

Acid News

NO. 1, FEBRUARY 1994



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SULPHUR

The making of a protocol

LAST DECEMBER the countries of Europe got somewhere near to an agreement for reducing the emissions of sulphur to the atmosphere. This agreement is intended to result in a new protocol to the UN-ECE Convention on Long Range Transboundary Air Pollution, to supersede the previous one, signed in 1985, for reducing the emissions of sulphur by 30 per cent between 1980 and 1993. The signing of the new protocol is expected to take place in May or June of the current year.

In the course of 1993 the negotiating group – Working Group on Strategies – has met several times in Geneva. Its latest formal meeting was, as reported in Acid News 4/93, held last September, and this was followed in November by two so-called informal ones, to which no environmentalist NGOs were admitted.

Discussions of the principles for

the new protocol started as early as 1988 – when the Executive Body of the Convention appointed a special working group to develop the so-called critical loads approach. The intention was, if that approach proved usable, to make it the basis of a new protocol. In the autumn of 1990 this working group was commissioned to draft a protocol for a further reduction of emissions after 1993. Negotiations did not get going however until the summer of 1991.

The new agreement differs from the 1985 protocol in not calling for a flat-rate reduction, i.e. the same percentage for every country. For the first time in any international environmental deal, different targets will be set for each one. The targets will take the form of emissions ceilings, expressed as the maximum permissible emissions per target year – although naturally they can

also be expressed as a percentage reduction from 1980, the base year.

This will also be the first international agreement to be based on the ability of the environment to withstand pollution, or more scientifically in this case, on data regarding the critical loads for sulphur deposition. As stated in Article 2 of the draft, setting forth basic obligations, “The Parties shall control and reduce their sulphur emissions in order to protect human health and the environment from adverse effects, in particular acidifying effects, and to ensure, as far as possible without entailing excessive costs, that depositions of sulphur compounds in the long term shall not exceed the critical loads for sulphur...”

Despite the escape phrases – “as far as possible,” and “without entailing excessive costs” – the draft clearly

Continued on page 11

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

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THE 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.

Process itself important

WHAT IS THE REAL ADVANTAGE of international agreements for the protection of the environment? Is it the agreements themselves, or is it the process of arriving at them? This is something that is seldom discussed, although it is vital for determining the strategy to be employed in the negotiations leading up to an agreement. Just now it is however especially pertinent, after the countries of Europe had arrived, in the main, at a new agreement last December for reducing their emissions of sulphuric pollutants (see first article in this issue). Here we take the process of negotiation leading up to it as an example of what goes on.

In this case it was thought particularly desirable to get as many countries as possible involved. Active participation in the working out of an agreement means that countries that are relatively uninterested are forced to produce information on emissions, depositions, and effects – the data that will show both the need to reduce emissions and indicate, to some extent, how a reduction can be brought about. This is one reason why the countries that feel a special engagement want to get the uninterested ones and the laggards to join in.

To obtain a wide participation it is necessary to allow, as long as possible while negotiations are still under way, great flexibility in the demands to be made of the adherents to the proposed agreement. In this way the door can be kept open for as many countries as possible to sign it.

But the uninterested and the laggards themselves have an interest both in being able to participate in the negotiating process and to eventually sign the agreement. It is naturally easier for governments to face environmentalist opinion, both on the national and the international level, if they can show that theirs is among the countries that have signed the latest international agreement. By participating in its development they can, moreover, both delay its conclusion and get its requirements watered down.

In the historical view, the process of arriving at agreements may be

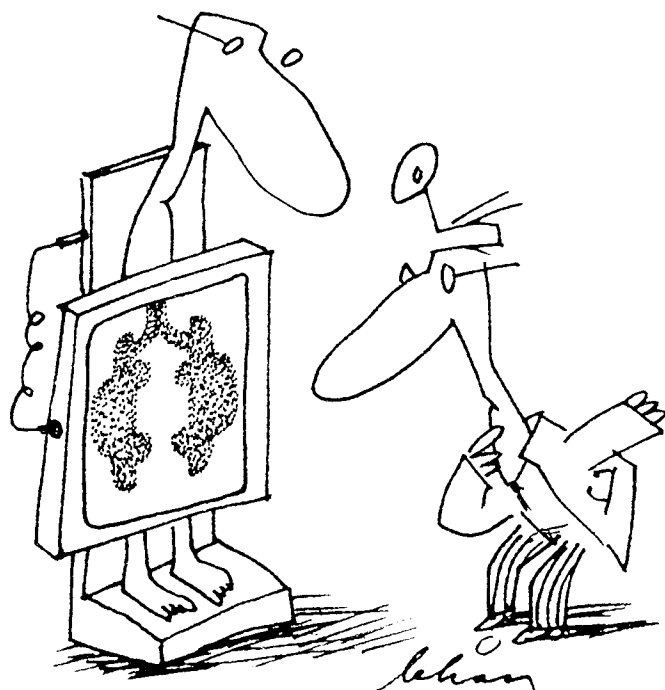
considered as having contributed considerably to the protection of the environment. It has caused a lot of data to be produced which otherwise would have been difficult if not impossible to come by. It has, moreover, hastened the exchanges of knowledge and experience – thus in turn influencing the decisions of various countries in regard to the measures for curbing emissions.

The actual effect of the resulting protocols is more difficult to determine. So far only one, that of 1985 for sulphur, has run its course. The final year for attainment of a 30-per cent reduction of emissions was 1993, so the country figures that are needed for evaluating the results are still not available. It may however be of interest to note that of the twenty-one original signatories, ten had actually reached the target in 1985, the year of the signing of the protocol, and four more had by that date already reduced their emissions by 20 per cent.

One important aspect of the process of negotiation is that it hastens the production of new data, both because the negotiations require it and because there is often a deadline for conclusion of the agreement. It is also important for the formation of opinion. No matter whether the agreement can be regarded as "good enough" from the environmental point of view or not, there is always a pressure from public opinion, as expressed through environmentalist groups, to get a protocol signed and respected.

In view of all this, it seems remarkable that so much attention should be fixed on the very last stage, when the time has just about come for an agreement to be signed, since the greatest possibility for all the interested parties to influence the outcome occurs during the first four-fifths or so of the negotiating period. This is something that environmentalists should bear in mind when the negotiations for a protocol on nitrogen start this year.

CHRISTER ÅGREN



ALLERGIES

Can be related to vehicle exhausts

THE INCIDENCE of various allergies is twice as high among children living near roads with heavy traffic, as among others in the same area but living further away from the traffic – according to a German study which also shows that allergies are more common among children in western Germany than in the former East.

The aim of the study, carried out by Institute of Environmental Medicine in Düsseldorf, was to try and find out how respiratory affections as well as allergies were influenced by air pollutants. A comparison was made of 9000 six-year-olds in towns with varying degrees of air pollution in eastern and western Germany.

It turned out that there was a clear connection between respiratory troubles of various kinds and the concentrations of sulphur dioxide in the atmosphere. Children in Leipzig, for instance, where the concentrations are high, suffered twice as much from common colds as children living in country parts of eastern Germany. But there was found to be no connection between sulphur dioxide and allergies.

Allergies can on the other hand be related to vehicle exhausts. The con-

centrations of those gases are far higher in western than in eastern Germany. Allergies were found to be twice as frequent among children in the Ruhr as they were in Leipzig. It also appeared that they were one-and-a-half to two times as common among children living within 50 metres of a road with much traffic, as among others in the same Ruhr town but living farther away from busy roads. Concentrations of the carcinogenic benzene were also found to be 50 per cent higher in the blood of children in the more exposed areas.

The study was presented at a conference on the effects of environmental factors on health, arranged last August by the Swedish Institute for Environmental Medicine. Ursula Krämer, one of the scientists who had taken part in the German study, pointed out in an interview with the Swedish monthly *Miljöaktuell* that genetic factors are the main cause of allergies. While unwilling to draw the conclusion that vehicle exhausts were a cause, she nevertheless agreed that they did contribute to making children more susceptible.

PER ELVINGSON

ON THE FOLLOWING PAGES

Windpower in Spain 4

A proposal put forward jointly by trade unions and the nature conservation society promises to ensure that Spain, already among the leaders in Europe in the utilizing of windpower, will continue to maintain its place.

Supercar 7

Novel idea, which surprisingly has not emerged before, has come from the Rocky Mountains Institute in Colorado in the form of a lightweight car driven by electricity but needing no charging from outside.

Roads delusion 8

The tragedy of current policies is that we have embarked on a course that is destroying communities and costing a lot of money. A new approach is required that will cost less, improve the environment, nurture communities, and make for better health. The Netherlands transport policy may be showing the way.

Critical loads 14

By comparing ecosystems' sensitivity to acid with other data on the depositions of acid pollutants, maps can be obtained showing 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.

Dirty shipping 15

Considerable amounts of air pollutants, principally sulphur and nitrogen oxides, are being emitted from ships plying in international trades. A clean-up is possible, but first there will have to be internationally agreed rules, and such are being strongly opposed by powerful interests in the oil industry as well as among shipowners themselves. The most likely solution for the moment might actually amount to allowing an increase in sulphur inputs to the environment.

Eastern energy 16

The energy supply in the Baltic States, having been developed as a part of the Russian system, is now showing its inadequacies for new sovereign nations with quite different ideas about the treatment of the environment. Although imports of natural gas from the CIS can help reduce excessive emissions of sulphur dioxide, the supply has become uncertain. Danish consultants have made proposals for combating the present wasteful use of energy.

Going ahead in Spain

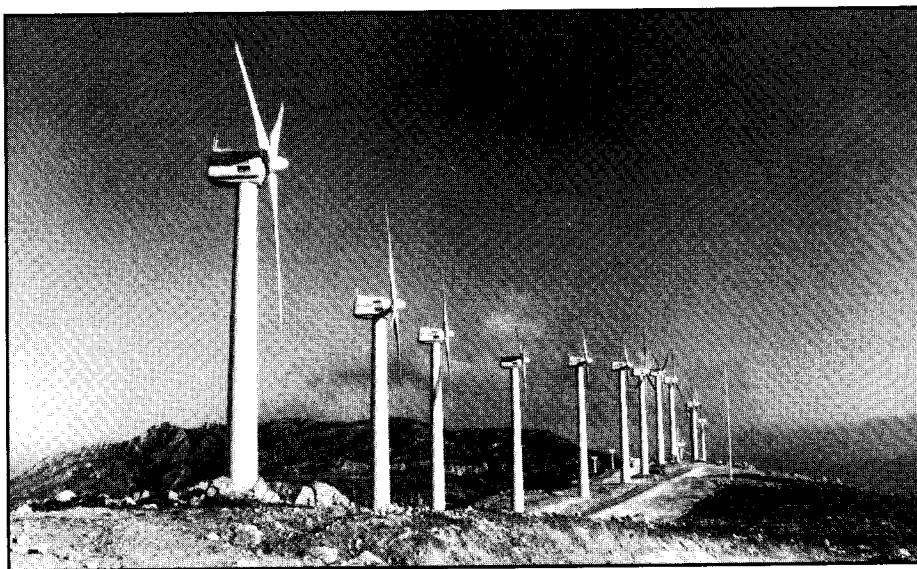
WITH PLENTY of windy sites, not only along the coast but also in its extensive mountain regions, Spain is, as regards windpower, on the way to becoming one of the most developed countries in Europe. It has the further advantage that the most windy parts of the country are among the most sparsely inhabited.

With twelve windfarms in operation – including one near Gibraltar with 277 turbines arranged in four groups – Spain is in fact already among the leaders in Europe. New construction in 1992 raised the installed capacity on the mainland from 10 to 50 MW, to which will now be added that of two large farms at Fuenteventura and Lanzarote on the Canary Islands, with respective capacities of 10 and 5 MW. Several other large projects are also on the way, so the target of 100 MW by 1995 seems likely to be easily attained.

The Spanish government had subsequently been planning to increase the country's windpower capacity to 175 MW by the year 2000. But early in 1993, as a result of a remarkable get-together of the two leading trade unions, the nature conservation society AEDENAT,* and the state power agency, the figure was raised to 750 MW. This would bring the total up to that of the renowned Altamont project in California, and it is currently the most ambitious program for development in Europe.

The proposal, which was originally a joint work of the unions and the conservation society, was presented to parliament just as a new national plan for energy was being debated, and it was then that the state power agency, Endesa, agreed to associate itself with it. Previously the agency had in any case been the chief promoter of windpower in Spain. It also has a manufacturing subsidiary for turbines, which is included in the group that has now been formed, together with the two trade unions, CCOO and UGT, to bring the new plan to fulfillment.

Expansion from 50 to 750 MW by 2000 is considered by all those in-



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Existing windfarm at Tarifa, in the mountain region just north of Gibraltar. As a result of a plan proposed jointly by leading trade unions and AEDENAT nature conservation society, there will be considerable additions to Spanish windpower.

volved as in general realistic (there are also more optimistic forecasts that put 1000 MW within the range of possibility). Endesa is already set to build a second 20 MW windfarm at Tarifa, and two more of the same size on the Canary Islands. Its subsidiary is about to market 300 kW turbines, and even has 500 kW machines on the drawing board. There are also other manufacturers in the field. US Windpower's 100kW turbines are being made on licence by Abengoa Wind Power, while a third company, Aerogeneradores Canarios, is producing Danish Vesta machines on the Canary Islands.

"The proposal to boost the windpower program should really have come from government," says Joaquin Nieto, head of CCOO environmental activities. "We had however two reasons for getting involved. One was that we wanted to develop renewable sources of energy. The other was that we needed new kinds of industry that would provide employment. The Worldwatch Institute has, for instance, in its *State of the World* report clearly shown that of all energy sources, nuclear power gives the least employment per kilowatt-hour, while windpower provides the most."

As regards the time schedule, Joaquin Calvo, director of the Ende-

sa windpower section, is rather more cautious than the others, saying: "It is difficult to tell exactly how far we shall get and when we shall reach the target. We may have 700 or 800 MW by 2000. We may have got so far even by 1998, or it may take until 2005. But we are agreed that windpower is a resource to be utilized, and we are intent on development of the technology."

Ladislao Martinez of AEDENAT adds another viewpoint. "As ecologists we can persuade other environmentalist groups to refrain from opposing windpower. We can also pressure local authorities into setting aside land sites for it."

Windy sites abound not only in Spain, but in the other Mediterranean countries as well. Greece has made a start, and some windfarms are already being installed in Portugal as well as in Italy, where windpower is being pushed by two large industrial concerns within the framework of a state-aided research project.

* Asociacion Ecologista de Defensa de la Naturaleza.

Adapted from an article by Tore Wizelius, freelance journalist and author of two books, *Vind 1* and *Vind 2*, published by Larsons förlag in association with the Swedish Windpower Association.

Tighter refrigerator standard delayed

ALTHOUGH THE TECHNOLOGY is already available for making refrigerators and freezers with an electricity consumption that would only be half the current European average, the EU Commission has issued a draft directive calling for no more than a 10 per cent reduction by 1997 – an improvement which, according to most observers, would have taken place in any case, without any prodding from the Commission.

Refrigeration consumes more electricity than anything else in a household, its total consumption in the European Union amounting to 100 TWh a year. Tightened standards for energy efficiency would mean lower bills for domestic consumers, as well as less damage to the environment.

"This directive is to be released at a time when the European Community (sic) is struggling to meet its commitments to stabilize emissions of carbon dioxide at 1990 levels by 2000. It is a thoroughly irresponsible move which demonstrates the extent to which Community policy on protecting the climate is in complete disarray," said Andrew Kerr, energy campaigner for Greenpeace International.

Greenpeace is also critical of delaying the application of the standards until 1997, when the proposed reduction could actually be achieved

within a year. The European Union's own energy advisers could find no justification for delay, either on economic or technical grounds. "The Commission has ignored its own advisers, and given the European appliance industry the weak draft directive it wanted," says Kerr. Greenpeace also notes that there is no mention in the draft of the need to avoid the use of ozone-destroying substances such as CFCs and HCFCs, nor of the chemical industry's new range of powerful greenhouse gases, HFCs.

Since the draft will now have to be scrutinized both by the European Parliament and the Council of Energy and Environment Ministers, it may be considerably changed. Greenpeace is urging short-term standards, which could be introduced within a year, and tough long-term ones for introduction within three years. It also calls attention to developments in the United States, where a gradual tightening of requirements has quickly led to a much more effective use of energy.

PER ELVINGSON

Mandatory energy efficiency standards for domestic refrigeration units in the European Community – analysis of the draft EC Directive and alternative proposals for standard. By Paul Waide for Greenpeace International. September 1993.

Climate convention

Having been ratified by fifty countries by December 21 last, the international climate convention can now come into force on March 21.

More than 150 countries had signed the document, which was one of the outcomes of the Rio conference in 1992. The date on which a convention can become applicable depends however on the rate at which it is ratified by the parliaments of the various countries. In this case the convention comes into force three months after the fiftieth country had ratified.

This sets a firm timetable for the work of the Intergovernmental Negotiating Committee in preparation for the first session of the Conference of the Parties, which is scheduled to be held in Berlin, Germany, from March 28 to April 7, 1995. At its ninth session in Geneva, February

7-18 this year, the Committee will, to remain on track, have to take a number of important decisions concerning the preparatory process.

Source: *The Network*, No. 34, January 1994.

Potential CO₂ reduction

A REVOLUTIONARY DEVELOPMENT in the design of compressors for refrigerators and air conditioners holds the possibility of greatly reducing the emissions of carbon dioxide. According to the Environmental Protection Agency, the new compressor is 9-15 per cent more efficient than current types, and if all the refrigerators in the United States were equipped with it, the result would be a reduction of about nine million tons in the amount of CO₂ emitted to the air.

Source: *New Scientist*, June 12, 1993.

BRIEFS

Signing separately

The EU member states have abandoned the idea of a common tax on carbon dioxide before ratifying the UN climate convention. Each can now sign the convention individually, which seven of the twelve have already done.

The proposal for a common tax has now become dormant, largely because of opposition from the United Kingdom. The European Union, in contrast to the old EC (that is, before Maastricht) has theoretically greater possibilities of making politically binding decisions concerning the environment, but the possibilities are reduced as soon as new taxes loom in sight. Such decisions still require unanimity.

Source: *Ny Teknik* No. 1-2/94.

Finally settled

The European Community finally has its own environment agency. It had been agreed in June 1989 that the Community needed an agency to collect and standardize environmental data, and to monitor the implementation of environment legislation. But the creation of a European Environment Agency was repeatedly delayed as member states quarrelled about where it should be located. Finally, at the end of October, it was agreed to base the EEA in Denmark.

Source: *New Scientist*, November 6, 1993.

Health hazard

All the petrol in Europe contains nearly 4 per cent benzene, an aromatic hydrocarbon which WHO has linked with leukaemia. In an article in the *New Scientist*, Simon Woolf of the University College Hospital Medical School in London points to the danger of inhaling benzene when riding in a car. He says that studies have consistently shown higher concentrations of benzene inside cars than outside, even on the busiest roads. "You could explain," he says, "the difference in rates of childhood leukaemia through different exposures around the country."

Source: *New Scientist*, November 13, 1993.

New TGV lines

Two new routes for high-speed TGV trains have been given the go signal from the French government. The TGV Méditerranée, extending the present Paris-Lyon line, is expected to be completed in 1999, while TGV Est, from Paris to Strasbourg near the German frontier, should be ready for inauguration a year later. While the Mediterranean line is expected to be highly profitable, the one to Strasbourg will need subsidies from the French state and the regions it serves, as well as from Luxembourg and the European Union.

Source: *Ny Teknik*, September 30, 1993

Miserly cars

CARS with a fuel consumption that will only be a third of that of current models is the aim of a newly instituted collaboration between the Clinton administration and three big American car makers.

By an agreement signed last September the American government and auto companies are to jointly promote the development of fuel-miserly vehicles. One of the aims is to produce, within a year, a middle-range car with a fuel consumption of 0.35 litre/10 km on the open road, and 0.45 litre/10 km in urban driving. Current figures are, according to the statistics, respectively 1.0 and 1.4 litres.

Source: *Ny Teknik*, No. 40, 1993.

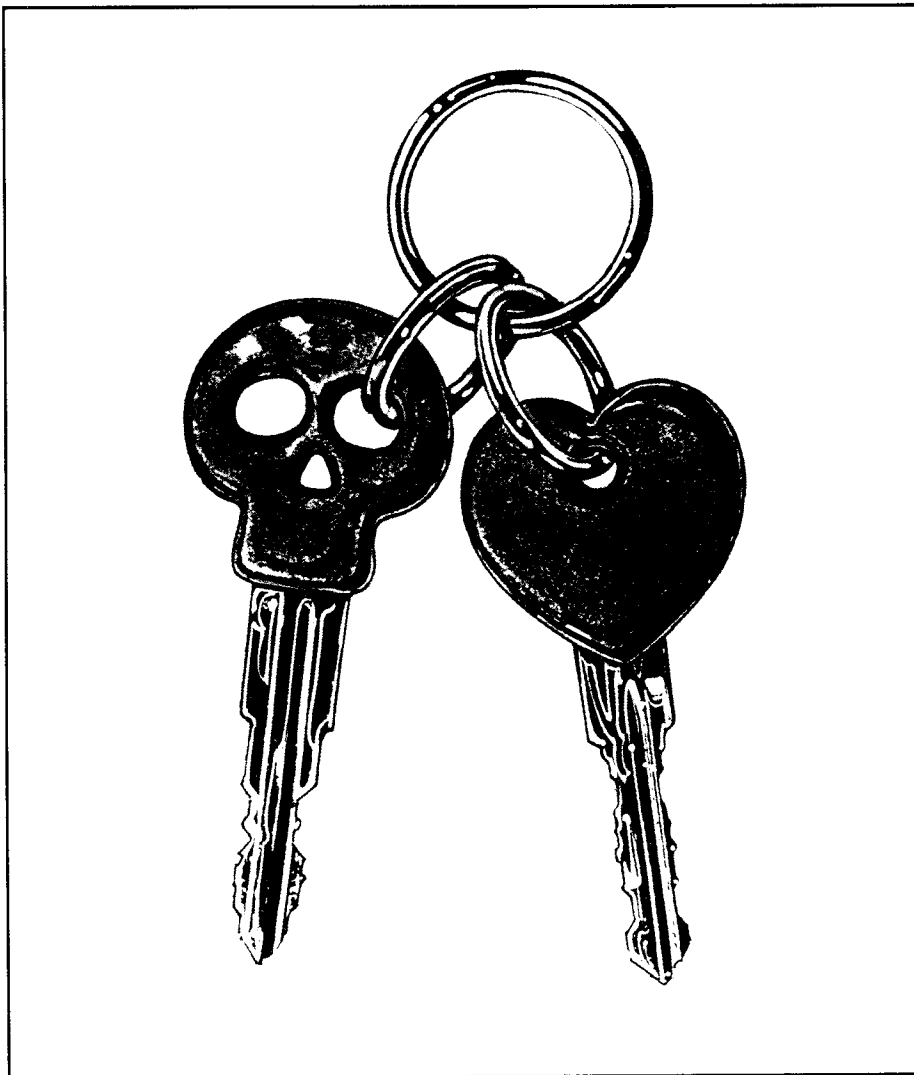
Catching them

BY MEANS OF A NEW technique, the substances in the smoke plume from car exhausts can be analyzed in a matter of seconds. Cars with unduly high emissions can thus be stopped and subjected to a quick test, and their owners required to make the necessary corrections.

Knowledge of the emissions of pollutants from road vehicles has hitherto tended to be unsatisfactory, since the tests are mostly carried out under controlled laboratory conditions. The new method, developed by the Environmental Research Institute (IVL) in Göteborg, uses a beam of infrared light, a mirror, and a computer which calculates in seconds the concentrations of carbon monoxide and volatile organic compounds in any passing vehicle's exhaust gases.

It has emerged, during the testing of this new technique, that 10 per cent of the vehicles were responsible for 50 per cent of all the emissions. This even applied to recent year models equipped with catalytic converters. Obviously if all the offending vehicles can be spotted and their defects rectified, there will be a great possibility for improving the environment. Often it is a matter of merely adjusting the engine – which itself will lower fuel consumption and save vehicle operators money.

Göteborgs Posten, November 9, 1993.



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Divergence on taxes

FOUR EUROPEAN environmentalist organizations* have issued a joint protest against the latest move of the European Commission to put off taking steps to control the emissions of carbon dioxide from road vehicles.

In the autumn of 1992 the Commission's Motor Vehicle Emissions Group presented a report – which the Commission had requested – on the options for reducing such emissions. It suggested a sales tax, which although it would not have been the environmentalists' first choice, was acknowledged to have some benefits.

The Commission has now said it thinks it unlikely that a sales tax "could be exploited at the EU level," and has asked the MVEG to consider an annual "circulation tax," based on the environmental burden of the vehicle.

Such a tax is criticized by the four environmentalist NGOs on six points

– one being that because it would not find immediate support in all the EU member states, there would be a danger of it yet again delaying agreement on measures for reducing emissions. Instead they propose a fuel tax, equal both for petrol and diesel fuel, and a sales tax that would be differentiated according to the vehicle's CO₂ emissions.

They would make any circulation tax additional to these two. The levels of the fuel and sales taxes should be high enough to ensure the average specific fuel consumption of new cars coming down by 40 per cent by 2005, compared with 1993.

T&E Bulletin, No. 22, October 1993.

* The European Federation for Transport and Environment (T&E), European Environmental Bureau, and the World Wide Fund for Nature and Friends of the Earth through their Brussels offices.

Battery-driven car charging itself

A NEW GENERATION of cars, with a petrol consumption of less than one litre per 100 kilometres, could be a reality within a few decades, according to Amory Lovins of the Rocky Mountains Institute in Colorado. He and his collaborators at the institute have come to this conclusion after studying the various paths towards the design of a cleaner car.

Their proposed "supercar" would be a combination of two previous lines of development, one of which being represented by the lightweight prototypes such as the Ultralite put forward by General Motors, the other by cars with hybrid drive, using both fuel and batteries. No one, it seems, has previously come upon the idea of combining the two – using a small engine simply to generate electricity for charging the batteries, which can also be kept smaller. Computer modelling at the RMI has shown however that by doing so there are considerable gains to be made on the energy side.

Attempts with electric propulsion have usually relied on batteries only, and have turned out to be inefficient on account of the batteries' weight. The great advantage of combining batteries with an engine, apart from the lower weight, is that the engine can operate continuously at optimum speed and power rating, only shutting off when the battery is fully charged. No more is needed than a 250cc engine, together with electric motors on each wheel. The battery can both store surplus electricity to provide the extra power needed on hills and when accelerating – part of it coming from braking energy recaptured from the wheel motors. Since all electricity is generated and stored within the vehicle, the risk is averted of transferring emissions back from the roads to the utilities, which might be the case if a lot of batteries were being charged from an outside source.

Other important factors are low aerodynamic drag and low rolling resistance. Aerodynamic improvements can reduce drag to half of that of current cars. It is estimated that

rolling resistance could also be halved by new types of tire, which together with the low weight of the vehicle – due to a small engine and smaller batteries – would make a great improvement.

The supercar would be made of composite materials, which are light but relatively expensive. The process of manufacture would on the other hand, according to the Lovins group, be simpler and less capital intensive. A four-seater family car could, they estimate, be made to sell at \$15,000.

The question is what would be needed to bring about a market breakthrough for the supercar. Raising petrol prices would, in Lovins' view, have little effect, since fuel only accounts for one-eighth of the total cost of driving in the US today. Stricter requirements in regard to fuel efficiency would help, but still fail to act beyond a certain point – giving no incentive for making further improvements. A far more promising option, he says, would be an efficiency rebate, ideally combined with incentives for scrapping "gas-guzzlers." This would immediately create a market niche for the supercar.

The regular car manufacturers, with billions invested in know-how and plant for making traditional vehicles, have so far shown little interest in the supercar. Lovins maintains however that full-scale production is a real possibility within five years. He warns car makers that new companies will arise and provide competition, just as they have in the computer business. Today's car makers, like mainframe computer firms, must be prepared to kill their own products in favour of better ones, before someone else does it for them.

PER ELVINGSON

Sources: *New Scientist*, June 26, 1993, *Rocky Mountain Institute Newsletter*, Volume IX, No. 2, Summer 1993.

Supercars: The coming light vehicle revolution. Publication T93-10. 32 pp. \$8.00. Can be ordered from RMI, 1739 Snowmass Creek Road, Snowmass, Colorado 81654-9199, USA.

BRIEFS

NOx from aircraft

If the current growth of air transport continues, the emissions of nitrogen oxides from aircraft will double within fifteen years, according to an EU Commission official.

The Commission is expected to propose that emissions of nitrogen oxides from aircraft of which prototypes are presented for air-worthiness approval after April 1995 should be reduced by 40 per cent, compared with current types. The proposal is being supported by the European Federation for Transport and Environment, T&E.

The Association of European Airlines and the manufacturers of aircraft are however against stricter limits unless they are made to apply internationally, through the International Civil Aviation Organization. While the ICAO is unlikely to favour the proposed standard, it did decide at the end of 1991 to lower the international limits for NOx emissions, but to levels already met by aircraft in production.

Source: *T&E Bulletin*, No. 22, October 1993



Solar dream car

A solar-powered Japanese car, the Honda Dream, recently completed the 3000-kilometre crossing of the Australian continent from Darwin to Adelaide at an average speed of 85kph. The time taken, 35 hours and 38 minutes, constituting an improvement of almost ten hours over the previous record from 1987, ensured a clear win in the 1993 World Solar Challenge.

Fifty-six cars entered the race, which is confined entirely to solar-driven vehicles. The entrants were allowed to drive as far as they could each day between 8 and 17 o'clock. Solar-cell technology is advancing fast. In the year's winning car the amount of solar energy converted to power was 20 per cent, compared with 15 per cent in 1987.

After the race, experts in solar power were predicting that it would not be long before solar cells were used in ordinary cars. The impetus would come from California, where 2 per cent of the new cars in the Los Angeles region – about 30,000 vehicles – will have to be non-polluting by 1998.

Source: *New Scientist*, November 20, 1993



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TRANSPORTATION

For a sustainable policy

ALL OVER EUROPE new motorways are planned. St. Petersburg is to have new motorway connections, as are all major centres in Hungary and Poland. The Pyrenees are to be breached by a new motorway, and Denmark is to have a new bridge to Sweden, with motorway links driving swathes of destruction around Copenhagen and Malmö.

In Britain the Lancashire County Council loudly proclaims its green credentials in documents on "Greening the Red Rose County," while implementing some of Britain's most destructive road-building plans. These include a new motorway across the Pennines designed to take 60,000 cars and 20,000 trucks per day, and a by-pass around Lancaster which is in fact part of a strategy to link the east-coast ports to Ireland via new motorways. The government's motorway proposals for Britain as a whole are already well known.

As long as national governments and local authorities regard roads as engines of economic growth, with an illusion of pots of gold arriving from trans-European motorways, there will be no possibility of reducing the

impact of transport on the local and global environment.

As regards emissions of carbon dioxide, current transport policies, fuelled by EU commitments to 12,500 kilometres of new motorways and national programs such as Britain's, will mean that a doubling of greenhouse-gas emissions can be expected by the year 2025.

The scale of the problem has been captured in the 1993 study by the *Umwelt und Prognose Institut* (Heidelberg) on the full life-cycle impact of a car over its ten-year life span. A car, fitted with a three-way catalytic converter, was assumed to be driven 13,000 kilometres per year, and to consume 10 litres of petrol per 100 kilometres. Over ten years it would produce:

Carbon dioxide	44.3 tons
Carbon monoxide	325 kg
Nitrogen dioxide	46.8 kg
Hydrocarbons	36 kg
Sulphur dioxide	4.8 kg

If the manufacturing process and eventual scrapping of the car were included, the total CO₂ total would increase to 59.7 tons.

Forecasting growth in CO₂ emissions from transport is difficult. In

Britain the 1990-91 National Transport Survey showed a 22-per-cent increase in the average distance travelled per week since 1985/86, while the number of journeys hardly changed. Such trends reflect feedback loops from planning decisions and changes in lifestyle. As the process accelerates, the option for non-motorized trips declines. These changes are gathering momentum and reversing them is not going to be easy – small tinkering with the system is not going to solve the problem.

A similar process is taking place in freight transport. Freight transported by road in 40-ton trucks produces five times more CO₂ per ton km than if it were shipped by rail. Planners have developed the smallest possible number of distribution centres, using the road system as an integral part of the production process. This ensures road freight having become the preferred option for the vast majority of European manufacturers and producers. Among the aims of the single market are a reduction of road-freight costs and an opening up of domestic carrying to the trucks of any other EU country.

In Europe road freight is responsible for one quarter of all traffic-related emissions of CO₂ (171 million tons in 1988), equivalent to the total CO₂ output of Switzerland, Austria and Denmark combined. Over the next 20 years, European road freight will grow by between 40 and 70 per cent, and considerably more in East Europe and the ex-Soviet Union. Such an increase is likely to cancel out any efforts for reduction in other sectors.

The gap between the potential for growth of greenhouse gases already locked into our production and distribution systems on the one hand, and the views of the Intergovernmental Panel on Climate Change (IPCC) as regards what must be done to reduce global warming on the other, is already alarmingly high. Realistic policies within Europe to match the IPCC's view of what is needed are few and far between.

One possible model may however be found in Dutch transport policy, although it is still too early to say whether it will attain its objectives (see box).

Immediate action is required to reduce the demand for private road transportation. More integrated re-

search into the potential for local travel, local production and consumption, and local facilities, must be given high priority. Improving public transport alone is not going to reduce demand for private motoring journeys.

Freight transport also requires immediate action – the possibilities

*We have embarked
on a course costing
a lot of money*

examined in the Dutch NGO example (again see box) should likewise be given top priority throughout Europe.

Transport costs must be doubled over a time scale that will be long enough to permit adaptation and innovation. Better still, the whole basis of taxation should be altered to inject price signals at every stage of the extraction, production, consumption, and disposal process. It is possible, without increasing the overall tax burden, to reduce the scale of activities that consume

large amounts of distance, energy, space, and raw materials, and thus improve the quality of the environment.

A high quality environment can provide a stimulus to local employment and reduce public expenditure on measures to deal with the negative consequences of current transport policy. Walking, cycling and public transportation are all means of reducing the demand for travel by private car.

The tragedy of current transport policies, and the associated planning for local and regional land use, is that we have embarked on a course of action that is destroying communities and costing a lot of money. A completely new approach is required, one which will cost less, improve the environment, nurture communities, improve health – and perhaps have the single most significant effect of helping to reduce global warming.

JOHN WHITELEGG

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Adapted from an article in Hot News, Issue 8, Winter 1993, published by Climate Action Network UK.

One possible model

Sixteen per cent of the Dutch emissions of greenhouse gases come from the transport sector. In common with the rest of Europe, Dutch policy for domestic transportation is severely hampered by the strength of economic arguments in favour of maintaining the country's share of the international market for road haulage and the standing of the Schiphol airport.

Current targets in the National Environment Policy Plan (NEPP) and the Second Transport Structure Plan, would however, compared to the trend of the last few years, result in CO₂ emissions falling just below 1986 levels by 2000; and reaching 16 per cent below 1986 levels by 2010. The plans were proposed by the Dutch government's Interdepartmental Traffic and Climate Working group in 1991.

These plans include "Rail 21 Cargo," a strategy to increase rail freight from 20 million tons in 1987 to 65 million tons by 2010. It is also proposed that passenger travel should rise from 9 billion passenger-kilometres per year in 1985 to 18 billion by 2005. The num-

ber of people travelling by rail is planned to rise from 650,000 per day in 1987 to 1.3 million in 2005.

Plans for a car-free city centre in Amsterdam that were published in October 1993 have been strongly resisted by the city Chamber of Commerce. But the success of planning for bicycles in cities like Delft and Groningen, where 50 per cent of the journeys to work are now made by bicycle, illustrates the enormous potential this has for reducing CO₂ emissions.

The Dutch government has also analyzed the potential saving from more drastic measures, such as improving vehicle technology, further reducing the use of cars, encouraging energy-conscious driving, and a switch (mainly for buses) to fuels that produce less greenhouse gases. In this way by 2005 CO₂ emissions could be reduced to 20.9 million tons, or 17 per cent below the 1988 levels.

The Werkgroep 2duizend Foundation has produced a freight plan that could, if put into practice, further reduce CO₂ emissions from this sector.

This outline proposal included urban distribution centres aimed at reducing the movements of trucks in cities, strategies to reduce empty journeys through arrangements for picking up return loads, and a substantial investment in transfer points between road, rail, and water. The results of this "new course" scenario are summarized in the table.

Despite there being a whole range of uncertainties in these various scenarios, any delay in implementing at least existing policy will inevitably mean that current CO₂ objectives will not be achieved.

Potential effects of Dutch "new course" freight scenario by the year 2015.

Environmental effect	Business as usual	New course
Energy use	147	54
CO ₂ emissions	148	57
NOx emissions	70	14

The base year 1990 has been given an index of 100, and the figures show the changes in relation to that year.

Insufficient reductions

IF DAMAGE to areas of natural interest is to be prevented in many parts of Britain, there will have to be a great reduction of the acid fallout. Government surveys had already indicated that even with an 80-per-cent reduction of the country's emissions, there would still be a risk of a number of sites of special scientific interest (SSSIs), predominantly upland, suffering damage from acidification. See AN 4/93.

The present proposals for reducing emissions emanate mainly from the EC Directive on Large Combustion Plants, which means that in Britain's case the emissions from existing plants should be reduced by 60 per cent by 2003, from 1980 levels. During the negotiations for a new sulphur protocol under the UN-ECE Convention on Long Range Transboundary Air Pollution, the suggestion came up that Britain should instead make an 80-per-cent reduction by the year 2000. (There is an account of the negotiations starting on the first page of this issue.)

Now comes a report from the Joint Nature Conservation Committee showing the effects that various higher degrees of reduction would have, compared to a 60-per-cent one. See table.

The conclusion is that it will require at least an 80-per-cent reduction of emissions to protect a large proportion of the lowland sites, including some especially important heathland habitats. This would also ensure the protection of some outstanding upland sites in Wales.

Area of SSSIs (in hectares) remaining at risk from acidification under various projections for a reduction of emissions from the 1980 baseline levels.

	Reduction			
	60%	70%	80%	90%
England	211,919	187,933	126,324	79,265
Wales	109,501	86,238	46,609	28,042
Total	321,420	274,171	172,933	107,307

Reference: **The environmental implications of UK sulphur emission policy options for England and Wales.** By Andrew Farmer and Simon Bareham. Report No. 176. Joint Nature Conservation Committee. Obtainable from English Nature, Northminster House, Peterborough, England PE1 5UA.

Attempt to make coal a more acceptable fuel

THE WORLD'S LARGEST coal-gasification plant was started up last November at Buggenum in the Netherlands. Designed as a full-scale demonstration plant, it has a capacity of 250 MWe. Costing the equivalent of \$500 million, it is being financed by four utilities within the Dutch Electricity Generating Board group.

The aim with this plant is to develop a cleaner method of generating electricity from coal. Coal gasification was also chosen as a means of diversifying the country's energy system, and making coal, which is generally regarded as a dirty fuel, more acceptable.

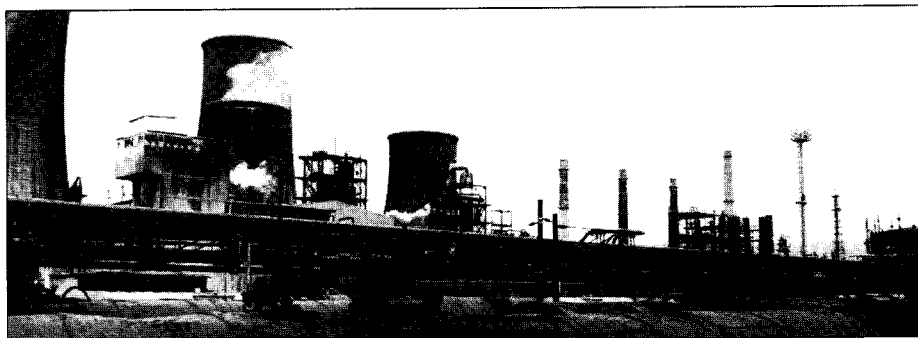
The high efficiency – 47 per cent, as against 33 per cent with conventional coal firing – results from the incorporation of a combined-cycle unit. This also means a lower emission of carbon dioxide per generated kilowatt-hour. Desulphurization of the gas (with 98-per-cent efficiency) reduces the emissions of sulphur dioxide and produces almost pure sulphur as a residue which can be sold to

chemical manufacturers. Through a system of recirculation the emissions of nitrogen oxides can also be kept down.

Various kinds of coal are to be tested during a three-year period. If this first plant turns out well, six others can be built in the Netherlands during the next twenty years. The EU is also entering the field of coal gasification, using money from its THERMIE program to partially finance the building and operation of a demonstration plant at Puertollano in Spain, which is scheduled to be ready in 1996. Included in Joule II, EU's long-term program for energy research, are also projects to develop technologies for gasifying biomass as well as coal.

PER ELVINGSON

Editorial note. From the point of view of the environment there can hardly be any reason to support the development of a so-called clean-coal technology. If the greenhouse effect is taken into account, there can be no such thing as clean coal. See AN 4/93, pp 9-11.



Dutch plan for CO₂ emissions revised

ACCORDING TO the National Environmental Policy Plan that was adopted by the Dutch parliament in 1990, the emissions of the greenhouse gas carbon dioxide were to be reduced by 3 to 5 per cent between 1990 and 2000. It was hoped that the emissions from the industrialized countries in general would diminish thereafter by 1-2 per cent per annum.

A revision of the NEPP that has just been published forecasts however an increase in emissions during the next few decades. This divergence from the original estimate is explained by the belief

that the demand for energy is going to rise. This means that additional measures will be called for, over and above those already decided upon, if the original objective is to be attained. These will have to concern fuel use, energy saving, and transportation.

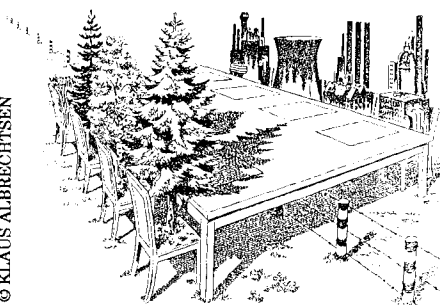
Source: **Change**, a newsletter from the National Institute of Public Health and Environmental Protection (RIVM), P.O. Box 1, NL-3720 Bilthoven, The Netherlands. No. 16, October 1993.

Note. In the Netherlands the emissions of carbon dioxide amounted in 1990 to 182 million tons. This corresponds to 12.4 tons per head of population. For the EU and EFTA countries as a whole the average was 8.3 tons.

New sulphur protocol...

Continued from front page

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sets forth the long-term aim, namely that of reducing emissions so much that the critical loads for sulphur will not be exceeded. Attaining that goal will require a very great reduction of emissions – so great that national decision-makers see little likelihood of its being achieved within the next ten to twenty years.

The new protocol must therefore be regarded simply as a first step towards a stated final goal. This means it will either be followed by yet another one, or be revised and tightened up as time passes. In paragraph 8 of Article 2 of the draft (Basic obligations) it says: "The Parties shall, subject to the outcome of the first review under Article 8 and no later than one year after the completion of that review, commence negotiations on further commitments to reduce emissions." Article 8, dealing with review procedure, also contains the flat statement that the first review shall be completed in 1997.

After it had been accepted early in the negotiations that the new protocol should only constitute a first step, it was agreed to proceed on the basis of a scenario under which the differences between current (1990) depositions and critical loads were to be reduced by at least 60 per cent – this being known as the 60-per-cent gap closure. Another general starting point was that different requirements should be made of the various countries, depending on the extent of the damage to which their emissions gave rise, and on the estimated costs of reducing those emissions. The intention here was to bring about measures which on the European level would be as cost-effective as possible.

That making the aim a 60-per-cent gap closure cannot be considered as carrying things too far is evident from the fact that even after it has been attained, 7 per cent of the European ecosystems will still be

left unprotected – in other words, depositions will still exceed the critical loads. It may be noted that in 1990 it was 28 per cent.

Within the working group it was generally agreed, as late as the spring of 1993, that the western countries should have arrived at the necessary reductions of their emissions (to bring about a 60-per-cent gap closure) by the year 2000, while the East European ones (defined as countries in economic transition) could be allowed a little more time, to 2005. But when the group met to really negotiate in September, and countries had put forward their bids, trouble arose. It turned out that many of them were either not prepared to make the necessary reductions, or did not think they could do so within the time period on which there appeared to have been agreement.

In November some countries improved their bids, but there were also others that did the opposite. Among the western countries whose proposals are far from what is expected of them by the year 2000 are especially Britain and Spain, although France, Belgium, Denmark, and Ireland also are expressing a wish to lag behind (see table). Moreover some countries – Greece, Portugal, and Cyprus – announced the intention of increasing their emissions during the proposed period. The east-central European countries that are unlikely to have reached their targets even by 2010 are Bulgaria, Hungary, and Croatia. Romania has still not produced any figures, but will probably fall into the same category.

It should also be borne in mind that the Baltic States – Estonia, Latvia and Lithuania – are still not adherents to the Convention, and so have not been able to participate in the negotiations for a new protocol. Any changes in the emissions from these countries will naturally affect depositions over sensitive areas, as well as the scenarios of the computer models.

The overall result of the commitments so far made, whether expressed as the total of European emissions or the extent of ecosystem protection, can hardly be described as a success. Actually it will amount, by and large, to what could in any case have been expected from current reduction plans (CRPs), which reflect

sions projected for the year 2000 for various countries.

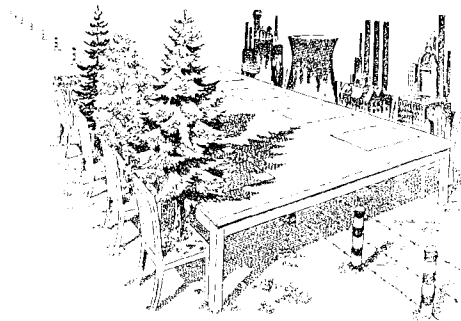
At the meeting of the Executive Body in December, the Norwegian chairman, Jan Thompson, expressed clear displeasure at the outcome of the negotiations, observing that with present commitments the goal of a 60-per-cent gap closure would not be attained until somewhere around 2015.

It is remarkable that the new agreement should not include any distinct criteria as to what any country must commit itself to (by way of a certain reduction of emissions by a certain year) if it is to be in a position to sign the protocol. The reasons are various, but the chief one seems to be that the negotiators did not manage to agree on a definite target year. There is also the fact that although there has been general

The reductions that will be required of each country according to the RAINS scenario for a 60-per-cent gap closure, and those promised to date (November 1993) for the year 2000 (for East European countries, in parenthesis, for 2010), all from 1980, the base year.

	RAINS	Commitment by 2000 (2010)
Austria	-80%	-80%
Belarus	-38%	-38%
Belgium	-77%	-70%
Bulgaria	-74%	-33% (-45%)
Croatia	-40%	-11%
Czech Rep.	-72%	-50% (-72%)
Denmark	-87%	-80%
Finland	-80%	-80%
France	-80%	-74%
Germany	-90%	-83%
Greece	+49%	+38%
Hungary	-68%	-45% (-60%)
Ireland	-41%	-30%
Italy	-73%	-65%
Luxembourg	-58%	-58%
Netherlands	-77%	-77%
Norway	-76%	-76%
Poland	-66%	-37% (-66%)
Portugal	+11%	+18%
Romania	-41%	- ¹
Russian Fed.	-38%	-38% (-40%)
Slovakia	-72%	-60% (-72%)
Slovenia	-45%	-45% (-70%)
Spain	-55%	-35%
Sweden	-83%	-80%
Switzerland	-52%	-52%
Turkey	+236%	- ¹
Ukraine	-56%	-40% (-56%)
UK	-79%	-50%

¹ Has still not presented any commitment for a reduction of emissions.



agreement as to the basic principles on which the new protocol should rest, some countries have cast doubt on the underlying work of mapping the critical loads, as well as on the choice of computer model and the scenarios. In doing so, they have also put the resulting requirements for emission reductions in question.

One consequence of this curious situation seems to be that the various countries are now proposing reductions that happen to suit them, mainly to the year 2000. In cases however where the proposed reductions are less than would be required under the scenario for a 60-per-cent gap closure, figures are given for 2005, and frequently even for 2010. As already noted, there is still some countries that are unwilling to fulfill the requirements of the scenario even by 2010, and yet are intent on signing the protocol. They are naturally being subject to pressure, especially from neighbouring countries that suffer from their emissions, but in the absence of any clearly stated criteria for signing, it will be difficult to prevent them from signing it.

The reliability of emission forecasts extending fifteen years ahead may also be questioned. Looking back, it appears that practically all the national forecasts for energy use – along with emission limits a decisive factor for the volume of sulphur emissions – which were made in the seventies showed little correspondence with the actual figures for the eighties.

Besides prescribing ceilings for national emissions, the draft protocol contains some requirements for the use of the best available technology (BAT) in large combustors. The demand for this has come from a group of countries, prominent among which have been Germany, the Netherlands, Austria, Switzerland, and France. In a joint document put forward in 1992 they proposed in es-

sence that the emission-limit values for such plants in the Community that had been introduced in 1988 should be made mandatory in the new protocol. Large combustors are those with an installed thermal capacity of at least 50 MW.

This proposal would make the requirements compulsory for new plants within a year of the protocol's coming into force, and within five years for existing ones. It would also restrict the sulphur content of heavy fuel oils to 2 per cent, and 0.2 per cent for gas oil, to apply within two years of the protocol's coming into force.

Several countries, in particular Norway and Britain, were however strongly opposed to the idea, claiming that requirements of this sort were inimical to programs for pro-

Signing expected to take place in May or June

moting cost efficiency, and so to one of the basic principles of the critical loads approach, which is itself the basis for the new protocol. The group sponsoring the proposal leant primarily on the so-called precautionary principle, adding that unless the application of BAT was included among the measures for reducing emissions, the set targets could not be met.

It soon appeared that most of the countries, with the exception of Britain, Norway, and Spain, were prepared to support a BAT requirement for new plants. The United States and Canada were also among the unwilling, but were allowed to opt out from any kind of BAT-requirement through reference to their own bilateral Air Quality Agreement of 1991.

It may be worth noting that the BAT requirements that are here in question are on a technical level of the early 1980s, and do not even match the emission requirements set up in Germany as early as 1983.

Distinctly weaker was the support for the application of BAT requirements to existing plants. Besides the countries already named, several others, both from east and west, were also opposed to it. The

compromise that was finally reached amounted to no more than a strong recommendation to make the requirements applicable to the largest combustors (>500 MW_{th}) within eight years of the protocol's coming into force. For other existing plants (50-500 MW_{th}) the emission values are only to be "used as guidance."

In the late summer of 1993 Norway, partly because of pressure that had surfaced during campaigning for the parliamentary election, changed its stance in regard to BAT requirements for new plants. Then Britain, too, fell into line, after requirements for existing plants had been watered down. The attitude of the two countries was, to say the least, paradoxical, since these very requirements were already enshrined in law in both countries. Their opposition obviously had nothing to do with the sulphur matter, but arose from fear of similar compulsory requirements becoming incorporated in coming protocols for nitrogen oxides and volatile organic compounds.

In the end Spain also agreed to BAT requirements for new plants – after inclusion in the protocol of a derogation similar to that already contained in the EC directive of 1988 for large combustors fired with local high-sulphur fuels. Such plants can thus emit considerably more sulphur dioxide than is permitted to others.

The proposal for maximum sulphur contents of fuel oil also became somewhat watered down in the course of the proceedings. For heavy fuel oil it was dropped, doubtless because there are no such requirements either in the Community or in the legislation of most East European countries. On the other hand the signatories to the protocol are to introduce a requirement for a maximum sulphur content of 0.05 per cent for diesel oils (for use in vehicles) and 0.2 per cent for other kinds of gas oil, at latest two years after its coming into force. This may, however, in certain cases be delayed.

A distinct improvement, as compared with earlier protocols, can be seen in articles 7 and 8 of the new draft. Article 7, on compliance, requires the setting up of an Implementation Committee of eight, to see that the signatories really live up to their commitments, report its findings to the Executive Body, and make such

recommendations as it "considers appropriate."

Reviews (Article 8) shall be made to reveal "the adequacy of the commitments and the progress made towards achievement of the objectives of the present Protocol." The first review shall, as mentioned above, be completed in 1997.

What was to be done about countries that wanted both to sign the protocol and yet increase their emissions of sulphur was also taken up at the meeting of the Executive Body in December. Such intentions obviously contravene the essential idea of the Convention, it being clearly stated that countries shall "limit and as far as possibly gradually reduce and prevent air pollution" (Article 2 of the Convention). On the other hand the computer-model scenario for a 60-per-cent gap closure does permit Turkey, Greece, Albania, and Portugal to increase their emissions. Naturally it was a mistake not to include in the model some restriction against increases – a mistake that some countries are now trying to turn to advantage.

The solution that the Executive Body came up with was to allow those countries both to sign and increase emissions – on condition that the increases would have stopped by 2000 and a reduction then started.

One reason for permitting increases according to the computer model is that the current critical-load maps only take into account the acidifying effect of sulphur on soil and surface water. If the effect on human health, as well as on structures and materials, were also included – these being probably more relevant for the countries in question – a different result would perhaps emerge.

The role of the North American countries in the negotiations has been rather confusing. Like all the European countries, the United States and Canada are both members of the ECE, and take active part in the proceedings. But now it is a matter of a protocol based on the critical loads approach, which at present can only be made applicable in Europe. The United States has in any case always been sceptical of it, and has instead, through the Clean Air Act of 1990, adopted a program for reducing emissions of sulphur by a combination of standards for com-

bustion plants with a system of tradeable permits (AN 5/93, pp 11-13).

After having done a lot to draw out the proceedings by attempts to introduce various escape clauses into the protocol – solely to benefit its own national interests – the United States suddenly announced last November that it would not be signing the protocol, giving as the main reason that going along with the critical loads approach would be incompatible with its Clean Air Act.

The reductions that are expected to result from that act are, it may be noted, not especially impressive. During the negotiations for the protocol it appeared that the United States could only guarantee to reduce its emissions of sulphur by 23 per cent by the year 2000, and 40 per cent by 2010, from 1980 base-year levels.

Canada, on the other hand, intends to sign, but only under exceptional terms. It will bind itself to reducing emissions for the whole country by no more than 30 per cent by 2000 (between 1980 and 1990 emissions had in any case already dropped by rather more than 20 per cent). But in its southeastern part, which in 1980 was answerable for two-thirds of the total, emissions are to be reduced by 46 per cent. This is a region that has been designated in the draft as a Sulphur Oxides Management Area (SOMA).

Canada has no national standards for emissions from combustion plants, and has also opted out from adopting any of the BAT requirements that may be called for in the protocol as basic obligations.

Although the main lines and the more important details of the coming protocol can now be regarded as settled, there still remains a good deal of fine-tuning before there can be a final draft. It is hoped that this can be done at the next meeting of the Working Group in the beginning of March.

Provided agreement has been reached on a final draft, the official signing of the new protocol is expected to take place at an extra session of the Executive Body, probably in Norway in May or June. The protocol will come into force three months after ratification by sixteen of the signatories, a procedure that usually requires two or three years.

CHRISTER ÅGREN

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 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 AN 5/93, pp 16-17) 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 (see p. 14) 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.

How they are mapped

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 (see first article in this issue). 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 Co-ordination Center for Effects.

The data on which the maps are based derives principally from the individual reports of fifteen countries, which are annexed to the report. The standard method for the 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 the quantity 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 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 of critical loads for sulphur start with data on the criti-

cal 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 sensi-

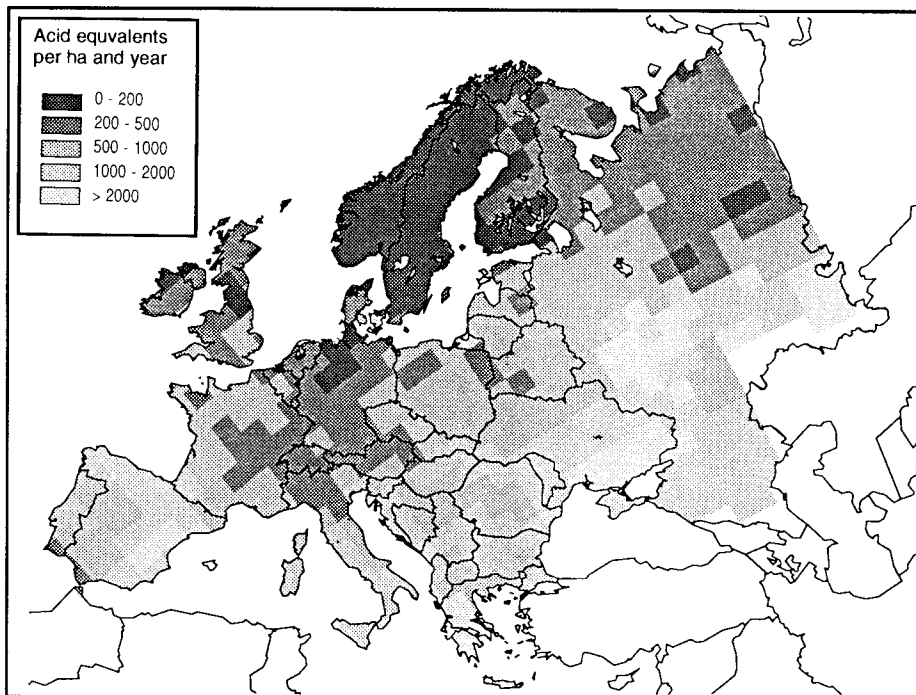


Figure 1. Critical depositions of sulphur: 5 percentile. The map shows the sensitivity of ecosystems – forest soils and surface waters – to sulphur deposition. The darker the colour, the more sensitive the area. The values are calculated to protect 95 per cent of the ecosystems in each grid cell.

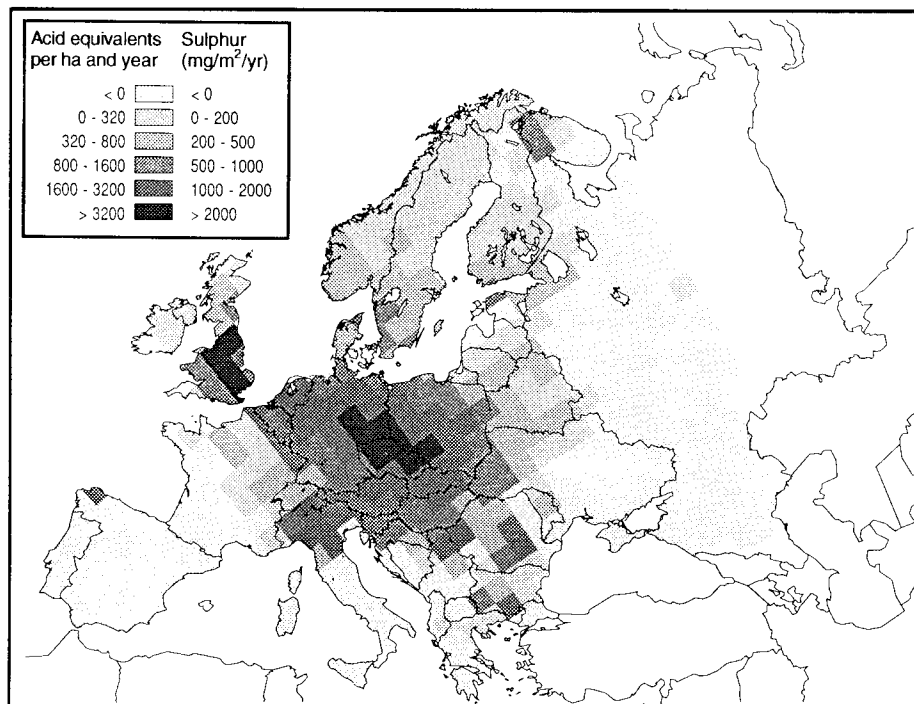


Figure 2. The degree by which critical sulphur depositions were exceeded in 1990 (5 percentile). The darker the colour, the greater the extent to which the critical loads were being exceeded.

tivity, 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. 1).

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 2 shows the extent to which the critical depositions of sulphur were being exceeded in 1990.

There are proposals for a future ECE protocol 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 ground-level 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 report.

CHRISTER ÅGREN

***Calculation and mapping of critical loads in Europe: Status report 1993.** 163 pp. In English. Obtainable from the Coordination Center for Effects, RIVM, P.O. Box 1, NL-3720 BA Bilthoven, The Netherlands. The Center was established in 1990 to aid the work on the critical loads approach that is being carried out within the UN-ECE Convention on Long Range Transboundary Air Pollution.

Aurora

The emissions of sulphur from shipping can be reduced by switching to low-sulphur fuels. For nitrogen oxides, catalytic cleaning of the exhaust gases would appear to be a promising method.

Measurements recently carried out aboard the ferry *Aurora* (AN 3/92) show the potential for improvement to be considerable. Here urea is injected into the exhaust gases just before they enter the catalyzer. There was a very high and consistent reduction of nitrogen oxides (96-97 per cent) and hydrocarbons (85-91 per cent), without any extensive increase in the emissions of secondary pollutants such as HCN, HCNO, NH₂, and N₂O, or none at all, even during rapid transient loadings. This performance was maintained after as much as 6000 hours of operation.

Source: IVL Report B 1103.

SHIPPING

Outlook for a reduction of emissions cloudy

SEA FREIGHTING tends to be an energy efficient mode that also gives rise to pollution. According to estimates of IMO, the International Maritime Organization, the annual emissions of sulphur dioxide and nitrogen oxides from shipping in international trades amount to 7.5-11.5 million and 9.3 million tons respectively. The emissions of CFCs, halogens, and volatile organic compounds are also considerable.

A clean-up is however possible, as may be seen from the example of the ferry *Aurora* (see below). But first there will have to be internationally agreed rules, such as have been debated for several years within the IMO, and two years ago its Sub-Committee on Bulk Chemicals was, for that purpose, given the task of working out a draft annex to the MARPOL convention, to be ready in 1993. The committee's work has however been held up by oil and shipping industry interests, supported by heavily lobbied flag states, so that a draft is not expected to be forthcoming before 1995 at the earliest.

The main objective of the proposed annex will be to bring about a reduction of the emissions of sulphur dioxide. In consequence of the tightening of controls on land-based plants, shipping has become a steadily growing market for high-sulphur fuel oils, including oil residues from refinery processes. For a long time these fractions have also been cheaper – a situation that ship operators have not been slow to turn to advantage.

Bunker oil now has an average sulphur content of 2.9 per cent, so that from the point of view of the environment a reduction would be highly desirable. The opposition from many IMO members can only be explained by an overestimate of the cost and an unawareness of the advantages of using a higher-quality fuel oil, which include a reduced consumption of lubricants and more reliable operation. Provided the rules were generally observed, so as not to upset competition, fears for the economy seem to be exaggerated. In most cases the increase in costs would

only have a marginal effect on the price of the goods carried.

The oil industry's opposition to quality standards for fuel oil would appear to stem from the fact that residual fuels are a waste product of the refinery process and shipping is one of a fast diminishing number of profitable outlets for them.

The IMO is now considering three possible ways of controlling the emissions of sulphur from shipping. The best one, requiring stringent global measures, lacks support, thanks to effective lobbying from the oil industry. The third option, requiring regional measures only, is not acceptable to those looking for effective measures that do not interfere with existing competitive trade patterns.

It seems the most likely way to be adopted will be the one inbetween – involving a global limit on the sulphur content of bunker fuel, combined with regional measures. Here the crucial point will be the level at which the cap is set. As noted, the average sulphur content of bunker fuel is now 2.9 per cent. To achieve the 50-per-cent reduction that has been agreed on in the IMO, this level would have to drop to around 1.5 per cent. The current debate within the Sub-Committee on Bulk Chemicals seems to favour a cap of 3.5 per cent. While that would eliminate fuels with a very high sulphur content, it would actually represent a potential increase in sulphur inputs to the environment from international shipping – hardly a satisfactory outcome.

Condensed from an article by Ellen Ninaber in *North Sea Monitor*, September 1993, as well as an unsigned report in the same paper. *North Sea Monitor* is published by Seas at Risk, a federation of European environmentalist groups working for the protection of the marine environment in the northeastern Atlantic area. Address: Vos-siusstraat 20, NL-1071 AD Amsterdam, The Netherlands.

The International Maritime Organization is a United Nations body, and MARPOL is the principal global instrument for regulating pollution from shipping.

Misdirected energy system

A SERIES of very full reports on the energy system and its consequences in the Baltic States was published in 1991-92.* Although parts of the voluminous statistics are tending to become outdated, the reports still give a good general picture of the energy situation in these three countries.

Their energy supply having been developed as a part of the former Soviet system, the Baltic countries are now having to grapple with more or less the same problems.

□ While they are still highly dependent on gas and oil from the CIS, supplies are becoming ever more uncertain.

□ The per-capita use of energy is, especially in Estonia and Lithuania, about as high as in the Scandinavian countries, although the general standard of living is low.

□ The consumption of energy in industry is higher than the European average. Considerable restructuring is however now taking place, and many of the more energy-intensive undertakings have been forced to close down.

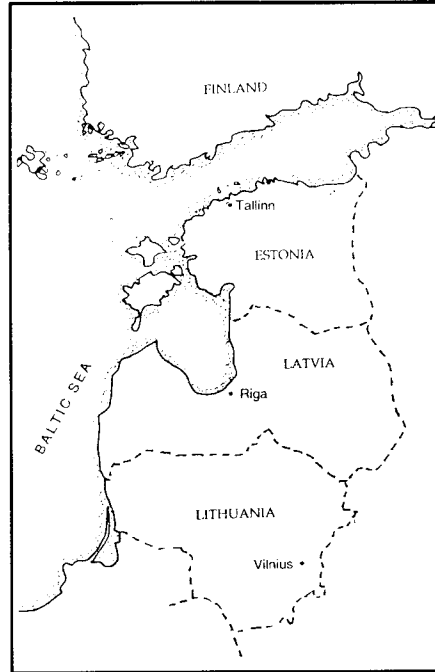
The Risø group's proposal for reducing the use of energy in the Baltic States would be to give priority first to energy saving, then to making the electricity supply system more effective, and thirdly to developing an extensive use of renewables.

There is a great potential for saving energy in space heating in all three countries. But as elsewhere in eastern Europe, there is also a great lack of metering and heat-regulating equipment, of insulation materials, and even information and training for energy efficiency. To bring down the total consumption, energy prices will also have to be altered – it having been largely the absence of market signals in the Soviet system that has contributed to low efficiency in the use of energy.

The reporters say, moreover, that the energy system should be decentralized and electricity production combined with district heating.

There are however also great differences between the three countries. In Estonia the huge oil-shale deposits in its northeastern corner,

which are used as fuel for power plants and raw material for chemical industries, are an enormous source



of pollution. Here two great power stations, Balti and Esti, have together been emitting some 125,000 tons of sulphur dioxide a year (1990). The country's total emissions of sulphur dioxide in 1990 came to 208,000 tons, making it one of the world's worst emitters, per capita, of this pollutant.

In Latvia at least half of the electricity has had to be imported, the rest being produced about equally in hydroelectric and thermal plants. Due to an increased use of natural gas, the emissions of sulphur dioxide from the thermal plants had decreased by more than 30 per cent between 1980 and 1990. But the gas all has to come from the countries of the former Soviet Union.

Almost half of the power-producing capacity in Lithuania resides in the Ignalina nuclear plant – of the same type as Chernobyl and equally, if not more, unsafe. Most of the remaining capacity is in the Elekrenai thermal plant which burns oil, has no flue-gas cleaning, and according to the statistics emits 66,000 tons of sulphur dioxide annually. One way of improving the situation would be

to increase the imports of natural gas, although again, the sources would be Russian. The best, it is suggested, would be to start desulphurizing the oil at the Mazeikiai refinery, which is also a big emitter of sulphur dioxide (11,000 tons a year).

Otherwise the great problem is to improve efficiency. In Lithuania half of the energy is consumed by industry, and only 20 per cent in residential and service use – just about the reverse of the situation in western Europe. The researchers found that the largest share of energy was being wasted in the heating and ventilating of industrial premises. In residential space heating twice as much heat per square metre is consumed as in developed countries generally, and, significantly, three times as much as in equally cold Scandinavia. As already indicated, a massive introduction of metering and regulating devices, as well as better insulation, is the prescribed solution.

It may be noted that both Estonia and Lithuania have a great overcapacity of electricity, exporting their surpluses on the one hand to Russia and Latvia, and on the other to Belarus and the Russian enclave in Kaliningrad.

Both Latvia and Lithuania have set up commissions to stimulate the effective use of energy. The Latvian government has also promulgated a national energy-saving strategy as well, covering the period to 2005, and in Lithuania there is a National Energy Efficiency Program dating from 1991.

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* **Energy and Environment in Estonia, Latvia and Lithuania and Energy Conservation Potentials in Lithuania and Latvia**, with an intervening report on energy use and emissions scenarios to the year 2000 for Estonia only. 1991-1992. Edited by Jørgen Fenhann of the Risø National Laboratory and produced as a part of a project entitled Baltic-Nordic Cooperation in the Field of Energy and Environment, financed by the Nordic Council of Ministers. Available from Risø Library, Risø National Laboratory, P.O. Box 49, DK-4000 Roskilde, Denmark.