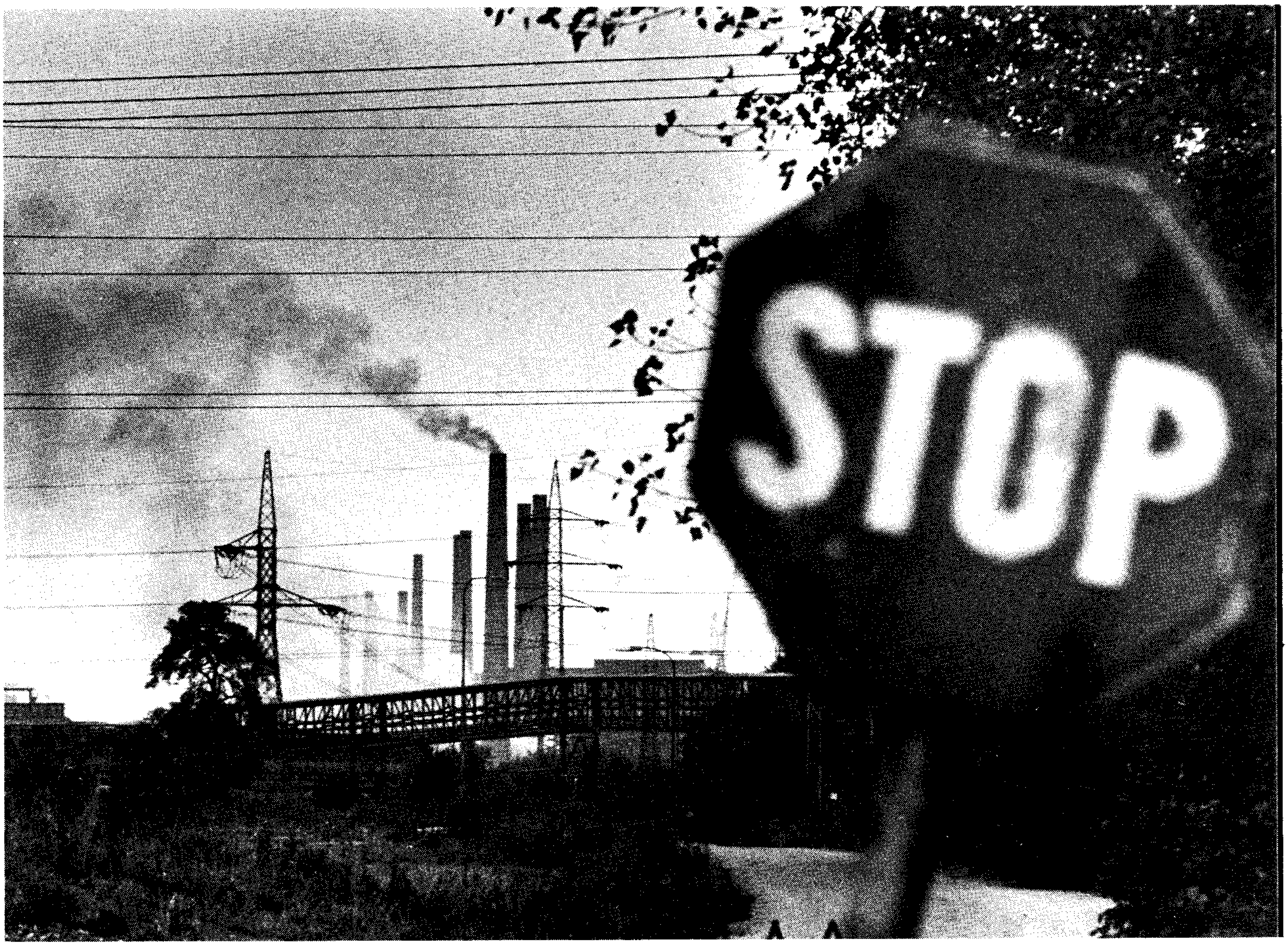
NO.1, MARCH 1991

Acid News

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



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CZECHOSLOVAKIA

Bohemian problem bared

FROM A CORNER OF northern Bohemia, known as the Basin, with no more than 2 per cent of the country's area, the yearly emissions of sulphur dioxide amount to more than 750,000 tons. This part of Czechoslovakia, with an area of 2500 sq kil-ometres, is the home of half a million people, yet its emissions of sulphur equal the combined total of all those from Sweden, Norway, Finland, and Denmark.

Northern Bohemia as a whole, with an area of 7800 sq kilometres, covers six per cent of the country. Here three-quarters of Czechoslovakia's brown coal is mined, over 90 per cent by opencast methods. More than half of the total is also burned in northern Bohemia, where a good third of the country's electricity is generated, and almost a third of the gas. Here, too, is ten per cent of the country's industrial capacity, and more than half of the uranium is mined.

Within the Basin, which fills 32 per cent of the area of northern Bohemia, are parts of the following districts: Usti n.L., Teplice, Most, and Chomutov. For decades the Basin has been important for its brown coal, although the kind mined here is of poor quality, with a regular ash content of 25-30 per cent, and sometimes up to 45 per cent. The sulphur content is usually between two and three per cent, but may be as much as five per cent. The increased demand for energy in the fifties led to an expansion of brown-coal mining in the Basin, and heavy industry became concentrated to a large extent just here.

According to the reigning ideology, industrialization was the basis of all development, with a top

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Acid News

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

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

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

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

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Editor: Christer Ågren

Published by: The Swedish Society for the Conservation of Nature

Printed by: Williamssons Offset, Solna

ISSN 0281-5087

THE SECRETARIATS

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

- The Environmental Federation (Miljöförbundet)
- The Swedish Anglers' National Association (Sportfiskarna)
- The Swedish Society for the Conservation of Nature (Naturskyddsföreningen)
- The Swedish Youth Association for Environmental Studies and Conservation (Fältbiologerna)

Address and telephone: see above.

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

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

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EDITORIAL

Encouraging

THE CONTRIBUTION OF road traffic to the pollution of the atmosphere is at last beginning to get proper attention. The matter has come to be increasingly debated within the European Community, yet several of its members are still impatient at the slow rate of progress.

Denmark for instance has challenged the Community by making the US 1987 standards compulsory for new cars already last autumn. The Netherlands is going to give financial incentives for the purchase of buses and trucks with emissions lower than required by the present EC directive. Belgium allows tax reductions, such as have prevailed for several years in Germany and the Netherlands, for cars equipped with three-way catalytic converters. The Germans on their part are now considering an entirely new scheme of incentives, under which vehicles would be divided into three classes: 1. With very low emissions. 2. With low emissions. 3. Only meeting the standards. Various means, such as tax incentives, would be used to promote the sale of cleaner vehicles.

A similar proposal is to be put before parliament by the Swedish government during the spring. If approved, this will involve the classification of cars and heavy vehicles according to emissions, and the introduction of financial incentives as early as for 1993 year models.

The possibility of setting standards for CO_2 emissions from cars is now also being debated, both within the Community and in Europe generally. The EC Commission is proposing an absolute limit of 250 grams of CO_2 per kilometre, corresponding to a petrol consumption of 1.05 litres per 10 kilometres. Although such a requirement would be far too lax to have any real effect – most cars already meet it, some by a margin of more than one half – it is at least a step in the right direction.

It is encouraging that so many countries should want to go beyond the EC requirements. By doing so they contribute directly to a reduction of emissions, and indirectly by exerting pressure on the Community to introduce standards that will be more closely in line with technical developments. It is however also important that measures for control should be used not only to bring about technical improvements in vehicles and fuels, but also to promote more environmentally sound systems of transportation and even to reduce the demand for transportation as such.

Christer Ågren

Do your part!

THE SWEDISH NGO Secretariat on Acid Rain is calling on environmental organizations all over Europe to highlight the problems of the "Black Triangle" region during their activities on Earth Day, April 22, 1991, and on World Environmental Day, June 5.

On June 21-23 there will be a Pan-European Conference of Environmental Ministers in Czechoslovakia. This is the first occasion on which ministers from Eastern Europe and member countries of the European Community and EFTA will be getting together to discuss Europe's common environmental problems. NGOs should urge their countries' ministers to make the problems of the Black Triangle a main point on their agenda for action.

Scheduled for March 22 and May 22 are also meetings of the Environmental Council of the European Community. NGOs are urged to write to the EC and its member governments, proposing more financial aid to the Black Triangle region from EC funds and banks for international development such as World Bank and the Bank for European Reconstruction and Development (BERD).

EC Council of Environmental Ministers, Rue de la Loi 170, 1048 Brussels, Belgium. **EFTA**, Rue Darlon, 1040 Brussels, Belgium. **BERD**, 6 Broadgate, London, England EC2M 2QS. **World Bank**, Avenue Léna 66, Paris 16, France.

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priority for heavy industry. Despite its lack of acceptable energy sources, the country was ordered, in 1948, to develop a heavy industry requiring large amounts of energy as well as raw materials.

In the Basin, the state of the environment can only be described as catastrophic. Mining, almost entirely by the opencast method, has ravaged a greater part of the area. Before any coal can be extracted, a 100-metre-thick layer of soil has to be dug away. Streams must be diverted, whole villages moved, and a new road network laid down.

One of the worst problems is however air pollution. That in the Basin has been described as the worst in Czechoslovakia, and perhaps the worst anywhere in Europe. The country's emissions of sulphur dioxide amount altogether to almost three million tons. Of this total, the twenty-five largest sources account for 1,6 million, with almost half coming from the Basin (Table 1). Then, too, are the emissions from smaller industries and domestic boilers. Various toxic, mutagenic and carcinogenic substances also get out into the atmosphere, further aggravating matters.

Predominant winds from the southwest and west help spread air pollutants over the whole Basin. Because the area is shaped like a valley, inversions often occur, and then, instead of being swept away by the winds, the pollution accumulates for several days. In consequence there are periods, especially in winter, from October to March, with very high concentrations. Consequently, too, the trees on the north side of the Basin are either dead or dying.

In Teplice, the concentrations of sulphur dioxide, nitrogen oxides, and carbon monoxide have been recorded for several years. There the monthly averages for sulphur dioxide have regularly exceeded 200 micrograms per cubic metre (µg/m^3) during winter, and have often been 40-60 µg/m^3 even in summer, and peak (half-hour) levels of 2000 micrograms have been recorded.

These figures may be compared with the highest permitted for sulphur dioxide in Czechoslovakia, which are: yearly average 60 µg/m^3, 24-hour average 150 µg/m^3 and half-hour average 500 µg/m^3.

Considerable additions to the pollution come from the brown-coal mining operations themselves. The slag often catches fire or simply goes

Table 1. The 12 largest emission sources for SO_2 in Czechoslovakia (more than 50,000 tons per annum, 1987). With the exception of Utvínoy all are power stations.

	SO_2 (tons/yr)	Solid particles (tons/yr)	NOx (tons/yr)
Prunérov II	202,000	10,700	55,500
Pocerady	123,500	13,900	53,700
Nováky	123,200	55,900	34,800
Melník	114,500		53,400
Tusimice I	102,300	11,300	32,700
Tusimice II	97,600	9,300	27,700
Prunérov I	93,500	24,300	26,400
Utvínoy	93,500	17,200	28,500
Tisova	89,700	23,800	27,400
Chvaletice	74,400	7,900	27,100
Komorany	69,300	43,300	15,100
Vojany	56,400	32,500	24,100

Source: Ecoforum, 1990.

Table 2. Child health

	All Czechoslovakia	Bohemian Basin
Infant mortality	12.4/1000	17.6/1000
Disorders among newborn at maternity clinic	9.48%	17.8%
Chronically ill and children with defects		
– Preschool	12.4%	17%
– School age	24.2%	27.6%
Teenagers in good health	58.7%	45.7%
Teenagers with health threatened	6.8%	17.4%

Source: Ecoforum, 1990.

On the following pages

on smouldering. In 1988 samples were taken of three carcinogens in the village of Roudniky, four kilometres from Teplice. The concentrations were found to be 500-800 times the permissible levels.

There must be similar concentrations in other parts of the Basin as well. The smouldering slag probably emits a number of carcinogenic substances. Workers in the opencast mines will therefore be especially at risk.

As regards the nation's health, between 1945 and 1960 the Czechoslovakian record was among the best in Europe. But from 1960 onwards the situation got steadily worse, and the Basin was one of the worst affected areas. Among the chief causes are the high levels of air pollution. Among the problems troubling the inhabitants of the Basin is diminished immuno defence. Continued exposure of mucous and other tissues to harmful substances in the air opens the way to respiratory infections, of which there has been a great increase, especially among children (Table 2).

Life expectancy is among lowest in the industrialized world

From blood tests it has been seen that children in the Basin have a deficiency of red blood cells. Staying for a fairly long time in a cleaner atmosphere leads to improvement, only to be followed by a relapse a few weeks after returning home.

While the average life expectancy in Czechoslovakia is in any case among the lowest in the industrialized world, in the Teplice district it is 1-3 years shorter than in the rest of the country. The mortality rate from cancer (of the respiratory tract , large intestine, and stomach) is also higher in the Basin than the national average. Since cancer often takes a long time to develop, these effects may be said to reflect the environmental situation as it was twenty years ago. Given the present situation, health will continue to be affected and victims claimed during decades to come.

Irena Klasterska

UPPER SILESIA

In need of aid

ALREADY IN THE early 1980s twenty-seven parts of Poland had been officially classified as areas at ecological risk. Areas so defined were those in which the standards of pollution were exceeded in at least two respects. Today, according to official estimates, such areas constitute 11 per cent of the country's total area, and include 34 per cent of the population.

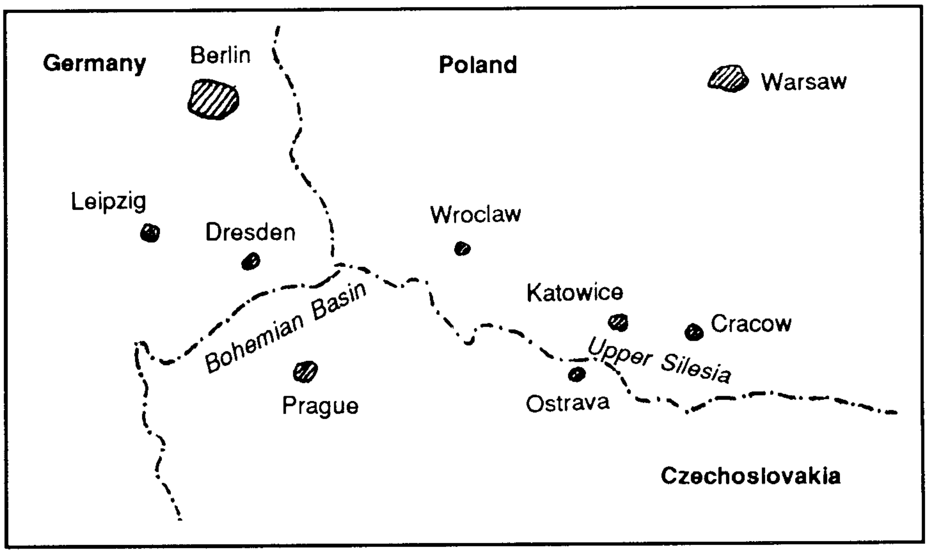
The regions of Upper Silesia and Cracow represent only 2.2 per cent of Poland's territory, but have about 5 million inhabitants, or 12.7 per cent of its population. These two industrial regions in southern Poland use an extremely high share of the country's natural resources, and are also responsible for large amounts of environmental pollution – including 30 per cent of the national emissions of dust, 28 per cent of the sulphur dioxide, and 53 per cent of industrial wastes.

The concentrations of great amounts of air and water pollution as well as industrial wastes in such a relatively small area, with a high population density, gives rise to health as well as ecological hazards. Most important of them are the large emissions of SO_2, affecting primarily the local inhabitants, but also, through long-range transport, people and environments in distant parts of Poland and other European countries. Both Upper Silesia and the Cracow region are also relatively more affected by water pollution than other areas of Poland.

The degradation of the natural environment constitutes a substantial threat to human life and health, with a resulting decrease in average life expectancy, as may be deduced from the table. Such data does not however only relate to the state of the environment. Life expectancy is also strongly affected by the general deterioration of living conditions which has lately taken place in Poland. It is however generally acknowledged that environmental hazards are important contributors to this alarming tendency.

The situation in the Upper Silesia and Cracow regions is in large extent due to the high concentration of heavy industries, in particular steel and nonferrous metallurgy, as well as chemical industries. Their negative impact on the environment has in many cases been intensified by the continued use of obsolete technology. For example until late in the 1980s some coking plants had been using equipment dating from 1916. Also adding to health risks are the dangerous locations both of old and new plants, as for instance the old smelting plants in the centres of some Silesian cities and the Lenin (now Sedzimir) steelworks which was built in the 1950s, for political reasons, in the suburbs of Cracow.

In the official list of the fifty-two largest industrial sources of air pol-



The so-called Black Triangle region of coal mining and heavy industry at the junction of Germany, Czechoslovakia, and Poland.

Inhabitants of Bytam, near Katowice, demonstrating on Earth Day 1990.

lution, eighteen are in the Upper Silesian and Cracow regions. These account for 23 per cent of the total emissions from large sources. Of the fifty-seven largest sources of untreated sewage in Poland, eighteen are mines and industrial plants in these two regions, which "produce" more than one-third of the total of untreated sewage.

The dramatic environmental situation of the traditional industrial regions of southern Poland calls for urgent changes in regional environmental policy. However the effectiveness of any appropriate policy can be considered only in the context of national environmental policy, or of the economic and social changes now taking place in Poland.

In the medium and long term the environmental situation in these regions will be mostly affected by the extent of implementation of the National Program for Environmental Protection that is now being debated. The general aim of this program is to reverse existing degradation trends in the natural environment. In regard to air pollution the program proposes an initial 30-percent reduction of SO_2 emissions and a stabilization of NO_x emissions.

For protecting waters the program envisages among other things a 50 per cent reduction of untreated sewage discharged to rivers by the year 2000.

Despite the poor situation in the country itself, and its effect on the environment in neighbouring countries, Poland will not be able to improve matters only through the use of its own internal resources. In the first place, the size of the expenditures that Poland could embark on for environmental protection, without conflicting with other economic and social goals, is determined by the income level per capita (US $2070 in 1989). In the years 1975-1985 Poland spent 0.5 per cent of its GDP on environmental protection. In 1980-1982 that indicator actually dropped to 0.25 per cent, and it was only in 1988 that it rose to 0.8 per cent. According to OECD estimates, as much as 2 per cent of national income should be spent merely for maintaining the environment in its existing state.

Environmental degradation also causes substantial economic losses. At the turn of 1970 they were estimated to be 10 per cent of the Polish GDP. The last estimates made in 1986 put the losses at 1000 billion zlotys, of which 40 per cent was related to SO_2 emissions.

The implementation of radical environmental programs in Poland is also hampered by the size of the foreign debt, amounting in 1989 to US$41.4 billion. Since huge amounts of hard-currency earnings have to be earmarked for debt service, the ability to use hard currency for environmental protection is limited.

There are some cases of foreign aid being offered for restoration of the environment in Upper Silesia and the Cracow region. The most important would seem to be a project financed by the World Bank. The US$15 million loan offered to Poland by this institution will be used for financing the upgrading of environmental policy and regulation, assessment of capabilities for the reduction of industrial emissions, setting up a system for air-quality management in the Upper Silesia and Cracow regions, and one for water-management in the upper Vistula basin.

Besides the World Bank project, some countries are engaged in individual environmental projects in South Poland. The United States has for example offered US $7 million for environmental protection in the Cracow region, Germany is giving DM 50 million for the construction of a district heating system in Gliwice (Upper Silesia), and the Nordrhein-Westfalen government US $5 million for environmental monitoring in the Katowice area.

The above article is based on a report by **Professor Adam Budnikowski** at the Central School of Planning and Statistics, Warsaw.

Selected health indicators for Poland and the Katowice district 1984.

Disorders	Poland	Katowice district
Per 10,000 of population		
Pregnancy complications	123.8	143.1
Natural abortions	41.8	66.7
Cancer	71.2	75.5
Diseases of the digestive system	135.9	157.0
Injuries, intoxication	108.7	114.7
Infant mortality (per 1000 of births)		
Total	19.1	20.5
Urban population	18.8	20.7
Rural population	19.5	18.5

Source: B. Stephien et al., **Eko** 1989, No. 2.

Power clean-up envisaged

SPEAKING AT A SEMINAR in Serock, Poland, last October, the then Under Minister for Environment, Maciej Nowicki, claimed that his country's emissions of sulphur dioxide could be reduced by 30 per cent by 1995 and 40-50 per cent by the year 2000.

Here is a somewhat shortened version of Mr Nowicki's address.

Contemporary Poland has fifty-four generating and heat-and-power plants in operation. Their total capacity amounts to 28,900 MW electricity. In 1989 they burnt approximately 57 million tons of anthracite and 70.5 million tons of brown coal. In addition there are various industrial enterprises with 230 small plants for generating electricity and heat, with a total capacity of 3,150 MWe. There are also 119 hydro-electric plants which provide approximately 2,000 MWe. These plants produced altogether 145.5 TWh (terawatt hours) of electrical energy and 512 PJ (petajoule) of thermal energy in 1989.

The emission of dust from power generating is estimated to total 1.0-1.2 million tons per annum, which means 30-35 per cent of the nation's emissions of particulate matter. The emissions of sulphur dioxide (SO_2) from fuel-burning power processes amounted to 2.8-3.0 million tons in 1989 (approximately 70 per cent of the country's total). The figures for nitrogen oxides (NO_x) are 0.6-0.65 million tons (40-45 per cent of national emissions). In addition to this, power plants produced 35.8 million tons of wastes (slag and soot), of which only 43 per cent were re-utilized. The remainder – about 20 million tons – was added to the enormous landfills which already contain about 250 million tons of such waste. In addition to the pollution resulting from the burning process itself, there is also the damage from mining of anthracite (devastation of the Silesian environment) and lignite (removal of huge quantities of soil, subsidation, etc.).

Seventy-five per cent of all Poland's forests are endangered, 60 per cent of the soil is suffering from acidity, and the tangible losses resulting from air pollution account for several percentage points of the GNP. Any increase of pollution, or even maintaining the emissions of dust, SO_2 and NO_x at present levels in the years to come, would greatly add to the destruction now being witnessed. Every effort must therefore be made to quickly reduce the pollution from power generating, while at the same time increasing the output potential.

It will be necessary to pursue eco-development with the aim of promoting human health and a clean natural environment. In any program the saving of raw materials and energy will occupy a prime place. The countries of western Europe have, over the past fifteen years, proven that rapid economic development is possible with a stable, or even falling, use of energy. In Poland the potentials are particularly great in both the industrial and construction as well as the transport sectors.

The implementation of a nation-wide program aimed at the rational use of energy in all its forms should be a top priority for the government, industry and every citizen. It would be possible to save 30-40 per cent of the energy now being used while at the same time greatly decreasing environmental pollution, raising the quality of products manufactured by Polish industry, and raising the standard of living of the citizen.

Achievement of this will involve restructuring industry by on the one hand replacing old, energy intensive technologies with newer, energy efficient ones, and on the other reducing the proportion of heavy industry in favour of high-technology industries requiring many times less energy in relation to the value of the product.

The most important and simplest method of reducing the emissions of SO_2 resulting from the burning of anthracite coal over the next 3-5 years would undoubtedly be to implement the fuel-enriching and desulphurization program.

It should be noted that today, no generating plant receives coal with the specifications for which the plant was designed. The plants have to take delivery of coal with a low heat value (18.3 megajoule/kg on the average), with a large ash content (average 28.5 per cent) and a sulphur content in the order of 0.6-3.5 per cent (1.14 per cent average). Because the coal that is being burned is of low quality, 1,000 to 1,200 MWe is being "frozen" in existing plants, electro-filters are overburdened by dust, and excess emissions of SO_2 amount to about 400,000 tons yearly, while about 5 million tons of rock are needlessly being hauled around the country.

By using simple flotation methods, long known in Poland, it is possible to eliminate most of the rock found in coal as well as so-called pyritic sulphur (which accounts for 30-50 per cent of the sulphur content of anthracite coal).

Poland's ten largest SO_2 emission sources 1988.
All are coal-fired power stations.

		District	SO_2 (tons/year)
1.	Belchatow	Piotrkowskie	341,600
2.	Turow	Jeleniogonskie	205,400
3.	Polaniec	Farnobrzeskie	149,800
4.	Jaworzno III	Katowickie	123,400
5.	Rybmik	Katowickie	123,200
6.	Kozience	Radomskie	116,100
7.	Siersza	Katowickie	111,500
8.	Konin	Konin-Goslawice	84,000
9.	Dolna Odra	Szezecinskie	78,300
10.	Laziska	Katowickie	77,600

Source: **Statistical Yearbook Poland 1989.**

Tradition for dwellings to huddle around industrial plants in sothern Poland.

© W. KOMPALA

During the next two years concentration facilities are expected to be built at the four mines producing 10 million tons of coal with the greatest sulphur content. All the remaining mines that supply coal for energy production should have such facilities within three years. The cost is estimated to be 2 trillion zlotys (approximately US $200 million).

In contrast to anthracite, brown coal has its entire sulphur content in organic form, and thus it cannot be separated from the coal prior to the burning process. The only way to reduce SO_2 emissions from the large power plants using lignite (Belchatow, Turow and Patnow) will be to install equipment for desulphurizing the flue gases. It is entirely within reason to expect at least the Belchatow and Turow plants to be so equipped within five years. This will make it possible to limit SO_2 emissions by about 500,000 tons per year, at a cost of approximately 5-6 trillion zlotys (US $500-600 million). Similar facilities must be installed simultaneously at the power plants in Upper Silesia on account of the need to concentrate effort on cleaning up this, the most polluted region of Poland, as quickly as possible.

It may thus be assumed that Poland's emissions of SO_2 can be reduced by at least 30 per cent within five years. The cost will, however, amount to one billion dollars.

It should be added, that only one new large-capacity power plant will be commissioned during this period (Opole 3,200 MW). It will be equipped for highly efficient flue-gas desulphurization. The electricity potential of the Polish power industry can increase by 4,200-4,500 MW within five years.

In the medium term, within 10-15 years, the main task will be the introduction of new, more effective coal-burning technologies through the manufacture, in Poland, of FBC (fluidized bed combustion) boilers. This technology will make possible not only savings in coal, but also greatly decreased emissions of SO_2 and NO_x (by 60-80 per cent), without any need for special cleaning equipment. Such boilers will steadily replace the old conventional types. The Polish factories at Raciborz, Sosnowiec, and Sedziszow are now phasing out the old types and starting the manufacture of FBC boilers.

Another major problem, power blackouts during evening peak hours, makes it necessary to build peak-load plants, fuelled by gas. An increased import of natural gas is planned through a pipeline from the North Sea, as well as increased domestic production. Gas-fired plants emit no SO_2 or dust, while NO_x emissions are many times lower than for coal-burning plants.

A middle-term step is the development of district heating systems, to replace the inefficient individual furnaces used for residential heating. The improved efficiency can result in savings of several million tons of coal annually. Modernization and expansion of the heating network of the industrial generating plants could further add to this potential. The implementation of any program such as the above will not, however, be possible prior to the total reform of fuel and energy prices (bringing them in line with world prices) coupled with the introduction of tax breaks and other economic instruments for those who undertake tangible pro-environment action.

The end result of all this could be an increase of 10,000-12,000 MW in Poland's potential capacity by the year 2000, accompanied by a reduction in SO_2 emissions by 40-50 per cent, compared with today's figures.

Maciej Nowicki is now Minister for the Environment in Poland.

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WHO REPORT

Air pollution and health

"MILLIONS OF EUROPEANS live in areas where the air pollution is severe enough to cause thousands of premature deaths each year and many more to become chronically ill and disabled." Such is the conclusion, among others, of a report that is expected to be published shortly, entitled *Impact on Human Health of Air Pollution in Europe*, from the World Health Organization (WHO). It has been compiled by the organ's Regional Office for Europe,* with the aid of experts from the Netherlands and the United States, at the request of the Executive Body of the UN ECE Convention on Long Range Transboundary Air Pollution.

The report concentrates on characterizing and assessing four different situations involving air pollution: summer episodes, winter episodes, situations with long-term exposure to high levels of pollution in urban environments, and with long-term exposure to mixtures of pollutants in such environments.

Summer episodes, which are characterized by high concentrations of photochemical oxidants, in particular ozone, appear to be most serious in western Europe, as well as in some of the south European cities, such as for instance Athens. Since ozone is formed from nitrogen oxides and volatile organic compounds under the influence of sunlight, it is in summer that the highest concentrations occur. Among the typical health effects are coughing, chest pains, and breathing difficulty. Chronic exposure may cause irreversible loss of respiratory reserves.

The one-hour air quality guideline (AQG) level for ozone set by WHO is 150-200 micrograms per cubic metre (µg/m^3), and the 8-hour level is 100-120 µg/m^3. It is said in the report that "there is very little or no margin of protection at these levels." In Athens, one-hour average ozone concentrations above 300 µg/m^3 have been observed for many days, and a maximum of 500 µg/m^3 has even been reported. In years with severe episodes, such as 1982 and 1989, one-hour ozone concentrations of 300-350 µg/m^3 were regularly observed for several days in parts of western Europe.

Immediate abatement and control action should be taken

Winter episodes occur when a high-pressure system persists for several days, giving rise to temperature inversions that hinder the mixing of air, thus causing an accumulation of pollution. The main pollutants of concern during such episodes are sulphur dioxide (SO_2) and suspended particulate matter (SPM), but high concentrations of other pollutants, such as carbon monoxide, nitric acid, and nitrogen dioxide, may also occur. This type of pollution can cause substantial acute pulmonary function decrements and severe respiratory symptoms, and repeated exposure may lead to persistent decline in lung function. Significant increases in morbidity and mortality are said to be likely to occur in the most polluted areas.

The proposed AQG values for combined exposure to SO_2 and SPM have been set at 125 µg/m^3 of SO_2 and 120 µg/m^3 of SPM, as 24-hour levels. For long-term effects, the recommended AQG value is 50 µg/m^3 for both SO_2 and SPM, expressed as an annual mean. For SO_2 alone, a one-hour exposure of maximum 350 µg/m^3 is recommended by WHO. Winter episodes are more severe and occur more frequently in eastern than in western Europe. In the densely populated areas of eastern Europe, such as the northern part of Czechoslovakia, eastern Germany, and southern Poland, SO_2-levels are especially high. For example 24-hour average concentrations of 1100-2500 µg/m^3 were observed in December 1989 in the south of former East Germany. The populations in many cities of southern and western Europe may experience high levels of pollution during winter episodes.

Long-term exposure in urban areas to high levels of air pollution causes an array of acute and chronic health effects, including increased respiratory symptoms, morbidity and mortality, and increased cancer

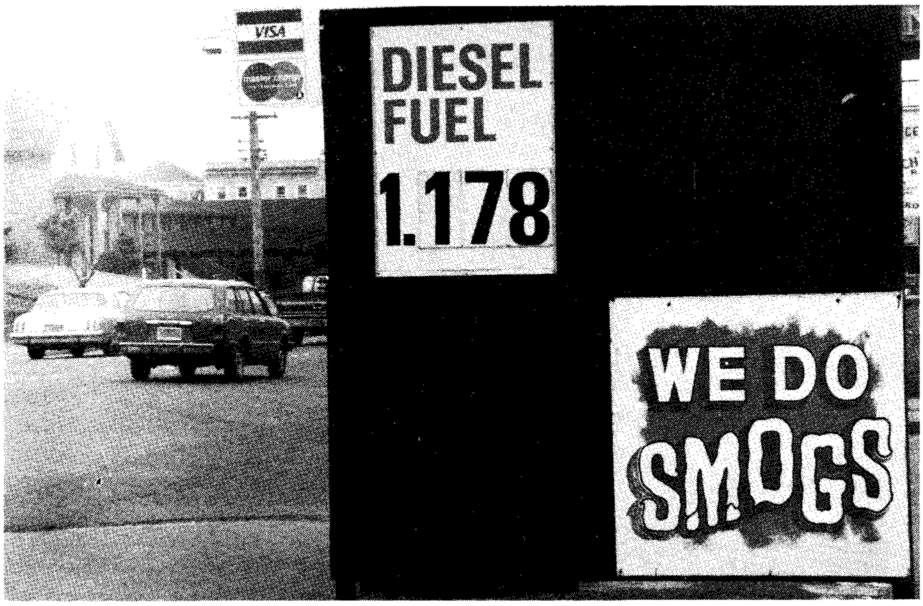
Move towards convergence

EMISSIONS OF AIR pollutants from heavy diesel-driven vehicles are expected to go on increasing all through the nineties in Europe. In some countries, such as Sweden and the former West Germany, such vehicles already account for about 20 per cent of all the emissions of nitrogen oxides, and as cars, generating plants, and industries generally become cleaner in Europe, the proportion of NOx emissions from heavy road vehicles will become still greater.

The emission standards for nitrogen oxides, hydrocarbons, carbon monoxide, and particulates from heavy road vehicles lag far behind those for cars. Within the UN ECE sphere (United Nations Economic Commission for Europe) a directive, ECE R49, was issued in 1982 setting forth limits and test methods for the control of emissions of gaseous pollutants from heavy diesel engines. Since adoption is voluntary, however, it is up to individual countries to decide whether or not they will comply.

The emission limits laid down in ECE R49 are moreover so outdated and feeble that modern types of engine can meet them without alteration. For testing, the engine is placed on a test bench and run at a number of determined loadings, the so-called 13-mode test. Nor are there any clauses concerning durability, control of durability, or the manufacturer's direct responsibility for the durability of the exhaust cleaning.

In the United States standards were formulated in 1985 for emissions of gaseous pollutants and particulates. These came into force initially for 1990 year models (in California 1988) and are gradually being tightened as far as the 1994 year models (see table). At the same time it was decided to apply a more advanced test method, the so-called transient test.



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The engine is again mounted on a test bench, but in this case the effects of acceleration and deceleration are also tested, which means that the equipment also has to be more advanced. The idea has been to approximate the test more closely to actual driving conditions. The differences between the ECE and the American test methods make it difficult however to compare the various requirements.

In America, every new vehicle that is sold must, by law, have been proved capable of meeting all the requirements. First the vehicle has to be certified according to an accepted procedure. Then the manufacturer must reveal the results of tests of prototype engines, showing the emissions when the engine is new, and, as a guarantee that it will fulfill the durability requirements, after a period of use.

Random sampling ("selective enforcement auditing") is used to see whether mass-produced vehicles are meeting emission requirements, while a check on durability is maintained through a recall program, involving vehicles that have actually been running on the roads. If any engine model fails to meet the requirements, the maker must take steps to remedy the fault. The recall program acts as a deterrent, since

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mortality associated with exposures to carcinogens, such as polyaromatic hydrocarbons and benzene. Due to lack of data on the combined and possibly synergistic effects of air pollution mixtures in urban areas, in this report WHO uses the annual average concentrations of SO_2 and SPM as indicators of this type of pollution.

Long-term multimedia exposure includes air pollutants such as heavy metals, polyaromatic hydrocarbons, PCBs and dioxins, which give rise to increased concentrations of pollution in different media, i.e. air, soil, water, and food. Human exposure to such contaminants occurs mostly through the food chain and drinking water. These pollutants may accumulate in the body, and may lead to an excess cancer risk, neurotoxic and immunotoxic effects, as well as other health effects. For example air quality and deposition data on arsenic, cadmium, and lead clearly indicate that populations in large areas of eastern Europe are likely to be chronically exposed, directly and indirectly, to elevated levels of these contaminants.

The report says the impact of air pollution on human health is so severe that "immediate abatement and control action should be taken," and that such action should not be delayed while waiting for additional studies.

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failure will mean high remedying costs as well as bad publicity – thus by its very existence helping to keep emissions down.

The European Community laid down requirements for the emissions of gaseous pollutants from heavy vehicles for the first time in a directive from 1988. This was intended to apply to all new vehicles as from October 1, 1990. The requirements are essentially those of ECE R49, somewhat tightened up. But again adoption is voluntary for each nation, and the emission limits are still so low that most new vehicles should have no trouble in meeting them.

Early last May, only five months before the above directive was to come into force, the EC Commission put forward a proposal involving stricter requirements which would, moreover, be obligatory (see table). These would come into force in two stages, the first from July 1992 for new models of engine and from January 1993 for all new engines, and the second from October 1996 for new engine models, and one year later for all new engines. The basis is still however ECE R49, with the same test method.

This proposal has subsequently been debated both within the member countries and the various Community organs. The United Kingdom, to some extent supported by the Netherlands and Denmark, has advocated stricter requirements, similar to the US1994 standards, together with the American test method. When the matter came up in the European Parliament earlier this year, a proposal for tightening up the Commission's proposal was also presented. A decision is expected during the course of the year.

During the last half of the eighties Switzerland, Austria, Sweden, and Norway had each decided to introduce obligatory emission standards for heavy diesel vehicles. As will appear from the table, the year in which they will come into force, as well as the actual emission standards, will vary somewhat, but on the whole they will be in agreement with the American requirements for 1990/91.

The rules and emission limits for heavy vehicles have also been under discussion within the so-called Stockholm Group. This group, which was founded in 1984, includes Austria, Denmark, Canada, Finland, Liechtenstein, Norway, Switzerland, Sweden and the United States, with Germany and the Netherlands as observers. Although work is still going on, there seems to be general agreement that the US1994 standards represent what is reasonably possible of achievement with present knowledge of the best available technology.

Country/ countries	Year	Standards (g/kWh)[1] NOx	HC	CO	Particles
United States[2]	1990	8.2	1.1	8.2	0.7
	1991	7.2	1.1	8.2	0.3
	1994	7.2	1.1	8.2	0.15[3]
ECE R49		18.0	3.5	14.0	–
EC	1990	15.8	2.6	12.3	–
	1993[4]	9.0	1.2	4.9	0.4
	1997[4]	7.0	1.1	4.0	0.3/0.15
Switzerland/Austria	1991	9.0	1.2	4.9	0.7
Sweden	1993	9.0	1.2	4.9	0.7
	1996[4]	7.0	0.6	2.0	0.15
Norway	1994	7.0	1.2	4.9	0.35
Stockholm Group	1996[5]	7.0	0.6	2.0	0.15

1 Emissions in grams per kilowatt-hour, based on the European 13-mode test cycle (ECE R49).
2 The American standards appear in the original as grams per brake horsepower/hour. The figures here are conversions taken from EC documents. On account of different test methods, they cannot be exact equivalents.
3 For buses in urban traffic the limit of 0.15 g is to apply for 1993 year models.
4 Proposal
5 Discussed

There are a number of technical measures that can help to reduce the emissions of nitrogen oxides from truck and bus engines. Unfortunately some of these, such as retarded injection and exhaust-gas recirculation, may result in increased fuel consumption and possibly an increased emission of particulates. A system is however under development for more advanced injection control in particular, as a means of optimizing combustion at various loads on the engine and thus minimizing NOx emissions as well as fuel consumption.

No increase of emissions from greater numbers of vehicles is allowable

During the eighties it became ever more usual to fit large diesel engines with turbochargers, and so increase the surplus air and consequently the power output. This may however have the disadvantage of leading to increased emissions of nitrogen oxides. On the other hand the addition of an intercooler at the air intake can, by keeping the maximum combustion temperatures down, also reduce NOx emissions.

Various technical measures have made it possible to hold the NOx emissions from modern diesel engines at 6-7 grams per kilowatt-hour, or half of what they were at the beginning of the eighties. There is no possibility with a diesel engine of reducing the nitrogen oxides to nitrogen by means of a three-way catalyzer, as in the case of petrol engines. The reason is that in a diesel engine combustion takes place with a surplus of air, and so the exhaust gases in turn contain a surplus of oxygen. Laboratory experiments are now being made to get over the problem by adding ammonia to the exhaust gases in order to create a chemically reducing ambience (the principle used for denitrification of the flue gases in power plants).

Emissions of particulates can be reduced, not only by arrangements in the engine itself, but also by installing dust traps in the exhaust system. While still in process of development, such traps have already been tried out for some time in practice, mostly in buses on urban lines. When fully developed they should enable emissions to be reduced by at least 50 and perhaps as much as 80-90 per cent.

The main problems so far with particle traps have concerned durability and regeneration. The latter implies cleaning the trap at certain intervals, as for instance by efficient combustion. There would be less difficulty in this respect if diesel fuel with a lower sulphur content (less

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than 0.05 per cent) were generally available and actually used.

Meeting the USA requirement for 1994, of 0.15 grams of particulate per kWh, will call for a combination of low-sulphur fuel and dust traps. (A lowered content of aromatics in the fuel can also help to reduce particulate emissions.) Last year the United States therefore decided to lower the sulphur content of diesel fuel still further. As from October 1993 the limit will be 0.05 per cent by weight, thus facilitating the use of dust traps. The particulate traps can also be made to serve as oxidizing catalyzers by coating their surfaces with noble metals. This would be a way of reducing the emissions of carbon monoxide and gaseous hydrocarbons still further.

Large diesel engines, said to easily meet the US1994 standards, are already commercially available for buses in city traffic. They are equipped with dust-trap, oxidizing catalyzers and run on low-sulphur fuel. It is still not certain, however, whether they will fulfill American durability requirements.

Tests to see whether emissions from heavy vehicles can be reduced by using alternative fuels have been and are being made in various parts of the world. Interest has focused primarily on vehicles that are used in city traffic, in other words, buses and light and medium-sized trucks. The fuels that have been tried include alcohols (ethanol and methanol) and gas (compressed natural gas, CNG, liquified petroleum gas, LPG, and bio-gas). Alternatives are electric power and hydrogen, and a further possibility is to switch to petrol in combination with a three-way catalyzer. Gas, alcohol, and electric propulsion (of buses taking power from overhead conductors) are already being employed for heavy vehicles in many countries.

Gas gives a great reduction in the emissions of particulates, and also reduces nitrogen oxides. Emissions of less than 2-3 g/kWh can be achieved for NOx – especially if engines working on the Otto principle (as in ordinary petrol angines) are used in combination with three-way catalyzers. A disadvantage is that emissions of hydrocarbons and carbon monoxide may increase, relatively to diesel engines, as well as fuel consumption. "Environmentally optimized" engines using CNG and LPG are under development.

Methanol and ethanol also do best in Otto-type engines. Lower combustion temperatures, due to the lower energy density of alcohols, result in lower emissions of NOx. Since the diesel engine has a greater potential for a higher degree of energy efficiency, attempts are being made to use alcohol in modified or converted diesel engines too. This should result in emissions of about 3 grams NOx/kWh, very low emissions of particulates, but somewhat higher emissions of hydrocarbons and carbon monoxide, compared with ordinary diesels.

A problem with the use of methanol, in particular, is an increase in emissions of formaldehyde, which is not only suspected of being carcinogenic, but also relatively highly reactive – in other words, can greatly contribute to the formation of ozone. It seems probable, however, that formaldehyde emissions could be markedly reduced with the aid of oxidizing catalyzers.

Basic changes necessary to minimize effects

Alternative fuels can play an important part in reducing the pollutant load on local environments – and especially in built-up areas – by reducing the emissions of particulates and nitrogen oxides. To avoid contributing to global problems, such as the greenhouse effect, it is important that fuels derived from renewable sources, such as bio-gas and ethanol, should be given highest priority. Propulsion by electricity and hydrogen can also provide good alternatives, depending on how they are produced.

Since 1950 the number of motor vehicles in the world has increased tenfold, from 50 to 500 million. Trucks and buses account for about one-fifth of the total. Forecasts for Europe and other parts of the world are unanimous in predicting a continued increase, so that only about 20-30 years from now there may be a billion motor vehicles in use. But the emissions of air pollutants from them must on no account be allowed to increase – on the contrary they will have to be drastically reduced. Basic changes in social planning and transport policy will therefore be necessary in order to bring down the demand for transportation. Moreover improvements are highly needed in both transport technology and in the vehicles themselves, with the aim of minimizing the effects of the transport sector on the environment.

Christer Ågren

Emissions both up and down

AS SHOWN IN a new EMEP report, between 1980 and 1989 European emissions of sulphur declined from 26 to 20 million tons. Those of nitrogen oxides on the other hand continued to rise. The report, which also includes fresh data on transboundary fluxes of air pollutants in Europe, is the latest from the EMEP centre in Oslo*.

The emission data is based on the official figures supplied by each country, which have been assembled by the EMEP since the late seventies (Table 1). Together with data from field measurements of concentrations and fallout, meteorological data and advanced mathematical calculations are used to describe the transformation and deposition of pollutants between European countries. A general description of the EMEP monitoring program appeared Acid News 1/90.

While most of the national figures have become more reliable, and are presented in a more comparable form, those from some countries still invite scepticism. The figure of 100 tons for sulphur emissions that has been reported from Romania, for instance, should in reality most probably be 7-8 times greater. In the opposite sense, the Greek data for nitrogen oxides is probably a distinct overestimate.

This last year the EMEP's computer model has been revised and improved. The emission data has for instance been expanded so as to cover the areas of sea and include emissions from international shipping as well as natural emissions of sulphur (Table 2). As a result, the contributions of sulphur from indeterminate sources (IND), that is, depositions that cannot be attributed to any known source of emission, are now only about half of what they appeared to be previously – having come down on an average from 22 to 12 per cent of the total.

Every year the EMEP presents information on emissions, transports (exports and imports), concentrations, and depositions of sulphur and nitrogen pollutants. The latest available data on exports and imports of sulphur and oxidized nitrogen compunds appears in Tables 3 and 4. Since they are as recent as for 1989, however, the figures must be regarded as preliminary.

The EMEP reports provide an important check on the way signatories to international agreements are fulfilling their obligations, as well as on the general effect of such agreements. They are also useful in the development of new agreements, based on the critical-loads concept. It should therefore be the obvious duty of every country to deliver correct data within the agreed time, thus improving still further the value of the EMEP work.

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Table 1. Emissions of sulphur and nitrogen oxides employed in the calculations.

		Sulphur (1000 tons/year)		Nitrogen oxides (1000 tons as NO_2/year)	
		1980	1989	1985	1989
Albania	AL	[25]	[25]	[9]	[9]
Austria	AT	185	52*	230	207*
Belgium	BE	414	209*	281	299*
Bulgaria	BG	517	515*	150*	150*
Czechoslovakia	CS	1550	1387*	1127	950*
Denmark	DK	224	127*	258	252*
Finland	FI	292	139*	251	282*
France	FR	1669	636	1615	1761
German Dem. Rep.	DD	2132	2621	955*	1005
German Fed. Rep.	DE	1600	530	2950	2729*
Greece	GR	200	250*	746	746*
Hungary	HU	816	542	262	249
Iceland	IS	3	3*	12	12*
Ireland	IE	110	91*	68	93*
Italy	IT	1900	1205*	1595	1700*
Luxembourg	LU	12	6*	19	16*
Netherlands	NL	233	127	544	552
Norway	NO	71	33	203	226
Poland	PL	2050	1955	1500	1480
Portugal	PT	133	104*	96	132*
Romania	RO	100	100*	[390]	[390]
Spain	ES	1625	1559*	950	950*
Sweden	SE	257	105*	394	382*
Switzerland	CH	63	34	214	189
Turkey	TR	138*	199*	[175]	[175]
Soviet Union**	SU	6400	4659	3369	4190*
United Kingdom	GB	2424	1776	2278	2513
Yugoslavia	YU	650	825	400	480*
Sum		**25793**	**19814**	**21041**	**22119**

The table shows national official data received at the ECE secretariat up to August 31, 1990.
* Interpolated data (no data have been officially submitted).
** European part of USSR within EMEP area of calculation.

* EMEP is the acronym for the **Co-operative Programme for Monitoring and Evaluation of Long Range Transboundary Air Pollution.** Started in 1977, the program is carried out under the UN ECE Convention on Long Range Transboundary Air Pollution. The EMEP has two meteorological centres, one (EMEP-West) in Oslo, Norway, and the other (EMEP-East) in the USSR, in Moscow. Its Chemical Co-ordinating Centre (CCC) is also located in Oslo. The data shown in the tables is from the EMEP MSC-W Report 2/90, entitled **Calculated Budgets of Airborne Sulphur and Nitrogen over Europe.** It can be had from The Norwegian Meteorological Institute, P.O.Box 43-Blindern, N-0313 Oslo, Norway.

Table 2. Estimated emissions of SO_2 and NO_x from ships in international trade, and biogenic emissions from sea. (Unit 1000 tons/year).

Emission Origin		SO_2	NO_2
BAS	Baltic Sea	73	80
NOS	North Sea	173	192
ATL	Atlantic Ocean[1]	317	349
MED	The Mediterranean	12[2]	13[2]
BLS	Black Sea	no data	
NAT	Biogenic	1510	0

[1] Remaining Atlantic Ocean inside EMEP calculation area.
[2] Data only close to Gibraltar, otherwise no data.

Table 3. Provisional estimate of sulphur budget for Europe 1989. Total (dry + wet) deposition of sulphur. Unit: 100 tons sulphur per year.

	AL	AT	BE	BG	CS	DK	FI	FR	DD	DE	GR	HU	IS	IE	IT	LU	NL	NO	PL	PT	RO	ES	SE	CH	TR	SU	GB	YU	REM	BAS	NOS	ATL	MED	BLS	NAT	IND	SUM
AL	40	1	0	22	11	0	0	1	11	1	18	12	0	0	26	0	0	0	9	0	2	3	0	0	0	5	1	40	2	0	0	0	0	0	6	52	265
AT	0	135	18	4	365	4	1	58	412	110	1	93	0	1	240	1	12	0	166	0	3	13	2	12	0	21	41	96	1	1	3	1	0	0	7	176	1999
BE	0	0	417	0	15	1	0	132	39	66	0	1	0	2	3	2	34	0	8	0	0	8	0	0	0	1	106	1	0	0	12	2	0	0	5	39	894
BG	3	2	2	1249	68	2	1	4	66	8	36	83	0	0	22	0	1	0	103	0	41	1	1	0	12	139	4	168	2	0	1	0	0	0	12	213	2244
CS	0	27	23	5	3642	9	2	54	1437	136	2	314	0	1	46	1	14	0	721	0	5	9	3	3	0	56	47	77	0	2	5	1	0	0	8	214	6867
DK	0	0	13	0	22	140	1	16	97	36	0	2	0	2	2	0	12	1	26	0	0	3	5	0	0	4	98	1	0	5	10	1	0	0	10	49	558
FI	0	0	10	1	43	20	405	12	138	24	0	7	0	2	1	0	8	6	119	0	1	1	55	0	0	450	71	3	0	15	5	1	0	0	36	343	1780
FR	0	5	212	1	97	6	1	2224	262	212	0	24	0	13	320	8	60	0	53	15	0	534	1	18	0	4	510	55	7	1	51	39	0	0	88	729	5553
DD	0	3	47	1	638	25	1	76	6794	280	0	16	0	2	13	2	31	1	168	0	0	11	3	1	0	14	109	8	0	5	13	2	0	0	11	143	8421
DE	0	18	229	2	388	28	2	418	1393	1705	0	24	0	7	118	11	138	1	128	2	1	60	4	26	0	18	362	19	0	5	41	7	0	0	28	345	5529
GR	9	1	1	199	28	1	0	3	32	4	471	29	0	0	32	0	1	0	40	0	10	3	0	0	16	54	2	53	5	0	0	0	0	0	24	209	1227
HU	0	19	5	11	341	2	1	13	196	25	3	1468	0	0	72	0	3	0	254	0	15	5	1	1	0	52	11	261	1	1	1	0	0	0	5	165	2933
IS	0	0	0	0	0	0	0	1	1	1	0	0	5	1	0	0	1	0	0	0	0	1	0	0	0	0	15	0	0	0	0	1	0	0	22	48	98
IE	0	0	5	0	4	1	0	9	9	5	0	0	0	194	0	0	3	0	3	0	0	5	0	0	0	1	109	0	0	0	3	9	0	0	23	70	452
IT	2	19	19	23	153	3	1	132	199	60	15	88	0	1	3213	1	9	0	95	3	4	83	1	21	1	13	51	277	22	1	4	3	0	0	61	554	5132
LU	0	0	3	0	1	0	0	11	2	5	0	0	0	0	1	10	1	0	0	0	0	1	0	0	0	0	3	0	0	0	0	0	0	0	0	3	41
NL	0	0	109	0	13	2	0	75	47	142	0	1	0	3	2	1	195	0	11	0	0	8	0	0	0	1	162	0	0	0	20	2	0	0	8	45	847
NO	0	0	17	1	31	36	11	25	126	43	0	5	0	12	3	0	14	74	64	0	0	6	24	0	0	102	333	5	0	5	19	8	0	0	78	398	1444
PL	0	14	51	9	1233	56	10	90	3067	243	2	183	0	5	42	2	36	2	6516	1	7	15	18	3	1	210	164	77	1	17	17	3	0	0	29	483	12603
PT	0	0	0	0	0	0	0	3	0	0	0	0	0	0	1	0	0	0	0	255	0	172	0	0	0	0	5	0	3	0	0	23	0	0	15	75	555
RO	3	9	7	165	330	4	3	14	296	31	24	468	0	0	66	0	5	0	454	0	320	6	2	1	13	489	19	443	2	1	2	0	0	0	15	441	3633
ES	0	0	10	1	5	1	0	96	17	14	1	4	0	3	41	0	4	0	4	113	0	4290	0	0	0	1	74	12	28	0	5	44	3	0	68	478	5319
SE	0	1	27	2	101	114	52	36	351	77	1	16	0	7	9	0	22	28	239	1	1	5	277	0	0	123	225	9	0	24	19	5	0	0	62	408	2244
CH	0	4	15	0	30	1	0	91	81	45	0	5	0	0	200	1	6	0	7	1	0	27	0	91	0	1	37	9	1	0	3	2	0	0	5	80	744
TR	1	1	1	107	31	1	1	2	51	6	59	29	0	0	13	0	1	0	78	0	12	3	1	0	551	262	5	32	4	0	0	0	0	0	45	697	1996
SU	1	19	67	124	1037	115	248	103	1949	245	25	544	0	11	97	2	50	13	3183	1	84	21	103	2	48	18431	347	243	2	58	29	5	0	0	170	4833	32210
GB	0	0	48	0	17	7	1	91	64	40	0	1	0	72	3	0	29	0	32	2	0	29	2	0	0	12	4784	1	0	1	50	28	0	0	63	224	5602
YU	14	29	7	160	361	5	2	31	310	43	40	478	0	0	385	0	4	0	255	0	27	20	1	2	2	80	18	2889	7	1	2	1	0	0	31	519	5725
REM	0	1	6	6	7	0	0	31	8	7	11	5	0	1	73	0	2	0	4	5	0	97	0	1	1	3	12	13	604	0	1	3	1	0	53	624	1577
BAS	0	44	114	3	214	283	156	72	895	189	1	32	0	8	14	1	41	11	737	1	2	13	179	1	0	415	295	16	1	119	29	4	0	0	131	487	4508
NOS	0	2	222	1	112	105	3	399	416	248	0	7	0	62	11	2	268	30	115	3	0	63	19	1	0	25	3335	4	0	8	295	42	0	0	254	616	6669
ATL	21	1	96	1	36	34	57	400	162	109	0	3	10	252	17	2	54	34	62	232	0	2197	31	1	0	512	1808	6	4	6	68	685	1	0	2127	3203	12232
MED	45	18	33	323	284	5	1	270	326	74	525	242	0	4	2340	1	15	0	241	18	29	1050	1	7	119	171	100	688	344	1	9	12	2	0	603	2044	9944
BLS	1	2	3	155	109	4	11	4	128	14	21	57	0	0	11	0	2	0	231	0	32	2	2	0	134	902	13	54	1	1	1	0	0	0	108	597	2602

Table 4. Provisional estimate of oxidized-nitrogen budget for Europe for 1989. Total (wet + dry) deposition of nitrogen. Unit: 100 tons nitrogen per year.

	AL	AT	BE	BG	CS	DK	FI	FR	DD	DE	GR	HU	IS	IE	IT	LU	NL	NO	PL	PT	RO	ES	SE	CH	TR	SU	GB	YU	REM	BAS	NOS	ATL	MED	BLS	NAT	IND	SUM
AL	1	1	0	2	3	0	0	1	2	3	16	2	0	0	15	0	0	0	3	0	2	1	0	0	0	2	0	8	0	0	0	0	0	0	0	15	80
AT	0	48	12	0	79	5	1	65	58	221	1	14	0	0	106	1	25	1	50	0	5	3	5	20	0	7	29	18	0	2	4	1	0	0	0	68	850
BE	0	1	31	0	4	1	0	70	5	59	0	0	0	1	2	1	29	0	3	0	0	2	0	0	0	0	58	0	0	0	7	2	0	0	0	17	296
BG	0	3	1	28	18	1	1	3	10	15	41	13	0	0	13	0	2	0	30	0	42	0	1	0	4	43	3	26	0	0	0	0	0	0	0	57	358
CS	0	27	16	1	245	9	2	63	149	270	3	38	0	1	31	1	31	2	161	0	7	3	7	7	0	18	36	18	0	3	6	1	0	0	0	80	1237
DK	0	1	7	0	6	18	1	17	15	54	0	0	0	1	1	0	19	3	7	0	0	1	4	0	0	1	69	0	0	2	7	2	0	0	0	19	257
FI	0	1	9	0	15	23	108	18	33	68	0	1	0	2	1	0	19	18	45	0	1	1	76	0	0	88	56	1	0	13	7	2	0	0	0	105	710
FR	0	8	87	0	30	6	1	941	43	340	0	5	0	7	147	5	89	2	18	10	1	139	3	24	0	2	328	15	1	1	42	42	0	0	0	273	2611
DD	0	4	28	0	96	16	2	80	216	409	0	3	0	1	9	2	57	3	41	0	1	3	6	3	0	6	73	2	0	4	12	2	0	0	0	62	1140
DE	0	17	111	0	95	18	2	357	170	1174	0	5	0	4	53	8	200	5	41	2	2	16	7	37	0	7	233	5	0	4	33	8	0	0	0	149	2763
GR	1	2	1	12	9	1	0	4	6	10	146	5	0	0	20	0	1	0	13	0	14	1	1	0	4	19	1	11	1	0	0	0	0	0	0	64	346
HU	0	20	3	1	71	2	1	16	29	57	5	76	0	0	51	0	6	0	77	0	18	1	2	2	0	16	8	46	0	1	1	0	0	0	0	51	565
IS	0	0	1	0	0	0	0	2	0	3	0	0	2	1	0	0	2	1	0	0	0	1	0	0	0	0	16	0	0	0	1	1	0	0	0	28	58
IE	0	0	4	0	1	1	0	15	2	14	0	0	0	13	0	0	8	0	1	0	0	3	0	0	0	0	50	0	0	0	3	8	0	0	0	29	153
IT	0	23	13	3	43	3	1	157	32	128	20	15	0	1	599	1	19	1	33	2	7	30	2	28	0	5	34	55	4	1	4	4	0	0	0	182	1448
LU	0	0	2	0	0	0	0	7	0	5	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	1	20
NL	0	1	27	0	3	2	0	46	6	89	0	0	0	1	1	0	62	1	3	0	0	2	1	0	0	0	85	0	0	0	11	2	0	0	0	20	365
NO	0	1	14	0	10	29	10	39	31	109	0	1	0	7	2	0	32	59	22	0	1	2	33	1	0	10	254	1	0	5	18	9	0	0	0	150	851
PL	0	19	33	1	259	43	12	107	358	482	2	30	0	3	31	2	72	8	617	1	9	4	32	8	0	65	118	20	0	13	17	3	0	0	0	171	2542
PT	0	0	0	0	0	0	0	4	0	1	0	0	0	0	1	0	0	0	0	44	0	38	0	0	0	0	4	0	1	0	0	19	0	0	0	44	157
RO	0	12	4	16	82	4	3	15	45	67	31	71	0	0	44	0	10	1	125	0	156	1	4	1	5	127	12	68	0	1	2	0	0	0	0	113	1022
ES	0	0	7	0	2	1	0	117	4	32	2	1	0	2	34	0	9	0	2	60	1	458	1	1	0	0	56	5	6	0	6	43	3	0	0	215	1068
SE	0	2	18	0	31	72	39	45	70	162	1	3	0	5	7	1	43	52	83	0	2	2	139	1	0	40	171	2	0	17	20	5	0	0	0	140	1171
CH	0	4	10	0	9	1	0	90	13	94	0	1	0	0	59	1	12	0	2	1	0	9	1	37	0	0	25	2	0	0	3	2	0	0	0	32	409
TR	0	2	1	8	11	1	1	3	11	15	68	6	0	0	10	0	2	0	29	0	20	1	2	0	73	117	4	9	1	0	0	0	0	0	0	239	633
SU	0	32	49	14	312	116	192	141	379	601	34	92	0	7	76	2	116	39	956	1	109	7	180	8	18	2966	270	60	0	52	33	6	0	0	0	1356	8222
GB	0	1	20	0	6	6	1	73	12	73	0	0	0	23	2	0	39	2	12	1	0	9	3	1	0	4	664	0	0	1	23	23	0	0	0	89	1089
YU	2	36	5	16	95	5	2	38	49	96	48	74	0	0	226	0	10	1	86	0	40	7	3	5	1	25	12	216	1	1	2	1	0	0	0	151	1254
REM	0	1	5	1	2	0	0	50	2	18	17	1	0	0	46	0	6	0	1	3	1	34	0	2	1	1	9	5	37	0	2	3	1	0	0	338	587
BAS	0	4	29	0	59	86	49	74	138	292	1	5	0	4	10	1	67	22	156	0	3	4	112	2	0	67	176	4	0	27	23	4	0	0	0	143	1561
NOS	0	3	63	0	25	34	2	209	54	291	0	1	1	23	5	2	147	25	30	2	0	16	16	3	0	7	967	1	0	5	68	34	0	0	0	215	2250
ATL	0	1	60	0	12	32	25	376	34	250	0	1	7	57	11	2	104	70	21	42	1	201	40	3	0	39	888	2	0	6	59	256	0	0	0	1371	3972
MED	2	21	19	20	60	4	1	246	40	140	264	30	0	2	574	1	26	1	61	8	34	146	2	12	18	45	57	96	25	1	8	10	1	0	0	562	2537
BLS	0	2	1	6	15	3	2	3	16	22	20	7	0	0	5	0	3	0	47	0	26	0	3	0	18	180	6	8	0	1	1	0	0	0	0	116	514

Explanation of the tables

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

Avoiding lasting damage

SCIENTISTS AND POLICY-MAKERS at the Second World Climate Conference in November 1990 were urged to reduce their concentration on economic forecasts and place a major new emphasis on limiting greenhouse-gas pollution to levels which avoid permanent damage to the world's ecosystems.

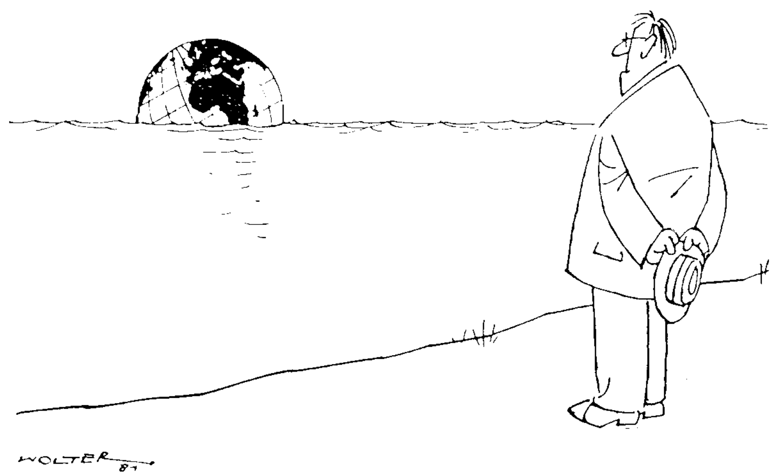
A study by the Stockholm Environment Institute, which was distributed at this Geneva confernce, called for limits to climatic change that are themselves based on the best estimates of the capacity of forests, oceans, and other natural systems to tolerate changes in sea level and rise in temperature. Until now, most studies and government policies have been based on guess estimates of national willingness to pay for greenhouse-gas controls.

The Institute's three-part study entitled *Responding to Climate Change: Tools for Policy Development* bases its policy recommendations for curbing carbon dioxide, methane, and other greenhouse gases on the ability of wetlands and coral reefs to withstand a rise in sea level, and of forests to successfully "migrate" as temperature alters. It points out that these are the more sensitive indicators for long-term policy than the crude total destruction of cities by rising seas.

The SEI report draws together work by many of the researchers who are most prominent in making climate change an international scientific and political issue. As such, the study has tremendous authority. It states:

"Based on an analysis of changes in the past and the adaptive capabilities of terrestrial and marine ecosystems, the study proposes the selection of quantitative targets for changes of the global mean temperature and sea level. Increases in global mean temeprature below 0.1°C per decade would allow ecosystems to adapt. Absolute temperature changes greater than 2°C above pre-industrial levels would entail major risks of extensive damage to ecosystems. Additionally, rapid unexpected changes in climate processes could occur because of uncontrollable system feedbacks. Although, in order to minimize these risks, temperature changes should stay below 1°C, the Working Group acknowledges that this lower limit may be unavoidable because of the greenhouse gases already emitted. Thus, some adverse impacts to ecosystems and probably to human society will occur even at the lower targets.

Changes in sea level above 5 centimetres per decade are likely to damage ecosystems such as coastal wetlands and coral reefs. While damage by absolute sea-level rise



would be minimized if kept below 20 cm, rises above 50 cm would endanger vulnerable coastal ecosystems, low-lying coastal areas, and islands, and the very existence of island nations."

The study also looks at the cost-effective feasibility of cutting greenhouse gases, noting:

"In the absence of any measures to control greenhouse gases, global energy consumption is projected to increase (on a business-as-usual basis) by 28 to 45 per cent by 2005, and 55 to 100 per cent by 2020. Implementation of available cost-effective energy efficiency measures can reduce the projected growth to 2005 by more than half. Under these circumstances, energy consumption in industrialized nations would decrease 17 to 25 per cent by 2005, from 1986 levels. The resulting reduction in fossil-fuel combustion would cut projected levels of global carbon dioxide by more than 10 per cent in 2005.

There are substantial obstacles to the adoption of these measures. Many efficiency improvements will not be realized unless new policies and programs are implemented by governments.

A wide variety of non-fossil alternative energy sources can be used to displace the use of fossil fuels. These include various solar-energy sources such as photovoltaics and solar thermal, wind, and biomass energy, geothermal, nuclear, and hydro power. Additional implementation of the last two options will, however, be severely constrained by environmental and sociopolitical factors.

Among these alternatives, no one technology is expected, by itself, to reduce carbon-dioxide emissions by a large fraction in either 2005 or 2020. However, the implementation of feasible alternative energy sources could, in aggregate, cut projected emissions by one-quarter to one-half by 2020."

The SEI report also notes that carbon emissions from forest burning and other biosphere sources could be reduced to zero by 2005, through a combination of strong protection measures for existing forest and small-scale replanting programs. Methane build-up could be halted with existing technologies. In summary, say the authors, "our best estimate is that...such policies could reduce carbon-dioxide emission by 25 per cent by 2005 and 40 per cent by 2020, compared to 1986 levels."

ECO, Climate Action Network
November 1990

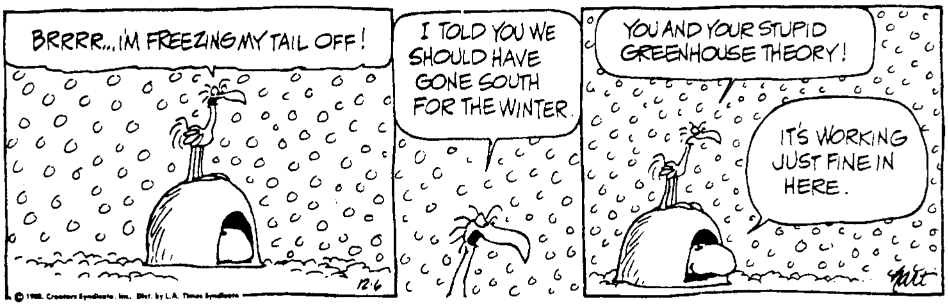
CO_2 EMISSIONS

Lengthy negotiations endanger timely action

NEGOTIATIONS ON A framework convention on global warming were set to commence in February 1991.

In June 1988, the Toronto Conference on the Changing Atmosphere became the first high-level international meeting to recommend targets for achieving reductions of emissions of carbon dioxide. In their final declaration, delegates called for a initial 20-per-cent reduction in CO_2 emissions, to be followed by further cuts to take the figure past 50 per cent.

Not surprisingly, the relative ease with which the declaration was agreed has proved to be no precedent. The conference was attended by scientists and policy makers from only 48 countries, and, because the meeting was not hooked into any international policy-making machinery, many of them did not trouble to engage seriously in the drafting of the declaration.



With the international community now committed to negotiating a framework convention on climate change in time for it to be ready for signature at the UN Conference on Environment and Development in Rio de Janeiro in 1992, the stakes are now orders of magnitudes higher. From now on, every word of every declaration and legal instrument will be argued over.

It will not be apparent for some months whether the convention itself will impose obligations on countries to reduce their contributions to global warming, or whether these will come some time after 1992 in protocols under the convention. Whichever proves to be the case, the lengthy nature of the negotiating process sits uneasily alongside what is happening in the atmosphere.

As put simply, the longer curbs on greenhouse-gas emissions are deferred, the greater the reductions that will be necessary at a later stage to achieve the same concentrations of those gases in the atmosphere. For CO_2, for example, a 20 per cent cut in emissions would be needed in 2000 to achieve the same atmospheric CO_2 concentration as would stabilizing emissions now. Nevertheless, there will be no escape from an inevitably incremental process of building a consensus, if nations are to be persuaded to take action in sufficient numbers to make that action effective.

The Second World Climate Conference in Geneva last November laid bare some of the conflicts to come. The main countries producing and using fossil fuels – the USSR, the United States, and Saudi Arabia – sucessfully resisted any attempt to write specific commitments into the declarations, arguing that scientific uncertainty about the advance and effects of global warming was too great to justify any such. Most western European countries disagreed, and urged that negotiations on the key protocols should begin at the same time as those on the convention. And a group of island states and African nations, whose very survival is at risk from global warming, emerged as a new bloc to demand immediate curbs on greenhouse gases.

The main achievements of the conference included the endorsement of the report of the Inter-governmental Panel on Climate Change (IPCC), despite the efforts of the United States in particular to emphasize the remaining scientific uncertainties. The final declaration says a global response should be implemented "without further delay," with the developed countries taking the lead by committing themselves to "actions to reduce their major contributions to global net emissions."

For the developing countries, a crucial success was the inclusion in the declaration of a clause stressing that "adequate and additional financial resources be mobilized and the best available environmentally sound technology be transfered expeditiously on a fair and most favourable basis" from the developed world.

The convention is likely to be based on the format of the Vienna Convention for the Protection of the Ozone Layer. It will include provisions for protocols or, alternatively, annexes to the convention itself which will deal with issues such as the allocation of emission reductions, whether greenhouse gases should be treated singly or in a "basket" for control purposes, how carbon "sinks" such as forests should be treated, and mechanisms for transferring funds and technology.

The task will be a formidable one. The risks of failure were put into perspective by the final statement from a scientific and technical conference which preceded the ministerial meeting in Geneva. In order to stabilize atmospheric CO_2 concentrations at 50 per cent above their pre-industrial level by the middle of the 21st century, the statement says "a continuous worldwide reduction of net carbon-dioxide emissions by about 1-2 per cent per year, starting now, would be required."

This implies global reductions of almost 10 per cent by 2000, and 14 per cent by 2005, and cuts by the industrialized nations of a magnitude such as only Germany is presently contemplating. According to calculations by Friends of the Earth, even if these targets were achieved, a global mean temperature increase of 1.6-2.5°C over pre-industrial levels would be likely by 2050. Extensive ecosystem damage, and a mean rise of 20 centimetres in sea level, would be among the consequences predicted by the IPCC.

ENDS Report 190/November 1990
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Attack on pollution

NEGOTIATIONS ARE continuing between Norway, Sweden, Finland, and the USSR for a solution of the problems of pollution on the Kola Peninsula. Hopes are held out of an agreement being reached during the summer. One quarter of the air pollution over Finland originates in the Soviet Union, the main sources being two nickel smelters which together emit 500,000 tons of sulphur dioxide annually.

According to a Finnish proposal, one of the smelter plants should be rebuilt with the financial aid from the Scandinavian countries, and the other shut down. This should enable the emissions of SO_2 to be reduced to 75,000 tons a year, although it would still not bring them down to the permissible limits of the Scandinavian countries.

In 1989 Finland and the USSR agreed to reduce emissions of SO_2 by 50 per cent by 1994, from 1980 levels. The area concerned in the USSR covers Estland, the Leningrad region, Karelia, and the Murmansk-Kola peninsula. Finland and Norway have already agreed to provide the equivalent each of 300 million Swedish kronor. The total cost of cleaning up is estimated to be at least SEK 5 billion.

Call to action

TEN ENVIRONMENTAL and social organizations in Budapest have formed an Action Group against Air Pollution. According to the group, road traffic is a major cause of environmental degradation in Hungary. It is mainly on account of the pollution from motor vehicles that the number of respiratory disorders and other pathological conditions has risen sharply during the last few decades. Between 1975 and 1988, for instance, the number of people suffering from asthma rose 9.3-fold, and from chronic bronchitis 2.4-fold.

The group has set up a detailed plan for action and campaigning to show how traffic problems could be tackled in Hungary through technical measures and system changes to make public transportation more attractive.

Action Group Against Air Pollution, c/o Talento Foundation, Budaors, Pf 50, H-2041 Hungary

Recent publications

RAINS model

A new version has lately been released of RAINS – Regional Acidification Information and Simulation model developed at the International Institute for Applied Systems Analysis (IIASA). The model simulates alternative user-defined international strategies for the reduction of SO_2 and NO_x emissions in Europe, explores their cost, and analyzes the regional impacts of acid deposition on the acidification of forest soils. It is currently being used to support the coming international UN ECE negotiations on the next sulphur protocol.

The model can be implemented on IBM compatible personal computers (XT,286, or 386), and is operational even for less-experienced users of computers. The new version (5.1) can, together with a comprehensive user's manual, be obtained from IIASA for AS 7500/15000. Requests for further information should be addressed: Marcus Amann, Regional Air Pollution Project, IIASA, A-2361 Laxenburg, Austria. Phone +43 2236 71521.

Driving Forces: Motor Vehicle Trends and their Implications for Global Warming, Energy Strategies and Transportation Planning (1990)

A report from the World Resources Institute, by James MacKenzie and Michael Walsh. The global vehicle fleet accounts among other things for some 14 per cent of the CO_2 emissions from fuel burning, and the book discusses what can be done to mitigate the impact of transportation on climate. It concludes that only through increased fuel-efficiency of new vehicles, combined with a development of more efficient transportation systems and new kinds of transport that emit no greenhouse gases at all, can the challenge be met. 49 pp. Available from World Resources Institute, 1709 New York Avenue NW, Washington, DC 20006, USA.

Transport Policy and the Environment (1990)

Seven case studies from the UK, the US, FRG, France, the Netherlands, Greece and Italy. Edited by J-P Barde and K Button, and commissioned by the OECD, this book focuses on the issue of integration of environmental with other policies, such as those for transportation and the economy. 211 pp. Price £9.95. Obtainable from the publisher: Earthscan Publications Ltd, 3 Endsleigh Street, London, England WC1H 0DD.