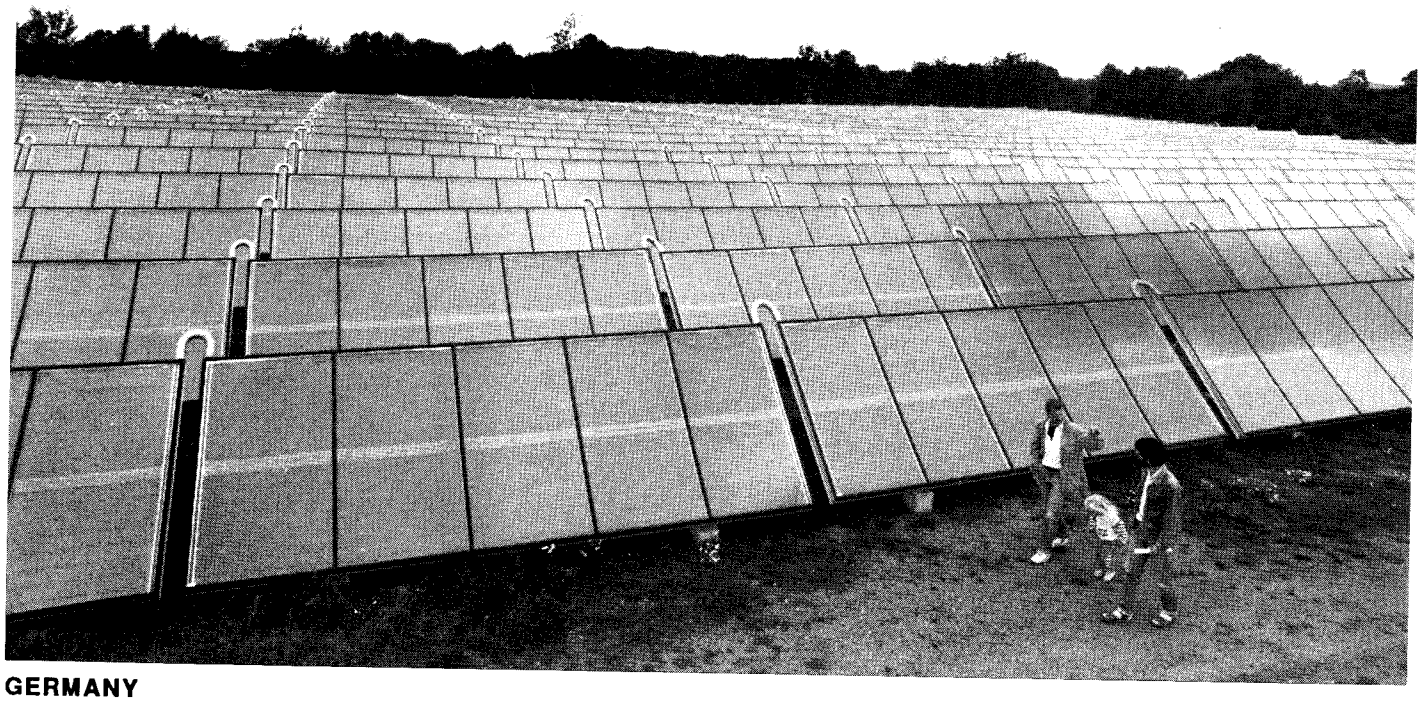
It will be fairly easy, when renewable energy has become available, to substitute it for fossil fuel in stationary plants, such as those for heating. Given the current technology, this will be more difficult in parts of the transport sector and the basic industries. The scenarios therefore assume that a small amount of fossil energy will still be needed for such purposes in Sweden and Norway. In Denmark the proportion will be greater, because there most of the land transport will have to be run on fossil fuel, since it is thought there will not be enough from renewable sources available for this purpose.

By applying the technology to improve efficiency, and using renewable domestic energy resources, the three Scandinavian countries should, while maintaining current levels of energy services, be able to reduce their emissions of SO_2 and NO_x to well under "critical load" limits – now set respectively at 8.3 and 7.2 kilograms per capita per annum. These are the amounts that the most vulnerable ecosystems are calculated to be capable of withstanding, provided the per capita emissions are the same for all the countries contributing to the acidification of the area.

Under the same presumptions, both Norway and Sweden could meet the target for CO_2 emissions, and reduce them by 93 per cent from today's levels. In Denmark, where the emissions per capita are now highest, a similar percentual reduction could be achieved, but this would not suffice to meet the environmental target.

If on the other hand Denmark were able to import electric power and fuels based on biomass from Norway or Sweden, and so reduce its need to rely on fossil fuel for transportation, the CO_2 target could be met there too. The possibilities of coordinating the energy systems of the three countries to a great extent will be examined in the next stage of the Energi 2030 study – which will also consider the political and economic measures that will be necessary for achievement of the goals now set up, as well as the effects of a change-over on business activity and employment.

G.HOWARD SMITH



© MARK EDWARDS

GERMANY

Arguing a tax on energy

THE FISCAL APPROACH is one means of steering economic development and cutting pollution. Recently the German *Bund für Natur und Umweltschutz*, with 190,000 members, released a study explaining its preference for an energy tax, which could lead to energy savings of 50-80 per cent, according to sector.

There are in principle a number of ways to realize the proposed tax. Among the possibilities are a tax on final energy use or one on secondary energy production. These tax forms would, for practical reasons, have to be complemented with a sizeable tax on the discharge of waste heat. Only in that way could the large heat losses of thermal electric generating plants be incorporated into the price system. The complications connected with such a solution can be avoided through a tax on primary energy, which the BUND prefers.

This should cover all forms of energy except renewable ones, i.e. both fossil and nuclear energy. The BUND is pleading for a general coverage of this kind and for a uniform tax rate in order to prevent conflicts over nuclear power, and the supposed advantages of one or other type of energy blocking the introduction of an energy tax. This reasoning is even more valid in an international perspective, since countries rely on quite different energy supply mixes.

The choice of a tax on primary energy implies taxing imports of secondary energy to avert unethical tax avoidance, the consequence of which would simply be to shift emissions to other countries. A similar problem occurs with respect to the import of energy-intensive materials such as aluminium and aluminium products, or, for that matter, of all products involving an energy input.

Nuclear energy, the production and use of which should be stopped immediately, has to be converted for the purposes of tax calculation to equivalents of primary, secondary, or end energy forms until the time for its use will have ended.

In the case of a primary energy tax, as preferred by the BUND, it is necessary to decide whether to consider the different uses of primary energy. The tax burden on primary energy forms can be apportioned proportionately according to the energy content of secondary forms (e.g. electricity and district heat). As an alternative, it could be weighted more in favour of the more valuable secondary forms (e.g. electricity) to the benefit of those forms with low energy that are nonetheless used, such as district heat.

While energy-tax rates should reflect the ecological costs of energy consumption, they should be set primarily according to the energy savings that are aimed at. The tax should be introduced step-by-step, beginning with low rates that are regularly increased until they reach the required level. Producers could then plan their investments accord-

ingly. The initial rate should be set at (an additional) 2 Pfennig/kWh on the primary energy level.

Yearly increases should lie somewhere between 0.5 and 1 Pfennig/kWh until the desired level of about 5 to 10 Pfennig/kWh of (additional) tax on the primary energy level is reached. The lower rate would generate, in the case of a tax on primary energy production, yearly revenues of DM 150,000 million (in 1986 prices) for the current levels of production.

In comparison, the crude-oil tax on petrol generated revenues in 1985 of DM 23,000 million, and together with a host of other existing energy taxes and charges, a total of DM 32,000 million. Available estimates and data as to demand reactions to energy price changes suggest that the allocative effect of a primary energy tax of between 5 and 10 Pfennig/kWh would lower energy consumption by about 50 per cent and more in the medium to long run. This presupposes a lifting of the barriers to adjustments to higher energy prices. The technical potential for realizing these savings is available in most sectors.

Recent estimates of the technical energy-savings potential arrive at demand reductions of about 80 per cent in several sectors (space heating, electricity consumption, petrol consumption). These savings would be economical if energy prices were substantially higher than they are today. There is also a significant potential for savings in industry.

It seems that the price sensitivity is especially low as regards private car use, at least in the short term. Additional measures would therefore be appropriate.

The proposed level for an energy tax is also supported by preliminary calculations of ecological and social costs of energy consumption. Olav Hohmeyer arrives at costs of 4-9 Pfennig/kWh for electricity from generating plants oprating on fossil fuels, and 10-21 Pfennig/kWh for electricity from nuclear generating plants. The weighted average for the Federal Republic of Germany would be 5-12 Pfennig/kWh for electricity from all types of generating plants. Homeyer's calculations, based on end use of energy, fail to include all the ecological and social costs for these forms of electricity production. But these are either difficult or impossible to value in money.

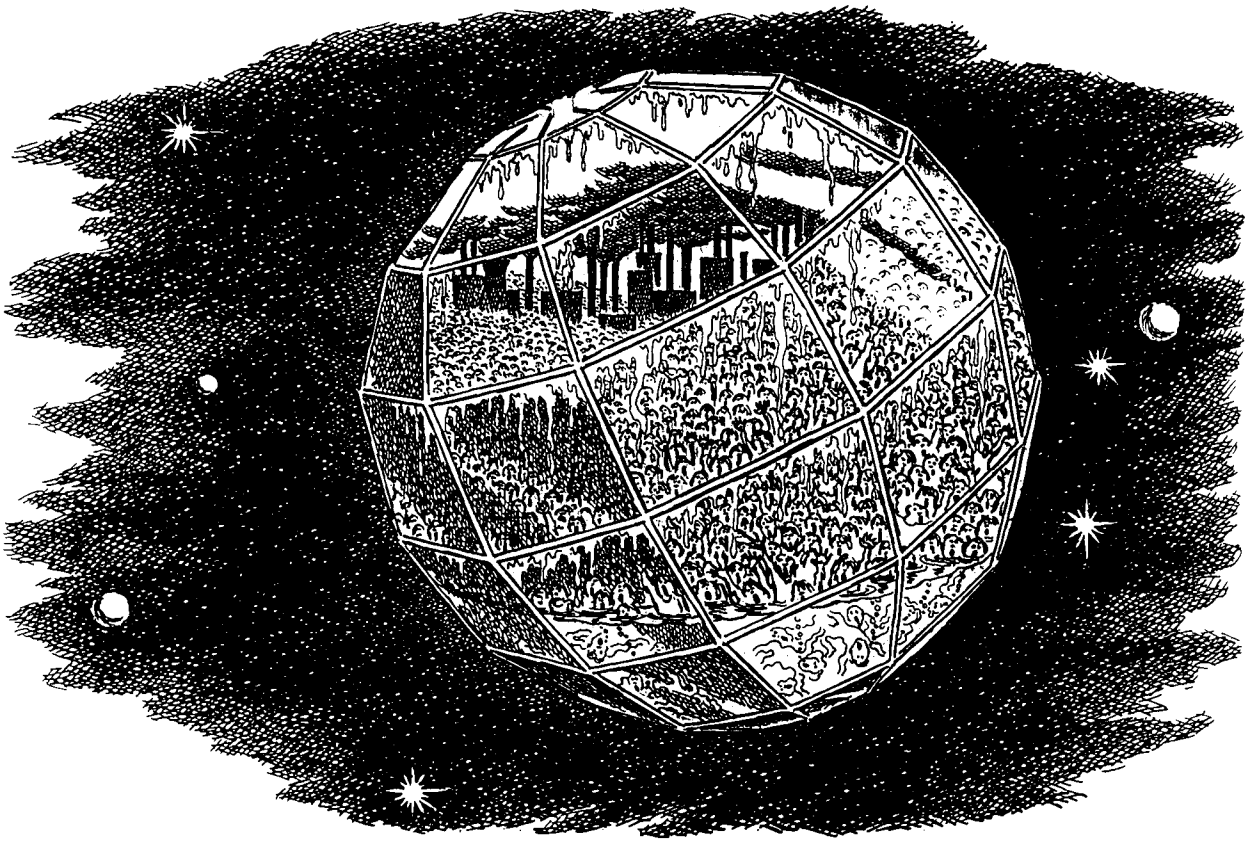
Energy taxes should be set primarily according to the required savings

It is quite possible to assume ecological and social costs of 10 Pfennig/kWh for electricity. These are equivalent to 3.5 Pfennig/kWh for primary energy if one converts on the basis of the usual assumptions about energy transformation efficiencies in electricity generating plants. This justifies the proposed goal for a tax rate of 5-10 Pfennig/kWh on primary energy if one makes allowance for the ecological and social costs that have not been included in the calculation or proved impossible of monetarizing.

Renewable energy sources, e.g. wind power or photo-voltaics, actually generate a net ecological and social gain, thus providing a reason for exemption from the energy tax. This net gain would actually justify additional measures to encourage their use, such as subsidies for market introduction, prescriptions for solar energy use, etc.

Therefore, the BUND proposes that renewable energy for own consumption should be exempted from tax. Commercially produced renewable types of energy should also be exempted until further notice, depending on the demonstration of their environmental acceptability.

Extract from article **A tax on energy**, in **Metamorphosis**, No 6-7, 1991, published by the European Environmental Bureau.



In the run-up to Rio

DURING THE EIGHTIES there was a tendency for environmental debate to concentrate on single issues, such as forest decline and the use of pesticides. A reversion to consideration of the interacting effects of environmental problems took place after publication of the Brundtland report in 1987, and launching of the idea of sustainable development. It became evident that the application of technical measures, such as filters on power stations and catalyzers on cars, would by no means suffice to surmount the problems of the environment.

Attention turned to the need for a general reorientation of energy and transportation systems, and changes in lifestyles, particularly in the industrialized countries. There also came a growing awareness that bringing about such changes would require economic measures as well.

In May last year a conference was called in Bergen, Norway, by the UN Economic Commission for Europe and the Norwegian government. Taking part were environmental ministers from thirty-four countries in the ECE group – the aim being, in fulfillment of the name of the conference, Action for a Common Future, to discuss ways of achieving sustainable development within the Commission's sphere.

Two months earlier 300 representatives of environmental organizations in the ECE countries had met on the Danube to hold what was called a bridging-the-gap conference. The agenda for action that was agreed on the trip between Vienna and Budapest was later submitted to the ministers at the meeting in Bergen.

The Bergen conference was one of five regional meetings in preparation for the global UN Conference on Environment and Development (UNCED), popularly known as the "Earth Summit," which is to be held from June 1-12, 1992, in Rio de Janeiro. Campaigns for this event are now being prepared by NGOs all over the world, and a conference with about 1000 delegates is being arranged in Paris, December 17-20, to prepare an NGO memorandum for the UNCED meeting.

What then are the actual proposals that are being put forward by governments and NGOs for dealing with the environmental crisis? If we confine ourselves to matters concerning energy and air pollution, they appear principally as follows.

Among renewable energy resources, the Brundtland report points to wood, plants, dung, falling water and geothermal, solar, tidal, wind, and wave power as huge potential sources of primary energy. It also says the most cost-effective and environmentally advantageous solution to the energy problem lies in efficient use. And as regards the long-range transport of air pollutants and forest decline it concludes that no single strategy for control is likely to be effective, but that an integrated mix of strategies and technologies will be required, tailored for each region.

An obvious need to speed up the preparatory work

As a complement to this general statement, the NGO conference on the Danube steamer submitted the following specific demands:

In the industrialized countries, emissions must be brought down below the critical loads for the environment by reducing

- Sulphur dioxide by 90 per cent
- Nitrogen oxides by 75 per cent
- Ground-level ozone concentrations by 75 per cent
- Carbon dioxide also by 75 per cent (with a reduction of 20 per cent already by the year 2000).

In these developed countries, there should be a reduction in the use of primary energy by 50 per cent by 2025, combined with a commitment to obtain 50 per cent of the supply of electricity from renewable, environmentally benign sources. The conference further demanded:

- Decentralization of the energy supply system.
- That funding of all energy projects and programs be based on the principle of sustainable energy use.
- The establishment of a new institutional structure for energy supply, with an emphasis on end use rather than on production.
- Jettisoning the idea of nuclear power as a sustainable means of generating electricity. Nuclear power should be no part of a sustainable energy strategy.
- Full reflection of the environmental and social costs of generating and supplying electricity in the prices paid by consumers.
- Diversion of investment in research from nuclear and military purposes to the development of energy-efficiency technologies and renewable sources.
- An updated system of energy labelling, and mandatory standards for products and processes for the improvement of energy efficiency in buildings and appliances.
- Reductions in emissions from the transport sector should accord with the overall targets for energy and emission reductions. There should be no further expansion of the network for primary road transportation. The ECE countries should commit themselves to reducing vehicle use and improving vehicle efficiency so as to make possible a reduction of 50 per cent in road traffic by the year 2000.
- Investments must be switched from road to rail traffic, with emphasis on the development of the rail freight network and fast passenger trains. New cars, buses, and trucks should conform to best available technology for the reduction of emissions. The Californian or still better standards should be imposed in all ECE countries.

In the Ministerial Declaration from Bergen there is the following statement:

"Taking into consideration that the ECE region presently accounts for about 70 per cent of global primary energy and fossil fuel use, we assume a major responsibility to limit or reduce greenhouse gases and other emissions and to lead a global effort to address this matter by promoting energy efficiency, energy conservation and the use of environmentally sound and renewable energy sources."

The Declaration contains no specific commitment to reducing emissions of carbon dioxide. Nor were any definite targets figures agreed upon for energy saving, transportation or other emissions.

Governmental preparations for the UNCED conference are now concentrating on the formulation of a Climate Convention, which might be adopted by the UN either in 1992 or 1993.

Although the questions of transboundary air pollution, energy saving, and transportation policies are all on the agenda for the UNCED conference, it is not clear whether the governments will be making any new commitments in these respects. A large number of environmental NGOs are currently engaged in developing practical proposals for strategies to achieve the necessary changes in, for instance, our transport and energy systems.

There is an obvious need to speed up the constructive work, as the chances of having any real influence on the UNCED agenda will decrease progressively as the time for the conference draws closer. It is expected that the agenda will be more or less finalized at a governmental preparatory meeting in Geneva as early as this August.

REINHOLD PAPE

Sensitive ecosystems
continued from front page

cations from the soil, and also because the greater flow of water decreases the ability of the soil to neutralize the acid depositions.

A combination of these various factors results in eight sensitivity classes, which for practical reasons have been reduced to five, for presentation in the form of a map (Fig. 1 on front page).

Previous research into the sensitivity of various ecosystems to acidification, together with critical-load limits for sulphur and acid depositions, has then been used by SEI to quantify its five relative sensitivity classes. Through such combination an indication can be obtained of the amounts of acidic deposition the various areas can withstand without suffering damage.

For the Class 5 sites, the most sensitive, a deposition target has been set of 20 kilo equivalents hydrogen ions per square kilometre per year (keq H^+/km^2), which corresponds to a deposition of 3.2 kilograms of sulphur per hectare a year. For Class 4 it is 40 keq H^+/km^2, Class 3 80, and Class 2 160 keq. The least sensitive areas, classed 1, are assumed to be able to support depositions of more than 160 keq H^+/km^2, or more than 25 kilograms of sulphur per hectare a year.

By comparing maps based on the size of the depositions that the various areas are assumed to tolerate, with others showing the actual fallout over Europe (Fig. 2), further maps have been developed to see where depositions exceed the target values (Fig. 3). Data on the emissions, exports, and imports of air pollutants are compiled for each year by the EMEP (see AN 1/91, pp 12-13), and the EMEP transfer model has been used by the SEI in building up its map of depositions.

A country-by-country compilation of critical loads, confined in the first place to sulphur and total-acid depositions, has been underway since last year (the acidifying effect both of sulphur and nitrogen being included in the latter). The work is being coordinated under the Convention on Long Range Transboundary Air Pollution as part of the UN Economic Commission for Europe. The first complete map of Europe resulting from such national recordings is expected to appear during the summer.

Compilations of this kind will for instance be used in the negotiations that are now proceeding in regard to new international agreements for reducing emissions of sulphur and nitrogen. Since one existing agreement, the so-called sulphur protocol of 1985, will elapse in 1993, a new one should be ready before that date. It had already been agreed, within the ECE Convention, that new agreements should be based on the critical-load concept.

Strategies for limiting the emissions of acidifying substances can be developed through the use of intruments such as the RAINS computer model evolved at the International Institute for Applied Systems Analysis (IIASA). Such strategies could for instance aim in the first place at reducing the emissions from sources that contribute most pollution to the most sensitive areas. By using computer models the strategies could also be made as cost-effective as possible.

JENS BUSCH
CHRISTER ÅGREN

***The Relative Sensitivity of Ecosystems in Europe to Acidic Deposition**, by M. Chadwick and J. Kuylenstierna. Obtainable from the Stockholm Environment Institute, Box 2142, S-103 14 Stockholm, Sweden.

Figure 2. Sulphur deposition in Europe 1985.

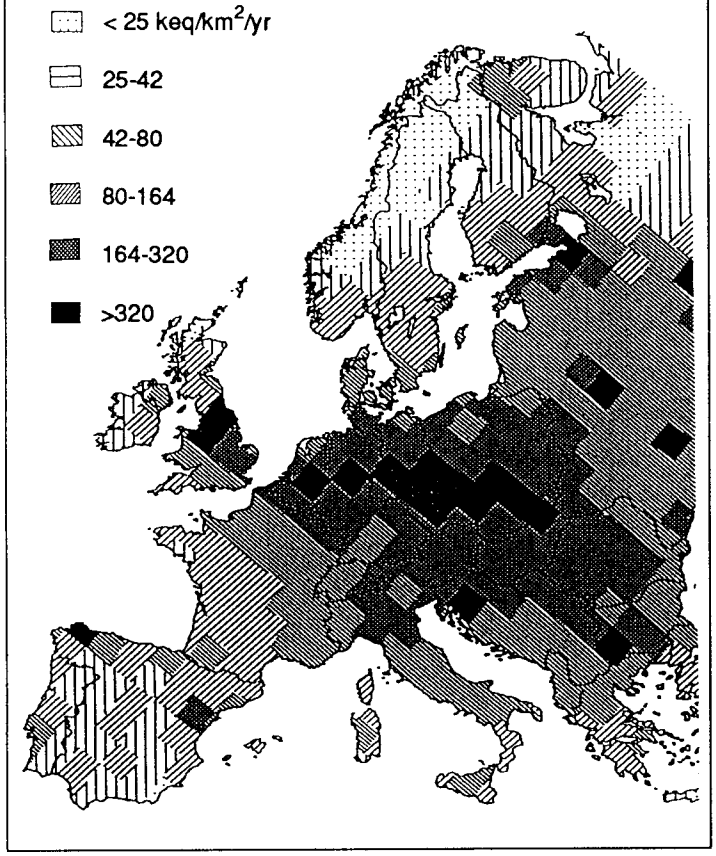


Figure 3. Amount of excess deposition of sulphur over targets 1985.