NO. 2, APRIL 1995

Acid News

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AIR QUALITY

New standards in the offing

THE WORLD HEALTH ORGANIZATION is currently engaged in revising the guidelines for air quality that were originally issued in 1987 (WHO Air Quality Guidelines for Europe). At the same time the European Union is working on an adjustment and extension of its system of mandatory limits for concentrations of air pollutants. In its fifth program for environmental action the latter had already declared that in principle it would follow the WHO recommendations – which are also expected to have considerable influence on policy in those parts of Europe that are still outside the Union.

The World Health Organization has just shown in a new report that the state of the air over Europe is far from what it ought to be. Twenty per cent of the people living in towns of more than 50,000 population in Europe are at present breathing air with concentrations of sulphur dioxide that exceed the WHO recommendation for a yearly average of 50 micrograms per cubic metre.

The short-term values for sulphur dioxide are also being widely exceeded. Almost every other European town dweller (45 per cent) lives in a place where the recommended maximum 24-hour level is regularly exceeded every year. The situation is worst in the Black Triangle, comprising southern Poland, southeastern Germany, and the northern part of the Czech Republic – where excessive concentrations occur not only in the towns, but also out in the countryside.

Available data on particles covers only 29 per cent of the town population generally in Europe. These pollutants are measured in two ways, the one BS (Black Smoke) being an optical method that chiefly records the smaller particles, while the other, TSP (Total Suspended Particulates) gives a measure of the total weight of particles.

Measurements by the BS method indicate that the yearly average guide value (50 $\mu g/m^3$) is being exceeded in the case of 23 per cent of the people living in towns.

The number of those affected rises to 61 per cent when the yearly average guideline value according to the TSP method (60 $\mu g/m^3$) is exceeded. As much as 95 per cent of the total European town population will be exposed at some time of the year to concentrations above the 24-hour limit of 120 micrograms per cubic metre, and 18 per cent will be exposed for more than two hundred days to concentrations above that limit. Among the places suffering worst are Kaunas and Shuaylay in

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Acid News

is a newsletter from the Swedish NGO Secretariat on Acid Rain, 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 secretariat. All requests for information or material will be dealt with to the best of our ability. Acid News is distributed free of charge.

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: +46-(0)31-15 39 55
Telefax: +46-(0)31-15 09 33

Editor: Christer Ågren

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THE SECRETARIAT

The Swedish NGO Secretariat on Acid Rain was formed in 1982 with a board now comprising one representative from each of the following organizations: The Environmental Federation, the Swedish Anglers' National Association, the Swedish Society for Nature Conservation, the Swedish Youth Association for Environmental Studies and Conservation, and the World Wide Fund for Nature Sweden.

The essential aim of the secretariat is to promote awareness of the problems associated with air pollution, and thus, in part as a result of public pressure, to bring about the required reduction of the emissions of air pollutants. The eventual aim is to have those emissions brought down to levels – the so-called critical loads – that the environment can tolerate without suffering damage.

In furtherance of these aims, the secretariat operates as follows, by

- ☐ Keeping under observation political trends and scientific developments.
- ☐ Acting as an information centre, primarily for European environmentalist organizations, but also for the media, authorities, and researchers.
- ☐ Producing and distributing information material.
- ☐ Supporting environmentalist bodies in other countries by various means, both financial and other, in their work towards common ends.
- ☐ Acting as coordinator of the international activities, including lobbying, of European environmentalist organizations, as for instance in connection with the meetings of the bodies responsible for international conventions, such as the United Nations Convention on Long Range Transboundary Air Pollution.
- ☐ Acting as an observer at the proceedings involving international agreements for reducing the emissions of greenhouse gases.

EDITORIAL

Not very interested

WHAT IS THE ATTITUDE of the makers of cars and trucks to the environment? What sort of solutions do they have in mind, for instance, for the problems of air pollution? At least some of the answers surfaced recently at the 3rd international conference on the automotive industry and the environment.

This conference, which had the official support of the European Automobile Manufacturers Association (ACEA), took place at the beginning of March in Geneva in conjunction with the big motor show and drew an attendance of more than hundred.

The introduction of stricter emission standards for cars by the EU in 1996 would, according to the representatives of the motor industry, bring Europe alongside the United States and thus into world lead in this respect. The opinion was also expressed that the principle hitherto employed for setting emission requirements in accordance with the best available technology (BAT) was no longer satisfactory – that it was an altogether too expensive and inefficient means for achieving environmental objectives.

Emission standards should instead, it was said, be set through collaboration between industry (i.e. the motor industry represented by ACEA and the petroleum industry by EUROPIA) and the European Commission, a so-called Tripartite Initiative. These have already been running, since 1993, the Auto-Oil Program. The aim is to have new standards ready for introduction by the EU from 2000, as well as other measures that would help to reduce emissions from the whole transport sector in a cost-effective manner.

It will naturally be excellent if the research is done and the necessary analyses carried out. But there are also other parties which are both capable and dedicated – and probably more innovative and radical too – that ought to be brought in.

When ways of reducing emissions of the greenhouse gas carbon dioxide were being discussed, diesel engines were put forward by several speakers as preferable to the petrol type – although that would mean ignoring the need to reduce emissions of NOx and particulates as well.

There was however support for more technical solutions, such as lean burn (for petrol engines), as well as for a general increase in engine efficiency. Demands for a limit on the fuel consumption of new cars were simply brushed aside.

Any marked increase in the use of alternative (non-fossil) fuels, or of electric propulsion, was in general regarded as highly utopian. In fact it was hardly discussed at all. Nor were the possibilities of reducing or at least checking the increase of road traffic given much attention.

To generalize somewhat, it may be said that the motor industry's view of the environmental problems connected with their products is largely confined to their emissions of the air pollutants nitrogen oxides, hydrocarbons, carbon monoxide and particulates. Even these they tend to regard primarily as local health problems – which they say will, according to their own forecasts, have largely been solved by 2010 through the use of catalyzers and better diesel engines. The question is, however, whether anyone outside the industry gives any credence to these forecasts. In any case it is time the motor industry realized that the pollutants in question contribute to region-wide problems in the form of acidification, eutrophication, the formation of low-level ozone, damage to forests and crops, etc.

Other ways in which motor vehicles and road traffic affect the environment – by way of noise, intrusions into nature, and consumption of resources – were hardly touched upon at all at the conference.

When, then, are automotive manufacturers going to shoulder their responsibility to society by helping to develop a system of transportation that will be sustainable in the long run? One small step in the right direction would be to accept responsibility for their own products fulfilling environmental requirements at least during their lifetime – which most European manufacturers continue however to oppose.

CHRISTER ÅGREN

"...by 1995, all people of the Region should be effectively protected against recognized health risks from air pollution."

"...the achievement of this target will require the introduction of effective legislative, administrative and technical measures for the surveillance and control of both outdoor and indoor air pollution, in order to comply with criteria to safeguard human health."

Quoted from *Targets for health for all* (1985), a preliminary to the present WHO Air Quality Guidelines for Europe.

Continued from front page

Lithuania, Sofia and Ruse in Bulgaria, Barcelona in Spain, and Turin, Italy.

Calculations indicate that about 20 per cent (56 million) of Europe's town dwellers are meeting concentrations of nitrogen oxides that exceed the WHO guide figure of 150 $\mu g/m^3$ for a 24-hour exposure. An equally large proportion of the town population is subject, over a year, to average concentrations (above 60 $\mu g/m^3$) that are known to cause damage to respiratory systems. The highest levels have been found in Belgrade, where the annual average for NO_2 exceeds 100 $\mu g/m^3$. There is however no WHO guideline for such long-term exposure.

Concentrations of ozone vary from year to year in accordance with the weather situation. Raised concentrations stem from emissions of nitrogen oxides and hydrocarbons, which form ozone under the influence of sunlight and warm weather. While raised values for ozone have their origin in central town areas, the high concentrations usually occur elsewhere. This is mostly what happens in western and northern Europe. Around the Mediterranean there are often high concentrations in town centres.

The formation of ozone was exceptionally strong during the summer of 1989, when 56 per cent of all Europeans – 367 million persons – were calculated to have been exposed to concentrations in excess of the WHO one-hour guide value of 200 $\mu g/m^3$. The highest excess values were recorded in South England, the Benelux countries, Germany, northern France, and Switzerland – the highest local values having been found in southern England and around Lisbon in Portugal.

Although ozone formation was low during the summer of 1985, it is estimated that 16-22 per cent of Europeans were subject, especially in the south, to one-hour values in excess of WHO recommendations.

Lacking the power to make legislation, the WHO, which is a United Nations body, can only give advice as to the requirements for air quality. Its present guidelines are fairly numerous, covering twenty-seven subjects and groups of subjects.

The European Union on the other hand can set limit values which the member states are bound to accept. So far requirements only exist for sulphur dioxide and particles (in combination), lead, and nitrogen dioxide. A directive for ozone contains no binding limits for air quality, only requiring the member countries to measure the concentrations in the air and issue warnings when they are very high.

The work on the new WHO guidelines for Europe is being carried on in close association with EU's environmental directorate. The US authorities are also evincing great interest, probably in part because they fear a tightening of European requirements would increase public pressure for adoption of the same standards in the US, which in some cases might be very difficult (expensive) to meet.

The new limit values will be adopted by the Union as a consequence of a new framework directive for measuring and protecting air quality that is presently under discussion. In the draft version it says that a) the present limit values are to be revised, and b) that limits for some other substances are to be added. Revision of the limits for substances 1-5 (see box) has to be com-

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pleted before the end of 1996, and the values for the substances 6-14 incorporated in the directive at latest by December 31, 1999.

So far the debate within the EU has primarily concerned the items that are to be included. Thus:

☐ The term "acid deposition" is causing trouble, one reason being that setting limit values would be too complicated, on account of the large geographical variation in sensitivity.

☐ Another difficulty is ozone. Since high concentrations often occur far from the emission source, it may be impossible for a member country that is exposed to such high levels to do anything to bring down concentrations in its own airspace.

☐ A third problem concerns particles that are considered capable of causing cancer as well as other diseases. Since there is thought to be no sure level for carcinogenic substances, medical experts hesitate to propose any limit value. Nor are the current definitions and measuring methods thought to give an adequate idea of the risks. Also particles are often lumped together in a single value, whereas it is probably the very smallest that are most dangerous from the medical point of view.

MAGNUS NILSSON

Note. The figures regarding air quality have been taken from *Concerns for tomorrow*, WHO 1995, which is being published by Wissenschaftlige Verlagsgesellschaft mbH, Stuttgart 1995 (in publishing).

The Swedish NGO Secretariat on Acid Rain will shortly be issuing a report describing the progress of the work on the new recommendations and requirements, with an account of the effects on health of the chief air pollutants and the requirements for protection of the environment.

Substances in EU draft directive on air quality.

1. Sulphur dioxide
2. Nitrogen dioxide/oxides
3. Black Smoke
4. Suspended Particulate Matter
5. Lead
6. Ozone
7. Carbon monoxide
8. Cadmium
9. Acid deposition
10. Benzene
11. Polyaromatic hydrocarbons with benzo-a-pyrene as indicator
12. Arsenic
13. Flouride
14. Nickel

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STREETCARS

Reawakened desire

IN 1927, there were nearly 14,500 trams in Britain, in dozens of different places. By 1990, there were fewer than a hundred, all of them in Blackpool. And Britain is not unique in this respect. In the intervening sixty years trams had vanished from the streets of cities all over Europe and North America.

Lately, however, the tide has been turning. Trams are no longer seen as hindering car traffic, rather that cars are getting in the way of public transport. More and more has it to come to be realized that scrapping the tramway systems was a mistake. New systems have already been installed in Manchester and Sheffield, and between thirty and fifty local councils in other parts of Britain have been considering plans to build light-rail lines – in other words, tramlines. Last December the British government approved a £154 million project for the London borough of Croydon, which means that trams will again be running on the streets of the capital for the first time since 1952.

The same thing has been happening elsewhere. In Paris, where the trams had disappeared in 1938, they were back again, in the St Denis arrondissement, in 1992. In the United States, the very paradise of the car, new systems have been built in cities such as Los Angeles, Buffalo, and Portland. Many cities in Germany and the Netherlands had on the other hand retained their tramway systems, and have gone on to modernize them.

It costs considerably more to lay a new tramline than to employ buses on the same route. Trams have however an advantage over buses in that they are more likely to attract passengers who would otherwise have travelled by car. It appeared from a poll of tram riders in Manchester, for instance, that 40 per cent possessed cars, but had nevertheless chosen to go by tram. Other studies have shown, too, that car owners often prefer not to take the bus, possibly because they feel if they have to sit in a traffic jam, they might as well do it in their own car. Modern trams in any case have an attractive image, and with well organized signal systems they can be faster, at times of congestion, then either cars or buses.

More people travelling by tram and fewer by car not only helps to relieve congestion and reduce travel time – it also brings great gains to the environment. Energy consumption and noise are reduced, air quality becomes greatly improved. Since their movements are easier to predict, trams are also said to provide a safer ambience for pedestrians. By relieving inner-city congestion, too, they may eliminate a need to build more roads.

PER ELVINGSON

Adapted from an article in New Scientist, January 28, 1995.

DENMARK

Cogeneration to reduce energy consumption

THE DANISH GOVERNMENT is setting out to try and persuade the European Commission and the other EU member states that cogeneration – the combined production of heat and power – is a good way to reduce energy consumption. Half of the Danish households are connected with district heating systems, and more than half of the heat (60 per cent) comes from CHP plants. In Europe generally only 6 per cent of the power plants salvage their surplus heat to supply heating systems.

Figures presented at a Danish-organized workshop on cogeneration have shown that energy use would fall by 15 per cent, and emissions of carbon dioxide by 11 per cent, if all suitable cities in the European Union were to have district heating systems using heat from cogeneration.

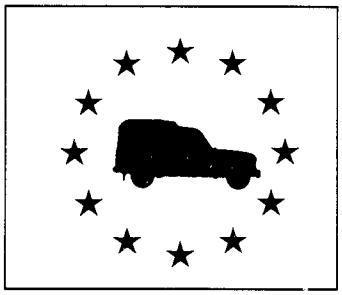
Draft EU legislation designed to open up the member states' energy markets does not mention the environment directly but says that states might be allowed to limit competition to the extent of requiring power companies to perform certain public services, such as securing the power supply. The Danes want this exemption extended to include environmental services – partly to prevent their investments in cogeneration from being cancelled out by imports of cheap power.

Source: **Environment Watch: Western Europe**, January 6, 1995.

EU COMMISSION

New proposals for limits on exhaust emissions

THE EUROPEAN COMMISSION has issued two long-delayed proposals that will tighten limits on exhaust emissions from light commercial road vehicles of up to 3.5 tons and relax upcoming curbs on particulate emissions for the smallest diesel truck engines.



The proposed new emission limits for light commercial vehicles are intended to be equivalent in severity to those that will apply to passenger cars from 1996-97. For the smallest vehicles, the emissions standards are identical with those for cars; for larger vehicles, the limits are scaled up to take account of their greater weight. The limits will be phased in between 1996 and 1998, but only apply until year 2000 – by mid-1996 the Commission is to propose further standards to take effect in 2000.

The proposal on particulate emissions from small diesel-truck engines is temporary – a derogation from a tighter set of truck emission standards that is due to enter into force in October this year. The Commission accepts that most small engines cannot meet these limits as far as particulate emissions are concerned. A laxer limit will therefore apply until October year 2000. This move has been criticized by the European Environmental Bureau, an umbrella organization for environmentalist NGOs within the EU. The EEB wants the stricter limit to be introduced in line with the ordinary plan, pointing to increasing evidence that diesel particulates are a major threat to health.

To become law, both proposals require approval by the Council of Ministers and the European Parliament.

Source: **Environment Watch: Western Europe**, February 3, 1995.

NETHERLANDS

Supplanting nuclear power

IN THE NETHERLANDS nuclear power is to be phased out by the year 2004, when the two existing generators will have been shut down. The Dutch minister for energy, Hans Weijers, says there is no reason to consider any more reactors so long as the problems of safety and disposal of the atomic waste remain unresolved. According to the minister, closing down the reactors will not affect the country's electricity supply – in fact there is expected to be a surplus, due to a great increase in cogeneration. This increase is in turn due to a government decision, made in 1989, to give subsidies to companies building plants for cogeneration on their existing sites.

Environment Watch: Western Europe, January 6, 1995.

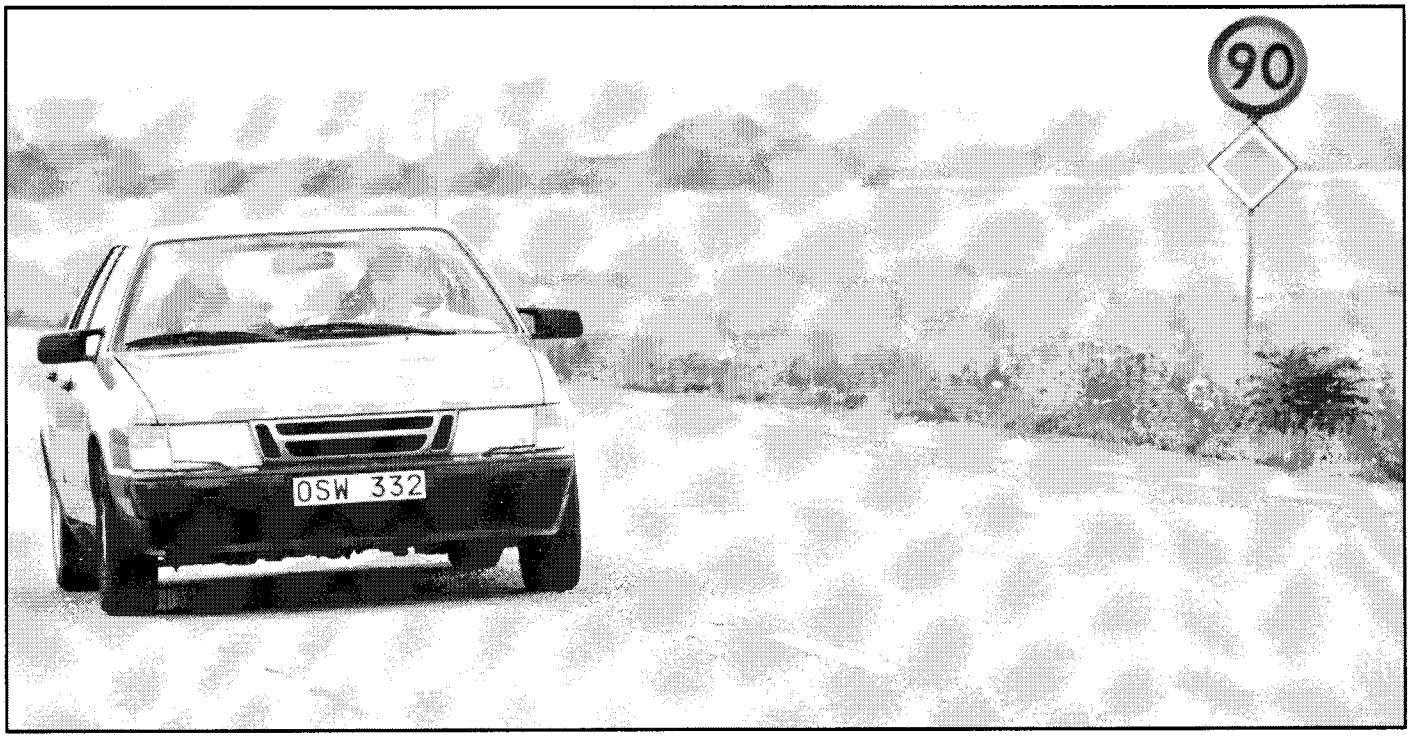
SPAIN

Misuse leads to limitation

THE SPANISH GOVERNMENT has taken steps to limit the production of alternative power, by stopping the subsidy it has hitherto enjoyed. This will especially affect independent producers of cogenerated electricity, but also wind, solar, and other renewable energy schemes.

Until this year alternative energy producers, besides being guaranteed access to the national grid, have been paid almost twice as much as the general tariff for power. Seeing a way of making a profit, some enterprises started extensive production of alternative electricity, largely through cogeneration. The regular power companies reacted violently, so that now, by decree, the subsidized price for electricity will only be available to individual installations with a capacity of 100 MW or less. The ceiling also applies to wind and solar-generated electricity, small-scale hydropower, and energy derived from biomass and waste.

Environment Watch: Western Europe, January 6, 1995.



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EU MINISTERS

Want to lower cars' fuel consumption

THE EU environment ministers want cars sold in Europe within the next ten years to consume much less fuel than the present models. Ministers from twelve of the fifteen member nations favour a proposal that would limit the average consumption of petrol driven cars to 5 litres per 100 kilometres, and of diesels to 4.5 litres by the year 2005.

The twelve ministers had in fact asked the European Commission to ready legislation along these lines by this spring, but because of opposition from Greece, Italy, and Spain, the figures 5 and 4.5 do not appear in their statement. In a separate statement, Greece and Italy have called for measures to reduce emissions of carbon dioxide from cars as soon as possible, while at the same time taking into account the overall environmental cost of the car, during manufacture and disposal and with regard to "secondary effects" while in use.

Originally a Franco-German proposal, the 5/4.5 limit would bring about a marked alteration in the average fuel consumption of cars throughout Europe. According to the automobile manufacturers' association, ACEA, the average consumption of newly registered cars now ranges from 6.4 litres per 100 kilometres in France to 7.7 litres in Germany and 8.4 in Sweden. The figures, representing a combined average for petrol and diesel-driven cars, are based on the European test cycle, entailing driving in urban conditions and at 90 and 120 kph. The US average, according to the association, is 9 litres per 100 kilometres.

Makers claim it will be impossible to attain proposal target in time

A majority of the car makers claim it will be impossible to arrive at the proposed target as early as 2005 – despite the fact that Volkswagen, for instance, is preparing to have a car ready at the turn of the millennium which will consume no more than 3 litres per 100 kilometres.

The 5/4.5 figure is intended as an average for each car maker's whole output – in other words, this is the US Corporate Average Fuel Efficiency approach. But the ACEA says it would not be readily applicable in Europe, since some manufacturers, such as BMW and Mercedes-Benz in Germany, and Volvo in Sweden specialize in making big, thirsty cars, and have no smaller cars with which to lower the average fuel consumption of their range.

Within the Commission there appears to be a general leaning towards taxation measures rather than production standards as a means of curbing fuel consumption. Its taxation and industrial affairs departments would prefer the member states to impose an annual road tax based in large part on the car's emissions of carbon dioxide and other exhaust gases, while the environment directorate favours a purchase tax that would reflect its emissions of carbon dioxide. It remains to be seen how the two will settle their differences.

PER ELVINGSON

Source: **Environment Watch: Western Europe**, January 6, 1995.

Note. If nothing is done, the emissions of carbon dioxide from cars in the EU may be expected to have increased by 20 per cent from current levels by the year 2000 and by 26 per cent by 2010. According to the Commission, cars were responsible, in 1990, for 45 per cent of the emissions of carbon dioxide from transportation and account for about 12 per cent of all CO_2 emissions in the EU.

BRITAIN

Cheaper renewable energy

THE PRICE OF ENERGY from renewable sources has dropped markedly in Britain during the last few years, and is now approaching that paid for electricity from conventional power plants.

When the market for electricity was privatized in 1990, the government imposed a charge on plants fired with fossil fuels as a means of making nuclear power more competitive. Of the resulting annual revenue of £1.2 billion, 94 per cent goes to the nuclear industry. But money from this nonfossil fuel obligation (NFFO) is also used to subsidize selected generators using renewable fuels, by forcing the regional electricity companies (RECs) to buy at a premium price all the power that the generators can produce over a period of fifteen years. The generators decide the premiums, but only those with the lowest prices are approved under the scheme.

Last December, when the Department of Trade and Industry announced 141 projects with a combined capacity of 630 megawatts that had been approved under the third NFFO round, it appeared that electricity prices had dropped considerably since the previous round in 1991.

Now, under the third round, generators that burn off methane from landfill sites will receive an average of 3.79 pence per kilowatt-hour, operators of waste incinerators 3.48p and wind developers 4.32p/kWh. In Scotland, for which a separate announcement was made, allowing thirty renewable projects, wind farm operators will be paid on an average 3.99 p/kWh. Wind power in fact answers for the most striking price fall – with an approximate halving over three years. The reason is thought to lie in bigger and more efficient turbines, together with the possibility of obtaining loans at better interest rates, following the good results shown by established operators.

The prices of energy from renewables are now close to the 3.2p/kWh that the Office of Electricity Regulation estimates the RECs pay for energy from coal-fired plants. They also straddle the 3.7p that Nuclear Electric reckons it would have to charge for electricity from Sizewell C, its proposed pressurized-water reactor in Suffolk.

Of still greater interest is perhaps the fact that most customers have to pay about 7p/kWh for the electricity from their RECs – which means there is a great opportunity for companies or local communities to save money by starting their own plants for producing electricity from renewable fuels.

PER ELVINGSON

Source: **New Scientist**, January 7, 1995.

SLOVAKIA

No need for nuclear

TWO INDEPENDENT STUDIES have concluded that the Mochove nuclear power plant is not the most effective means of meeting Slovakia's energy needs. "Not only is there no need to complete new plants but the dangerous reactors of the existing Bohunice power plant could be shut down by 1995," says Radko Pavlovec, author of an Austrian report on the energy situation in Slovakia.[1]

A Slovakian report, published in August 1994,[2] reached a similar conclusion; "Development of combined heat and power production is the least-cost option among three possible ways of providing the same heat and power outputs in Slovakia." The three ways considered were CHP, nuclear power, and condensing steam plants for power and heat.

Source: **AEGIS**, December/January 1995.

[1] "Alternative ways of meeting power needs in the Slovak Republic in the light of a withdrawal from nuclear energy" by R. Pavlovec, Global 2000 Research Institute, Flurschützstrasse 13, 1120 Vienna.

[2] "Possibilities for combined heat and power production in Slovakia" by Emil Bedi, Foundation for Alternative Energy, Gorkeho 6, 81101 Bratislava, Slovakia.

BRIEFS

Disappearing flowers

Lush mountain meadows brimming with lilies, larkspur, lupins, and wild sunflowers may disappear forever if global warming proceeds unchecked. Using infrared heaters, scientists from Berkeley University in California raised the temperature above alpine meadow at an altitude of 2920 metres in the Rocky Mountains. The rise so produced, carrying between 1.5 to 4.5°C, corresponds to that which will bring global temperature up to the levels expected in 2040 if the emissions of greenhouse gases are allowed to continue as at present. A dramatic change took place in the vegetation of the test meadow. The original ecosystem, characterized by a wide variety of flowering plants, gave way to scrub. Insects and microorganisms were also affected.

New Scientist, February 18, 1995.

East to harmonize

Environment ministries in Poland and Hungary held meetings last November to bring their environmental legislation into compliance with that of the European Union by 2000, the year by which they hope to have formalized their accession. "We want to be sure that environmental legislation will not be a hindrance," said Stanislaw Wadja, legal adviser to the Ministry of Environment, Natural Resources and Forestry. During 1995 a calculation of the cost of harmonizing Polish law and procedures with some EU directives will be made in a PHARE project, and the ministry will start to work out a detailed program. Projects using PHARE aid for policy development and harmonization of environmental laws are also planned for Hungary and the Czech Republic.

AEGIS, December/January 1995

Higher premiums

Higher insurance premiums may be one result of the greenhouse effect. Last winter's floods in Europe may have been due to global warming, according to a spokesman of the world's largest reinsurance company, München RE. Statistics are now showing a worldwide increase in violent storms and other natural catastrophes, a predicted accompaniment of climate change.

The German reinsurer's warning may have considerable effect on the market, not only by way of increased premiums, but also in a blank refusal of insurance for some geographical areas.

Natur & Miljö Bulletin, February 10, 1995.

BRIEFS

Wall cladding produces power

Solar power has taken a major step forward in Britain with the inauguration of the first building clad with photovoltaic cells and powered by them. The building, a refurbished office block at the University of Northumbria in Newcastle, will get one-third of its annual power needs from an array of PV modules on its south face. Covering 280 square metres and with a maximum output of 40 kW, this array is one of the largest building claddings in Europe. Although the electricity it generates will be far more costly than any produced by traditional means, supporters of the technology believe that PV-clad buildings will be economically viable in Britain within 10-30 years. The project is 40-per-cent subsidized from the EU's THERMIE program.

ENDS Report No. 240, January 1995.

Making electric cars competitive

This year two French car makers, Peugeot and Renault, will start marketing electric cars. To make them competitive, the difference in price between electric and petrol-driven models will be made up by the manufacturers and the French government. The state subsidy is likely to be 20,000 francs per vehicle, and 2500 cars are expected to be sold during this first year. The target for 1998 is 10,000 vehicles. Several municipal authorities are now considering hire projects for electric cars.

Ny Teknik, No. 50-51, 1994.

Pollution credit swap

In the first deal of its kind, two American power companies have agreed to swap "credits" that give them the right to pollute the atmosphere. One party in the deal, the Arizona Public Service Company, has earned credits "worth" 25,000 tons sulphur dioxide by reducing its emissions by that amount. It has agreed to swap these for 1.75 million tons of carbon dioxide credits owned by the Niagara Mohawk Power Corporation in New York State. While Arizona Public Service will hang on its CO_2 credits, Niagara Mohawk will donate its SO_2 credits to an environmentalist organization, which will "retire" them. The Niagara Mohawk will earn a $1 million tax deduction for its donation. That money will be used to finance more projects to reduce greenhouse gases in the United States and other countries.

New Scientist, November 26, 1994.

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BICYCLES

Coming into favour in many places

SOME 108 MILLION BICYCLES were produced worldwide in 1993, outstripping global automobile output by nearly three to one. Following a 1988 surplus that forced the industry to stockpile some 13 million bicycles and to scale back production for two years, the resumed climb in output since 1990 largely reflects economic recovery in China.

China's image as the Bicycle Kingdom suffered a jolt in 1993, when officials in Guangzhou and Shanghai announced their intention of banning bicycles from certain thoroughfares in order to make way for cars and trucks. But in a country with some 250 bicycles for every automobile and with little space for widening roads, such decrees are hard to justify, let alone enforce. At least in Guangzhou, the mayor – blasted by an immediate public outcry – was forced to alter his proposed ban.

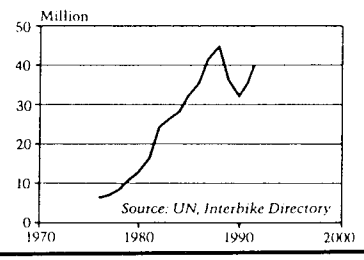
In other developing countries, a long history of government discrimination has failed to dislodge the bicycle as the most widely used vehicle for transport. In many cities in Asia, pedal power – including cycle rickshaws – accounts for 20-60 per cent of people's trips.

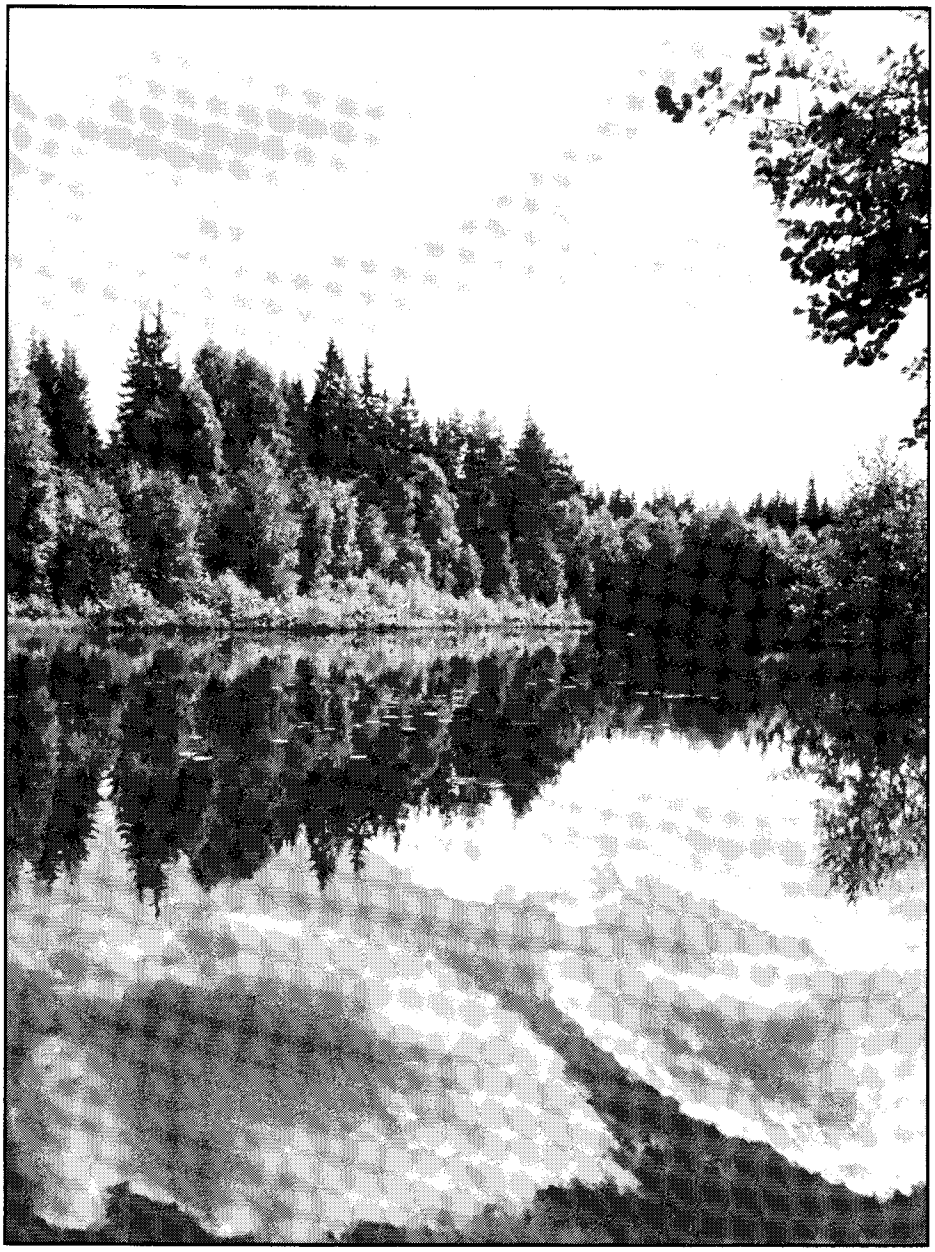
Largely because of rising oil prices and growing environmental awareness, bicycle use is on the increase even in countries with a high rate of car ownership. In such cases much depends on the infrastructure. In the United States, where the bicycle has long been ignored as a means of transportation, federal law now requires every state to appoint a bicycle coordinator, and each state and metropolitan area to have a long-range bicycle plan. New flexibility for the provision of bicycle facilities has also been given to state and local authorities by allowing them to use much of the federal funding that was formerly reserved for highways.

In Lima, Peru, and Rio de Janeiro in Brazil, officials are aiming to reduce smog and improve transportation efficiency by building cycle tracks, subsidizing purchases of bicycles for low-income workers, and educating people as to the advantages of cycling.

Source: **Vital signs 1994 – trends that are shaping our future.** Published annually by the World Watch Institute, 1776 Massachusetts Ave. NW, Washington DC 20036, USA.

World bicycle production, 1950-1993.





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Produced by
The Swedish NGO Secretariat on Acid Rain
Box 245, S-401 24 Göteborg
Sweden
Phone +46-(0)31-15 39 55
Fax. +46-(0)31-15 09 33

The Secretariat is organized by
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

So much and no more

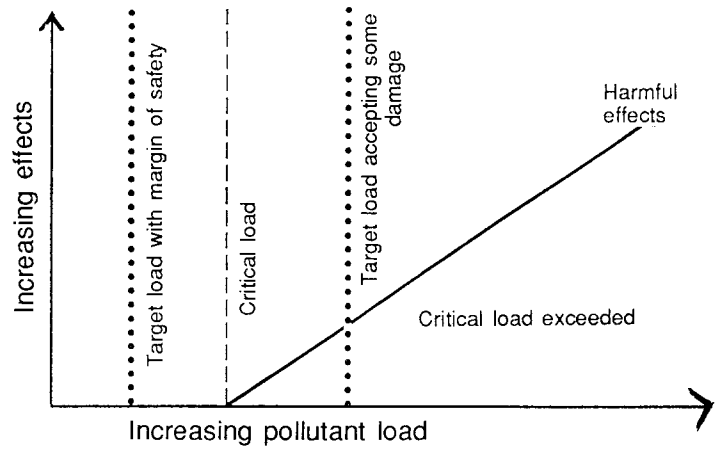
In order to determine the extent to which the emissions of air pollutants will have to be reduced, if the environment is to be protected from damage, it is essential to know the limits to nature's tolerance.

Critical loads

Various attempts have been made since the late 1970s to calculate the tolerable levels for acid deposition – later to become known as "critical loads." Then in 1986 an international scientific workshop on critical loads for sulphur and nitrogen produced this definition: "The highest load that will not cause chemical changes leading to long-term harmful effects on the most sensitive ecological systems" (1).

It can be said that in a strict sense a critical load, according to that definition, is one that does not produce any effect on the most sensitive receptor

Figure 1. Critical loads and target loads.



even in the long term. Receptors may be individual species, types of soil, ecosystems, etc.

In 1988 the UN ECE Convention on Long Range Transboundary Air Pollution (CLRTAP, see factsheet No. 3, April 1993) adopted the critical-load concept, making it basic to the future development of international agreements concerning limitation of the emissions of air pollutants. As work within the Convention has proceeded, various alternative definitions of a critical load have been tried, the most favoured one being: "A quantitative estimate of an exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge" (2). As a definition this is however hardly satisfactory, since it allows too much room for interpretation.

Target loads

Also appearing in political negotiations aimed at the reduction of emissions is the term "target load." While determined essentially in accordance with the critical-load concept, target loads take other aspects into consideration as well, such as national environmental objectives. They may therefore be higher or lower than the critical loads, depending on the manner in which the situation is judged in different cases. They may be set lower, for instance, in order to leave a margin of safety, thus following a practice that is standard in the medical field. Target loads may on the other hand be allowed to be higher, which means in effect a deliberate acceptance of a certain degree of environmental damage, or risk of damage (see Figure 1). When set higher, they may be regarded as interim targets, reflecting the need for a stepwise approach to the reduction of emissions. In which case they should later be progressively reduced to a level at or below the critical load.

Scientific agreement

In the spring of 1988, two major international scientific conferences were held on the subject of critical loads. One was concerned with sulphur and nitrogen depositions (3), the other with atmospheric concentrations of gaseous pollutants (4). Later follow-up meetings included those in 1992 on nitrogen (5) and gaseous pollutants (6), another in 1993 on effects on materials and on ozone (7), and a fourth in 1994 on nitrogen (8).

The conclusions from these various meetings are summarized below. It should be kept in mind, when considering them, that the proposed critical-load figures have always tended to be set successively lower as research methods improve and more data becomes available. It is thus not unlikely that today's critical loads will also be revised downwards.

Acid deposition: sulphur

The critical load for acid deposition will depend on the buffering capacity of the soil – on how quickly the minerals in the soil can be freed by weathering, and so enabled to neutralize the acid.

One effect of soil acidification is to impoverish the soil's nutrient status, according as base cations, such as potassium, calcium, and magnesium, are leached out of it. This may in turn result in nutrient deficiencies and imbalances, which

Table 1. Critical loads of acid and sulphur in relation to the weathering capacity of forest soils

	Minerals controlling weathering	Usual parent rock	Acid input (keq $H^+/km^2 \cdot yr$)	Sulphur deposition kg S/ha • yr)
1.	Quartz K-feldspar	Granite Quartzite	<20	<3
2.	Muscovite Plagioclase Biotite (<5%)	Granite Gneiss	20-50	3-8
3.	Biotite Amphibole (<5%)	Granodirite Greywakee Schist, Gabbro	50-100	8-16
4.	Pyroxene Epidote Olivine (<5%)	Gabbro Basalt	100-200	16-32
5.	Carbonates	Limestone	>200	>32

are thought to be among the causes of forest decline in Europe.

Another effect is to increase concentrations of potentially toxic metals, such as aluminium, in the soil water. This is especially the case when the pH of the mineral soil has fallen below 4.4. Increased soil-water concentrations of aluminium can produce damage to trees' roots, and aluminium ions, when leached out into lakes and streams, can become transformed and so toxic to organisms such as fish.

In lakes and streams the biological effects of acidification can in any case be extensive. The diversity and number of aquatic species diminish, with greatly changed and impoverished ecosystems as a result.

Table 1 shows the critical loads for various types of soil, calculated a) for the total input of acid, and b) for a corresponding quantity of sulphur. By way of explanation, a kiloequivalent of hydrogen ions per sq kilometre corresponds to 0.16 kg of sulphur per hectare. In any effort to protect a given area from acidification, the total acid input must however be taken into account. In the table the figures for sulphur assume sulphur to be the only cause of acidification. Should nitrogen also be a cause, the soil will be able to tolerate less sulphur than is there indicated. The limits will have to be lowered, too, if other acidifying processes, such as the removal of biomass in forestry operations, also have to be taken into consideration.

As regards forest soils, the critical load for sulphur in the most sensitive areas is at the most 3 kg per hectare per year. Since the critical loads for surface waters and ground waters are usually determined by the sensitivity of the surrounding soils, they are often about the same for both. If the deposition is higher than the critical load, the system will suffer long-term acidification. From mapping it has appeared that in 1990, the critical depositions of sulphur were being exceeded over nearly one-third of Europe. (See also pages 6 and 7 on mapping.)

The depositions of sulphur vary greatly however from one region to another in Europe. Where emissions are very great, as in parts of the Czech Republic, the deposition may reach 100 kg S/ha a year, as against 20-40 kg/ha in much of the rest of Central Europe. Whereas in the forest areas of southern Scandinavia the depositions may amount to 20-30 kg/ha, in the far north they are only about 3 kg/ha a year.

Nitrogen

Nitrogen can cause over-fertilization (eutrophication) as well as acidification of ecosystems. It is this dual effect that has made critical loads more difficult to define – than it is, for instance, if only the effects of sulphur have to be considered. Furthermore, the critical loads for nitrogen will depend on a variety of factors, including ecosystem productivity, the activity of microorganisms in the soil, and the composition of the vegetation.

Eutrophication is a frequent occurrence, since most terrestrial and some inshore ecosystems are nitrogen-limited and thus additional nitrogen coming into the system will be quickly taken up by organisms (plants, trees, plankton) and usually stimulate their growth. This commonly leads to ecosystem imbalances, in the form of changes in nutrition, competitive relationships, and resistance to insects, fungi, and stress from temperature and drought. These changes can almost all be regarded as adverse. Excess growth from eutrophication may also mean that more nutrients/base cations may be taken up by plants and trees, thus impoverishing and acidifying the soil still further.

Acidification occurs in soil when most of the system is saturated with excess nitrogen that can no longer be bound or retained by biological matter. Nitrogen in the form of nitrate (NO_3^-) will consequently leak from the system, taking with it nu-

trient (alkaline) base cations such as calcium and magnesium (Ca^{2+}, Mg^{2+}), and thus acidifying the soil. Acidification may also occur in non-saturated soils during winter when the vegetation is not taking up nutrients.

In terrestrial ecosystems the critical loads for nitrogen are usually defined with reference to forest soils, the intention being to preserve ecosystem stability in the long term, or at least not to reduce the vitality of forest trees. Using the simple mass-balance approach, the critical load has been put between 3 and 20 kg N/ha/yr, according, among other factors, to whether the site is low productive or high productive. These figures are however probably too high, since they are based primarily on trees. If other vegetation also has to be considered, the critical load would probably have to be lower. For "natural" forests, with no biomass removal, the critical load should be 2-5 kg/ha/yr.

In the case of freshwaters, the effects of acidification arising from nitrogen deposition are usually of greater importance than those from additions of nutrient. It has been shown that in some areas of Europe, nitrogen deposition contributes significantly to the acidification of freshwater systems – especially in areas where there is little or no vegetation surrounding the lakes and streams, as in parts of Norway, northern Britain, and some alpine regions.

The critical loads for eutrophication effects on semi-natural ecosystems are mainly based on *observed* changes in vegetation, such as alterations in the composition of species. Such observations are of course only possible after the critical load has been exceeded – and sometimes only after that has been going on for a long time. Such empirically derived data can therefore be said to represent an upper limit for the critical loads. In Table 2 the critical loads are either given in ranges or expressed as a "less than" figure. This is because of the variation in sensitivity within the same type of ecosystem and/or the lack of data to enable a figure to be set for the upper limit. The critical loads of nitrogen for several types of ecosystem still have to be determined.

The average deposition of nitrogen over much of the Central European area is now 30-40 kg N/ha/yr. Over forest land in southern Sweden it is 20-30 kg/ha, and on coniferous forest in the Netherlands it may locally exceed 100 kilograms.

Gaseous forms

Instead of critical loads, the term critical levels is often used when speaking of gaseous pollutants. These have been defined as: "The concentrations of pollutants in the atmosphere above which direct adverse effects on receptors, such as plants, ecosystems or materials, may occur, according to present knowledge" (2).

Usually figures are given for one pollutant only. In fact however the air over Europe consists of a cocktail of substances, and it has long been known that in combination they can intensify each other's effect (so-called synergism). Thus if the synergistic effects are to be taken into consideration, the critical levels should be lower.

Ozone

Crops are believed to be particularly sensitive to ozone (O_3), but at present concentrations forest trees may also be damaged. At the conference in 1988 (4) critical levels were agreed for each kind of pollutant, including ozone.

The 1992 workshop (6) saw the development of a new concept of critical levels for ozone – it now being expressed as cumulative exposure over a threshold concentration, using the formula: (x) ppb-hours above (y) ppb baseline (ppb=parts per billion: 1 ppb=2 $\mu g/m^3$). At a workshop in 1993 (7) the threshold level was set at 40 ppb (referred to as AOT40, accumulated exposure over a threshold of 40 ppb).

In respect of crops the critical level for ozone only relates to daylight hours during a three-month growing season, usually May-July. The long-term critical level has been set at AOT40 values of 2600 ppb-hours or 5300 ppb-hours, according to what is regarded as an "acceptable" loss in yield. Experiments have shown that such exposures may cause yield losses – which are signs of a chronic effect – in the first case of about 5 per cent and in the second of up to 10 per cent. The critical levels for crops are

Table 2. Critical loads for nitrogen (kg N per hectare and year) to (semi-)natural terrestrial and wetland ecosystems.

Critical load		
Soft-water lakes	5-15	**
Mesotrophic fens	20-35	*
Ombrotrophic bogs	5-20	(*)
Calcareous species-rich grassland	14-40	**
Neutral-acid species-rich grassland	20-30	*
Montane-subalpine grassland	10-15	(*)
Lowland dry heathland	15-22	**
Lowland wet heathland	17-22	**
Species-rich heath/acid grassland	7-20	(*)
Upland Calluna moorland	10-20	(*)
Arctic and alpine heath	5-15	(*)
Acidic (managed) coniferous forests	10-50	**
Acidic (managed) deciduous forests	15-50	*
Deciduous calcareous forests	15-20	*

** reliable, * quite reliable, (*) best guess

Crops are believed to be particularly sensitive to ozone. Monitoring data shows that the critical levels agreed in 1988 are being exceeded over almost the whole of Europe.

derived primarily from the results of experiments with wheat.

Furthermore, a provisional short-term critical level was set at an AOT40 value of 700 ppb-hours accumulated over three consecutive days. If subjected to a higher exposure, sensitive species such as beans and clover may develop visible ozone injuries (show acute effects).

An AOT40 value of 10,000 ppb-hours has been proposed as a provisional critical level for forest trees. In this case the cumulative exposure should be calculated for 24 hours per day during a six month period, which should cover the trees' period of highest sensitivity. It should apply to both broadleaf and coniferous trees.

No critical level has been set for ozone effects on natural and semi-natural plant communities, although there is data for some individual species. At the workshop in Bern (7), it was stated that the effect of greatest concern would be changes in the composition of species, but that the existing data was still insufficient for setting critical levels. Results from some experiments suggest however that changes in species composition could occur at values of AOT40 similar to the critical level for crops that has been given above.

Ozone is formed in the troposphere as a result of reactions between nitrogen oxides and volatile organic compounds (VOCs) in the presence of sunlight. Monitoring data shows that the critical levels agreed in 1988 are being exceeded over almost the whole of Europe. For example, in the period 1985-87, the "old" one-hour critical level of 150 micrograms per cubic metre ($\mu g/m^3$) was shown to be exceeded at about 75 per cent of the measuring stations in western Europe. The "old" eight-hour and the seasonal mean critical levels were exceeded at all of the stations (9). Computer modelling has shown that a reduction of at least 75 per cent of the emissions both of nitrogen oxides and VOCs will be needed if critical concentrations are not to be exceeded.

Sulphur dioxide

The atmospheric concentrations of sulphur dioxide (SO_2) that are critical for forest ecosystems and natural vegetation have been put at 10-20 $\mu g/m^3$ both as an annual mean and a half-year (October-March) mean. For agricultural crops the critical level is 30 $\mu g/m^3$ both for annual and half-year means. The most sensitive species are believed to be certain lichens, which may be damaged at annual means as low as 10 $\mu g/m^3$.

In some parts of Europe, particularly the eastern and central, these critical levels are being greatly exceeded.

Nitrogen oxides

Nitrogen oxides (NO_x) are generally regarded as less toxic to plants than sulphur dioxide and ozone. Because of its relatively low toxicity, no critical levels have been set for NO_x alone, but only in combination with O_3 and SO_2, assuming that the concentrations of the two latter pollutants are each below the critical levels noted above. The aim of the critical levels defined for NO_x is to protect the structure and functioning of the plant community. The maximum annual mean for NO_x (NO and NO_2 added together and expressed as NO_2) would then be 30 $\mu g/m^3$ and the peak level 95 $\mu g/m^3$ (average 4-hour exposure).

These levels are likely to be exceeded only in urban areas or their vicinity.

Ammonia

Direct damage from ammonia occurs primarily in farming areas with intensive stock-keeping. The yearly, monthly, 24-hour, and hourly mean values for critical concentrations are 8, 23, 270 and 3300 $\mu g/m^3$

Effects on materials

The deterioration of materials caused by atmospheric pollution is a cumulative and irreversible process, although some deterioration may take place even in the absence of pollutants. It has been proposed, in discussion of the possible critical levels, to define an "acceptable rate of deterioration" which would be linked to pollution values (10). No such rate has been agreed, but it has been suggested that for trial purposes values between 1.2 and 2

times the rate of corrosion in pristine areas could be used.

Provisional dose-response functions for a number of materials, such as carbon steel, zinc, copper, and limestone, exist for sulphur dioxide. By using data on the annual mean SO_2 concentration, the rates of deterioration at different sites and for various types of material can be calculated, and areas where the acceptable rate of deterioration is exceeded identified. For each such mapping unit, the SO_2 concentration that would keep this rate at an acceptable level – the critical level – can then be calculated.

The impact of ozone on organic materials, such as rubber, pigments, and various polymers, was also considered, and a provisional critical level of 20 ppb has been chosen.

Mapping of critical loads

Mapping of critical loads for air pollutants goes steadily on. The maps are used particularly when international agreements are being negotiated for reducing emissions of sulphur and nitrogen oxides. The latest maps to show the critical loads for acid depositions in general and sulphur in particular have now been published in a report from the Coordination Center for Effects in the Netherlands (12).

The data on which the maps are based derives principally from the individual reports of fifteen countries, which are printed separately in an annex to the report. The standard method for the actual mapping was developed by the Task Force on Mapping of the UN-ECE Convention. Where national data is lacking, European data is used for assessing the critical load for acid on forest soils.

The critical load for acid deposition equals to the amount of acid – expressed as acid equivalents per hectare per year – that can be absorbed by the soil without causing harmful long-term effects on the ecosystems. From the Coordination Center's maps it appears that it is the northern and central parts of Europe that are especially sensitive to acid deposition. About 15 per cent of the European land surface falls, too, into the most sensitive category – in other words, can at the most withstand a deposition of 200 acid equivalents per hectare per year (eq/ha/yr). In terms of sulphur, that amounts to 3.2 kilograms S/ha/yr.

The critical loads data have been aggregated to 150 x 150 km grid squares by constructing cumulative distributions of critical loads for the ecosystems within each grid

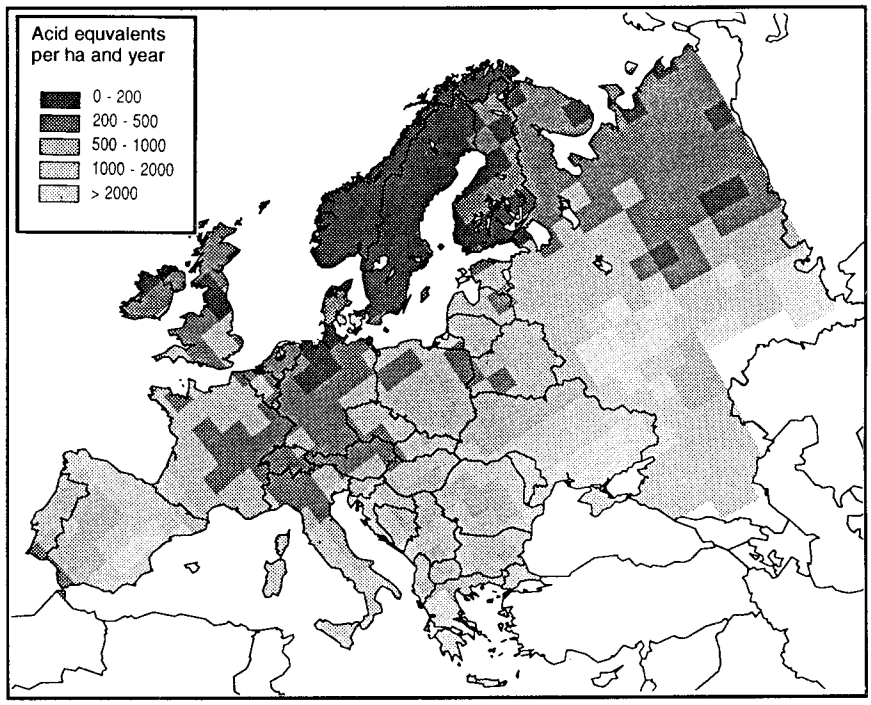


Figure 2. Critical depositions of sulphur: 5 percentile. The map shows the sensitivity of ecosystems – forest soils and surface waters – to sulphur deposition. The darker the colour, the more sensitive the area. The values are calculated to protect 95 per cent of the ecosystems in each grid cell.

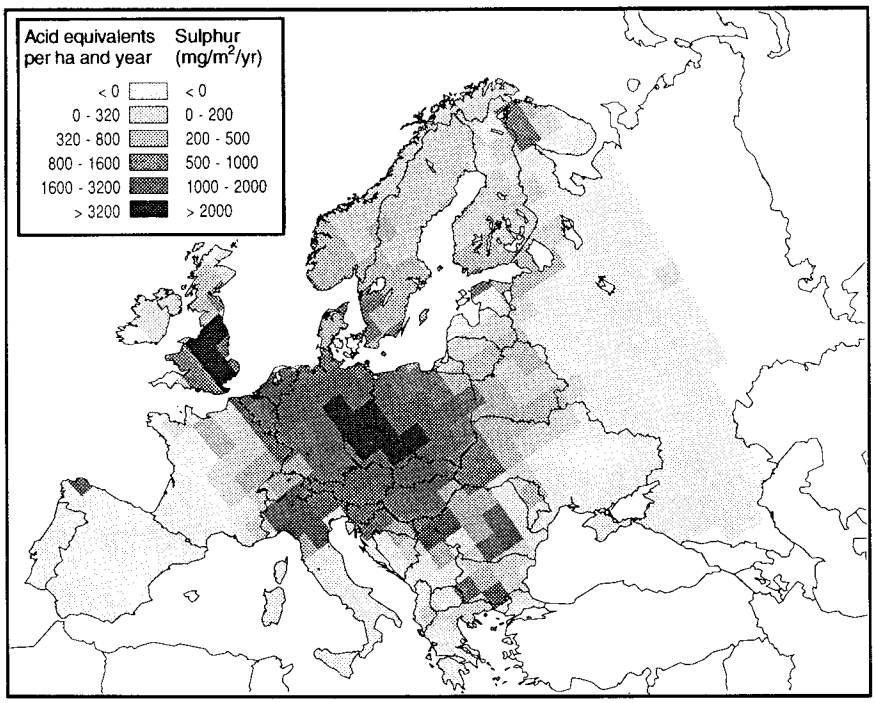


Figure 3. The degree by which critical sulphur depositions were exceeded in 1990 (5 percentile). The darker the colour, the greater extent to which the critical loads were being exceeded.

square. All the Center's maps are on a 5 percentile basis, which means that if the input of acid (or sulphur, in maps for sulphur) does not exceed the amount indicated by the square's colour, 95 per cent of the ecosystems within that grid cell will be safe from acidification. If a lower one, say 1 percentile, were used, it would show still more ecosystems being protected.

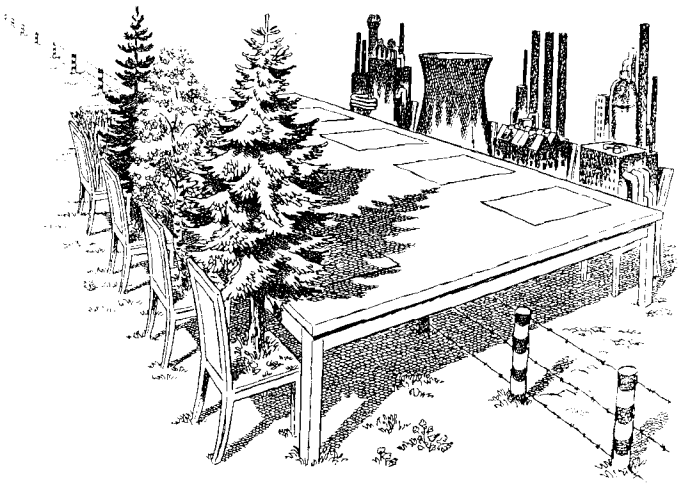
Calculations for critical loads for sulphur start with data on the critical load for total acidity, after which the acid deposition is apportioned between sulphur and nitrogen, the outcome being a map of the critical loads for sulphur.

There are however other factors affecting ecosystems' sensitivity. These are primarily a) depositions of base cations, which have a neutralizing effect and so lessen the sensitivity, and b) the take-up of base cations by vegetation, which has an opposite effect. Through the inclusion of these data, a map of the critical sulphur depositions can be obtained (see Fig. 2).

By comparing data on the ecosystems' sensitivity with data on the depositions of acidic pollutants, maps can be obtained which show where and by how much the critical loads are being exceeded – and so give information as to how much depositions, in other words emissions, need to be reduced. The map in Figure 3 shows the extent to which the critical depositions of sulphur were being exceeded in 1990.

There are proposals for a future international agreement covering both sulphur and nitrogen at the same time. In that case it would be necessary to take into account several effects, including eutrophication as well as acidification, and possibly also the formation of near-surface ozone. In practice it would then be possible to make trade-offs between sulphur, nitrogen, and ammonia.

A method for calculating and mapping the critical loads in such a situation is proposed in a separate chapter of the Dutch report.



Assembling scenarios

The idea of the critical loads approach is that emissions reductions shall be negotiated with an eye to the emissions' effects. The aim is to bring about reductions, in a cost-effective manner, so that eventually the critical loads for various pollutants will not be exceeded. Since the reductions will have to be large, it will be necessary to proceed step by step.

It is also assumed that BAT (Best Available Technique) standards will have to be applied, as well as various other measures, such as for the development of energy efficiency, if the necessary reductions are to be attained.

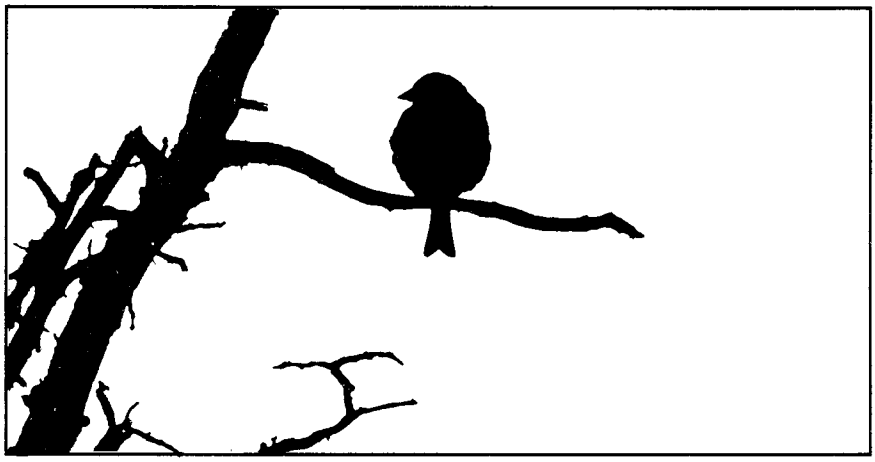
The information required for negotiating along these lines consists primarily of national figures for present and (probable) future emissions, estimates of the cost of measures to reduce emissions, data regarding cross-border exports and imports of air pollutants, and maps showing the spread and degree of the estimated critical loads.

For making reduction scenarios, as well as analyses of their cost and effects, computer models are used – the principal one being that known as RAINS, developed by the Institute for Applied Systems Analysis in Austria. Into this model are put the official figures for emissions, supplied by each country every year to the secretariat of the LRTAP Convention at the ECE in Geneva. Also fed in are estimates of the costs of various technical measures for limiting emissions, worked out by the IIASA itself.

There are also other integrated assessment models, which are used on the one hand for checking the RAINS results, and on the other for investigating alternative scenarios.

From EMEP (see factsheet No. 3, April 1993) comes data on transboundary movements and depositions of pollutants (such as sulphur). Data for critical loads is produced first by each country and then assembled, at the Coordination Center for Effects in the Netherlands, in maps covering the whole continent, which are also used in the RAINS model.

With information on the costs and effects of various scenarios, negotiators can then proceed with the framing of new international agreements for the reduction of polluting emissions.



What is required

A drastic reduction in emissions of air pollutants is urgently needed if the environment is not to be further damaged. In order to stop the ongoing deterioration, concentrations and depositions of air pollutants will have to be brought down to below the critical loads.

More than twenty European environmentalist organizations have, on the basis of up-to-date and internationally agreed scientific data on critical loads, agreed on the following as objectives in regard to the overall emissions of air pollutants in Europe (11):

☐ At least a 90 per cent reduction in emissions of sulphur dioxide.

☐ At least a 90 per cent reduction in emissions of nitrogen oxides.

☐ At least a 75 per cent reduction in emissions of volatile organic compounds.

☐ At least a 75 per cent reduction in emissions of ammonia.

☐ At least a 75 per cent reduction in the concentrations of tropospheric ozone, to be achieved by meeting the objectives for NOx and VOCs, as above.

The reductions are based on the emission levels in the early 1980s and refer to western and eastern Europe, including the European part of Russia.

These are minimum demands, but they do not necessarily imply that every country or region must achieve equal reductions. In areas with very high emissions, greater reductions will be necessary, while in some other areas the reductions may be allowed to be lower.

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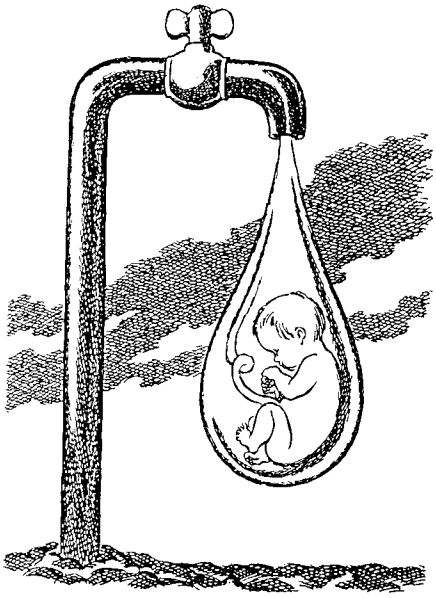
At risk and bringing risks

IN EUROPE and North America, groundwaters are being increasingly drawn upon as a source of water for domestic, industrial, and agricultural use. In the EU member states about three quarters of the population takes its supply from groundwater. While groundwater is thus tending to be ever more valuable as a resource, it is also becoming more liable to the unwanted effects, such as acidification, of other human activities.

Acidified groundwater can cause trouble, for instance, by corroding pipelines, but also by starting health risks. Although acid water is not in itself dangerous, it can increase the mobility of various poisonous metals – causing aluminium and cadmium to be leached out of the soil, and copper, zinc, and lead to be freed from water pipes.

Greatly increased releases of aluminium occur when the pH value of the groundwater drops below 5.5. According to some estimates, the reactive free aluminium (Al^{3+}), which is liberated when the water becomes acidified, poses a long-term threat to human health. It has been shown to be extremely toxic to aquatic organisms and plants. As yet, too little is known of the effects on human health to make it possible to set a limit to the permissible amounts of aluminium in drinking water. Investigations made by the Central Bureau of Statistics in Norway have however shown there to be a parallel between acidification levels, high concentrations of aluminium in drinking water,



and the death rate from senile and pre-senile dementia.

Lead is a problem particularly for Great Britain, where the water pipes are often made of it. According to estimates, the concentrations of lead in the drinking water of about five million people in that country exceed the EU recommendations. Lead is liable to harm the nervous system, especially in children.

Acidified groundwater appears first in places where the bedrock does not easily weather. The soil will consequently have little ability to neutralize the depositions of acid. If the depositions exceed the soil's buffering capacity, the groundwater will sooner or later become acidified. In glaciated regions with thin soil, such as in Europe and northern America, the location of sensitive groundwater can be roughly determined from maps of the bedrock geology.

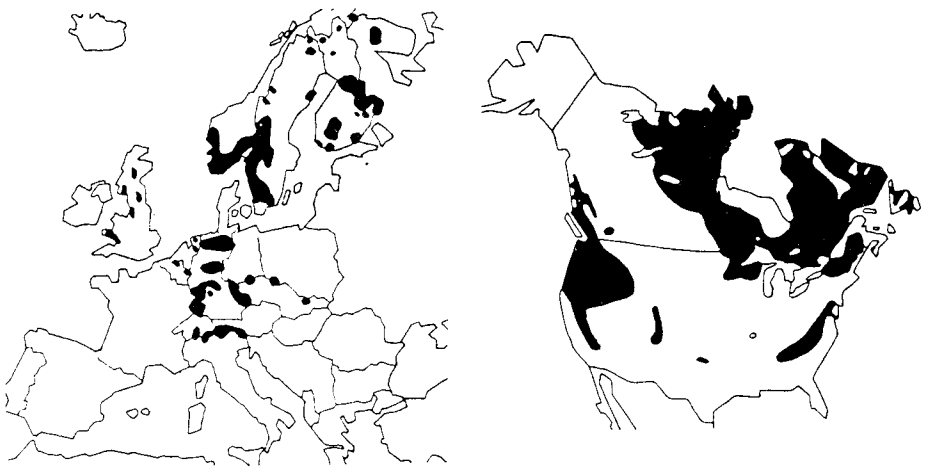
So far acidified groundwater has mostly been proven in southern Scandinavia, but acid depositions over large areas of central Europe and Canada constitute a serious threat.

First to be affected are the top layers of the groundwater, and thus a lot of private wells. As time goes on, however, municipal systems, which get their supply from greater depths, will also be subject to risk. But as soil acidification is a relatively slow process, varying greatly from place to place, actual developments are difficult to predict.

Although the general rate of acidification has now slowed down in Europe and North America, as a result of reductions in the emissions of sulphur dioxide, still further and more drastic reductions will be required to halt it entirely – and not only of sulphur dioxide. Nitrogen also contribute to acidification, to an extent that promises to increase. Continuous inputs cause soils and ecosystems to become oversaturated, and when the surplus leaks out it leaves the ground acidified. The groundwater can then be spoilt in two ways: by acidification, but also through raised concentrations of the poisonous compound, nitrate.

PER ELVINGSON

Areas in Europe and North America where groundwaters as well as surface waters are reported to be affected by acidification.



Source: **Possible impact of acid deposition on the quality of groundwater in the ECE region.** UN ECE 1994.

BRIEFS

Pollution in China

A top environment officer, Qu Geping, has said China's economy suffers a loss of 100 billion yuan (US$11.5 billion) a year from environmental pollution, and that further deterioration could derail rapid growth. He also revealed the goverment's intention of gradually increasing its allocations for environmental protection, now amounting to about 20 billion yuan, or 0.7 per cent of the gross national product. The increase will be funded from fines on polluters. Although 30 per cent more was collected in fines last year, Qu said factory managements often prefer to pay up rather than install equipment for pollution control. Revenues from fines last year amounted to 2 billion yuan, just 0.11 per cent of the value of China's industrial output.

Car Lines, M. Walsh, May 1994.

FGD technology

The Japanese company Hitachi has developed a new low-cost technology for flue-gas desulphurization, known as "fast horizontal FGD." This reportedly cuts sulphur dioxide emissions by more than 80 per cent, as compared with the 90-95 per cent of fairly similar units installed in Japan. Construction of the first test unit has already started and is due for completion at a 300 MW power station in the Chinese province of Shanxi early in 1997. The project is receiving assistance from the country's Green Aid Program, as well as the Power Supply Development Corp of Japan.

Sulphur, No. 231, March-April 1994.

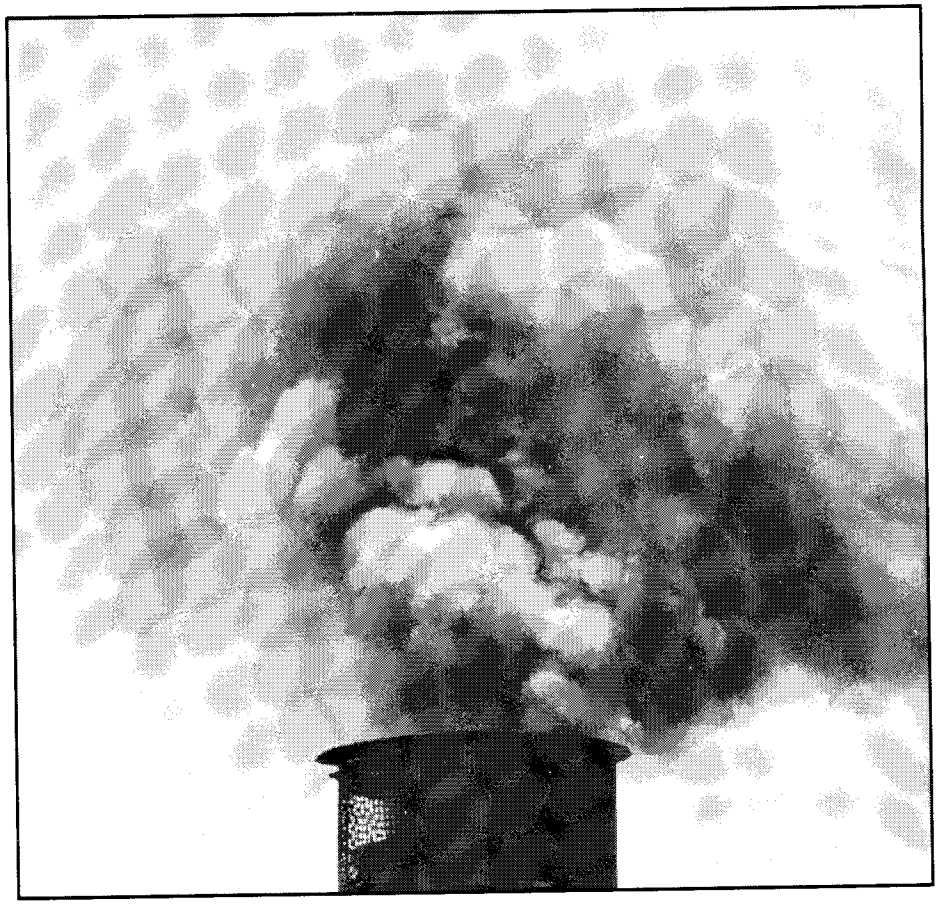
Two-stroke fuel injection

Lawn movers, chain saws, motorcycles, outboard motors, and other two-stroke engines are lightweight and cheap, but produce a lot of pollution. Soon, however, they can become cleaner, thanks to the development of a fuel-injection system for two-stroke engines. It is estimated that this will cut hydrocarbon emissions by up to 90 per cent, and those of carbon monoxide by 75 per cent, while fuel consumption will be lowered by a third. The solution has been developed by the German company Ficht. From 1996 the world's largest manufacturer of outboard motors, the Outboard Marine Corporation in Illinois, USA, will fit the system to all its motors.

New Scientist, December 3, 1994.

FAR EAST

Acidification looming as industry expands



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THERE IS A RISK of the emissions of acidifying air pollutants in the East Asian and Western Pacific region becoming doubled or even trebled in the course of the next two or three decades.

Apart from a few case studies, until recently little has been done to estimate the extent and likely effects of acidification in the region – the most significant development so far having been the formation of a multi-disciplinary group of scientists who are adapting the RAINS environmental assessment system for use in Asia (see AN 4/94, p.9).

Now however the WWF International has stepped in with an attempt to define the extent of the harmful emissions and the effects they may have. The results to date indicate that the subtropical and temperate rain forest and woodlands of southern China are most likely to be threatened. Other ecosystems found to be at risk include:

☐ The tropical humid forests of the Malay peninsula, Thailand, southern China (possibly including Taiwan), southwest India, and Sri Lanka.

☐ Tropical dry forests in Thailand and Sri Lanka.

☐ The mixed mountain systems of the southern Himalayas and southern Siberia.

☐ The temperate needle forests in southern Siberia.

☐ The temperate broadleaved forest in central China.

No damage to ecosystems comparable to that in Europe has yet been demonstrated. It is unclear whether this is because the cumulative deposition has not been as great as in Europe, or because the studies that have so far been undertaken have only been of limited extent. The WWF in any case emphasizes the need of money for research into the effects of air pollution in the region, and suggests projects that should be given priority.

The fund says that as a means of reducing emissions, attention should primarily be given to power generation, the worst offender. But in

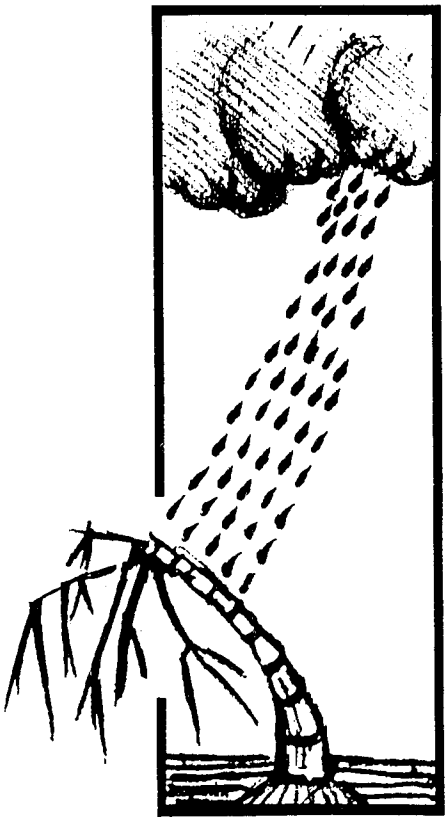
view of the limited resources of many of the countries in the region, it considers efforts should first be directed to energy conservation. Then as the local economies improve, measures such as changing over to better fuels and installing equipment for flue-gas cleaning would be in order.

The WWF adds however that the outlook does not appear favourable just now for any of the possible measures for curbing air pollution in the region, for the simple reason that all effort is concentrating on industrial expansion. Even under the best scenarios for energy conservation and fuel substitution, the emissions of acidifying pollutants would probably be twice as high in 2010 as they were in 1988. With persisting economic growth, they might even, as mentioned, become trebled in the next 20-30 years.

The actual situation can be gauged from the estimates in the table and the adjoining commentary.

PER ELVINGSON

Source: **Acid deposition and related air pollution: Its current extent and implications for biological conservation in Eastern Asia and the Western Pacific**. Research report by David J. Roser and Alistair J. Gilmour, published by World Wide Fund for Nature, CH-1196 Gland, Switzerland.



Emissions in the region

Northeast Asia is where the situation appears most critical. Comprising China, Hong Kong, Japan, north and south Korea, Mongolia, and Taiwan, this sub-region is the largest centre of population and economic development in Asia. Here the most serious air-pollution problems arise from the burning of high-sulphur coal to power China's industrial expansion. Although better control of acid-precursor gases may be obtained through energy efficiency, fuel substitution, and pollutant removal, the resultant gains will be more than offset by industrial growth.

Acid deposition has been recognized and studied, mainly in Japan and China. The area most clearly identified as being affected is the Sichuan basin in southwestern China. In data on other areas of the sub-region, some factors may be missing. It has been suggested for instance that the effect of acid deposition in northern China is being mitigated by the alkaline dust blown in from the Gobi desert.

South Asia, which includes Bangladesh, Bhutan, India, Myanmar, Nepal, Pakistan, and Sri Lanka, rivals northeast Asia in population but not in economic activity. Its relatively small contribution to regional emissions is largely due to the low sulphur content of Indian coal compared with Chinese. The emission figures may however be underestimates, since the contribution of biomass combustion has not been satisfactory assessed. As in northern China, the effects of acid deposition may possibly be moderated by alkaline aerosols, especially in Punjab and the western part of the Ganges plain, with dust coming from the Rajasthan desert.

Southeast Asia: Brunei, Indonesia, Singapore, Malaysia, Thailand, Cambodia, Laos, Vietnam, and the Philippines. Still an area with relatively low emissions of acid precursors. In common with northeast and south Asia it is however undergoing rapid growth, with trouble probably soon coming from acid deposition.

Oceania, consisting of Australia, New Zealand, Fiji, Papua New Guinea, the Solomon Islands, and several other small island nations, is responsible for 6 per cent of the acid precursors emitted in the region. Sources are in the main power generation and metal-ore smelting. Most of the emissions come from Australia, where the smelters at Mount Isa and Kalgoorlie together account for more than one million tons of sulphur dioxide a year.

Eastern Russia and Kazakhstan: Emissions in the former Soviet Union tend to be regarded more as part of the European problem. They are however substantial in the eastern part, adjacent to Mongolia and China. The eastern Siberian region is notable as having a per capita emission rate for sulphur dioxide of 300 kilograms a year.

There may also be substantial emissions of sulphur dioxide and nitrogen oxides from burning in connection with land clearance, although precise figures are lacking.

Anthropogenic acid-precursor emissions in the East Asia-West Pacific region (ca 1988).

	Sulphur dioxide		Nitrogen oxides	
Region	kilotons a year	%	kilotons a year	%
Northeast Asia	23,610	63	10,825	60
South Asia	3,552	10	3,970	17
Southeast Asia	1,955	5	1,627	9
Oceania	2,250	6	1,130	6
Eastern Russia & Kazakhstan	6,045	16	1,392	8
Net land clearance*	3,000	–	3,000	–
Total	40,412	100	21,944	100
Total projected for 1993	51,000	126	25,000	114

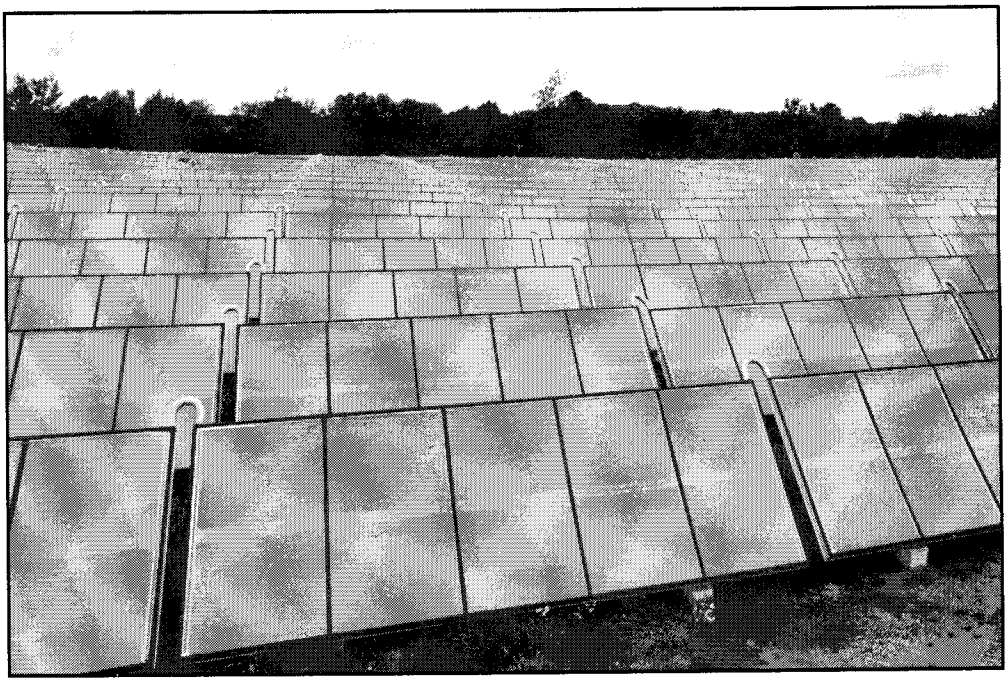
* Land clearance invariably involves burning of forests with the consequent release of nitrogen oxides and sulphur dioxide.

NORWAY

Solar energy comes to school

SOLAR ENERGY is now claiming attention at quite a number of schools in Norway – where a nationwide project is giving pupils a chance, through experiments and practical applications, to explore the possibilities of this form of energy.

Named simply "Solar energy in School," the idea got off to start in 1992, with the development of suitable measuring instruments and computer programs, as well as the training of a score of teachers who had volunteered to take it up. Each participant was provided with a set of instruments to take back to his or her school, and still more teachers have since associated themselves.



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The equipment consists essentially of a fairly inexpensive pyranometer, which measures the total radiation, direct and diffuse, falling on a given area. The temperature is measured by a thermometer, and all the information is entered in a computer (which is often put somewhere where it can easily be seen, in the hope of arousing pupils' interest). With the computer all the measurements can be sorted and presented in graphic form.

Each school's data is forwarded at regular intervals to the project centre, where national tabulations are made – thus enabling pupils to see how radiation intensity varies in different parts of the country. The figures also have a practical value, since radiation had previously been measured at only a few places in Norway. Then, too, collaboration with research institutions gives added status to the school work.

Besides being provided with equipment, each school receives a handbook with general information on solar energy, instructions for the use of various computer programs, lists of publications and individuals who can be contacted for information and advice, as well as suggestions for extended projects.

It may be mentioned, as examples of the last, that pupils have made sub-scale solar panels, solar heated stoves and grills, and small electric generators using solar cells. Such follow-up projects also help to make them aware of the best times of the year for using the various kinds of solar apparatus, how much useful energy can be got from any plant and at what price.

Giving pupils the chance to explore possibilities of this energy form

Through the network that the project has provided, pupils and teachers can gain inspiration and ideas from others all over the country, reinforced by regular get-togethers on a national scale. Moreover the handbook not only gives information on Norway, but also on the possibilities of using the technology in other countries with other kinds of climate and differing economic and technical status.

In which connection it may be of interest to note that at present there are more solar power installations in Norway, where 80,000 vacation cabins are so equipped, than in the whole of Africa.

PER ELVINGSON

The above information has been taken from a book entitled *Solsverige 1995*. The Norwegian project is being financed largely by the department of education and as part of the state solar energy program. Further details can be obtained from the Department of Education, P.O. Box 8119 Dep., N-0032 Oslo, Norway.

Towards a sustainable Europe

Friends of the Earth Europe has released *Towards sustainable Europe Report and Handbook*, as a first phase of its Sustainable Europe Project. The report contrasts the present levels of resource consumption in Europe with the amount of "environmental space" available in the year 2010. Environmental space is the total amount of non-renewable resources, agricultural land, and forests that may be used globally without reducing the access to these resources for future generations. As a second phase of the project, already under way, twenty-six environmentalist groups in Europe are expected to compile national reports, based on the guidelines in the handbook.

Further information: Teo Wams, Friends of the Earth Netherlands, Damrak 26, 1012 LJ Amsterdam, the Netherlands.

RUSSIA

Surface waters also affected

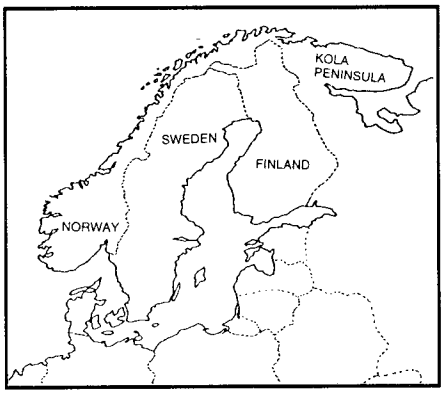
IT HAS LONG BEEN KNOWN that the Kola peninsula, in Russia's extreme northwestern corner, is a heavily polluted area. Every year its big smelting plants pour out more than 500,000 tons of sulphur dioxide, as well as considerable quantities of metals. Dead forests and health problems are no longer news, and the pollution is affecting adjoining areas of Norway and Finland too. It can therefore hardly be a matter of surprise to hear that the surface waters have also been found to be to a great extent acidified.

Finnish, Norwegian, and Russian scientists have lately been mapping the area's sensitivity to acid deposition: in other words, determining critical loads. The geological and climatic conditions do in fact make the peninsula extremely sensitive. According to preliminary calculations, 48 per cent of the surface waters are receiving a greater amount of acid than they can neutralize.

Acid depositions on Kola now average 7-10 kilograms per hectare a year, although locally, near the emission sources, they can go up to 300 kilograms. In the vicinity of the sources the effect of the sulphur is however counteracted to a certain extent by huge depositions of dust, which in addition to various metals contains alkaline matter.

The only way to reinstate the peninsula's surface waters to their pre-industrial state will be to reduce acid deposition by 95 per cent, it seems.

Source: **Acidification and critical loads in surface waters: Kola, northern Russia**. By Tatjana Moiseenko. Ambio, Vol. 23, November 1994.



FINLAND

Keeping up aid to east

DESPITE A DIFFICULT economic situation, Finland is still managing to maintain its aid for environmental projects in eastern Europe at previous levels – with a total allocation of 50 million marks in the year's budget. For some years the Finnish ministry of environment has been giving support to projects in sixteen areas of Russia and Estonia.

A condition for such aid is that the projects shall have an improving effect of Finland's own environment, and also that they shall employ Finnish technology. The environment ministry refunds up to half of any Finnish contractors' costs. Thus the expenditure not only contributes to improving the region's environment, but also to providing jobs in Finland itself. Although many of the larger projects are still only at the drawing-board stage, between 5000 and 10,000 jobs have already been created.

Among the projects, both started and planned, are many aiming to reduce the emissions of air pollutants from industrial plants and power stations. Modernizing the big power plants at Narva in Estonia, and equipping them for flue-gas cleaning, will, it is hoped, reduce their emissions of sulphur by 70-90 per cent. Another project for Estonia that is being given high priority is the substitution of natural gas as fuel in Kothla-Järve, instead of the excessively polluting oil shale. Measures to curb emissions of sulphur are also being supported in Karelia.

Source: **Finlands Natur**, No. 2, 1994.

Recent publications

Memorandum on transport and environment to the European Parliament (1994)
Outlines the major environmental issues in current European transport policy – some that are likely to come before the EU parliament in a near future, others that should, according to T&E, be given priority on the political agenda.

16 pp. Report 94/14. Available free of charge from T&E, Rue de la Victoire 26, 1060 Brussels, Belgium.

Opportunities for environmentally friendly development of Bulgarian industry (1994)
By Tzvetana Dimitrova. A study of industry's emissions of pollutants affecting air, soil, and water, with a debate on the possibilities of bringing about an environmentally sustainable development concurrently with a change-over to a market economy.

78 pp. Published by Green Future, Bul. Gotze Delchev 7, Sofia 1612, Bulgaria.

Environmental cooperation in Europe – the political dimension (1994)
Edited by O. Höll. Leading European experts analyze the theoretical and practical aspects of environmental cooperation. The editor concludes that to be effective, policy must take into account countries' varying resources, and that those more rich in resources must accept a larger share of the burden of responsibility.

300 pp. Published by Westview Press, 36 Lonsdale Road, Summertown, Oxford, England OX2 7EW.

Joint Implementation from a European NGO Perspective (1994)
By Climate Network Europe. Presents a statement on joint implementation of carbon dioxide reductions by thirty European NGOs dealing with climate change. Scientific background documents are also included.

59 pp. Can be ordered from Climate Network Europe, 44 rue du Taciturne, 1040 Brussels, Belgium. Fax +32-2-230 5713.

Liming of acidified surface waters: a Swedish synthesis (1995)
Edited L. Henriksson and Y.W. Brodin. Sweden has employed large-scale liming to counteract the acidification of surface waters. The scientific results published here show that the measures taken have resulted in substantially improved conditions in lakes and streams.

458 pp. Published by Springer-Verlag. ISBN 3-540-58505-2.

Boreal forests may be threatened

A PROFOUND disruption in the earth's climate is now under way – a disruption with immense implications for the future of the boreal forest. Without urgent action, catastrophic climate change may soon destroy up to 90 per cent of the global boreal forest, the earth's largest ecosystem and the home of more than one million indigenous people.

The boreal forest is a violent ecosystem, driven by vast disturbances in the form of fires, storms, and insect outbreaks. Boreal landscapes are made up of a complex patchwork of diverse tree stands and peat bogs, each bearing unique scars from its own tumultuous history.

The frequency of disturbances, especially of fires, plays a fundamental role in determining the distribution of species in the boreal forest. In cooler, moister areas with an average of 100 years between fires, fir and spruce tend to dominate. When fires occur more often – between every 50 and 100 years – the faster-growing, more fire-tolerant pines prosper. Still more frequent fires give the edge to aspen and birch. When fire returns more often than once every 10 years, no tree species can sustain itself and the area becomes grassland.

Fires are intricately interconnected with storms and insect outbreaks – the other major natural boreal disturbances. Storms are associated with lightning, the major cause of large boreal fires, and can cause blowdown – uprooted and damaged trees over wide areas – which can create enormous amounts of fuel. Gale-force winds can turn ordinary fires into a vast conflagration that consumes millions of hectares. Insect outbreaks can kill trees over a wide area, creating more fuel. Insect populations thrive in fire and wind-damaged stands.

The frequency and extent of boreal disturbances is largely determined by climate. Fires normally occur during warm, dry weather. Warmer weather also increases the number of thunderstorms, tornados, and lightning strikes. Regions in the southern boreal forest with longer growing seasons support insect populations that could not develop farther north.

It is the influence of climate over boreal disturbances that largely determines the location and structure of the boreal forest. Individual trees can grow both north and south of the natural range of the forest, but larger stands outside this range are much more susceptible to disturbances and competition from other species.

Abrupt temperature increase could cause a decline of 50-90 per cent

Relatively small changes in global climate have had profound effects in the past on the location of the boreal forest. During the last ice age about 18,000 years ago, with a global temperature only about 5 degrees Celsius cooler than today's climate, in North America the boreal forest reached as far south as Kansas and Nebraska.

For millions of years, a naturally occurring "greenhouse effect" has played a crucial role in the development of the earth's climate. Greenhouse gases in the atmosphere, such as carbon dioxide and methane, have trapped heat radiated from the earth in response to sunlight. Without the natural greenhouse effect, the earth's average temperature would be 18°C below zero and the earth would be a lifeless, frozen wasteland.

For at least 160,000 years before the industrial revolution, atmospheric levels of carbon dioxide never exceeded 300 parts per million. Since 1850, however, carbon dioxide levels have risen by about 25 per cent, primarily because of the burning of fossil fuels and widespread deforestation; methane levels have increased by 100 per cent, and nitrous oxide by 15 per cent. In 1992, the levels of carbon dioxide reached 355 parts per million. Some degree of climate change is thus already inevitable.

Without urgent action by industry and governments, however, levels of

carbon dioxide may rise to 600 parts per million in less than fifty years. At this concentration, there is a very real risk of catastrophic climate change, with profound implications for both the environment and human health.

There are alarming signs that this climate change has already begun. Studies suggest that the area of forest burned has increased by 400-600 per cent over the last two decades in both Canada and Russia. Tornado frequency has increased in Canada by 400-500 per cent over the same period of time. Three major spruce-budworm outbreaks have hit the North American boreal forest during the 20th century, in 1910, 1940, and 1970. Each outbreak has defoliated twice as much forest as the outbreak before it. If this trend continues, the next outbreak, which is expected to begin by the end of the century, could affect 100 million hectares of forest.

These recent changes in frequency of disturbances have been associated with only a small amount of global warming – about 0.5°C over the last century. The Intergovernmental Panel on Climate Change, the body of experts set up under the UN Climate Convention, projects temperature rises three to nine times higher than this over the next few decades. Recent research by forest-climate researchers suggests that such an abrupt increase in temperature could cause the decline of 50-90 per cent of the existing forest. While the models predict that some new forest would grow on what is now tundra, this migration would be likely to take place much more slowly than the massive forest die-off sparked by warmer weather, drought, and increase in disturbance and stress. As a result, billions of tons of carbon would be released into the atmosphere, speeding up the rate of climate change still further.

KEVIN JARDINE
GREENPEACE CANADA

Peat burning's effects on the climate

PEAT has long been used as a source of energy, primarily for indoor heating. Today Finland leads the world in peat extraction, followed by Ireland, Russia, and Sweden.

Opinions have varied as to peat's contribution to the greenhouse effect. The question is complicated by the fact that the extraction of peat alters the environment in a complex manner, with consequences for the exchange of carbon dioxide as well as other greenhouse gases, in particular methane. A key issue is how to compare the positive and negative contributions from such modified exchange rates and from the combustion process itself.

Peat producers maintain that extraction reduces the natural emissions of methane from wetlands, thus compensating the emissions of carbon dioxide resulting from the burning of peat.

Two Swedish scientists, who have studied the matter for the account of the Environmental Protection Agency, have come to the conclusion that only 15 per cent of the emissions of carbon dioxide from the burning of peat are compensated through the reduced emissions of methane that result from peat cutting. They have concluded that in a long-term view of several hundred years or so, peat must be regarded as a fossil fuel. Peat burning contributes less than coal to the greenhouse effect, but more than natural gas. Compared with oil, its effect is about equal.

While the calculations refer to peat bogs in south-central Sweden, data from other parts of the world were also taken into consideration. Comparisons between the changed volumes of carbon dioxide and methane were mainly based on the concept of Global Warming Potential, launched by IPCC, the Intergovernmental Panel on Climate Change.

PER ELVINGSON

Source: **Impact on greenhouse effect of peat mining and combustion**. By Henning Rodhe and Bo Svensson. Report 4369. Can be ordered from the Swedish Environmental Protection Agency, Customer Service, S-171 85 Solna, Sweden.

Further publications

Atmospheric heavy metal deposition in Europe – estimation based on moss analysis (1994)
Report from the Nordic Council of Ministers. Represents a first attempt to map depositions from the air of heavy metals over the whole of Europe. In contrast to previous studies, a significant decrease in the concentrations of most elements during the last decade was found in Scandinavia.

57 pp. Nord 1994:9. Can be ordered from CE Fritzes AB, 106 47 Stockholm, Sweden. Fax +46-8-20 50 21.

The structure and efficiency of energy use in a reforming economy – the case of Estonia (1994)
By Stockholm Environment Institute. The country's pollution problems, plus the reliance on imported oil and gas at world market prices, create an enormous incentive for improving energy efficiency in Estonia. A reduction in energy intensities of 25-50 per cent is said to lie within the range of possibilities.

94 pp. Available from SEI, Box 2142, S-103 14 Stockholm, Sweden. Fax +46-8-723 0348.

Reducing environmental pollution: looking back, thinking ahead (1994)
Despite decades of effort and investment to control pollution, the burden remains high in OECD countries. This report reviews national programs designed to achieve substantial, measurable improvements in environmental quality during the 1990s and beyond.

48 pp. Available from OECD, Publications service, 2 rue André-Pascal, 75775 Paris Cedex 16, France.

Impacts of nitrogen deposition in terrestrial ecosystems (1994)
Report by the United Kingdom Review Group on Impacts of Atmospheric Nitrogen, prepared at the request of the Department of Environment. Outlines current scientific consensus in regard to emissions, atmospheric transport, deposition to terrestrial surfaces and impacts on vegetation, soils, and freshwaters. It also reviews the evidence for direct effects of gaseous nitrogen compounds, and summarizes the current situation as regards the mapping of critical loads and levels for nitrogen.

110 pp. Can be ordered from Department of Environment, Technical policy branch, air quality division, Rm B356, Romney House, 43 Marsham Street, London, England SW1P 3PY.

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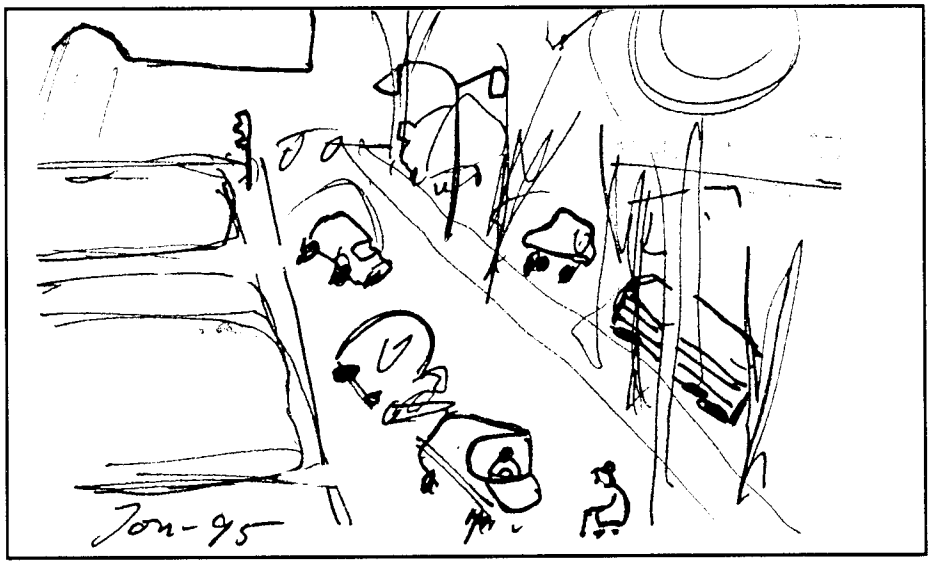

JON SUND

CLIMATE AIMS

Will remain unfulfilled

NONE OF THE COUNTRIES of the European Union will achieve stabilization of its emissions of carbon dioxide between 1990 and 2000, according to a report from the DRI/McGraw Hill consultancy in Paris, which was issued just before the international meeting on climate in Berlin.

Whereas west European emissions of carbon dioxide will, according to the report, in general be 6.4 per cent higher than they were in 1990, the increase for the EU countries will stay at 5.9 per cent. Then between 2000 and 2015 there will be increases of 14.7 and 13.9 per cent respectively. The DRI analyses are based on the measures already taken or about to be taken by the individual countries.

The only countries in western Europe that will come anywhere near to achieving stabilization will be Germany and Belgium – although that will depend more on the effects of the business recession than on any active steps that they have taken to reduce emissions. For these two the DRI forecasts only small increases of 0.8 and 0.6 per cent – which contrasts curiously with Germany's aim of reducing emissions by 20-30 per cent between 1987 and 2005, and Belgium's to reduce them by 5 per cent in the period 1990-2000.

Only France, Ireland, and Spain can be expected, according to DRI, to achieve their own targets. There will however in every case be increases. Britain, which has repeatedly declared its ability to achieve stabilization, will, says DRI, actually increase its emissions by at least 4 per cent.

The transport sector is expected to have accounted for as much as 80 per cent of the increase in west European emissions by 2000. After that year however power generation will draw up alongside transportation as the other chief contributor to increases. This will be due, according to DRI, to a greater use of coal and oil in response to an increased demand for electricity, as well as to the shutting down of nuclear generators. The emissions from industrial and domestic sources will remain more or less unchanged.

Although a great expansion in the use of renewable fuels can be expected during this twenty-year period, it is not thought likely that they will account for much more than 3 per cent of fuel use in power generation up to 2015.

Source: **European Energy Forecast**. DRI, 8-10 rue Villedo, 75001 Paris, France.

Coming events

Climate Action Day, May 15, 1995.
International environmentalist networks, such as Action for Solidarity, Equality and Development (A SEED) are calling for a day of international action to protest against global warming. Further information can be had from A SEED EUROPE, P.O. Box 92066, NL-1090 AB Amsterdam, the Netherlands. Fax +31-20 665 01 66.

Transnational Investments in Eastern Europe. May 21-28, 1995. Strasbourg, France.
Inquiries: A SEED Europe, tel. +31-20 668 2236, fax +31-20 665 0166.

10th World Clean Air Congress. Espoo, Finland, May 28-June 2, 1995.
Convened by the International Union of Air Pollution Prevention and Environmental Protection Associations.
Inquiries: Merja Tolvanen, P.O. Box 57, SF-02151 Espoo, Finland. Fax +358-0-4567022.

Acid Reign '95? 5th International Conference on Acidic Deposition. Gothenburg, Sweden, June 26-30, 1995.
Inquiries: Gainmore AB, Conference & Exhibition Services, St. Badhusg. 18-20, S-411 21 Göteborg, Sweden.

Urban Transport and the Environment. Southampton, England, July 4-6, 1995.
Inquiries: Conference secretariat, Wessex Institute of Technology, Ashurst Lodge, Ashurst, Southampton, England SO4 2AA. Fax +44-703-292853.

Greenhouse Gases: Mitigation Options. London, England, August 22-25, 1995.
Inquiries: Dr. P. Reimer, IEA Greenhouse Gas R&D Programme, CRB, Stoke Orchard, Cheltenham, England GL52 4RZ. Fax +44-1242-680758.

Ecology '95: Environmental Fair and Conference. Göteborg, Sweden, August 28-31, 1995.
Inquiries: Svenska Mässan, Box 5222, S-402 24 Göteborg, Sweden.