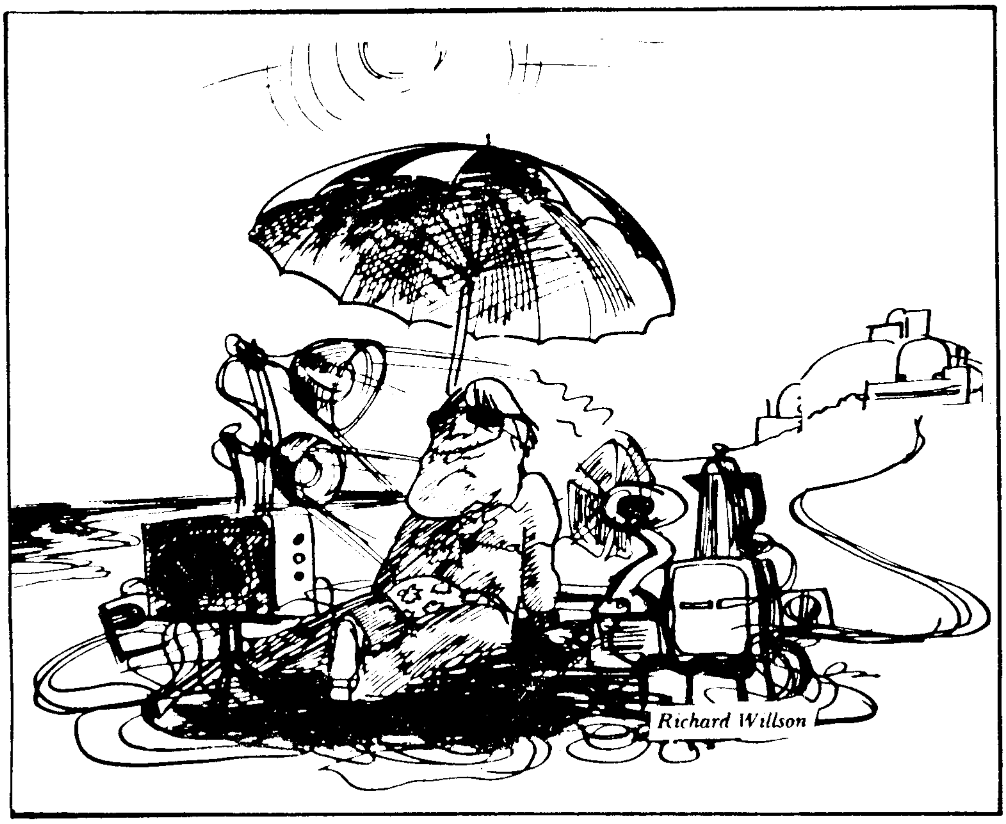
NO.1, JANUARY 1990

Acid News

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



ENERGY

Efficiency only way forward

In little more than the decade that followed the first energy crisis of 1973, energy efficiency has transformed the energy debate and the economic fortunes of many countries. It appears also to offer one of the best opportunities for reducing the impact of global warming from the greenhouse effect.

Energy efficiency works. The world has saved energy worth $300 billion per year since 1973 when the price of oil escalated and forced energy planners to rethink their strategies. In the 21 countries belonging to the International Energy Agency (IEA), founded in 1974 under the aegis of the OECD, economic output grew on average by 32 per cent between 1973 and 1986 and yet energy demand rose by just 5 per cent. In the US, which consumes a quarter of the world's fuels, the annual demand for energy is still below that of 1973 even though the country's gross domestic product, an indicator of economic activity, is up by 40 per cent.

Japan has gone one better. The country used, per capita, 6 per cent less energy last year than it did in 1973 even though its GDP grew, also per capita, by 46 per cent over the 15 years. The savings have further sharpened Japan's commercial edge, according to recent estimates which indicate that as a result of the country's low energy intensity – the amount of energy needed to produce economic growth – Japanese exports are 2 per cent cheaper than American ones.

These results have dispelled the myth that rising energy consumption runs hand in hand with economic growth. Without the improvements, we would now be burning the equivalent of an extra 1.4 billion tons of coal, and producing more than 3 billion tons of carbon dioxide, every year.

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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 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 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 Stop Acid Rain Campaign/Norway,"** is organized by five non-governmental organizations concerned with the environment:

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

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EDITORIAL

Moving nevertheless

Apparently in the offing this year are a number of new or revised international agreements for limiting the emissions of airborne pollutants. Early in the summer there will be a reconsideration of the Montreal protocol concerning chlorofluorocarbons (CFCs) and other ozone-depleting compounds. There is also the possibility of some kind of agreement being reached for dealing with the problem of carbon dioxide and other greenhouse gases.

Air pollutants that contribute to acidification and forest damage are dealt with primarily, in their international aspects, by the UN Economic Commission for Europe under the Convention on Long Range Transboundary Air Pollution. The Executive Body for the Convention held its seventh session last November in Geneva. For the last year, too, there has been a Working Group on Volatile Organic Compounds, set up for the purpose of developing an agreement, again a so-called protocol, for limiting the emissions of VOCs. The intention is that it should have a draft ready for the eighth meeting of the Executive Body, this coming November.

It still remains to be decided however on what principle such a protocol should rest. Some are proposing so-called flat-rate reductions – a certain percentual reduction by some specified year – while others favour the use of the best available technology (BAT) as a means of arriving at agreed air-quality standards, particularly as regards concentrations of ozone. The problem is however that several countries have not yet reported their national emissions of VOCs to the ECE, and some may not even have calculated them.

Last November the Executive Body also decided that the Working Group on Abatement Strategies should draft a revised protocol, or perhaps an entirely new one, for the reduction of sulphur emissions. The present protocol, which calls for reductions of at least 30 per cent between 1980 and 1993, will soon have to be either replaced or revised. The big question is whether the critical loads approach is now considered to be sufficiently developed to enable it to be employed for the first time in an international agreement.

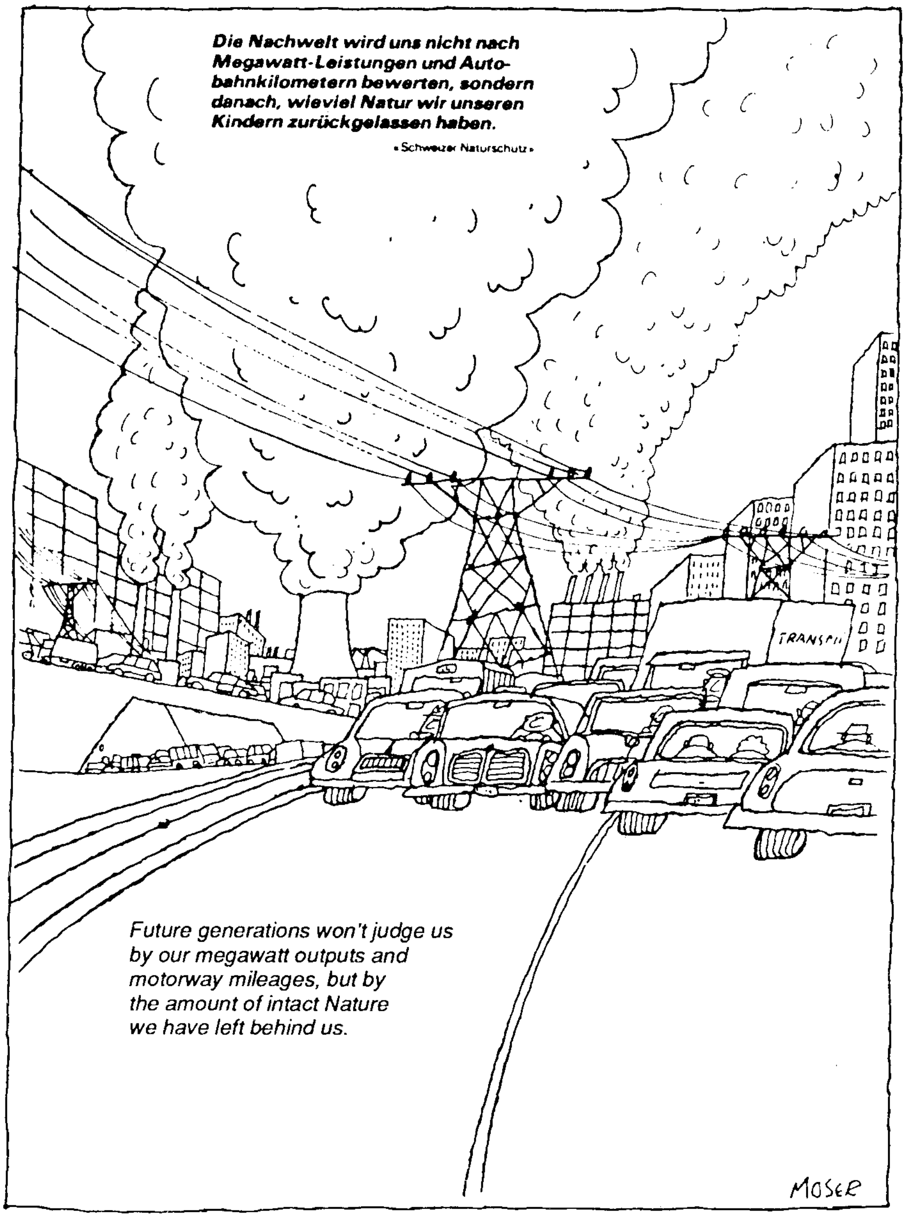
While the work on international agreements has thus been proceeding at a somewhat leisurely pace, the acceptance of bilateral accords has been all the more rapid – and particularly so between East and West. Last October, for instance, Finland and the Soviet Union signed an agreement on air-pollution control, by which they undertake, amongst other things, to reduce sulphur emissions by 50 per cent, from 1980 to 1995, in Finland, Estonia, and Karelia, and also the Leningrad and Murmansk areas.

Most of the bilateral agreements seem to concentrate on the exchange of information and transfer of technology, which will be important for short-term improvements of the situation as regards emissions of sulphur and nitrogen oxides in eastern Europe. Latterly, too, several countries in the West have shown a willingness to provide financial aid for environmental measures in eastern Europe. The Swedish government for instance has decided to allocate 300 million kronor to Poland for such purposes.

While technology transfers, information, and financial aid are themselves important, it is also essential that the recipient countries should be enabled to develop their own manufacturing capacity and know-how. This will apply especially in the fields of combustion technology, energy efficiency, and renewable energy sources – if measures are to be effective in the long run.

Already last year the Dutch government demonstrated that it is possible to employ the critical loads approach in the development of air-pollution control policies. Their Acidification Abatement Plan (Acid News 4/89, p.12) could well serve as an example for other countries, as well as for negotiations under the UN ECE Convention during 1990.

Christer Ågren



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We waste around 60 per cent of the energy available as lumps of coal, crude oil, gas, and uranium ore before we extract a useful service such as motion, heat, or light. And yet governments have become complacent as fuel prices have dropped, slowing the progress of efficiency measures, such as the improved thermal insulation of buildings, better systems of heat recovery and recycling, and the development of more productive appliances.

Energy efficiency is not simply an option for the industrialized world. Although consumption is often low in the developing world, there are still huge inefficiencies in its energy systems. For example, the Pakistan National Energy Conservation Centre estimates that more efficient use of energy could reduce the projected growth in electricity demand within the country by at least 30 per cent over the next 15 years.

Saving energy is "mainly a matter of doing a number of simple and relatively boring things well." This is particularly true in buildings, which consume more than 40 per cent of the total demand for energy in most industrialized countries. In the northern hemisphere, three-quarters of the energy goes to heating space and water. Stricter building regulations, which set the maximum heat losses allowed through walls, roofs, windows, and floors, are part of the answer. Older buildings, however, need substantial renovation. Improvements must include thicker insulation, greater control of the heating systems and making buildings more airtight.

In the 21st century, homes are likely to be super-insulated buildings; only a few of these exist today. Such structures have thick insulation. Judicious control of the system also helps to reduce heating bills by more than 80 per cent, even for large houses in harsh climates. More than half of the new dwellings in Saskatchewan, Canada, are now super-insulated; one group of houses in the north of the province requires no heating even when temperatures fall to –30 °C.

In 1986 builders erected four super-insulated homes, designed in Finland, in one day in Milton Keynes , Britain's most energy-efficient city . The measures to improve the energy efficiency of the buildings added £2000 to the cost of each home, but annual fuel bills are around £30 compared with £250 for

On the following pages

a home built to the national standards.

Thermostatic and time controls are another simple way of ensuring that heating, cooling, and lighting occur at the right place and time.

In the transport sector, engineers could redesign transmissions so that engines always run at their most efficient speeds.

Within the industrial sector, measures complementing existing techniques, such as heat recovery and combined heat and power could be more used, as well as new catalysts in chemical reactions and more robust sensors and controls to work in harsh environments.

More efficient appliances, compact fluorescent lighting and advanced industrial motors are the other main areas for savings. The running cost of the least efficient domestic appliance, such as a fridge or cooker, is almost three times that of the most efficient. With, on average, a kilogram of carbon dioxide being released for every kilowatt-hour of electricity produced from fossil fuel, the small losses in individual households quickly add up to an enormous waste of energy and cash.

Environmentalists in the US expect tremendous results from the National Appliance Efficiency Standards Act, which came into force in March 1987. By the year 2000 they predict that the act, which requires new domestic appliances to meet stringent energy-efficiency standards, will be reducing electricity consumption by 53.5 billion kilowatt-hours per year; this is equivalent to one-fifth of last year's energy demand in Britain. They say that the fall in peak demand will make 22 large power stations redundant, reducing emissions of carbon dioxide by 50 million tons per year, or about 3 per cent of the volume released in the US.

So why don't individuals, companies and governments conserve more energy? Adding up the advantages of energy efficiency invariably leads to the conclusion that spending £1 on efficiency measures, rather than on new sources of supply, is much more cost-effective. The answer lies mainly in the lack of financial incentives and reels of red tape. We need to consider the large subsidies our energy industries receive, the negative value of the pollution that energy generation causes, and our inertia over energy-efficiency measures.

"Our problem, once solar energy is in operation, is to find a way to have the citizens whose homes are heated by the sun continue to pay *us* every month."

Taken from: What's so funny about science? By: Sidney Harris (William Kaufman, INC)

Energy subsidies are enormous. In 1984, they totalled $44 billion in the US alone; that is more than $500 for every household in the country. Around 93 per cent of them go to traditional technologies, such as those exploiting nuclear, coal, and gas power; less than 2 per cent assist energy efficiency. In Britain, the government has given the nuclear industry more than £16 billion towards research and development since the late 1950s. The coal industry has also received large subsidies to develop new mines and to help with its corporate restructuring. Such market distortions lead to bad economic and technological decisions.

Saving energy is mainly a matter of doing simple and relatively boring things well

In the developing world and in Comecon states, the situation is even more extreme. For example, coal in China costs one-quarter of what it does elsewhere in the world. The subsidies have caused excessive demand and frequent supply shortages, which has led to idle plant and equipment in industry. In Comecon states, cheap fuel and extravagant power generation have caused grossly polluted cities and dying forests. East Germany has the dubious distinction of the highest level of carbon dioxide emissions per capita in the world. The Soviet Union is not far behind.

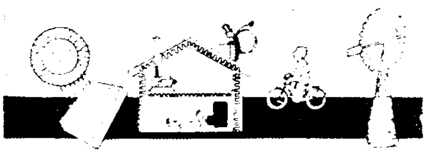
Now we need to do more than just end the subsidies. The introduction of a "carbon tax" on fossil fuels will encourage energy efficiency and reductions in emissions of carbon dioxide. It has been estimated that a levy of just 0.5 US cents per kilowatt-hour of electricity generated by fossil fuel would produce a revenue of £33.2 billion per year for the European Community. This could be used to encourage, through subsidies, the adoption of more efficient energy systems. The tax would probably be applied on a sliding scale, higher for coal than for gas, to take account of the greater emissions of carbon dioxide from coal combustion.

Institutional obstacles to energy efficiency include little consumer information about the impact of products on energy consumption and on pollution; restricted access to finance and expertise for new technologies; and financial rates of return that support investment in projects that supply energy rather than reduce demand. There is also the simple inertia among electricity utilities that have never had to assess the option of "negawatts," or energy savings, as an alternative to increasing the supply of megawatts from new power stations.

So, industry willing, how much can energy efficiency achieve? The world now consumes the equivalent of more than 7 billion tons of oil in the form of fossil fuels every year: 42 per cent is oil, 34 per cent is coal. and 24 per cent is gas. Hydroelectricity provides the equivalent of a further 524 million tons of oil, nuclear energy another 400 million tons,and biomass about 2 billion tons.

Countries belonging to the OECD consume 55 per cent of the world's total energy, though they support only 15 per cent of the world's population. Comecon countries use up 38 per cent of the total. The rest is used by "awakening giants," such as China, India, and Brazil, and other developing countries where much greater consumption of fossil fuels is likely in the absence of measures that encourage a more efficient use of energy.

Estimates of the future worldwide demand for energy vary enormously. Since 1979 a variety of institutes and academics have produced more than 25 "low energy" scenarios covering 14 countries. These assessments of the "technical potential"



for energy efficiency over the next 30 to 40 years suggest that energy consumption could be cut by between 30 and 60 per cent. Technical potential is however not the same as the practical potential.

Only a few countries have shown what can be done if the efficiency message is taken seriously. In Denmark, energy demand per unit of GDP is only 76 per cent of the 1972 value; it is expected to fall to 60 per cent by the turn of the century. Sweden is about to embark on a journey that will tell us how far energy efficiency can go. The country is faced with restrictions on three fronts. Nuclear power, providing nearly more than 50 per cent of electricity supply, is to be phased out by 2010. Legislation now protects four major rivers from exploitation of their hydroelectrical potential, and last year the Swedish parliament passed a resolution restricting carbon dioxide emissions to current levels. The only way forward in the next 20 years is energy efficiency on a vast scale.

Perhaps the key challenge in policy-making is to change popular perceptions, or rather misconceptions, about energy saving. Rather than associating energy efficiency with the notions of "switching off" and "wrapping up," people should see it as a characteristic of high technology and advanced social and industrial systems. The problem may lie in our negative attitude to any form of decline. One solution therefore, is to take the familiar energy/GDP curve, which has been falling since 1973, and turn it on its head in order to show how nations are getting "more from less." That's one form of growth that the planet desperately needs.

Stewart Boyle

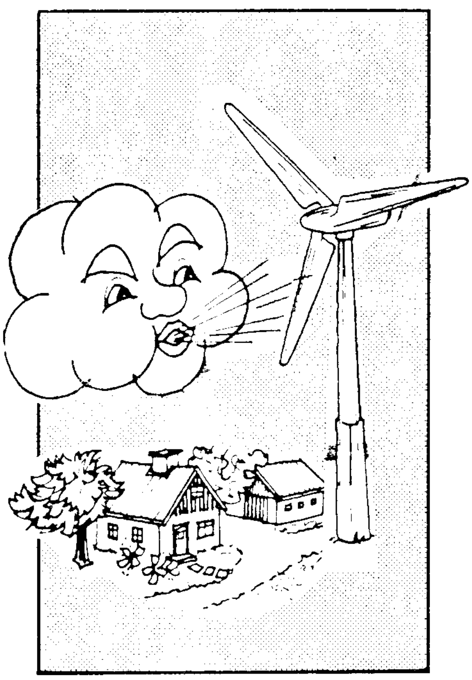
Energy and Environment Programme Director, Association for the Conservation of Energy, Author of *The Greenhouse Effect: A Practical Guide to the World's Changing Climate,* New English Library.

Outlook for wind power

Electricity produced by wind power is becoming steadily cheaper. In Denmark, where they started to use wind power in the mid-seventies, they have got the price down to the equivalent in Swedish currency of 30 öre (0.30 kronor) per kilowatt-hour – from 90-100 öre only seven years ago. Technical improvements, as well as budding mass production of the equipment, have made this possible. So far only one per cent of Danish electricity is wind-generated, but the intention is to make it ten per cent by the year 2000.

The main difficulty now is to find places to put the generators where they will not cause disturbance of one kind or another. Some will therefore have to be set up in groups several kilometres offshore – where the additional construction cost will be offset to some extent by better wind conditions.

While Denmark has concentrated more on small plant (200 kW), in



Sweden a number of larger generators (3 MW) have been built. The small type has been furthest developed, and has also proved to be the most economic so far. According to a recent Swedish study, power from such plants may be expected to cost 27-37 öre/kWh, as against 38-59 öre for the 3 MW plants.

By comparison, electricity from a modern coal-fired condensing plant, or a combined heat-and-power station fired by natural gas, will cost 25-30 öre/kWh (flue-gas cleaning not being included in either case). From a coal-fired combined heat and power plant the electricity will cost 20-30 öre, or with firing by biofuel, 30-40 öre/kWh.

Since Sweden has already decided to impose a charge on emissions of sulphur, and is preparing one for nitrogen oxides and carbon dioxide, electricity from coal-fired plants will become more expensive – which makes the outlook appear bright for wind power.

Per Elvingson

Tracking air pollutants

Every year many million tons of sulphur and nitrogen compounds are emitted from sources in Europe. A considerable proportion of these pollutants will be carried by the winds over long distances – for hundreds or even thousands of kilometers – before being finally deposited. The consequences can be seen, for example, in the acidification of lakes and streams in such distant parts as northern Scandinavia.

During the same year, 1977, that saw the first conferences for reducing emissions taking place within the UN Economic Commission for Europe, a European monitoring system was started – called the Co-operative Programme for Monitoring and Evaluation of the Long Range Transmission of Air Pollutants in Europe, but generally known as the EMEP, European Monitoring and Evaluation Programme. It has one centre (EMEP-West), in Oslo, Norway, and another (EMEP-East) in the USSR, in Moscow.

One of the main tasks of the EMEP is to calculate the airborne transports of various pollutants between different countries. To this end it receives data on concentrations and depositions from more than 90 measuring stations spread over some 25 countries. The participating countries, which are funding the program, have to send in official data every year concerning their national emissions of the various pollutants. As may be seen from Table 1, some countries are better than others in this respect.

At first only sulphur was measured. Only relatively recently were oxidized and reduced nitrogen compounds included in the program, and to these (nitrogen oxides and ammonia) are now being added hydrocarbons (VOCs) and photochemical oxidants.

Meteorological data, such as that concerning precipitation and wind directions, provide a further base of calculations, as do mathematical models of the chemical transformation and rates of deposition of the pollutants. The results are plotted on a grid covering the whole continent, in which each square measures 150 by 150 kilometres.

Yearly reports give information on the emissions, transport (both exports and imports), and deposition of pollutants. Tables 2 and 3 give the latest figures for exports and imports of sulphur and oxidized nitrogen. Since they are as recent as for 1988, they must however be regarded as preliminary. Being based on so much data from so many sources, and including so many assumptions concerning the conditions of chemical transformation and deposition, the calculations can naturally not be exact. Despite this amount of uncertainty, the figures nevertheless give a clear indication as to which counties for instance contribute most to the depositions over any other particular country.

Especially in the case of western Europe a considerable proportion of the deposition of sulphur comes under IND, standing for indeterminate sources. This sulphur is probably the result of a combination of emissions from outside the European grid system (for instance from North America), of European emissions that have been under way for more than 96 hours (the time limit for modelling so-called trajectories), and of sulphur from natural sources.

Judging from data so far presented, it appears that between 1980 and 1988 the European emissions of sulphur were reduced by almost 20 per cent (fully 5 million tons). Taking Europe as a whole, depositions have also, according to the

Continued on page 8

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	1987	1988	1985	1988
Albania	AL	[25]	[25]	[25]	[9]	[9]
Austria	AT	177	(75)	(70)	216	(194)
Belgium	BE	414	224	(234)	281	(301)
Bulgaria	BG	517	535	(535)	(150)	(150)
Czechoslovakia	CS	1550	1450	(1425)	1127	(1003)
Denmark	DK	224	(124)	127	263	(265)
Finland	FI	292	162	(159)	240	(263)
France	FR	1756	759	(759)	1693	(1685)
German Dem. Rep.	DD	2500	(2495)	(2495)	(955)	(995)
German Fed. Rep.	DE	1600	1000	(945)	2950	(3000)
Greece	GR	200	(180)	(180)	(150)	(188)
Hungary	HU	817	(710)	(707)	(300)	(300)
Iceland	IS	3	(3)	(3)	12	(12)
Ireland	IE	110	(84)	(92)	68	(93)
Italy	IT	1900	(1185)	(1185)	1595	(1631)
Luxembourg	LU	11	(6)	(6)	22	(18)
Netherlands	NL	232	141	(136)	537	(517)
Norway	NO	71	36	36	203	(219)
Poland	PL	2050	2100	2100	1500	1550
Portugal	PT	133	(116)	(106)	(192)	(192)
Romania	RO	100	(100)	(100)	[390]	[390]
Spain	ES	1625	(1581)	(1570)	950	(950)
Sweden	SE	232	(116)	(110)	301	(286)
Switzerland	CH	63	(31)	(31)	214	(187)
Turkey	TR	(138)	(177)	(177)	[175]	[175]
Soviet Union*	SU	6400	5100	5000	2930	(3325)
United Kingdom	GB	2335	1935	1890	1840	2360
Yugoslavia	YU	588	(725)	(725)	[190]	[190]
Sum		26063	21095	20928	19453	20408

Data that have been officially submitted are underlined. Interpolated data are shown in parenthesis. Data estimated by MSC-W/CCC are in square brackets. The table includes corrections received at the ECE secretariat up to May 1, 1989.
* European part of USSR, within the EMEP area of calculation.

Table 2. Provisional estimate of sulphur budget for Europe for 1988. Total (dry + wet) deposition of sulphur. Unit: 1000 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	RE	IND	SUM
AL	5	0	0	1	1	0	0	0	1	0	1	1	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	3	0	7	28
AT	0	16	2	0	23	0	0	10	27	17	0	8	0	0	23	0	1	0	10	0	0	1	0	0	0	0	7	8	0	28	187
BE	0	0	47	0	1	0	0	13	2	9	0	0	0	0	0	0	3	0	1	0	0	1	0	0	0	0	11	0	0	10	101
BG	0	0	0	130	6	0	0	0	6	1	3	9	0	0	4	0	0	0	6	0	3	0	0	0	0	9	0	14	0	20	215
CS	0	3	3	0	351	0	0	7	116	23	0	38	0	0	7	0	1	0	63	0	0	1	0	0	0	1	8	9	0	28	665
DK	0	0	1	0	2	25	0	1	9	8	0	0	0	0	0	0	1	0	3	0	0	0	0	0	0	0	9	0	0	11	75
FI	0	0	1	0	3	1	51	1	8	4	0	1	0	0	0	0	0	0	10	0	0	0	4	0	0	53	4	0	0	72	215
FR	0	0	20	0	7	0	0	252	18	29	0	3	0	1	17	0	5	0	3	1	0	66	0	1	0	0	46	2	0	151	628
DD	0	0	5	0	56	2	0	9	614	41	0	1	0	0	1	0	3	0	18	0	0	1	0	0	0	0	14	0	0	22	791
DE	0	1	23	0	24	3	0	47	94	276	0	3	0	1	9	0	12	0	13	0	0	6	0	1	0	1	43	2	0	69	633
GR	0	0	0	12	3	0	0	0	3	1	41	3	0	0	4	0	0	0	2	0	0	0	0	0	0	3	0	5	0	23	107
HU	0	2	0	1	26	0	0	2	17	5	0	178	0	0	9	0	0	0	18	0	1	0	0	0	0	1	1	22	0	17	306
IS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	20
IE	0	0	0	0	0	0	0	1	0	0	0	0	0	22	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	24	58
IT	0	1	2	0	11	0	0	17	17	10	0	8	0	0	326	0	1	0	8	0	0	9	0	1	0	0	7	15	1	76	515
LU	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	6
NL	0	0	11	0	1	0	0	8	4	22	0	0	0	0	0	0	29	0	1	0	0	0	0	0	0	0	16	0	0	12	108
NO	0	0	2	0	4	4	1	3	17	9	0	1	0	0	0	0	2	9	10	0	0	0	3	0	0	10	25	0	0	110	216
PL	0	2	6	1	123	4	0	11	243	39	0	27	0	0	6	0	4	0	677	0	1	1	1	0	0	11	17	8	0	66	1252
PT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29	0	13	0	0	0	0	0	0	0	22	67
RO	0	1	1	14	30	0	0	2	29	6	1	54	0	0	9	0	0	0	34	0	31	1	0	0	0	27	2	36	0	49	333
ES	0	0	1	0	0	0	0	11	1	2	0	0	0	0	1	0	1	0	0	12	0	460	0	0	0	0	9	0	1	91	593
SE	0	0	3	0	11	10	7	4	39	14	0	3	0	0	0	0	2	3	28	0	0	0	34	0	0	17	20	0	0	107	306
CH	0	0	1	0	2	0	0	10	4	6	0	0	0	0	12	0	0	0	1	0	0	3	0	7	0	0	3	1	0	15	69
TR	0	0	0	10	4	0	0	0	4	1	6	5	0	0	3	0	0	0	6	0	1	1	0	0	54	18	0	4	0	69	192
SU	0	2	5	9	90	8	24	10	136	32	1	65	0	0	9	0	3	0	259	0	8	1	7	0	3	1986	21	23	0	499	3207
GB	0	0	3	0	1	0	0	8	4	5	0	0	0	6	0	0	1	0	1	0	0	2	0	0	0	0	540	0	0	65	639
YU	1	3	1	15	26	0	0	6	27	9	2	44	0	0	48	0	1	0	21	0	1	2	0	0	0	3	5	219	0	69	508
	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	RE	IND	SUM

Table 3. Provisional estimate of oxidized-nitrogen budget for Europe for 1988. Total (dry + wet) 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	RE	IND	SUM
AL	1	1	1	1	4	0	0	4	3	6	3	3	0	0	19	0	1	0	4	0	2	1	0	0	0	1	2	3	0	13	73
AT	0	36	13	0	65	4	1	71	44	239	0	11	0	1	82	1	20	1	34	0	2	4	2	17	0	1	34	6	0	30	720
BE	0	0	33	0	2	1	0	62	4	63	0	0	0	1	1	1	28	0	2	0	0	2	1	0	0	0	52	0	0	16	269
BG	0	3	1	29	16	1	0	4	8	18	8	16	0	0	18	0	2	0	18	0	40	1	1	0	1	26	3	11	0	37	265
CS	0	24	18	1	250	7	1	55	140	282	0	41	0	1	31	1	28	2	155	0	7	2	4	5	0	6	42	7	0	37	1148
DK	0	0	7	0	5	23	0	14	14	66	0	0	0	1	1	0	16	2	11	0	0	0	4	0	0	2	52	0	0	14	233
FI	0	1	5	0	11	18	115	11	20	65	0	1	0	1	1	0	13	11	35	0	1	0	43	0	0	135	29	0	0	62	578
FR	0	3	82	0	20	5	1	877	29	317	0	3	0	7	77	6	79	1	12	12	1	134	3	21	0	2	259	2	1	298	2251
DD	0	3	26	0	95	15	1	63	199	388	0	2	0	1	7	2	50	3	48	0	1	3	5	3	0	3	72	1	0	33	1024
DE	0	10	102	0	70	19	1	311	114	1173	0	5	0	5	37	8	169	5	42	1	2	13	6	31	0	4	229	2	0	96	2456
GR	1	2	1	11	10	1	0	7	5	14	39	7	0	0	25	0	2	0	9	0	10	2	0	0	3	11	3	6	1	56	226
HU	0	17	4	1	64	2	1	18	28	66	1	77	0	0	46	0	7	0	59	0	14	1	1	3	0	4	11	17	0	23	466
IS	0	0	0	0	0	0	0	1	0	1	0	0	2	0	0	0	1	1	0	0	0	0	0	0	0	0	10	0	0	36	54
IE	0	0	1	0	0	0	0	7	0	5	0	0	0	15	0	0	2	0	0	1	0	1	0	0	0	0	45	0	0	63	140
IT	0	15	11	1	40	4	0	156	28	136	2	17	0	1	514	1	15	1	31	2	3	28	2	27	0	2	48	16	3	120	1226
LU	0	0	1	0	0	0	0	6	0	6	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	0	1	18
NL	0	0	28	0	4	1	0	40	6	101	0	0	0	1	0	0	64	1	5	0	0	1	1	0	0	1	74	0	0	18	347
NO	0	1	13	0	13	30	9	24	30	107	0	1	0	4	0	0	32	66	29	0	0	0	33	0	0	19	144	0	0	85	642
PL	0	16	31	1	251	39	7	80	310	446	0	32	0	2	26	2	63	6	675	1	12	3	19	5	0	30	110	7	0	83	2259
PT	0	0	1	0	0	0	0	5	0	2	0	0	0	0	0	0	1	0	0	55	0	25	0	0	0	0	4	0	0	101	196
RO	0	12	5	14	82	4	2	17	44	81	4	77	0	0	50	0	11	1	109	0	162	1	3	2	2	76	14	26	0	74	873
ES	0	0	10	0	1	1	0	100	2	28	0	1	0	2	7	0	14	0	1	74	0	415	0	1	0	0	59	0	3	308	1030
SE	0	2	15	0	33	65	40	31	66	169	0	4	0	3	2	1	35	41	76	0	2	1	115	1	0	59	117	1	0	89	968
CH	0	1	8	0	5	1	0	85	8	80	0	1	0	1	46	1	9	0	2	1	0	6	1	33	0	0	26	1	0	22	337
TR	0	2	2	12	13	1	1	9	8	19	21	10	0	0	20	0	2	0	22	0	21	2	1	0	77	67	4	5	1	243	563
SU	0	23	31	12	250	79	151	92	241	449	5	97	0	2	54	2	65	25	738	0	103	4	97	6	19	2834	132	22	0	1028	6561
GB	0	0	12	0	3	3	0	47	8	47	0	0	0	22	0	0	18	2	5	1	0	6	2	0	0	1	626	0	0	117	922
YU	1	27	9	12	88	3	1	54	46	122	7	71	0	0	222	1	15	1	79	0	27	7	2	6	1	10	25	74	1	93	1004
RE	2	23	114	18	152	135	64	554	219	820	48	48	2	48	450	4	238	71	272	46	49	234	97	17	31	292	1282	34	10	1369	6741
	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	RE	IND	SUM

Explanation of the tables

The two-letter country codes 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. RE 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.

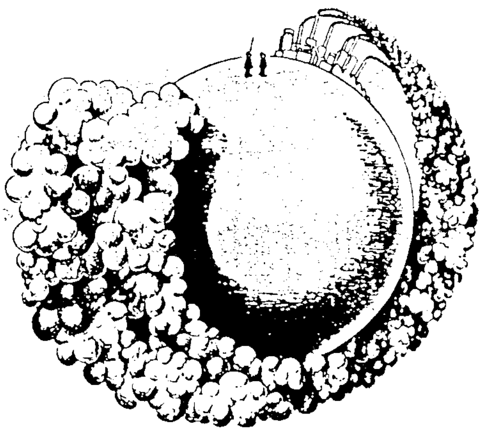
Ozone into the picture

During the sunny and warm summers of 1988 and 1989 much attention was drawn to ozone, a component of photochemical smog and summer haze. At many places in Europe and the United States the WHO guidelines were exceeded. Subsequently several reports have also been published.

During the weekend of May, 20-21, 1989 for instance, high levels of photochemical smog were observed over much of England. A peak one-hour concentration of 134 ppb was recorded in Devon, were levels remained over 100 ppb for more than 20 hours. On June 21, 1989, in Mannheim, West Germany, 162 ppb were measured, but the authorities issued no warning to the public. There had been a similar episode on May 23 in Baden-Würtemberg, where the concentrations reached 111 ppb. There however people were warned not to take too much exercise.

In Los Angeles, with 7.6 million cars, the limits for ozone were exceeded threefold during 172 days in 1988. The US Clean Air Act , sets the limit at 120 ppb and states that people should not be exposed to such a concentration for more than one hour a day.

According to the *New Scientist* (July 22, 1989) more than half of the American population is exposed to concentrations higher than that recommended by the Environmental Protection Agency. This emerged in July 1989 from a study by the Office of Technology Assessment (OTA) in the US. Its findings should



go to stimulating the efforts of politicians to rewrite laws for limiting air pollution. Almost two decades after the original legislation was enacted, 100 cities in the US were failing to meet the standards. Worse still, the OTA says, is the fact that the currently available technology could bring about compliance with the law in only half of those cities.

The OTA report cites animal studies which show that ozone causes biochemical and structural changes in lung tissue. There is however no conclusive evidence that people in cities where air is dirtier than prescribed by the Clean Air Act will be similarly affected.

Research presented at a joint meeting of the American Thoracic Association and the American Lung Association, early in 1989, suggests that the EPA may have to revise its limit, since it appeared that ozone causes inflammation in the lung even at low levels. Ten non-smoking males exposed to air containing ozone at 100 ppb and at 80 ppb. In

In Switzerland the Physicians for Environmental Protection organization has published a report, entitled "Air Pollution and Health," in which it lists the acute effects of ozone on human beings.

Acute effects of ozone

120 μg/m³	13-30 min. Hard work	Irritation of the mucous membranes of the eyes, nose, and throat. Worsened physical ability in sports.
240 μg/m³	13-30 min. Hard work	Intensifying of above symptoms.
240 μg/m³	2 hours' work	Decreased functioning of the lungs in schoolchildren.
300 μg/m³	1 hour's work	Ditto in adults.
300 μg/m³	Highest average hourly level on any one day	Irritation of the eyes in young women.
400 μg/m³	3 hours' exposure	Disturbance of ability to adjust to darkness.
500 μg/m³ and more	Highest average hourly level on any one day	Coughing and chest pains in ordinary daily work.

Continued from page 6

EMEP, diminished by about the same amount. (It may be noted, however, that those over Scandinavia have decreased very much less, by only about 6 per cent.) This is at least a move in the right direction, even if progress is far too slow. It seems, moreover, that the emissions of nitrogen oxides are still rising – which in consideration of the effects in the way of ozone formation, nitrogen saturation, acidification, and so forth, is highly disturbing.

The EMEP reports provide an important check on the way signatories to international agreements are fulfilling their obligations, and on the general effect of such agreements (such as the Sulphur Protocol 1985 and the 1988 protocol for nitrogen oxides). They will also be useful for 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, and so improve still further the value of the EMEP work.

Christer Ågren

Data shown in the tables comes from the EMEP MSC-W Report 2/80, entitled *Airborne Transboundary Transport of Sulphur and Nitrogen over Europe – Model Descriptions and Calculations.* Available from The Norwegian Meteorological Institute, P.O. Box 43-Blindern, N-0313 Oslo 3, Norway.

each case exposure lasted more than six hours, during which the men carried out moderate exercise. At both levels, macrophages – cells that scavenge in the lungs – were found to be less capable of consuming and destroying bacteria than they normally would be.

In addition, there was a significant increase in the cells and chemicals in the body that produce inflammation, such as white blood cells, fibronectin and lactate dehydrogenase.

Exposure to ozone at a concentration of 100 ppb also increased levels in the lung of protein and a hormone-like substance, called prostglandin E2, a potent regulator of the immune system, which also promotes inflammation. Research suggests too that sulphuric acid, combined with other pollutants such as ozone, may be more harmful than either sulphuric acid or ozone alone. Douglas Dockery from the Harvard School of Public Health in Boston is reported as saying "How far the limit comes down will depend on what risk people are prepared to take. I believe there are effects down to the lowest levels you can detect" ... "At the moment we are probably seeing effects down to 60 ppb. With more sensitive tests, you would probably see an effect down to 20 ppb."

Previously, in August, Friends of the Earth England had published a major research project entitled "Air Pollution and Health." It accused the British government of failing, in July 1989, during one of the worst weeks for photochemical smog since 1976, to warn the public of high pollution levels – in stark contrast to detailed "smog alert" procedures in some other countries. Friends of the Earth is campaigning for EC-wide air quality standards based on WHO guidelines.

The FoE report says that those who are most sensitive to air pollution are infants under two years of age, the elderly, and pregnant women, as well as individuals suffering from asthma, bronchitis, emphysema, chronic airway obstruction, angina pectoris and acute myocardial infection.

In the past, the majority of the measurements of ozone in the UK have been made in rural areas, rather than in urban centres of population. Concentrations are generally highest in rural parts, followed by suburban areas, with central city sites having the lowest levels due to the high levels of nitric oxide which rapidly remove ozone.

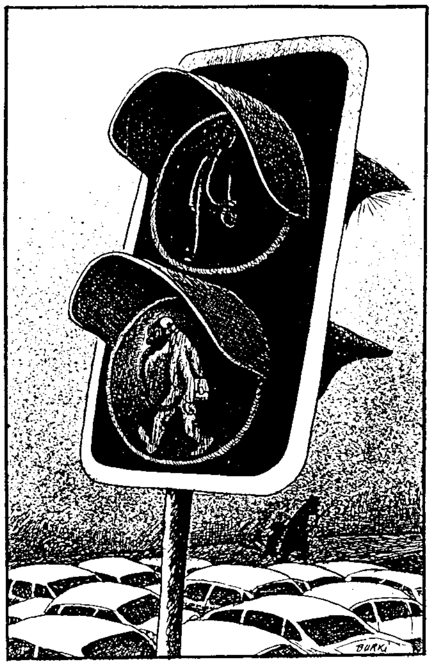
> In the US and UK, concentrations of ozone are often expressed in parts per billion (ppb), while e.g. in West Germany and Switzerland mainly micrograms per cubic meter ($\mu g/m^3$) is used. For ozone the conversion factor from ppb to $\mu g/m^3$ is 2.0.
>
> The World Health Organization's Air Quality Guidelines for Europe are equivalent to a one-hour average of 76-100ppb (150-200 $\mu g/m^3$) and an 8-hour average of 50-60 ppb (100-120 $\mu g/m^3$).

The Photochemical Oxidants Review Group has analyzed the UK ozone data since monitoring began in 1972 in terms of the number of days on which levels of 80 ppb and 100 ppb have been reached. At rural locations the 80 ppb one-hour average had been exceeded for up to 37 days and 235 hours a year, whereas 100 ppb had been exceeded up to 16 days a year and 154 hours.

In urban areas the WHO guideline is also regularly exceeded – for up to 18 days and 100 hours per year. Hourly values greater than 100 ppb were exceeded in the larger urban areas on a small number of days.

The FoE report makes the following recommendations:

1. The UK government should adopt the WHO air quality guidelines for Europe as statutory air quality standards. It should press the European Community to bring the existing limit values in EC Air Quality Directives into line with the WHO guidelines, and introduce new EC Air Quality Directives for carbon monoxide and ozone, using the WHO guidelines as limit values.



2. A system of smog "Alerts" should be developed in the UK, giving local authorities powers to reduce elevated levels of pollution by closing factories and controlling vehicle use during pollution episodes. The levels at which these alerts are triggered should be similar to the WHO Air Quality Guidelines.

3. The public should be informed as soon as reasonably possible, but no later than 24 hours after the start of a pollution episode, that pollution levels are high, and told what precautions need to be taken. A system of notification through the media needs to be established as a matter of priority, given the high levels of photochemical pollution seen so far this year.

4. The" polluter pays" principle should be extended to a tax on petrol and diesel fuel.

5. The UK should set up national monitoring networks for carbon monoxide and hydrocarbons.

6. Compliance with the EC Directive on nitrogen oxide in air should be monitored towards the back of the pavement (sidewalk) to protect those members of the public who spend a considerable amount of time there e.g. stall holders, traffic wardens. This would be more in keeping with the spirit of the Directive than the government's present "at-the-back-of-buildings" monitoring sites.

Reinhold Pape

Reports:

Air Pollution and Health: A briefing document prepared for Friends of the Earth by Claire Holman, August 1989. 26-28 Underwood Street, London, England N1 7JQ.

Luftverschmutzung und Gesundheit: Eine Publikation der Ärzte für Umweltschutz, Switzerland, March 1988. Available from "Luft ist leben," Postfach, CH-4123 Allschwil 3, Switzerland.

New Scientist: July 22, 1989, page 21, "Americans overdose on ozone," September 9, 1989, page 40, "Even low levels of ozone in smog harm the lungs."

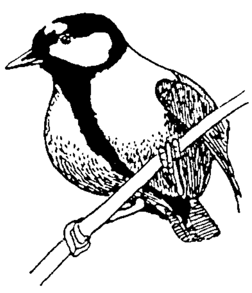
NATURE NOTE

Alarming effects of acid rain

There is a clear connection between depositions of acid and the thinning of wild birds' eggshells – as has been shown by a Dutch study published in *Nature* for June 8, 1989. Scientists at the Institute for Ecological Research in the Netherlands have for the past five years been observing the eggs of great tits (*Parus major*) inhabiting woodlands affected by acid rain. They noted a sharp increase in the proportion of eggs either with no shell or with shell of such poor quality that the embryo had dried up during incubation because of excessive evaporation.

One of the Institute's ecologists, Dr Pieter Drent, has also said that up to half the population of certain other species of wild birds, such as the blue tit, coal tit, nuthatch, and great spotted woodpecker, often failed to lay eggs with tough enough shells.

The shell thinning was said to be due to a changed relationship between calcium and aluminium in the soil, caused by acid rain. When



the calcium/aluminium quotient falls below 1, it becomes difficult for the plants to take up calcium. The leaves of beech trees growing on the poorest and most acidified soil had a 44-per-cent lower calcium content than those of trees that have grown in richer soil. As a direct consequence the leaf-eating larvae – the staple diet of most woodland birds – also had less than normal calcium in them. To be able to form sufficiently thick shells to their eggs, birds need great amounts of calcium.

The Dutch study is not the first to indicate a disturbing connection between eggshell thinning and acid rain. In a study of dippers (*Cinclus cinclus*) living along Welsh streams, made in 1987, evidence was found of shells being thinner when the water was acid than when it was neutral. In this case the link may have been the water invertebrates on which dippers largely feed. Some years previously (Acid News 1/85) the breeding abundance in Wales had been found to be much less along streams where the water was acid.

A still earlier Swedish study had revealed a thinning of the shells of pied flycatchers' eggs (*Ficedula hypoleuca*) in the northern part of the country. There the insects on which the birds fed were found to contain large amounts of aluminium, liberated from the soil by acid rain. The metal had accumulated in the birds' bone marrow, causing calcium deficiency. As in the Netherlands, often the eggs either had shells that were too thin, or had no shell at all.

Per Elvingson

BOOK REVIEW

Good on the subject

Acid Earth – the Global Threat of Acid Pollution.
By John McCormick. Published by Earthscan Publications Ltd. 220 pp. Price £6.95. ISBN 1-85383-033-X (1989).

This is one of the best books so far available on the subject of acid rain. Not only does it make an impressive array of facts easily accessible in a volume of handy format; it also continuously combines the facts with an analysis of policy development both on the national and international level.

Caution will nevertheless be needed in using it. Unnecessarily old and wrong data appears to have caused the author to be misled at times in his analyses and conclusions. He says more than once, for instance, that in agreeing to accept the EC directive on large combustion plants, the UK has gone well beyond requirements of the 3o Per Cent club. The directive itself is wrongly described as requiring a 60-per-cent cut by 2003 in the total national emissions of sulphur dioxide, whereas actually it requires a 60-per-cent reduction of the emissions from existing large plants (>50 MW). In the case of the UK, this means reducing the emissions from existing LCPs by 20 per cent by 1993, the target year for the 30Per Cent club. That only corresponds to about 16 per cent of the country's total emissions, or about half the amount of the club target.

The author is also wrong in saying that the twelve members of the Community have agreed to reduce emissions of nitrogen oxides by 30 per cent by 1998. Of the twelve countries that signed the declaration to this effect, in November 1988, only six are EC members, and the UK is not among them. The directive for large combustion plants does on the other hand require a reduction of 30 per cent in the emissions of NO_x from such plants by 1998 – but again this amounts only to a fraction of the total national emissions.

It is a pity that the author did not have more up-to-date information at his disposal, whether on national emissions or on international exports/imports of pollutants. Although there is more recent data available, the figures presented are often from the early 1980s. This also concerns the effects, especially as regards forest damage in the various European countries.

But errors apart, the information presented is essentially correct, and the book makes exceedingly interesting reading.

Christer Ågren

Acid News

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INTERNATIONAL AIR POLLUTION WEEK 1990

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PLEASE NOTE

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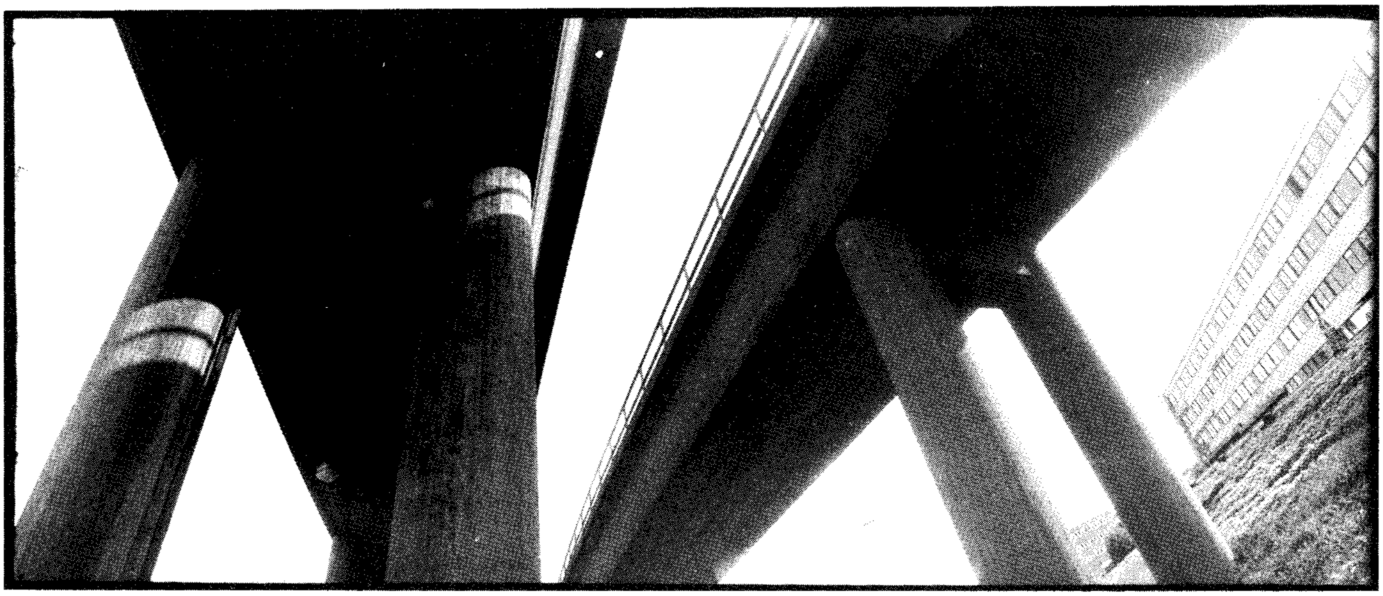
Far from paying its way



In Sweden the taxes on motor vehicles by no means cover the social costs for road traffic. That is the conclusion of the writers of this article after having studied official assessments of the costs of environmental damage and road accidents. They find that road traffic is being subsidized in the current fiscal year to the extent of at least 11 billion kronor.

The idea of cost responsibility first arose when vehicle taxes were introduced in 1923. The principle followed until the late 70 s was that the revenue from such taxes should correspond to the actual outlay for construction and maintenance of the highway system. The cost of traffic accidents was not taken into account, much less that of the effects on the environment, which at that time were practically unknown. Then in the seventies and eighties there began to be a growing awareness that society was incurring considerable hidden costs on account of exhaust emissions, noise, and accidents.

In the language of economists, such things as environmental damage are termed "negative external effects." By this they mean the side effects of any activity that business firms and individuals do not have to take into account in their calculations. The costs and risks can be passed on to others.

In 1988 parliament decided however that taxes and charges should approximate the actual costs to the community for each mode of transport, including those for environmental damage and accidents.

Taxes are partly variable (on fuel and mileage), and partly of the fixed type (excise and vehicle taxes) which are independent of mileage. The variable taxes are intended to correspond to the short-term marginal costs to the community, such as those for highway maintenance, accidents, and environmental effects. The fixed ones shall in principle match the other community costs, for road construction, and so forth.

The aim in Sweden is now to add economic incentives (disincentives) to the present regulatory system. This means that each mode of transport should be made to bear the cost of the environmental damage (as well as accidents) to which it gives rise. The problem is how such costs are to be calculated.

If only the harmful effects of exhaust emissions that have definitely been determined are taken into account, the result will be a distinct underestimate of the general willingness to pay the price of reducing them. In order to avoid that, the writers have elected to study the willingness to pay for reducing the effects of each separate pollutant. This give a baseline showing the lowest value that the community would be inclined to give to environmental damage. It appeared that in 1985 Swedes would have rated the damage to the natural environment from emissions of nitrogen oxides at 15 kronor per kilogram at the least (see box). The damage from emissions of hydrocarbons and sulphur dioxide would have been rated somewhat lower.

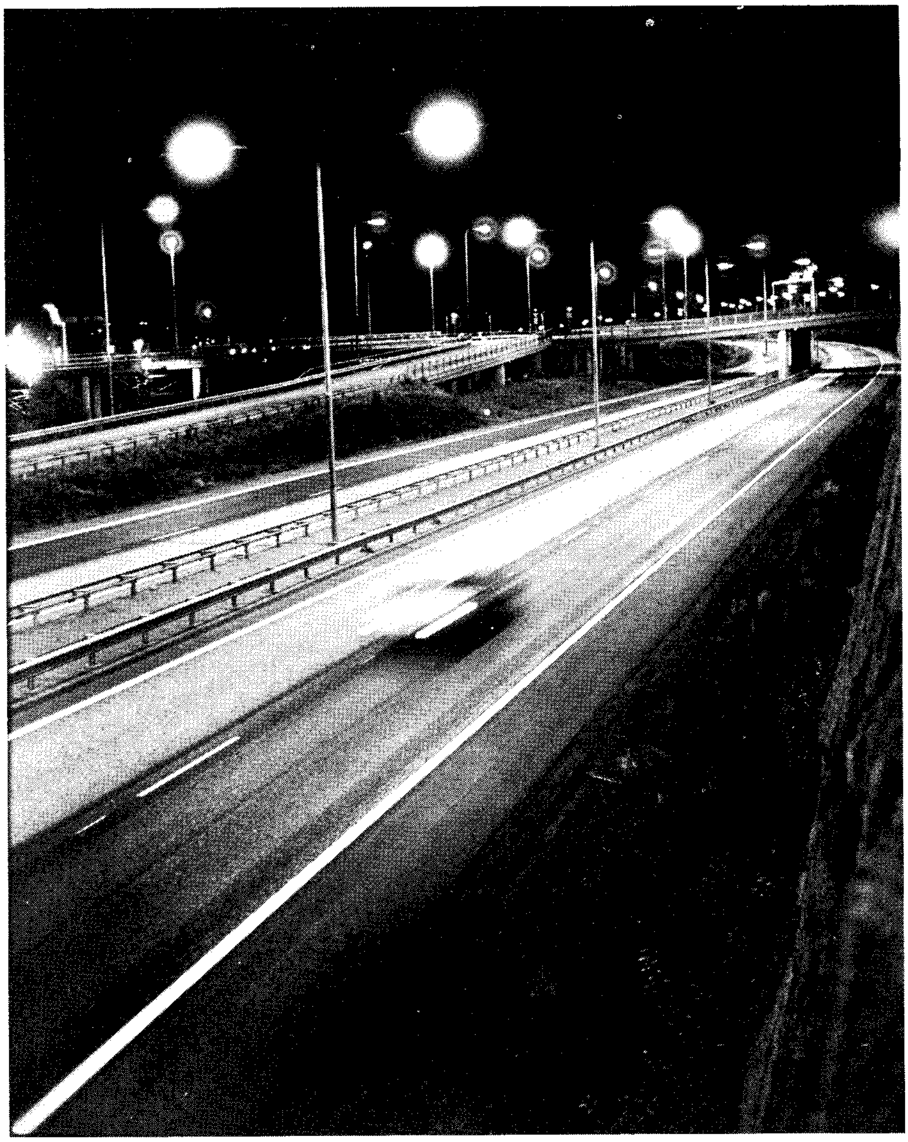
The above estimates have been officially accepted by the Department of Transportation, where they now form part of the material for the calculation of fuel and mileage taxes. An estimate was also made of the cost of the local effect of emissions in an urban environment (affecting health and causing grime and corrosion).

If damage to health as well as that to the natural environment were included, the cost attributable this year to all the emissions from road traffic would amount in Sweden to at least 8 billion kronorthis year.

The estimates are based on ratings for 1985. The value put on the environment has not remained constant, however, but has been steadily rising. In 1988 parliament expressed the desirability of reducing the emissions of sulphur dioxide by 80 per cent between 1980 and the end of the century, and of finding out what measures might be needed for reducing those of nitrogen oxides by 50 per cent within the same period of time.

To meet these objectives would require measures costing up to 20 kronor for each kilogram of sulphur dioxide that could be eliminated, and maybe 40 kronor per kilogram in the case of nitrogen oxides. Implementing such measures would imply that these figures represent the lowest value that can be put on the damage that would thereby be reduced. Consequently the total cost of the environmental damage attributable to present vehicle emissions can be assessed at 12 billion kronor. This would include damage to health and the natural environment, but not the effects of climate changes.

Then there is the question of the effect of the emissions of carbon dioxide on the global climate, which also needs to be priced. The parliamentary commission that is considering environmental charges has proposed taxing such emissions with 0.25 kronor per kilogram. If applied on the basis of the current fuel consumption of road vehicles in Sweden, such a charge would bring in about 5 billion kronor. Since the charge as proposed will not suffice to bring about the necessary reduc-



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How the figures were arrived at

In 1985 Sweden decided to bring in stricter emission controls for petrol-driven cars, starting with the 1989 year models. This meant in effect that from then on all new cars would have to be equipped with catalytic converters. The move had been carefully prepared and was well grounded in popular opinion.

This provided a gauge of the public willingness to pay for a better environment. It seemed evident that the benefits of exhaust cleaning were thought to outweigh the costs. Consequently an estimate could be made of the lowest price society should be prepared to put on the damage caused by exhaust emissions.

As regards damage to the natural environment, the price was found to be at least 15 kronor per kilogram for nitrogen dioxide, and about half that figure for hydrocarbons.

The estimates were checked against two proposals from the Environmental Protection Board for further measures to control emissions of nitrogen oxides. One was to limit the emissions from stationary combustion plants. The marginal cost for this measure was shown to be about the same as that already mentioned, that is 15 kronor per kilogram of nitrogen oxide, if not slightly more. Implementation of this measure would lend further support to the previous estimate of the value of damage to the natural environment.(It should be noted however that the estimate was made three years ago, and that 40 kronor per kilogram is now considered a nearer indication of willingness to pay the cost for betterment.)

An estimate was also made, although with a higher degree of uncertainty, of how society would rate damage in built-up areas in the form of effects on health, additional grime, and corrosion. The figure arrived at was around 20 kronor per kilogram of nitrogen oxide when emitted in a town of about 100,000 population.

Nitrogen-oxide emissions in an average town thus came to be rated at 15 + 20 kronor per kilogram, or at least 35 kr/kg NO_x. For the central parts of larger cities the figure would be considerably higher.

With the emission factors in hand for the various types of vehicle (grams of the various pollutants emitted per kilometre of travel), the cost of damage per vehicle kilometre could also be calculated.

Cost category	Accountability 1989/90 in billions of kronor	
	Lowest valuation	Revised valuation
Road costs, traffic control, etc.	13.2	13.2
Traffic accidents	10	15
Exhaust emissions	8	12
Carbon dioxide	–	5
Noise	–	3
VAT on fuel*	5.6	5.6
Total accountability	36.8	52.8
Less total vehicle and fuel taxes	25.6	25.6
Subsidy to road traffic 1989-90	**11.2**	**27.2**

* Hitherto motor fuels have been exempted from VAT, and so have in effect been subsidized in relation to other goods.

The lowest valuation is the present official one. The revised is based on more up-to-date statistics but not yet made public. The effects of various tax allowances, such as for travel to and from work and for company cars, have not been taken into account. Consequently the taxes paid will in fact be lower than indicated.

tion in the burning of fossil fuel, it would probably have to be at least twice as high if any real lowering is to be achieved in the emissions of carbon dioxide.

Currently the National Road Administration (NRA) assesses the cost of noise at 7000 kronor for each individual who is disturbed in his home. According to official figures, between 400,000 and 800,000 people are being markedly disturbed by noise from traffic. The cost in other words may be either 3 billion or more than 5 billion kronor a year.

The NRA has also developed a method for evaluating the cost of accidents to the community (used for determining the priorities for road projects). The items included in this valuation are hospital care, loss of production, damage to property, and administrative costs, plus a large one known as the "humane cost." This last takes account of the suffering, sorrow, and worry that an accident may involve.

A traffic death is given a value of 7.4 million kronor (1990 money value). Consequently it is regarded worthwhile to invest 7.4 million kronor if thereby a single "statistical" fatality can be avoided.

Calculating in this way, one arrives at a figure of no less than 25 billion kronor during the current fiscal year for all types of road traffic accidents. It would be wrong however to require accountability for the whole of this sum. The fact must also be taken into consideration that motorists voluntarily expose themselves to risk when setting out on the highway. Accountable should only be the harm and suffering caused to persons outside the car driver's own vehicle. By this reasoning, the cost of traffic accidents would come to 15 billion kronor a year.

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Automobile and road organizations usually include in the balance sheet for road traffic only those items of direct outlay that appear in public accounting. Thus the Swedish Road Association, a lobbyist organization, only records under expenditure the direct costs of the highway system plus the cost of hospital care for the victims of accidents. This leads to the conclusion that in the fiscal year 1989/90 the road users were being overtaxed to the extent of 13 billion kronor. Such an attitude is reasonable only if one takes into account the public budgetary costs. It is however outmoded and does not accord with parliament's intentions.

Today's official attitude is that the external effects, that is, the costs to the community of traffic accidents, as well as the health and environmental effects of exhaust emissions, shall be accountable. As may be seen from the table, the present vehicle taxes by no means cover the sum of items for which road traffic should be accountable.

Road traffic in Sweden, far from paying its costs, is in fact being heavily subsidized. The deficit for the budget period 1989-1990, assessed as in 1985, amounts at least to 11 billion kronor. By the method of assessment now current, but not yet official, it would have come to 25 billion if not more.

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Dealing with sulphur dioxide

In response to concern over the impacts of acid rain on the environment, an increasing number of countries have introduced limits on the permitted emissions of sulphur dioxide from utilities and industries. The most stringent limits apply to large new plants, and require removal of 85 to 90 per cent of uncontrolled SO_2 emissions (see Table 1). Standards are also being applied to small plants and those already in operation, to comply with international and national requirements to reduce the total emissions of sulphur dioxide.

These regulatory changes have resulted in the development and marketing of a range of technologies for controlling SO_2 emissions.

Methods of SO_2 control

Emissions of sulphur dioxide arise from oxidation during combustion of the sulphur contained in fuel. Although a proportion of sulphur may be retained in the ash produced when solid fuels burn (usually 5-10 per cent, although it may be higher in some low-rank coals), there is a direct relationship between fuel sulphur content and emissions of SO_2.

The emissions may therefore be controlled at any stage of the combustion process:

• Prior to combustion, by use of inherently low sulphur fuels, or by cleaning of fuels to remove sulphur.

• During combustion, by addition of a sorbent to the fuel itself, the combustion vessel, or the following ductwork.

• In post combustion, by treatment of the flue gas in a special vessel, commonly known as a flue-gas desulphurization (FGD) unit.

Any of these approaches can be applied to conventional combustion plants, and it is possible to retrofit controls to existing units as well as including them in the design of new plants. An alternative approach is the development of new combustion techniques with inherently lower SO_2 emissions, such as fluidized bed combustion (FBC) and integrated coal gasification/combined cycle (IGCC). Although these techniques use methods similar to conventional SO_2 removal (absorption during combustion or fuel cleaning), they are described separately because they utilize a completely different combustion approach. These technologies will be mainly applied to new plants, although in the US they have been used to "repower" existing plants; that is, to replace the combustor while retaining other elements such as generators.

The applicability, status, and efficiency of SO_2 control methods for coal-fired plants are outlined in Table 2, the different methods and their current use being further described below.

Low-sulphur fuels

Perhaps the most basic method for controlling SO_2 emissions is to use fuels with a low or reduced sulphur content. This can be achieved either by purchasing a fuel with little or no sulphur (e.g. natural gas or low-sulphur coal) or by cleaning the fuel to remove sulphur prior to combustion.

High-sulphur oil and natural gas are regularly cleaned to remove a high proportion of sulphur. The degree of sulphur removal achievable by coal cleaning depends on the form of the sulphur. Pyritic sulphur can be removed by physical cleaning processes, whilst organic sulphur remains bound in coal mineral matter and can only be removed by chemical or possibly biological action. Chemical and biological coal cleaning is not yet being commercially applied.

Many countries apply limits to the sulphur content of fuel oil for use in certain types of combustor, and limits have also been set on coal sulphur levels. Where emission limits are set in terms of the mass of SO_2 emitted per unit flue-gas volume or energy input, use of low-sulphur fuel alone may be sufficient to meet the limits. Switching to natural gas would also enable emission limits of this type to be met.

The main determinant of whether low-sulphur fuel is used for SO_2 control is its cost relative to other control approaches. Currently the price of low-sulphur coals differs little from that of other coals, and imported low sulphur coals may even be cheaper than indigenous high-sulphur fuels.

Natural-gas pricing policies vary considerably from country to country, although generally a considerable premium is payable compared to solid or liquid fuels. As new gas pipelines and grids are con-

Table 1
Current SO_2 emission standards for new large hard-coal-fired power plants.

Country	Plant size	Implementation date	Emission standards (mg/m^3)
Austria	>300 MWt	1984	200 (plus 90% removal)
Belgium	>300 MWt	1987	400
	>300 MWt	1995	250
Canada	all	(guidelines)	740
Denmark	> 50 MWt	1984	860
F.R.G	>300 MWt	1984	400 (plus 85% removal)
Finland	>150 MWt	1987	400
Italy	>100 MWt	1989	400
Netherlands	>300 MWt	1987	400 (plus 85% removal)
Spain	all	1985	2400
Sweden	all	1988	290
United Kingdom	>700 MWt	1988	– (90% removal)
USA	> 73 MWt	1978	1480 (plus 70-90% removal)
EEC*	>500 MWt	1987	400 (or 90% removal)

* Does not apply to Spain until 2000; also exceptions for plants burning high-sulphur indigenous coal.

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structed, increased competition may make the use of natural gas a more attractive option – although the future price movements of gas are highly uncertain.

Removal during combustion

Sulphur may be removed in the combustor or adjacent ductwork by using a sorbent. Calcium compounds are the most common sorbents, but sodium compounds have also been used.

In its simplest form, a sorbent may simply be mixed with the fuel prior to combustion. Alternatively the sorbent may be injected into the combustor, economizer, or flue-gas ductwork as a powder.

Using various measures to enhance the efficiency of sorbent injection, sulphur capture rates of up to 80 per cent have been claimed on a commercial basis at calcium/sulphur ratios of around 2, although experience of large-scale long-term applications is limited.

The chief attractions of sorbent injection compared with FGD are its lower cost and ease of retrofitting to existing plants. Costs of around half that of FGD have been claimed, although with lower SO_2 removal rates. It is clear that many of the measures that allow sorbent injection to increase SO_2 control efficiencies up to 80 per cent will add considerably to the cost.

Flue-gas desulphurization

Flue-gas desulphurization (FGD) is the most widely used approach for control of SO_2 emissions from large combustion plants. It was applied first to oil-fired plants, but has now been successfully used on coal-fired units worldwide.

FGD systems can be grouped into two broad categories, regenerable and non-regenerable, according to the way in which the sorbent is treated after it has taken up the SO_2. In non-regenerable systems, the SO_2 is permanently bound in a chemical compound which must be disposed of as waste or sold as a by-product. In regenerable systems, the SO_2 is subsequently removed from the sorbent and the regenerated sorbent returned to absorb more SO_2. Recovered SO_2 may be further processed and/or sold as a by-product.

Wet scrubbing is the most common FGD process currently in operation. Either limestone or slaked lime is used as sorbent and either calcium sulphate or a combination of calcium sulphite/sulphate is produced. The vast majority of new installations of wet scrubbers are based on limestone and are designed to produce gypsum, which is preferred because it can be marketed and also because of its superior dewatering characteristics.

Spray dry scrubbing has emerged during recent years as an alternative to wet scrubber systems, particularly for smaller-sized installations and low-sulphur coal. Slaked lime is commonly used as sorbent and the process gives a dry powdery end product consisting of calcium sulphite/sulphate. By using a fly-ash precollector ahead of the spray dry scrubbing systems, the FGD end product can be obtained free of fly ash. This is sometimes preferred if there is a market for either the fly ash or the FGD end product. Although in most cases the FGD end product must be disposed of, attempts have been made to produce a residue that could be saleable. The two most promising uses are as filler material for road construction and as a setting retardant in cement production.

Other less widely used non-regenerable systems include dual-alkali processes and sea-water scrubbers.

For a number of reasons, regenerable systems are far less widely used at present than non-regenerable systems. Regenerable systems

Table2
Methods of SO_2 control for coal-fired plants.

Approach	Applicability	Status	Efficiency
Use of low-sulphur coal	All users	Commercial	up to 80%
Coal cleaning	All users	Commercial	10-50%
Sorbent addition to fuel	All users	Demonstration	10-30%
Sorbent injection	New and retrofit	Demonstration, limited commercial	30-80%
<u>FGD</u>			
- spray dry scrubbing	New and retrofit	Commercial	70-80%
- wet scrubbing	New and retrofit	Commercial	80-90%
- regenerable	New and retrofit	Commercial/ demonstration	90-95%
<u>New combustion methods</u>			
- atmospheric FBC	New or repowering	Commercial	80-90%
- circulating FBC	New or repowering	Commercial	90%
- pressurized FBC	New or repowering	Demonstration	75-95%
- integrated gasification/ combined cycle	New or repowering	Demonstration	95%

tend to be more complex and hence have higher capital costs. Furthermore the economics of such systems rest heavily on the price obtainable for the end product, i. e. elemental sulphur, liquid sulphur dioxide, or sulphuric acid.

The most common regenerable FGD system is the **Wellman-Lord process** which is a wet system using sodium sulphite as a sorbent. The reaction product is regenerated to produce a sulphur dioxide-rich gas that can be further processed to give either elemental sulphur or sulphuric acid. Other commercially operated regenerable systems include the activated carbon adsorption process and physical adsorption processes based on organic solvents.

The performance targets and operating experience of FGD systems vary considerably among countries, and it is the SO_2 emission requirements imposed by regulatory standards that lead to the widest variations. Coal composition and the variability of feed coals also affect performance targets.

Many systems are now routinely capable of operating at design SO_2 removal efficiency at high availability levels. This is true for a range of wet scrubber systems, and preliminary data on spray dry scrubber systems also look favourable. Median availability of systems has shown improvement to a level where the FGD units match acceptable levels of boiler operation (better than 95 per cent).

Improvements in the reliability and availability of FGD systems are also associated with improved cost-effectiveness. Although reported costs of FGD vary widely between systems and countries, in general they lie within the range of 15-20 per cent of the total capital costs for new power plants, and contribute an additional 5-10 per cent to the costs of electricity generation from a power plant, depending on load, fuel characteristics, etc.

New combustion technologies

Despite the progress achieved in controlling SO_2 emissions from conventional combustion processes, the methods used are generally sub-optimal in cost and/or efficiency terms. An alternative approach is to seek new, more efficient combustion processes where limitation of SO_2, as well as of other emissions such as NO_x, is integral from the start. The most highly developed technologies are fluidized bed combustion and integrated coal gasification combined cycle.

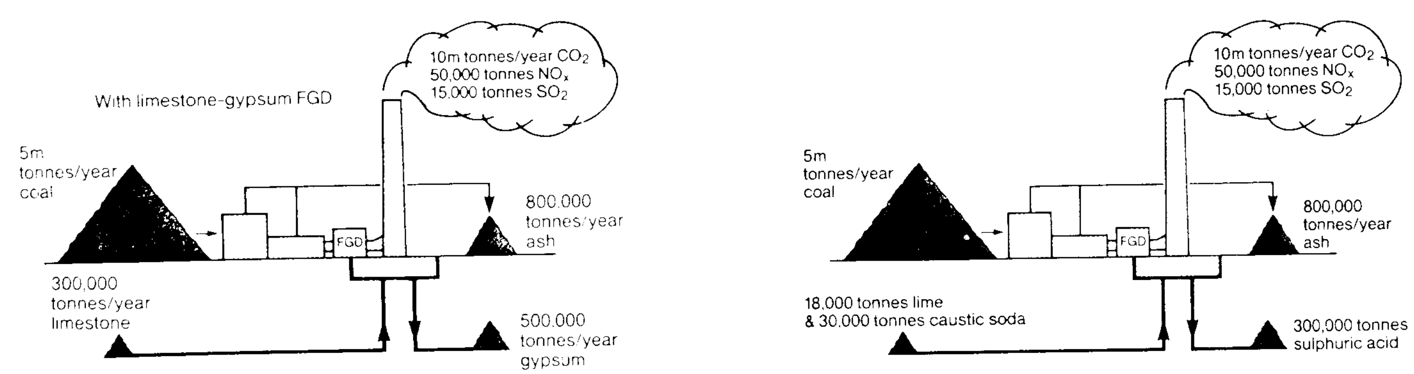
Fluidized bed combustion (FBC) has been under development since the 1960s. The basic concept involves the fluidization of inert particles by air and heating of the bed thus formed. Fuel is then fed into the bed, where it ignites. FBC allows the use of a wide range of fuels, including those with a high ash or moisture content. Bed temperature is maintained at around 700-900 °C, and by adding a sorbent to the bed material, sulphur can be removed as it is released from the fuel, giving capture efficiencies over 90 per cent.

The economics of FBC compared with conventional combustion technologies depend upon size, fuel characteristics and emission standards. Where SO_2 and other emission limits are tight, and especially where fuel flexibility is required or quality is poor, FBC may have clear economic advantages over conventional combustion plants with emission control equipment. This is particularly the case for small and medium-sized combustors. For larger combustion plants experience with FBC is more limited, and few detailed cost data are available, but plans for several large FBC plants in the USA indicate that operators expect FBC to be economically competitive.

One problem for FBC which remains to be solved is the matter of residue disposal. The very fact that atmospheric emissions from FBC are low means that a range of different substances are retained in the solid residues. The variability of the wastes produced, especially where a mixture of fuels is used, poses problems for their safe disposal or reuse.

Pressurized FBC (PFBC) is a further development of the FBC concept. Here the FBC unit is enclosed in a pressure vessel, and can be operated in combined cycle with combustion gases fed into a gas turbine, and exhaust gases and heat from the combustor used to raise steam for a parallel steam turbine. PFBC is still at the demonstration stage, although the manufacturers claim that problems have been overcome, and that the technology can achieve both high efficiency and very low emissions. As with atmospheric FBC, the disposal of solid residues remains a problem and it is not yet possible to assess accurately the economics of the process.

Integrated coal gasification/combined cycle (IGCC) also uses a combination of gas and steam turbines to increase combustion efficiency. Gasification acts by combusting coal with a restricted oxygen supply to produce a combustible fuel gas. A number of new, efficient gasifier designs are now available, using increased temperature or pressure to raise the effi-



Material flow for two 2000 MW coal-fired stations equipped with flue gas desulphurization. Left: With limestone-gypsum FGD. Right: With Wellman-Lord regenerative process. Drawings from information leaflet published by CEGB, UK.

ciency of gasification and extend the range of coals to which it can be applied.

The medium-energy-content gas that is produced can be cleaned by using standard chemical plant techniques; sulphur is in the form of water-soluble H_2S rather than SO_2, and hence is easier to remove. A demonstration IGCC plant in California has in this way achieved very low emissions of SO_2 and other pollutants.

Whilst the economics of IGCC are not yet clear, the demonstration plant indicates that power can be generated at a reasonably competitive cost. Further improvement of the efficiency of the process depends partly upon development of hot gas clean-up techniques. Currently the gas must be cooled before treatment with a consequent loss of efficiency.

Solid residues from IGCC vary with the gasification process used; whilst some wastes take the form of an inert slag, others contain a mixture of compounds which may present disposal problems. Large volumes of liquid effluent, requiring extensive treatment before discharge, may also be a problem.

In the USA, the Electric Power Research Institute (EPRI) has proposed a phased construction approach, with combined-cycle plants taking advantage of current low natural-gas prices, and adding a coal gasifier as the economics become more favourable.

Application of technologies

In many countries, legislation for SO_2 control is relatively new and thus the application of different control technologies is still underway. Programs have progressed furthest in the United States, Japan, the Federal Republic of Germany, and Austria. Other European countries, along with Canada and Taiwan, have plans for major investment in control technologies over the next few years.

Most countries, other than those with indigenous reserves of high-sulphur fuels, have policies favouring the use of lower-sulphur fuels. In most cases the policies focus on limiting the sulphur content of the coal and oil that may be used in combustion plants, and encouraging a switch from high-sulphur fuel oil to lower-sulphur coal. For countries importing coal, this policy is aided by the fact that 75 per cent of traded coals have a sulphur content below 1 per cent (although only 10 per cent of traded coals is below 0.7 per cent sulphur).

In general, the use of low-sulphur fuel as the sole means of SO_2 emissions control is limited to smaller plants. The use of natural gas in SO_2 control programs has been limited in the past by distribution constraints and by government policies restricting its use in power generation. More recently there has been renewed consideration of the use of natural gas for power generation, and there are firm plans for gas-fired power plants in several countries.

Concern over other air pollutants is also a factor influencing development

The search for lower-cost methods of meeting SO_2 control requirements has focused attention on sorbent injection. Considerable development and demonstration work is underway, but there are relatively few installations operating commercially.

By far the most widely applied technology for SO_2 control is flue-gas desulphurization (FGD). Over 100,000 MWe of coal-fired plants alone were fitted with FGD by the end of 1987, with a similar amount of further capacity planned.

The US has the largest installed FGD capacity. In addition to 60,000 MWe of utility FGD (representing 25 per cent of total capacity) there are in that country over 100 FGD systems fitted to industrial combustion plants. Japan also has FGD on industrial and utility plants, with the majority of the approximately 40,000 MWe equivalent capacity fitted to oil rather than coal-fired installations. Within Europe, the Federal Republic of Germany has progressed furthest. There a major retrofit program has resulted in the commissioning of about 37,000 MWe of FGD between 1983 and late 1988, covering 165 combustion plants.

Of the newer combustion technologies, only atmospheric fluidized bed combustion (AFBC) is commercially established. Large-scale PFBC plants are however currently under construction in Sweden, at Stockholm, at Teruel in Spain, and Tidd, Ohio, USA. The most highly developed IGCC plant is the 100 MW Coolwater plant, near Dagett, California. This plant started up in 1984 and has been put through a number of long-term test runs.

Further control developments

Technologies for the control of SO_2 emissions have developed most rapidly in two countries, the US and Japan, where emission standards have been in place since the 1970s. As legislation on SO_2 has developed, other countries have selected the technologies of which there has been the greatest commercial experience, adapting them to the needs of their own fuels and plants.

Countries which have yet to implement SO_2 control programs, the UK included, now have a far greater body of experience of control technologies from which to draw. As well as refinement of FGD technologies to give greater reliability, there has also been extensive research into lower-cost SO_2 control approaches and inherently clean combustion methods. The emphasis on these approaches can be expected to continue, although the apparent promise of sorbent injection, PFBC and IGCC has yet to be fully proven in commercial use.

Another key factor influencing the development of SO_2 control is concern over other atmospheric pollutants. A number of processes for joint control of SO_2 and NO_x already exist, and are likely to receive more attention in the future. Concern over CO_2 emissions is potentially a major influence, since processes such as FGD can reduce the efficiency of combustion plants, and thus increase the amount of CO_2 per unit of useful energy. The CO_2 issue may be expected to lead to pressure for increased energy efficiency, and thus favour the newer combustion technologies or even a move away from fossil energy altogether.

Jan Vernon

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Measures are still wanting

Limiting the worldwide use of fossil fuels will cost almost £200 billion over the next 15 years, an international climate conference at Nordwijk in the Netherlands heard on November 6 and 7. But the 72 nations attending the two-day conference failed to agree on specific measures to finance the switch to less polluting forms of energy for combatting the greenhouse effect.

The financial declaration merely called for international organizations such as the World Bank to arrange funding, and for a separate "international fund" to help developing countries to minimize their traditional reliance on fossil fuels.

The US, the Soviet Union, Japan, and Britain vetoed proposals by the Scandinavian and the Dutch for a freeze on emissions of carbon dioxide by the year 2000, and a 20 per cent reduction in emissions by 2005. The dissenting nations, which between them emit 50 per cent of the world's carbon dioxide, insisted on substituting the words "as soon as possible" for these target dates, claiming they were "unrealistic."

The vague wording of the resulting declaration did not prevent the British environment minister David Trippier from describing the conference as "a dramatic step forward" and a "clear commitment that we are taking the matter very seriously."

Trippier had earlier urged the conference to wait until United Nations officials report next June on the scientific causes and effects of global warming. This is the process in which gases such as carbon dioxide, methane and nitrous oxide trap the sun's heat instead of allowing it to reflect into space.

"Waiting will serve no purpose," said Mostafa Tolba, executive director of the UN Environment Programme. "Our planet faces unprecedented climate change. In the face of catastrophic possibilities we cannot await empirical certainty. We know enough right now to begin action."

Tolba said that carbon dioxide, which is generated by burning fossil fuels, is increasing in the atmosphere by 3-6 per cent annually. It could raise temperatures by 1.5 to 4.5 °C over the next 50 to 100 years.

The subsequent melting of the polar caps and glaciers is forecast to produce a rise in sea levels of 46 to 77 centimetres each century. This anticipated rise in sea levels is of particular concern to the Dutch, the conference hosts, who fear being swamped in 40 years.

The conference will be followed up by the Inter-Governmental Panel on Climate Change (IPCC), a UN group preparing for the International Climate Convention.

New Scientist
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NGOs' statement to the Nordwijk conference

The potential for catastrophic environmental damage, economic loss, and political instability from human-induced global climate disruption requires preventive measures now. Therefore we, 63 NGO representatives from 22 countries, who met in Rotterdam, November 4th 1989, urge immediate action by governments to face this challenge:

• As a first step, industrialized nations should commit themselves to reducing their CO_2 emissions by at least 20 per cent from 1988 levels by the year 2000. Those countries with higher than average per capita energy use should recognize their responsibility to make correspondingly greater reductions. The goal of international efforts should be the reduction of worldwide CO_2 emissions as necessary to allow atmospheric concentrations of CO_2 to begin declining at the earliest possible date, so as to protect the Earth's ecosystems and human societies. Available scenarios indicate that, to prevent further human-induced climate alternation, the range of necessary reductions in CO_2 emissions may be as high as 70-80 per cent.

• We also call on the wealthier industrialized nations to support innovative means to facilitate access to energy efficiency and renewable energy technology among industrialized nations with less flexible economies.

• Governments should also endorse the creation of enforceable international agreements to provide the technical and financial assistance to developing nations necessary to achieve the overall goal of emission reductions for CO_2 and other greenhouse gases.

• The Ministerial Conference should endorse the completion of a framework convention by the end of 1990, and the of 1990, and the initiation of simultaneous negotiations towards an international agreement on CO_2 reductions, to be completed by 1992.

We reffirm the goals and discussion of strategies contained in the NGO Statement of Policy Options to Curb Climatic Change, prepared for the UNEP Governing Council Meeting in Nairobi, May, 1989. We especially reiterate the following points:

• As a first step in the area of forestry policies, the primary need to halt deforestation.

• All necessary steps must be taken to strengthen the Montreal Protocol to phase out CFCs, halons, methyl chloroform and carbon tetrachloride no later than 1995 and to include all other ozone depleting substances in the protocol.

• The need for accelerated efforts to control all other greenhouse gases.

• Expansion of nuclear power is not a viable option for combating climate change, and would bring in its wake a host of environmental, social, economic, and security problems which may rival those associated with global warming.

An informed, active citizenry is essential for tackling the challenge of global climate change. We therefore call upon the governments represented at the Ministerial Conference to recognize and support NGOs as legitimate partners in our common endeavour to halt global warming.

Statement to the CSSR and DDR governments on European air pollution

During the third East-West Consultation of Non-Governmental organizations in Breclav, Czechoslovakia, on October 8-13, 1989, the participants reviewed existing energy strategies and evaluated the results of international agreements on air pollution, making the following statement:

We find it commendable that Czechoslovakia and the German Democratic Republic are signatories to the ECE Sulphur Protocol. We have noted that this decision contrasts favourably with the attitude of certain other European countries such as Great Britain and Poland, which have not committed themselves formally to any reduction of sulphur dioxide emissions. We are unable however to determine whether measures are being implemented in the CSSR and GDR for the reduction of SO_2 emissions by 30 per cent by the year 1993. Prominent authorities in the CSSR, such as Ing. Hanauer, have verified the impossibility of fulfilling the 30-per-cent requirement by 1993. We note that realization of the desulphurization facility at Tusimice II has been markedly delayed. This conference is generally concerned over the fact that the most advanced techniques of energy efficiency and conservation are not being applied as a prerequisite for effective pollution controls.

The German Democratic Republic has made no firm forecast in regard to SO_2 reductions. We are aware, on the other hand, that it is testing only a limited number of pilot plants which, even if fully operational, would not reduce emission levels to any significant extent. The manifold difficulties of desulphurization indicate a tedious period of implementation, especially in the case of large plants. We request a reexamination of the data published in the Statistical Yearbook of the GDR 1988, in which an identical figure for emissions of 5 million tons is given for the base year 1980 and for 1986, even though in the latter year an additional 53 million tons of brown coal must have been making an extra contribution to the emissions total.

In our common European house, the responsibilities commonly recognized must be shared by all. If difficulties are encountered, this should not be taken as an occasion to weaken a necessary objective; instead the burden must be redistributed among the affected countries. We therefore appeal to you to publish a prognosis on the goals that may be realistically achieved, and to call for a new meeting of ECE convention members to modify and enhance the existing strategies for SO_2 reduction.

We stress the necessity of reducing European emission levels of sulphur dioxide and nitrogen oxide by 90 per cent to enable the processes of natural regeneration to be re-established below critical loads in the ecosystem.

Sights that meet the eye along the East German-Czech frontier.

DAS GRÜNE NETZWERK arche DDR

Continued from page 20

groups in the environmental field, and adding: "A nationwide network should be created through the forming of regional bases within the provincial church organization." Arche's task should rather be to provide coordination and support.

During the two years of its existence, Arche has shown great activity. A number of working groups have been set up, and two newsletters, *Arche Nova* and *Arche Info*, are being issued regularly. Seminars are also arranged, as well as excursions to ecological catastrophe areas. Protest lists of names are often gathered, and letter campaigns are organized, addressed to the authorities.

Especial attention is being given to air pollution. Among the matters covered by the group that has been set up for dealing with this problem are forest damage, coal-fired power plants, waste incinerators, and energy conservation.

Besides arranging exhibitions and seminars on air pollution and health, this group is organizing the *Aktion 30%* campaign for attainment of the goals of the 30 Per Cent club. It also supports activities such as *Eine Mark für Espenhain* – a mock collection supposed to gather funds for cleaning the emissions from a notoriously dirty power station. Lately, too, Arche has become a member of Friends of the Earth International.

Reinhold Pape

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Environmental groups emerging

The environmental movement has been a more important factor than might at first appear in stirring up opposition to the Communist government in the German Democratic Republic. The ecological catastrophe that the country has suffered has caused people to associate either in legal conservation groups under the aegis of the official *Kulturbund*, or in more or less underground groups working in the shelter of the Lutheran church.

Now, in the present atmosphere of change and upheaval, the environmental movement has also started to branch out. Until the picture clears, however, it will be too early to report on all the new groups and constellations that are making their appearance. We shall therefore confine ourselves here to describing two environmental groups with church connections, which have both been very active during the last few years.

One group runs the *Umweltbibliotheken* (Environment Libraries) that have been set up in at least eight cities in various parts of the country. These serve as independent local and regional centres of information and as meeting places for environmentalists. From them, for example, the *Umweltblätter – Infoblätter des Friedens- und Umweltkreises der Zionskirche in Berlin* have been distributed. Issued almost every month, these newsletters have reported on environmental problems in the GDR and the activities of the opposition, as well as on the repressive acts of the state authorities in the face of criticism of any kind.

The *Umweltblätter* could only be circulated "for internal church information." Public lectures and evenings for debate could be arranged in the libraries, which were housed in church-owned premises, but there was always a difficulty in reaching a broad audience.

Then in January 1988 various environmental groups joined in forming *Arche – Das Grüne Netzwerk der Evangelischen Kirche DDR*. As it happened, the promoters were mainly from East Berlin. Centralization of any kind is much disliked in East Germany, and groups in other parts of the country preferred to maintain their independence, rather than joining the Arche network.

In the manifesto issued at its foundation, Arche in any case expressly denies any aim at centralizing, saying it does not wish to take the lead over or subordinate any other

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No time to waste!

Aktion 30 %

On July 9, 1985, the GDR committed itself, as adherent to the UN ECE Convention of Long Range Transboundary Air Pollution, to a reduction of sulphur dioxide by 30 per cent between 1980 and 1993 – as a contribution to the mitigation of air pollution in the interests of people's health and the natural environment, and the forests in particular.

At the 2nd Ecumenical Seminar on air pollution, held at Erfurt from September 30 to October 2, 1989, we examined, among other things, the connection between air pollution and diseases of the respiratory tract.

The facts are clear:

- There is a demonstrable connection between SO_2 levels in the air and the frequency of disorders of the upper parts of the respiratory tract.
- In the case especially of infants and small children a concentration of 0.3 mg/m^3 of SO_2 is sufficient to cause respiratory disorders. It should be noted that one of the causes of false croup in infants and small children is to be found in polluted air.
- Further risk groups needing especial mention are: All persons suffering from cardiac and circulatory diseases, those with chronic ailments of the respiratory tract as well as asthmatics, and in general all elderly persons.

Take part in Aktion 30% !

Contact your local authority and the district councillors concerned with environmental pollution and ask:

What is being done towards fulfillment of the above commitment?

How do matters now stand in regard to flue-gas desulphurization at power plants?

How high are the actual levels of SO_2 in the air, especially in big cities and around industrial concentrations?

Through *Aktion 30%* we wish to underscore our sense of personal responsibility and as mature citizens to engage in solving our country's problems.

Please address inquiries and experiences to:

Johannes Staemler, Allerheiligenstrasse 15, 5020 Erfurt, GDR.