NO. 3, JUNE 1993

Acid News

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

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ENERGY

For a fossil-free future

THE IMPLICATIONS of an energy system dominated by fossil fuels and nuclear power are becoming all too clear. The destruction of the world's forests has been hastened by acid rain – costing Europe alone an estimated $150-270 billion. Mexico City breaches the air-quality standards, set by the World Health Organization (WHO), 300 out of 365 days each year, and in a major pollution incident in March last year, birds fell out of the sky, children fainted in schools, and diplomats asked to be transferred out of the city.

The Chernobyl accident has cost an estimated $300 billion and at least 10,000 lives so far. Major oil spills like the Exxon Valdez get the headlines, but the equivalent of fifty Exxon Valdez disasters pollutes the world's oceans every year. Global warming is above all a fossil-fuel problem. Unless we drastically reduce carbon emissions – by the 60 to 80 per cent needed to stabilize the climate – unprecedented climate change is predicted. Fossil fuels can no longer be considered a viable long-term option for the planet.

With 85 per cent of the world's commercial energy now based on fossil fuel and nuclear power, could the world as we know it be run on renewable energy? Is it really possible to maintain our transport systems, industries, appliances, and homes with a range of natural energy flows such as solar, wind, biomass, geothermal, and hydro? Until recently, renewable energy has been viewed by governments and most establishment energy agencies as an interesting long-term option, but one that is unlikely to provide more than a small proportion of future supplies. That view is beginning to change.

Two new studies, one from Greenpeace International and the other from the United Nations Solar En-

Continued on page 3

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Acid News

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

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

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

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

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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 Nature Conservation (Naturskyddsföreningen)
- The Swedish Youth Association for Environmental Studies and Conservation (Fältbiologerna)
- World Wide Fund for Nature Sweden (Världsnaturfonden WWF)

Address and telephone: see above.

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

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

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EDITORIAL

A self-interest

AT THE END OF APRIL the European ministers for environment gathered at Lucerne, Switzerland, for a conference called Environment for Europe. The main outcome was an action program* for central and eastern Europe, as well as a ministerial declaration. The current pan-European activity in regard to the environment, of which the Lucerne conference was a part, includes the making of a report on the state of the environment in Europe.

It is of course hardly news that in parts of eastern Europe the environmental problems are acute. As recently as last February there came reports of extremely high concentrations of pollutants in the air over northern Bohemia, in the Czech Republic. Practically every winter the inhabitants of cities such as Most, Teplice, and Usti are exposed to toxic episodes of this kind. Among other east European cities that experience such conditions are for instance Prague, Cracow, Katowice, Leipzig, and Halle. The situation is not unlike that which prevailed in London during the 1950s and the Ruhr in the sixties.

The seriousness of this state of affairs is once again emphasized in the new action program, which also sets forth a general method for dealing with it, as seen from an official viewpoint.

According to the program, investments should be made primarily in areas where they will have the greatest effect on human health. They should also be as cost-effective as possible – that is, provide the greatest possible effect for the least possible money. In practice this would mean first attending to those emission sources that are chiefly responsible for the local pollution. Priority should moreover be given to investments that will provide economic as well as environmental gains – as for instance by improving energy efficiency and reducing the consumption of resources.

Over such aims there can be little controversy. The financing of the necessary investments is however another matter. The countries where they have to be made lack the means, and as a partial remedy several west European countries, among them Switzerland, Denmark, Italy, and Sweden, have proposed increasing aid to the East, for instance through a European environment fund. But here, in what would have been vital in the short-term aspect, the conference proved a complete let-down. No further money was forthcoming from the west for measures to improve matters in Central and Eastern Europe.

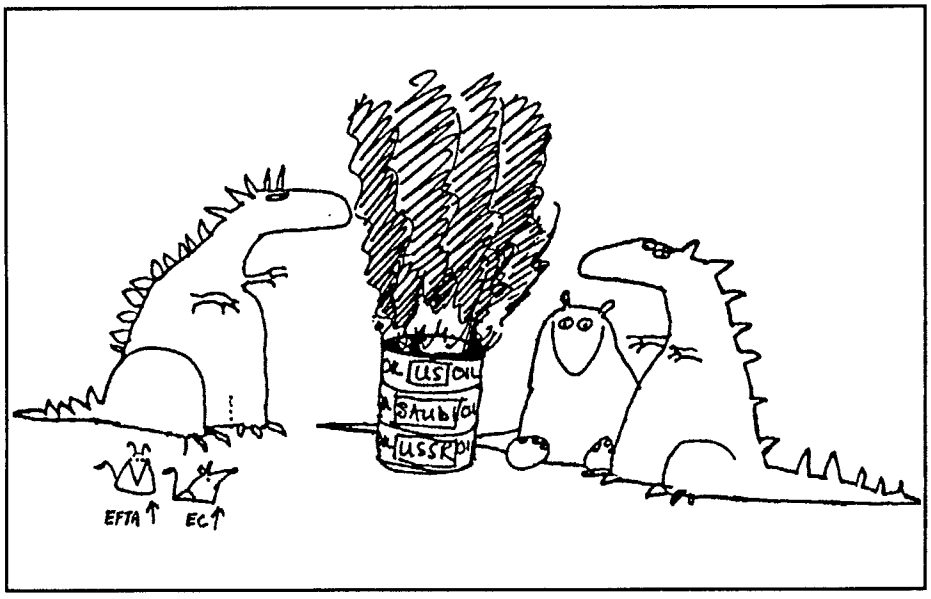
A representative of the environmentalists compared the action program to a ship without fuel, unable to even cast off. Doubtless an allowable metaphor. It should be in the interest of the whole of Europe to grapple with the problems of the central and eastern parts of the continent too – not only to save the environment but also for reasons of the economy and security. It must surely be time for the western countries to cease regarding aid to the east as nothing but a sacrifice. It is in fact a matter of investing in the future, a sort of insurance against ever increasing environmental problems.

Reduced emissions of pollutants in the East can only result in improved conditions in the West by way of a decrease in the fallout and concentrations of migratory airborne pollutants such as sulphur, nitrogen oxides, and ozone. Western self-interest would also make it advisable to support the development of better systems – from the environmental point of view – for the provision of energy and transportation. Inducements of this kind, should in themselves be cause enough for the West to loosen the purse strings.

The environmentalist groups had not only closely followed the preparations for the Lucerne conference, but had also staged their own conference for NGOs just before it. A more detailed report of both conferences will follow in the next issue of Acid News.

CHRISTER ÅGREN

* EAP, Environmental Action Program for Central and Eastern Europe.



Fossil, fos'l, or -il, *n* (obs.) a rock or mineral dug from the earth: (geol.) a relic or trace of a former living thing preserved in the rocks: an antiquated, out-of-date, or unchanging person or thing. – *Chambers Twentieth Century Dictionary.*

Continued from front page

ergy Group for Environment and Development (UNSEGED), have shown that a renewables-based future is both technically and economically credible.

The Greenpeace study – Fossil Fuels in a Changing Climate – was carried out over an eighteen-month period, and is based on analyses by the Stockholm Environment Institute and other technical experts. Despite its use of conventional assumptions for economic and population growth (which Greenpeace does not support), the study concludes that it is technically and economically feasible to halve the current global use of fossil fuel within forty years. The global emissions of carbon dioxide could fall by 52 per cent by 2030, and 71 per cent by 2075. Industrial regions could achieve a 20-per-cent reduction in CO_2 emissions by 2005.

The scenario is based upon a major program for improving energy efficiency in all regions of the world. This would mean developing efficient cars giving 80 to 100 miles per gallon, and running on a solar-hydrogen energy system, over the next forty years. It would mean constructing highly insulated buildings which would need less than 10 per cent of the energy of today's average for heating, lighting, and cooling. It would mean introducing advanced industrial processes using less materials and perhaps a quarter of the average energy intensities of today. A rapid uptake of efficient co-generation based on combined-cycle technology in Western Europe is also assumed to take place in the scenario. In the industrial sector for example, co-generation would supply 60 per cent of the steam and electricity by the year 2010, and 90 per cent by 2030.

Feasible to halve current global use of fossil fuel

It is important to note that most of the efficiency technologies assumed in the scenario are either already available, or are likely to be in use in the near future. The challenge is to ensure their widespread adoption around the world.

At present renewable energy provides around 13 per cent of current energy supplies worldwide, although much is based on the unsustainable use of woodfuel. A wide range of renewable technologies, which are either already proving themselves technically and economically, or are likely to do so, given increased research and development expenditure, have been introduced in the Greenpeace scenario. A combination of hydro, biomass, solar, wind, and geothermal provides 28 per cent of supplies by 2010, and 62 per cent by the year 2030. Biomass fuels such as wood, ethanol, and methanol ensure much of this in the next twenty years, while solar and wind become increasingly important thereafter. This is in line with expected cost reductions in solar energy. The overall costs of the Greenpeace scenario are estimated to be equal to or less than those for carrying on with our current wasteful energy system.

The UNSEGED report, which was produced by a group of eminent energy analysts such as Thomas B. Johansson from Sweden, Bob Williams and Henry Kelly from the United States, and Amulya Reddy from India, suggests that around 50 per cent of the energy supplies could come from cost-effective renewable energy sources by the year 2050. Johansson, who chaired the study as a contribution to the Earth Summit, concludes that "it is an existence proof that renewable energy sources can provide a significant proportion of energy supplies at costs similar to current levels."

The two studies provide an "existence proof" that renewable energy sources could provide a viable technical alternative to fossils fuels, at a similar cost. Making such a future a

On the following pages

reality will however require major policy changes. It will be necessary to overcome a huge inertia among institutions and in people's thinking, as well as in some of the most powerful transnational companies in the world.

The current energy system has been built up over the past forty years, with substitutes, preferential research and development (R&D) programs, and supporting international organizations. Among industrialized nations for example, more than 80 per cent of government R&D funds are currently being spent on nuclear power and fossil fuels. Over the past ten years, less than one per cent of energy loans from the World Bank has gone to energy efficiency. If, in the United Kingdom, British Gas and the electrical power companies were to invest heavily in energy efficiency, they would perversely reduce their own profits because of the current pricing system which encourages the selling of more energy.

Among the key policy changes needed are:

☐ The introduction of pollution externalities in the form of energy taxes. This could, as a minimum, double the current energy prices of fossil fuels and nuclear.

☐ The removal of subsidies to nuclear power and fossil fuels.

☐ The introduction of minimum efficiency standards for a range of appliances, lighting, electrical motors, and vehicles.

☐ New incentives to gas and electrical utilities to sell energy efficiency, for example, by introducing integrated resource planning.

☐ The setting up of a new international agency for energy efficiency and renewable energy.

To achieve the fossil-free energy future, countries would above all need to set and maintain tough targets for the reduction of carbon dioxide. If we are not ourselves to become a fossil species of planet earth, we need to embark on a fossil-free path without delay.

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STEWART BOYLE

The author is Energy Policy & Research Director, Greenpeace International.

Sources:

Fossil Fuels in a Changing Climate. Obtainable from Greenpeace International, Keizersgracht 176, NL-1016 DW Amsterdam, The Netherlands. Price US$10.

Renewable Energy for Electricity and Fuels, Johansson et al, UNSEGED, 1992.

A FOSSIL FREE ENERGY SCENARIO

THE MAIN RESULTS OF THE GREENPEACE GLOBAL ENERGY SCENARIO

Global

☐ CO_2 emissions are reduced by 52 per cent in 2030 and 71 per cent by 2075.

☐ Renewable energy provides more than 50 per cent of energy supplies by 2030.

☐ Fossil fuels are effectively phased out by 2100.

☐ Energy efficiency improves by a factor of more than two by 2030 and of four over the next century.

Western Europe

☐ Improved energy efficiency reduces energy consumption by 26 per cent over the next forty years.

☐ CO_2 emissions are reduced by 27 per cent by the year 2010 and 68 per cent by 2030.

☐ Renewable energy provides more than 60 per cent of energy supplies by 2030.

The climate implications of a fossil-free future

Under a "Business-as-usual" world the climate would be seriously affected by:

☐ Temperature increases of 2.8 to 4.0°C by the year 2100. This would take the planet into territory not experienced for several hundred thousand years.

☐ A rate of temperature change of 0.22 to 0.55°C per decade.

Given that none of the climate models includes possible climate feedbacks, the outcome above could be even worse.

The Global Energy Scenario reduces the potential climate impacts dramatically:

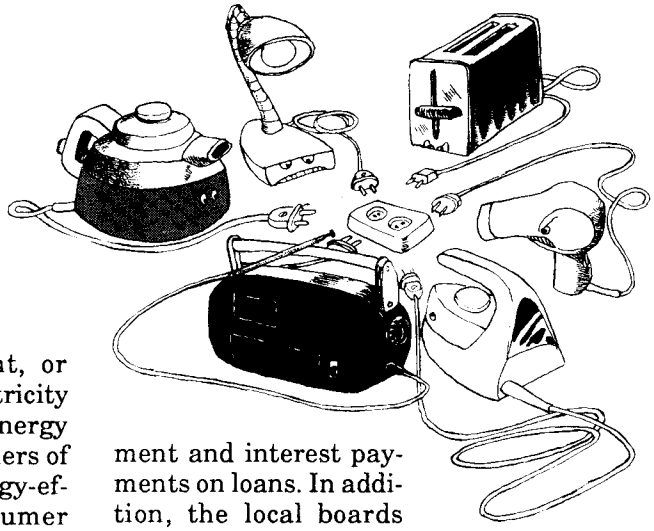
☐ Temperature increases less than 1.5°C.

☐ The rate of temperature change is reduced to below 0.1°C per decade.

☐ Increases in sea level are kept to 20 cm by the year 2100.

Less pollution, more jobs

DEMAND-SIDE MANAGEMENT (DSM) is a technique which is advocated by environmentalist groups and energy economists in the United States for handing over the responsibility for energy conservation to the electricity suppliers. In the US, it has saved money, created tens of thousands of jobs, and reduced pollution.



Demand-side management, or least-cost planning, turns electricity companies into suppliers of energy services, rather than mere sellers of electricity. If giving away energy-efficient bulbs, efficient consumer goods, or thermal insulation to consumers is cheaper than building new power stations, then this will be the least-cost option and the company will improve its balance sheet. It will also help to reduce its output of pollutants.

According to Ann Davison of the Oxford Institute of Energy Studies, DSM was developed in California in 1975, in response to price rises after the first oil crisis, as well as to increasing environmentalist objections to the building of power stations. Electricity companies quickly became adept, first at stabilizing soaring demand, and then reducing it. They offered free energy audits to large consumers and a range of opportunities for ordinary customers, such as paying part or all of the interest on loans for thermal insulation.

By 1987, as many as 59 power companies across the US were offering rebates to customers to encourage them to buy high-efficiency refrigerators. In 1988, South California Edison handed out 450,000 energy-efficient light bulbs to customers with low incomes, saving eight megawatts of electricity capacity. Elsewhere, the Tennesse Valley Authority handed out more than $250 million in interest-free loans to improve home insulation.

In the US, power companies act as both local distributors and suppliers of electricity. The payback they see from DSM comes in two forms. First, by deciding not to build new power stations they save on capital investment and interest payments on loans. In addition, the local boards which set electricity prices allow the power companies to pass on to consumers all, or a proportion of, the money they spend on energy-efficiency programs. In many cases, the boards prevent the companies from passing on the cost of new plants, giving them an added incentive to concentrate on reducing demand.

The Worldwatch Institute, an environmentalist organization based in Washington DC, estimates that by 1988, conservation measures taken by the six biggest American power companies had eliminated the need to build 7.24 gigawatts of generating capacity, or roughly six plants the size of Sizewell B in the United Kingdom. Between 1982 and 1990, annual spending on new plants all over the United States declined from $50 billion to $17 billion.

More effective than constructing new power stations

Last December, Greenpeace published a study of demand-side management in the US carried out by a Boston-based firm of analysts, the Goodman Group. It estimated that power companies spend $3.1 billion a year on DSM, and that every dollar invested in DSM avoids spending between $1.5 and $1.75 on building new generating plants.

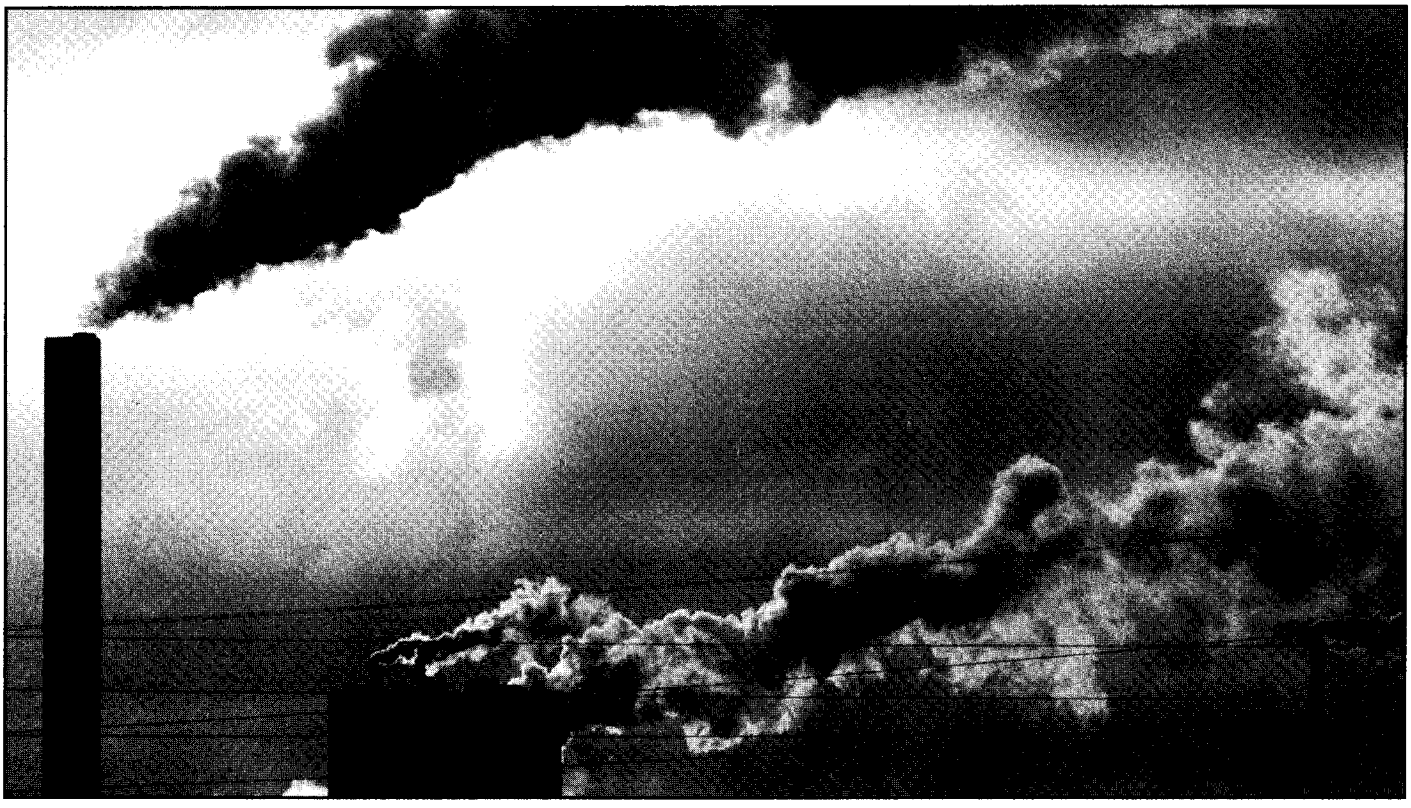
The Goodman Group found that, up until now, DSM has created 80,000 new jobs. Directly, DSM generates jobs in home insulation, double glazing, and other areas of the construction industry. But reduced fuel bills give companies more money to spend elsewhere, which leads to an indirect increase in jobs. The study estimates that DSM is roughly 70 per cent more effective as a means of creating jobs than constructing new power stations.

Betty Krier, the author of the report, says American power companies spend only about 1 per cent of their turnover on energy efficiency, so there is plenty of scope for expanding DSM schemes. "Investing in electricity efficiency is a major focus of US utilities with expenditures set to reach between $6.7 billion and $10 billion per annum by the end of the decade. Our analysis shows that the net employment benefits could increase from around 80,000 jobs today, to approaching 500,000 as a result."

DSM is not just a sophisticated device for developed economies, but a general principle for electricity provision. For example, in 1989, a study by the Lawrence Berkeley Laboratory in California calculated that conversion of just 20 per cent of India's lighting to efficient compact fluorescent lamps over ten years would avoid the need to build 8 gigawatts of new capacity and save $450 million – even if the bulbs were given away free.

Why then has DSM not figured in the British debate about electricity? Before privatization of the electricity supply industry in 1990, the state-owned monopoly, the Central Electricity Generating Board (CEGB), had a statutory duty to meet whatever demand there might be. While it could encourage consumers to use power at different, more convenient times of day, it had no obligation to reduce consumption. The local distributing companies were also part of the CEGB.

Privatization split up this close relationship. Regional electricity companies, which took control of



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local distribution, were given separate identities from National Power and PowerGen, which emerged from the former CEGB. While giving regional companies permission to build their own power stations brought the British system closer to the American set-up, there was no increase in enthusiasm for DSM.

Instead, the regional companies sought to decrease their reliance on National Power and PowerGen by building their own gas-fired plants. The results are now well known: last year, National Grid forecast that by 1998 Britain will have 52 per cent more generating capacity than it needs.

According to Steve Thomas, a senior researcher at the Science Policy Research Unit at the University of Sussex, by aiming to reduce electricity prices through market forces, the government encouraged the building of power stations – just the opposite of the trend in the US during the 1980s.

But there are now signs of renewed interest in DSM. Soon there will be no scope for building more power plants, so regional companies will need other ways to increase their profits. One would be to minimize the need to upgrade local distribution networks, by reducing demand for power.

But the prospects for such schemes are limited because DSM only makes sense when the distribution system is running close to its full capacity, or when new investment is needed. To some extent regional companies can balance their spending on energy-efficiency programs by buying less electricity from other suppliers such as PowerGen. But the problem still remains that regional companies only make money if they sell electricity. To increase the number of DSM projects, the companies would have to be allowed to pass on the cost of the investments they make in energy efficiency to their consumers.

Best way to unlock energy conservation's enormous potential

According to Stewart Boyle, director of energy policy at Greenpeace International, the door for energy efficiency has just started to open in Britain. "The only thing that now stands between the situation today and the spending of millions of pounds on demand-side management is a change in the regulations," he says. Boyle's optimism stems in part from the setting up of the Energy Savings Trust, to which all electricity companies and British Gas are contributing money. The new body, which was founded with government blessing to promote ways of saving energy, has £6 million of industry money with which to fund projects. Boyle argues that it would look very bad if OFFER (the Office of Electricity Regulation) were to obstruct new schemes introduced by the trust.

Boyle points out that consultants to OFFER report that funding a reduction in demand of 6 per cent through DSM would need just 0.1 pence per kilowatt-hour to be passed on to consumers. For the average domestic customer, this would mean an increase of a £4 a year on his electricity bill, but it would on the other hand generate savings of £1.1 billion per year.

Andrew Warren of the Association for the Conservation of Energy (ACE) agrees that "the Energy Savings Trust is the best way to unlock energy conservation's enormous potential, but it needs more money – at least £250 million a year." Analysis by ACE estimates that by spending £15.5 billion on DSM over ten years, the emissions of carbon dioxide would be reduced by 264 million tons.

CHRIS CRAGG

Adapted from an article in New Scientist, March 27, 1993. Chris Cragg is editor of FT Energy Economist.

Saving by efficiency

THE DEVELOPING countries' current energy path is driving them more deeply into debt and worsening the quality of life for millions, according to a study recently released by the Worldwatch Institute. Economic development will be increasingly elusive unless extensive reforms are undertaken to encourage investment in greater energy efficiency.

Plans for a massive expansion of conventional energy use are projected to cost more than $4 trillion over the next thirty-five years. That, notes Nicholas Lenssen, the author of the report, is triple the current Third World debt of $1.35 trillion.

"By investing in more efficient factories, appliances, and transportation, and in new energy supplies, developing nations can save hundreds of billions of dollars, reduce pollution, and make their economies more competitive.

"Each $1 invested in improving energy efficiency leads to average savings of $5 in energy supply," Lenssen finds. Such efficiency savings would free money desperately needed for education, health care, and water treatment plants. New supply sources – natural gas and renewable energy technologies – are also a key to a new energy strategy. Photovoltaics (solar cells) are now the least expensive way of supplying electricity in many rural areas.

It has long been recognized that energy is a key to development. But development planners have rarely questioned the assumption that an ever-expanding energy supply is necessary to build industries, provide jobs, and raise standards of living in the developing world.

Since 1960, developing countries have more than quadrupled their energy use. In sub-Saharan Africa, nearly a third of hard currency earnings are spent on petroleum imports. One fourth of Third World government debt payments in the eighties went to finance energy projects. Yet poor countries remain plagued by frequent fuel shortages and unreliable electricity – along with severe pollution that saps human health, degrades forests and croplands, and contributes to climate change.

"By emphasizing energy *services*, rather than simply increasing supplies of oil, coal, or electricity, developing countries can help solve the economic and environmental problems in the energy sector, and revitalize stalled development efforts throughout much of the world," says Lenssen. Tremendous improvements in efficiency are now within reach in industry, agriculture, building, and transportation. And by "leapfrogging" to advanced technologies presently being commercialized in industrial countries, developing countries can avoid hundreds of billions of dollars of misdirected investments in an economically and environmentally obsolete infrastructure of older energy technologies.

Long recognized that energy is a key to development

Over thirty-five years, $350 billion invested in efficiency improvements could eliminate the need for $1.75 *trillion* worth of power plants, oil refineries, and other energy infrastructure. The techniques are already available and in use. In 1980, China for instance launched an ambitious efficiency program to improve the use of energy in major industries. By directing roughly 10 per cent of its energy investment to efficiency over five years, the nation cut its annual growth in overall energy use from 7 per cent to 4 per cent, yet without any slowing of growth in industrial production. Efficiency improvements accounted for more than 90 per cent of the energy savings, while shifts towards less energy-intensive industries yielded the remainder.

Efficiency gains were found to be one-third less expensive than comparable investments in coal supplies. "Had the nation failed to make such progress, energy consumption in 1990 would have been 50 per cent higher," says Lenssen, "than it actually was – or, more likely, economic output would have declined."

In Brazil, the National Electricity Conservation Program invested $20 million in energy-efficient refrigerators, electric motors, and other power-saving technologies, and in helping private businesses to bring them to market. It replaced some 280,000 inefficient street lights with new mercury vapour and high-pressure sodium lights that reduced electricity use by up to 70 per cent. Its investments were matched by similar outlay from local governments and industry. In four years up to 1990, this program had saved enough electricity to reduce the nation's spending needs for new power plants and transmission lines by roughly $1 billion.

But even with massive improvements in efficiency, increased energy supplies will still be needed. The Lenssen report outlines some of the available alternatives to costly oil and polluting coal:

☐ Natural gas. Some fifty developing countries possess extensive unexploited stores of natural gas. In some countries, natural gas is considered a waste product of petroleum production and flared into the open air. In Nigeria, the 21 billion cubic metres of gas flared in 1990 could have furnished enough energy to meet all the country's current commercial demand for energy – plus that of neighbouring Benin, Cameroon, Ghana, Niger, and Togo.

☐ Solar and wind energy. Virtually all developing countries have abundant resources of solar, wind, biomass, or geothermal energy. It is already cheaper for utilities to provide hot water from solar energy than by using electricity from coal or oil plants.

During the past decade, the costs of solar and wind electricity systems have fallen by 66-90 per cent. In some developing countries they are emerging as the least expensive route to electricity. Already more than 60,000 households in developing nations have installed photo-

Swedish emissions down

BY 1991 the Swedish emissions of sulphur dioxide had diminished by 79 per cent from the 1980 levels – amounting two years ago to 107,000 tons a year, or 12 kilograms per head of total population. In other words, the country had by then practically achieved the aim, set by the parliament in 1988, of reducing emissions by 80 per cent between 1980 and the year 2000.

Among the measures that have particularly contributed to this development have been: a lowering of the sulphur content of light fuel oil as well as of heavy fuel oil, stricter requirements for existing as well as new combustion plants, and stricter control of the emissions from industrial processes. In 1991, too, there came a sulphur emission tax, and an environmental classification system for diesel fuels.

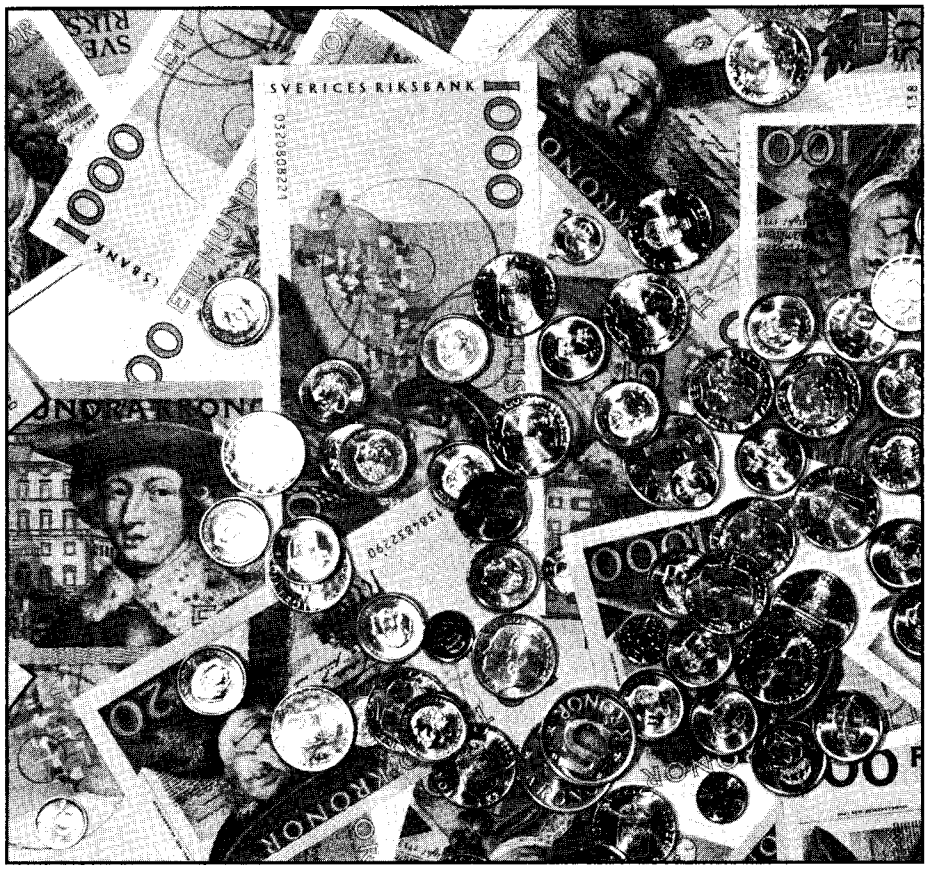
The emissions of nitrogen oxides had on the other hand only diminished by 8 per cent since 1980. It is therefore thought unlikely that the official aim, decided in 1985, of a 30-per-cent reduction by 1995, will be achieved. Emissions in 1991 amounted to 388,000 tons, or 45 kilograms per capita.

The most important measure for reducing the emissions of nitrogen oxides was the introduction of US standards for petrol-driven cars, in effect making catalyzers compulsory. At first only voluntary, for 1987 year models, the requirement became compulsory for 1989 year and all subsequent vehicle models. At the same time the requirements for new and existing combustors were tightened.

The emissions of the greenhouse gas carbon dioxide have also lessened, from 82 million tons in 1980 to 59 million in 1991 – that is, by 28 per cent, thus amounting per capita to 6.8 tons CO_2.

CHRISTER ÅGREN

Source: **Statistiska meddelanden No. 18 SM 9301.** In Swedish, but with an English summary and glossary. Obtainable from SCB Förlag, S-701 89 Örebro, Sweden. Fax +46-(0)19-176932.



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voltaic lighting units. With 2.1 billion people still without electricity, the market for photovoltaic electrification is huge.

☐ Biomass. Biomass resources also have enormous potential. If sugar mills burned all their residues, using advanced gas-turbine technology such as is now being commercialized in Brazil, it would meet more than a third of the total current demand for electricity in developing countries.

Other countries have also taken steps toward such a new energy strategy. Thailand, for example, has decided to invest $183 million in electricity efficiency over the next five years, and has just levied a tax on petroleum to provide some $50-60 million a year for investments in efficiency and renewables.

Although broad international support is needed for such measures, of the $67 billion that the World Bank and other development banks loaned for energy between 1980 and 1990, less than 1 per cent was aimed at improving end-use energy efficiency, and private banks, which provide the bulk of loans, typically follow the lead of the multilateral lending institutions.

World Bank staff had no plans to change direction before 1995. The bank's directors have however begun to call for a reform. Last July they refused to approve a new policy paper until it had been rewritten to encourage energy efficiency. Nevertheless, even the final document failed to integrate energy policy with broader development goals.

"If developing countries are to achieve the hoped-for gains in living standards for all their citizens, they will need to meet their energy needs in a way that allows them to close the gap between North and South, instead of falling further behind," concludes Nicholas Lenssen.

Empowering Development: The New Energy Equation. By Nicholas Lenssen. Worldwatch Paper 111. Available from Worldwatch Institute, 1776 Massachusetts Ave., NW, Washington, DC 20036-1904, USA.

A charge on NOx

AS FROM JANUARY 1992 there has been a charge of 40 kronor per kilogram of nitrogen oxides emitted from combustors in Sweden. Since the actual decision had been made some eighteen months previously, the effect was remarkably rapid. According to an estimate of the national Environmental Protection Agency, between 1990 and 1992 the emissions from such plants had dropped by 37 per cent.

The charge of 40 kronor per kilogram of nitrogen oxides, expressed as NO_2, applies to all plants with a capacity of at least 10 megawatts and an energy output in excess of 50-gigawatt-hours per annum. So as not to disadvantage large plants the charge is rebated according to the amount of energy made available. Thus plants with relatively large NO_x emissions are penalized with a net cost, while others can count on a net income. This system of rebates is considered to have made the introduction of charges definitely easier.

The charge system assumes the installation of devices for monitoring NO_x emissions at the affected plants. For those plants that do not have such devices, and for periods at others when the control apparatus is not functioning, a rule-of-thumb measure is applied, using the very high figure of 250 mg NO_x per megajoule of fuel input. The control apparatus is checked once a year by an accredited laboratory.

Whereas the emissions were estimated in 1990 to have averaged 150 mg/MJ of fuel input, estimates for last year indicate a reduction of about 37 per cent to 95 mg/MJ. This would mean that the total of emission from plants that were subject to the charge will have fallen from 21,000 tons in 1990 to 13,000 in 1992. The reduction can be ascribed to investments in new technology, improvements in combustion so as to bring down the emissions for a minimum, and sometimes bonuses to employees for keeping emissions to a low level. Some part of the reduction, and probably a lesser part, will have been due, not to the charge, but to stricter regulations in regard to emissions generally, and the fact of the climate in 1992 having been milder than usual.

Gas is the fuel that is relatively the most favoured by the charge, since burning it usually results in the lowest emission of nitrogen oxides. In Sweden the emissions from gas-fired plants average 55 mg/MJ of fuel input. The highest emissions are from plants burning household garbage, with an average of 133 mg/MJ, followed by oil (120 mg/MJ), coal (106), peat (102), and biomass (94 mg/MJ).

The cost of measures to reduce emissions has always turned out to be less than the corresponding charge would have been. Such measures have usually cost between 5 and 20 kronor per kilo of eliminated NO_x. It would seem that the cost of measures that have been taken so far as a result of the charge has amounted to 10 kronor per kilogram, which would imply that the annual cost of eliminating 8000 tons has been about 80 million kronor. To that must be added the annual cost of monitoring, amounting to 300,000 kronor per plant. The socioeconomic cost of the monitoring necessitated by the charge will thus be 18 million kronor a year, or 2 kronor for each kilogram eliminated.

Since parliament set the charge at 40 kronor per kilogram, it may be said that society values the damage from one emitted kilogram of nitrogen oxide at just that amount. Thus the charge will have resulted in an environmental gain of 320 million kronor a year (the reduction of 8,000,000 kilograms multiplied by 40 kronor). The socioeconomic net gain will be the environmental gain less the cost of counter-measures, i.e. 220 million kronor.

CHRISTER ÅGREN

Note. Converting emission data from energy-based units, such as are used in the article, to units based on concentrations in the flue gases, requires certain assumptions. These proposed conversion rates may serve as a guidance: 1 mg/MJ of fuel input equals: for coal 2.70 mg/m^3, for oil 3.57 mg/m^3, for peat and wood chips 2.6 mg/m^3 and for municipal waste 2 mg/m^3.

How sulphur is taxed

THE EFFECTS of acidification on Sweden's lakes and streams were first reported in 1967, and a few years later this was followed by measures to reduce acidifying emissions through restrictions on the sulphur content of heavy fuel oil. The emissions of sulphur dioxide have since come down by almost 90 per cent, from more than 900,000 tons in 1970 to 107,000 tons in 1991.

In order to further reduce these harmful emissions, a special tax was laid in 1991 on the sulphur in coal, peat, and fuel oil. Stated somewhat generally, it amounts to 30 kronor per kilogram of sulphur. For fuel oil it is 27 kronor per cubic metre for every one-tenth of 1 per cent of sulphur in the oil. It is however not exacted if the sulphur content is less than 0.1 per cent. For coal and peat it is 30 kronor for every kilogram of sulphur in the fuel. Where cleaning procedures, such as flue-gas desulphurization, are employed to control the emissions of sulphur, the tax is refunded.

The highest sulphur content that is permitted in Sweden for heavy fuel oil is 0.8 per cent, and for light fuel oil and diesel oil 0.2 per cent. A comparison of the sulphur content of the various types of oil in 1990 and 1991 shows the tax to have had its effect. The average content in heavy fuel oil had fallen from 0.65 per cent to 0.4-0.5 per cent, and in light fuel oil and diesel to less than 0.1 per cent.

This has meant that the emissions of sulphur dioxide dropped by something between 10,000 and 14,000 tons, or about 30 per cent of the emissions from oil combustion. Also contributing to the trend in the case of diesel fuel has been the system of classification (see p. 10). In that same year there was also some reduction of emissions from the burning of coal and peat. □

Classified for effects

IN JANUARY 1991 a three-tier classification system was introduced in Sweden as a means of encouraging a greater use of environmentally benign diesel fuel. Tax reductions for the two better types were to provide the incentive. The effect has been remarkable: after just two years about 75 per cent of the sales of auto diesel were of these two types.

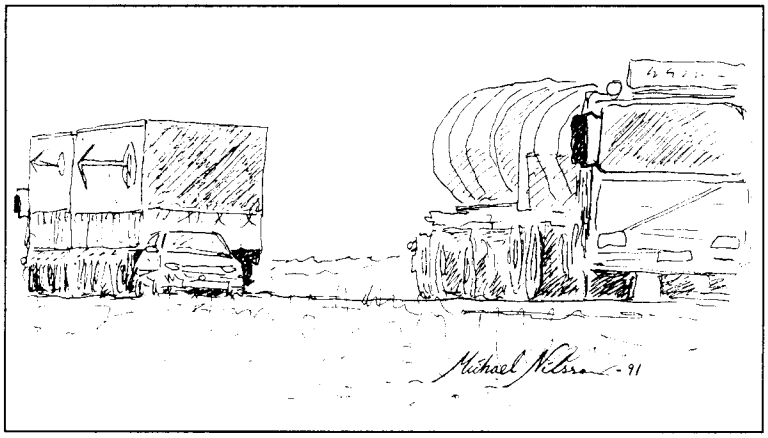
Ordinary diesel fuel, now classified as No. 3, may not contain more than 0.2 per cent of sulphur. In fact, however, the average sulphur content is less than 0.1 per cent – largely due to a tax on sulphur that was also instituted in 1991 (see p. 9). The tax is simply not levied on fuel oil with a sulphur content of less than 0.1 per cent. (It may be worth noting that the limit in many other European countries is 0.3 per cent.)

The limit for Class 2 diesel is 0.005 per cent for sulphur. Further the fuel may not contain more than 20 per cent of aromatic hydrocarbons, nor more than 0.01 per cent of PAH (polycyclic aromatic hydrocarbons). For Class 1 the limit for sulphur is 0.001 per cent, and for aromatic hydrocarbons 5 per cent. There must be no PAH. In both cases there are also requirements concerning the cetane number and distillation interval.

The tax reduction for Class 1 is 450 kronor per cubic metre, equivalent to 45 öre per litre, and for Class 2, 250 kronor. As from October 1, 1993, it will be increased to 535 kronor for Class 1. A tax for carbon dioxide, which was also introduced in 1991, and applies equally to all three classes of diesel fuel, will amount from January 1993 to 920 kronor per cubic metre.

Already in 1992, when sales of diesel fuel ran to 2.6 million tons in Sweden, half the total was of the Class 1 and 2 type. The market share of these more environmentally benign types had been steadily increasing throughout the year, so that by December 1 it was 10 per cent for Class 1, 60 per cent for Class 2, and only 30 per cent for Class 3.

According to the Environmental Protection Agency there are three main causes for this development.



In the first place there is the effect of the tax reductions, which have given the oil companies good reason to move into new products. Then there is the fact that the refining processes are similar for diesel and jet fuel, so they could use the capacity freed by a lower demand for jet fuel to produce diesel oil cheaply. Thirdly there is the increased environmental consciousness among users of diesel, which has quite simply brought an increased demand for fuels of Classes 1 and 2. Local authorities have also contributed to the trend by requiring these types of fuel to be used in public transportation and service vehicles.

Classification system voted mainly for reasons of health

The extra cost to society arising from the classification system, by way of higher costs for crude feedstock and a more expensive refining process, is estimated by the EPA to be about 430 million kronor. Against this can be set the gain resulting from reduced emissions of air pollutants – which, however, are naturally more difficult to quantify.

It was in fact mainly for reasons of health that parliament voted the classification system. The stated aim was to bring about a halving of the concentrations of carcinogenic substances in urban atmospheres between 1990 and 2005. City air pollution is estimated to be the cause of 70 deaths per million per year in Sweden, and diesel exhausts are thought to give off a great part of these substances. The emissions are lower when diesel fuels 1 and 2 are used.

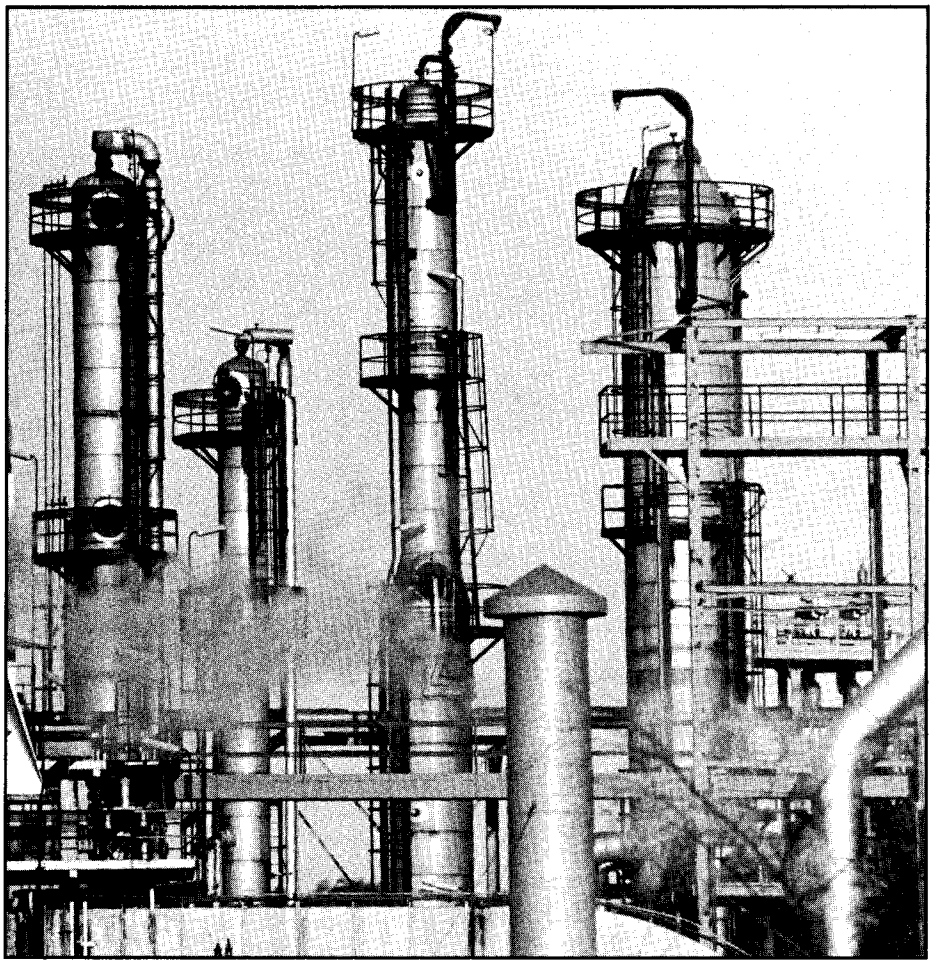
Sulphur and particulates can affect the respiratory tract, and this may trouble people for instance with asthma. Since the environmentally benign types of diesel oil contain 95-99 per cent less sulphur than the normal kind, the emissions of both these pollutants will also be much lower. If as result fewer people are laid up on account of sickness, and there is a general improvement in health, the social gain will be obvious.

Lower emissions of sulphur will also mean less corrosion of buildings and other structures, including cultural monuments, as well as less damage in general from acidification.

Whether the use of environmentally benign diesel is socio-economically effective or not will depend, according to Hans Bergman of the EPA, to some extent on the point of view. Driving with it on the open highway may not be particularly cost-effective. Its general use will on the other hand probably be a necessary step towards achievement of the legislators' aim of reducing the amounts of carcinogenic substances in urban atmospheres.

Now that such fuel has become generally available in Sweden, it will moreover be possible to equip heavy-duty vehicles with the most up-to-date cleaning techniques, which require low-sulphur fuel for their functioning.

CHRISTER ÅGREN



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THE COMMUNITY

Lowering sulphur content in gasoil

ON MARCH 23 the Council of Environment Ministers adopted a directive limiting the sulphur content of various types of gasoil, such as diesel fuels for motor vehicles and light heating oils. At present there is a limit of 0.3 per cent for sulphur, but under certain conditions the member states are allowed to require 0.2 per cent.

According to the new directive, as from October 1, 1994 the limit will be 0.2 per cent by weight. Furthermore, for diesel fuels it will be lowered to 0.05 per cent as from October 1, 1996. It is also stated that the member states will have to take steps to ensure that diesel fuels with a sulphur content of 0.05 per cent become gradually available on the market after October 1, 1995. This is necessary for the achievement of the new standards for emissions of particulates from heavy-duty vehicles, which are scheduled to come into force from that same date.

Originally it was proposed, as a second step, to lower the sulphur content in gasoils to 0.1 per cent from October 1999. The directive does not, however, set values for a second step, other than for diesel fuels. Instead, the Commission is required to submit before July 31, 1994 a proposal introducing by October 1, 1999, at the latest, lower limits for the sulphur content of gasoils as well as setting new limit values for aviation kerosene.

CHRISTER ÅGREN

Correction

In "Classifying cars and fuels" on page 8 of the last issue the figure for the maximum sulphur content of Class 1 diesel fuel was given as 0.0001 per cent. It should have been 0.001 per cent.

IN BRIEF

Better all around

Cost-effective investments could, according to estimates of the California Energy Commission, lead to a reduction of 40-75 per cent in the total demand for electricity in the United States, while at the same time improving living standards through cleaner air and lower electricity bills.

Source: California Energy Commission, Energy efficiency report. Sacramento, Calif. 1990, USA.

Windpower export

In 1992 there was a boom in exports for the Danish windpower industry, with income amounting to 915 million kroner, as against 620 million for the year before. Although exports to the United States declined, there was a considerable increase in sales to the United Kingdom and Germany.

Source: Information, Denmark

Swiss plan CO_2 taxes

The Swiss federal office of the environment is expected to submit to parliament draft legislation for an incentive tax on volatile organic compounds (VOCs). It will also be launching a consultation period for a proposal for a CO_2 incentive tax, prior to putting it before parliament later this year.

Source: European Energy Report 379, January 1993.

Plants adapt to ozone

One of Britain's common weeds, plantain, may have evolved a way of enabling it to tolerate local high levels of the pollutant ozone, say scientists at the University of Newcastle. Their survey shows that plantain *(Plantago major)* undergoes rapid genetic change in order to cope with this pollutant.

Source: New Scientist, December 19-26, 1992.

EC/EFTA criticized

Five environmentalist groups are claiming that environmental protection will be sacrificed to the principle of free movement during EC membership negotiations with Austria, Finland, and Sweden. The present stricter legislation in the EFTA countries, concerning for example hazardous chemicals and vehicle emissions, is under threat on account of EC harmonization policy.

Source: Europe Environment, March 30, 1993.

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MOTOR FUEL

Which is best environmentally?

USUALLY IT IS only the emissions from a vehicle's exhaust pipe that are considered when comparing the effects of various motor fuels from the point of view of environmental impact. Electric vehicles, for instance, are often regarded as producing "zero" emissions. But in order to arrive at the environmentally best type of fuel, it is important to analyse the whole chain from the primary source of energy to the end use in the vehicle. Only then can it be decided which aspect is to be determinative – whether it should be that of energy efficiency or the relative emissions of, say, greenhouse gases, nitrogen oxides, or "air toxics."

A study* to this end has been carried out by a Swedish consultant firm, Ecotraffic AB. Right at the beginning of its report Ecotraffic points to the difficulties associated with life-cycle analyses. Since no general sensitivity analyses were made of the results, either, they must in any case be regarded as preliminary.

The study has been divided in two stages, the first covering the production process from the primary energy form to the final fuel, the second the step-by-step conversion of the fuel energy to actual transport work. For the purposes of the second stage Ecotraffic has taken three typical vehicles: a passenger car, an urban bus, and a medium heavy-duty truck. An example of energy turnover from the primary source to actual transport work, comparing renewable energy with a fossil type, in this case low-sulphur (max 0.05 per cent) diesel oil, is shown in the chart opposite.

Electricity may be best for reducing acidifying emissions

It is assumed that the necessary infrastructures and plant are in place for each energy chain that is being considered, and therefore no account has been taken of energy use or environmental effect in their production, transporting, or erection. Consequently fuels requiring very complex installations and being highly demanding of resources in the energy chain may have been favoured in comparison with others that have lesser requirements of that kind.

The fuels considered in the Ecotraffic study were propane, natural gas, biogas, methanol, ethanol, rapeseed-oil methyl ester, and hydrogen,

as well as electricity (in some cases with both fossil and renewable feedstock). After comparing them from various points of view, the following were among the conclusions that were arrived at:

ENERGY USE. The energy turnover is much higher in the biomass-based systems than in those based on fossil oil and natural gas. This is because of the greater energy input needed for producing and converting biomass.

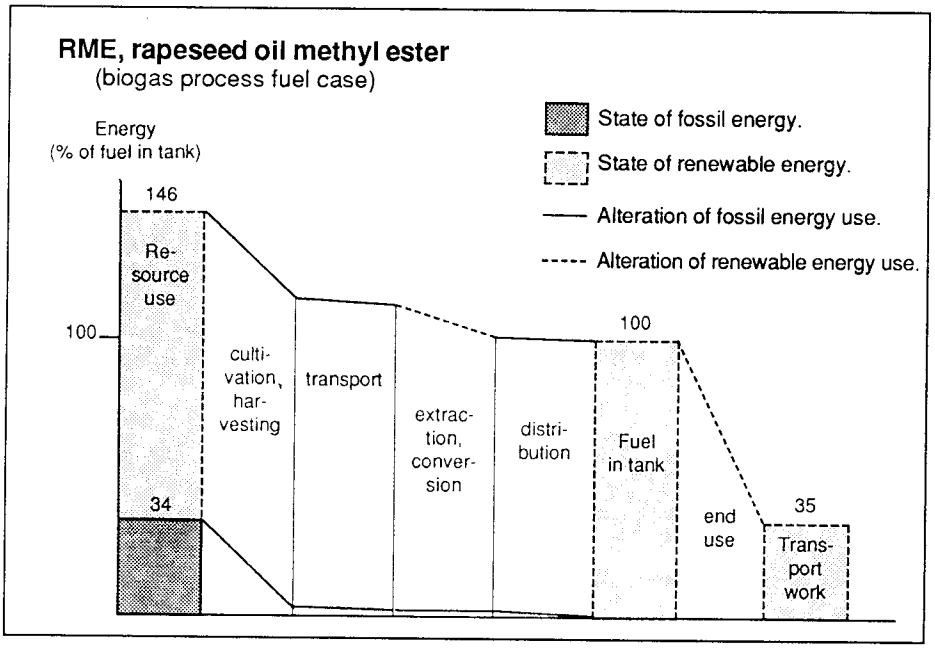
In the case of a petrol-driven car, only about 15 per cent of the total energy input finally becomes converted to transport work. For a diesel-driven bus it is about 30 per cent. The difference is partly due to the fact that petrol needs more energy for refining, but the main reason is that diesel engines are far more efficient than the Otto type using petrol. The way various alternative fuels relate to petrol and diesel oil as regards energy efficiency can be seen from Table 1.

CONSUMPTION OF FOSSIL RESOURCES. Another picture emerges if one considers the consumption of fossil resources instead of total energy turnover. In the case of fuels from renewable energy sources (biogas, methanol, ethanol, hydrogen, and also electricity) the fossil resource consumption is only about 10 per cent or less of total energy utilization, as compared with 100 per cent for petrol and diesel fuel (provided that biomass is used as the process fuel for ethanol, otherwise it is only slightly better than diesel oil). Fossil energy inputs in renewable systems may even be negative – that is to say, fossil energy is saved elsewhere.

GREENHOUSE GASES. The overall emissions of greenhouse gases from the bio-fuel chain are less than half, and often considerably less than half, of those from the oil-based fuel chains (Table 2). It may be noted that even when the electricity for an electric car is generated in a condensing plant fired with natural gas, the emissions of greenhouse gases will amount to less than a third of those arising in the case of a petrol-driven car, in great part because of the higher energy efficiency of an electric motor.

ACID GASES. The acidifying effect comes largely from the emissions of nitrogen oxides at the end use of the fuel. Diesel and vegetable oils show the highest figures, the lowest being obtained from fuel-engine combinations where catalytic NO_x reduction can be employed. The contributions of bio-chains to NO_x emissions are rather high at the production and conversion stages for the biomass. Electricity, even when produced from natural gas, may have the best potential for reducing emissions of acidifying substances.

OXIDANTS. Because of the lack of data for all stages of the conversion process, a less clear picture can be obtained of the emissions of oxidant-



Example of life-cycle analysis of fuel according to the Ecotraffic method. Stages in the production, from source material to end use, with deductions at each stage for input of processing energy. From The Life of Fuels, Ecotraffic study, 1992.

Table 1. Energy efficiency. Transport work at end use in relation to total energy input in the whole fuel chain.

Passenger car	%
Electricity[1]	50
Electricity[2]	30
Natural gas	20
Petrol	15
Methanol (natural gas)	15
Methanol (tree residues)	10
Biogas	10
Ethanol (wheat)	10
Ethanol (energy forest)	5
Hydrogen	3-6

Urban bus	%
Electricity[1]	50
Electricity[2]	30
Urban diesel	30
Methanol (natural gas)	25
Rapeseed oil methyl ester	25
Biogas (fossil process fuel)	20
Biogas (raw biogas process fuel)	15
Methanol (tree residues)	15
Ethanol (wheat)	15
Ethanol (energy forest)	10

[1] Swedish average generation; see box.

[2] Natural gas in a condensing plant.

Table 2. Emissions of greenhouse gases in the whole chain, including end use. Relative to petrol/urban diesel.

	Passenger car	Urban bus
Electricity[1]	0.03	0.06
Hydrogen (hydro power)	0.06	–
Methanol (energy forest)	0.20	0.19
Ethanol (energy forest)	–	0.31
Biogas	0.25	0.31
Rapeseed oil methyl ester	–	0.34
Ethanol (wheat)	–	0.43
Electricity[2]	0.3	0.69
Natural gas	0.7	0.88
Urban diesel oil	–	1
Petrol	1	–

[1] Swedish average generation; see box.

[2] Natural gas in a condensing plant.

The consequence will be this: Say that over a given distance a petrol-driven car will emit a certain unit of greenhouse gases. Substituting biogas or methanol for petrol will enable it to be driven four and five times as far without any increase in the emissions of greenhouse gases.

IN BRIEF

Victoria rediviva

Electric-powered pleasure boats, popular in the late 19th century, are on the way in again. Seen at London Boat Show earlier this year were electric boats that consume one-fifth of the energy needed for equivalent diesel-driven ones. Moreover generating the electricity produces only 30 per cent as much greenhouse gases as a diesel engine emits, according to the builder.

Source: New Scientist, January 16, 1993

Electric vehicle test

Twenty-two French municipalities are to engage on a large-scale test of electric vehicles, with the involvement of the EDF electricity company, car makers Renault and PSA-Peugeot Citroën, and the French government. Financial support for the project will come from the state in the form of allocations to cover half of the extra cost of purchasing electric vehicles as against conventional ones driven by internal-combustion engines. The aim is to have established an infrastructure of "filling" stations for charging and servicing batteries, as well as service stations with specially trained mechanics.

Sveriges Tekniska Attachéer. February 1993.

Less noise, less stink

A lawnmower driven by a petrol engine produces as great an amount of volatile organic compounds in one hour as a car that is driven for 80 kilometres, according to statistics from the US Environmental Protection Agency. The EPA, which plans to establish pollution control regulations for garden machinery, is now testing battery-powered mowers as an alternative. The battery-powered engines are only half as noisy as the petrol-driven ones, but the weight of the battery makes the electric mower heavier than its competitors.

Source: New Scientist, August 29, 1992

Going, going, gone!

On March 29, the US Environmental Protection Agency sold off rights to emit sulphur dioxide. In two sequencies it auctioned off 150,000 allowances, each permitting its holder to release 1 ton of SO_2 into the air. The sell-off raised $21 million. This emission-trading scheme was established through some 1990 amendments to the Clean Air Act.

Source: New Scientist, April 10, 1993.

Continued from page 13

forming precursors (mainly VOCs, NO_x, and CO). It seems likely that the emissions will chiefly come from the fuel's end use in petrol-driven and diesel engines, although they can be reduced to low levels in both cases through efficient catalysts. The lower reactivity of unburned methane and alcohols may give these fuels an edge over the oil-based fuels, as many air-quality modelling studies indicate.

HEALTH EFFECTS. Too little is known for certain of the effects of the various air pollutants on health. It appears that the use of alternative fuels such as natural gas, biogas, and alcohols, as well as electricity, would lead to a lowering of the health risks, compared with those arising from the use of petrol. This is mainly because it would practically eliminate the emissions of benzene, polyaromatic compounds, and particulates.

As regards the conclusions that may be drawn from the above, it can be said in the first place that even with existing technique, road vehicles can be made distinctly cleaner and more energy efficient. Since there are disadvantageous effects from the alternative fuels, too, it must be desirable to reduce the overall use of energy. In a sense, the cleanest fuel is that which there is no need to produce.

If the aim is primarily to reduce the emissions of greenhouse gases and oxidants, electricity produced by renewable means or motor alcohols are to be preferred.

But to reduce the emissions of acidifying air pollutants, electricity (again if produced renewably or from natural gas) and fossil energy (with the exception of diesel oil) are preferable.

Genotoxic emissions are best reduced by using electricity or chemically simple fuels such as methane and methanol. From the point of view of health it is naturally of importance where the emissions take place. In an urban environment, where many people will be exposed, electric vehicles have an advantage in their local zero emissions.

The availability of biomass for the production of renewable fuels may be limited at some times and in some places. The global annual increment is however ten times as great as would be needed to supply the total world energy use.

Bio-energy should perhaps be used in the first place to replace fossil fuels in stationary plants, since the process of converting biomass to motor fuel requires more energy than the fossil systems do. It would on the other hand be desireable to develop renewable fuels for transportation too.

In the State of the World '92, published by the World Watch Institute, Christopher Flavin puts the case for using natural gas as a bridge to renewable energy. Natural gas, he points out, is cleaner than present fuels, and any distribution system that is built up for it could gradually be taken over by biogas (both fossil natural gas and biogas consist entirely of methane). Eventually the same system could be used for distributing hydrogen generated with the aid of solar cells.

PER ELVINGSON

Editorial note. The fuel or fuels the use of which should be pressed for environmental reasons is a matter we shall have cause to revert to, and readers' views are invited.

* **The life of fuels. Motor fuels from source to end use. An energy and emissions study of conventional and future options.** Obtainable from Ecotraffic AB, Gamla Brogatan 29, S-111 20 Stockholm, Sweden. 180 pp. Price 1000 kronor (150 ECU).

Electricity generation

In comparisons of the kind treated in the article, electricity poses a special problem, since the environmental effects depend on the way it is generated. In Sweden 95 per cent of the power is produced in hydroelectric and nuclear plants, only 5 per cent being generated by burning fossil fuels. Assuming an energy efficiency of 38 per cent from fossil-fired stations, the average kilowatt-hour (kWh) from the Swedish network corresponds to 0.14 kWh of fossil-fuel energy. Similar figures are found in Norway, Switzerland, and France, but the typical European Community kWh of electricity is equivalent to 2.65 kWh of fossil-fuel energy.

Merits questioned

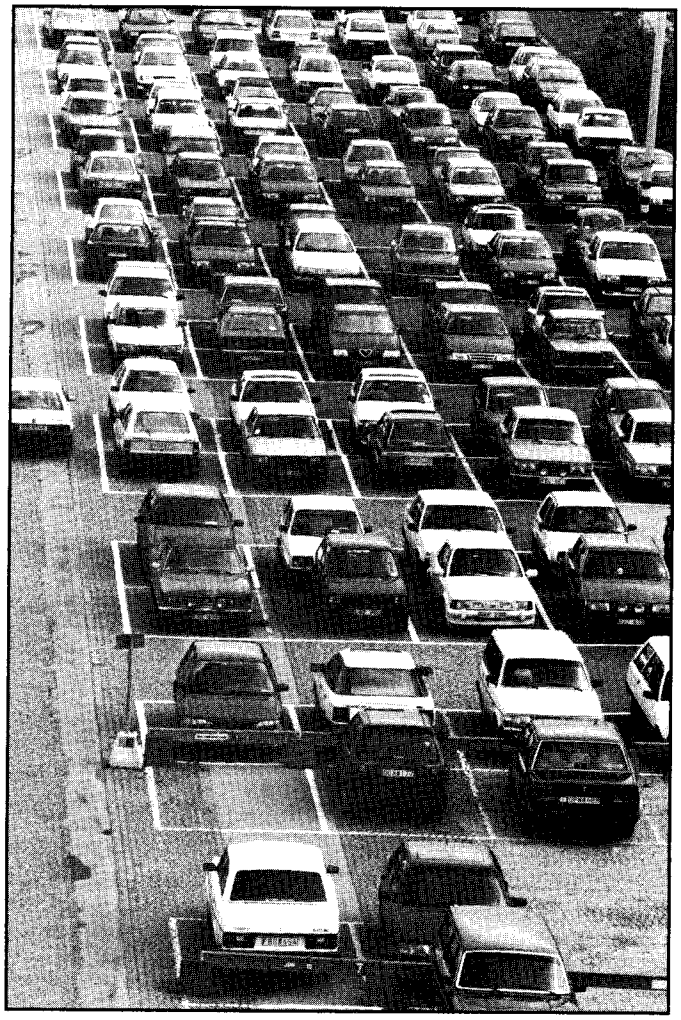
THIS LAST YEAR vigorous discussion has been going on concerning the environmental merits or otherwise of bio-diesel fuel. Critical views have been voiced, both by environmentalist organizations and scientists, maintaining that it is neither economically nor environmentally justifiable to grow crops to produce biofuels for motor vehicles.

Bio-diesel fuel – rapeseed methyl ester, RME – is, as the name indicates, made from rapeseed oil. It began really to attract attention after the EC Commission had proposed, in a draft directive of February last year, that the tax on bio-fuel should at the most be 10 per cent of that on petrol and fossil diesel oil.

Now several schemes for producing RME are either under way or about to start, for instance in France and Italy. The French government has already decided to subsidize RME in accordance with the Commission's proposal. It will moreover be spending FFr350 million on a three-year bio-fuel experiment in which 100,000 hectares of land will be used to produce 175,000 cubic metres of RME.

The instigation has come largely from the Community's new agricultural policy, by which farmers are, among other things, paid to withdraw 15 per cent of their cropland from food production. There is however nothing to prevent the land thus set aside from being used to grow energy crops, and farmers in France and Germany have already sown 60,000 hectares of rape for fuel use on set-aside fields.

But now the *Umweltbundesamt* (*UBA*, Federal Environment Office) has recommended that set-aside land should instead be allowed to revert to nature. In an ecological study it points out that the combustion of one kilogram of conventional diesel fuel produces 3.6 kg of carbon dioxide. The amount of carbon dioxide resulting from the cultivation, harvesting, crushing, and production of RME is 65 per cent less, but when other greenhouse gases such as nitrous oxide and methane are included in the analysis, the advantage of bio-diesel slips to only 35 per cent.



It would be better, in the view of the German Umweltbundesamt, to put money into engine design and other vehicle improvements, rather than subsidizing bio-diesel fuel.

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A tax incentive for RME is, in the UBA view, an ineffective and expensive method for reducing the emissions of greenhouse gases. It would, it says, pay better to invest the money in engine design and other improvements to road vehicles. According to the UBA calculations, even an enormous spending on RME would only reduce the emissions of greenhouse gases from the German transport sector by 0.25 per cent. The Federal Office scientists think, too, that the soil pollution caused by the chemicals that are required for intensive farming is itself enough to make RME undesirable.

Similar doubts have been expressed in Britain by the Energy Technology Support Unit in a recently published report for the Department of Trade and Industry, according to which it would be better to use set-aside land for energy crops for firing boilers.

In France however the Environment Energy Agency (ADEME) takes a more positive view, calculating that the growing, processing, and burning of RME will produce only a fifth as much greenhouse gases as the use of fossil fuels. The agency also claims there is no evidence that rape growing would be more damaging to the soil than any other kind of farming.

The EC Commission's proposal to subsidize bio-fuels – both RME and ethanol – has arisen not so much from any thorough environmental analysis as from political pressure, in particular from the French farm lobby. The fate of the draft directive is in any case still unclear. Since tax measures are involved, the proposal must be approved unanimously in the Council of Ministers before it can become a directive, and several countries have already expressed serious reservations.

PER ELVINGSON

Sources: **New Scientist**, October 24, 1992, February 6 and February 27, 1993. **ENDS Report**, Nos. 212 and 217, September 1992 and February 1993.

The UBA study, Entitled **Ökobilanz Rapsöl**, can be obtained from the Umweltbundesamt, Pressabteilung, Bismarckplatz 1, D-1000 Berlin 33, Germany.

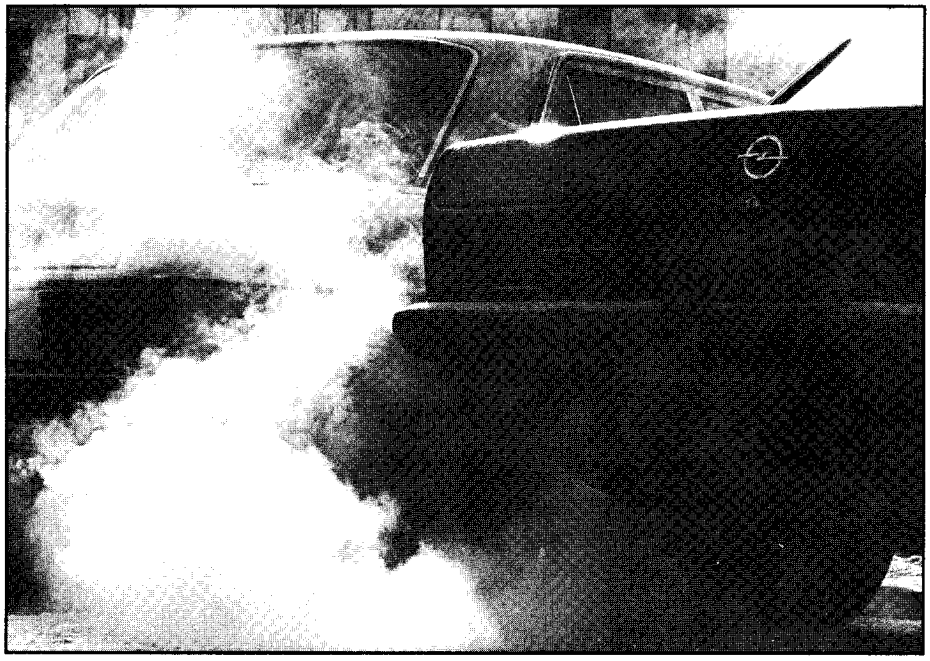
COLD STARTS

Catalyzers ineffective

A THIRD OF THE EMISSIONS of hydrocarbons and carbon monoxide from cars in Britain come from cold starts. Moreover, most of them occur in built-up areas, where the greatest number of people are likely to be affected. By the year 2000, when most cars will have been fitted with catalyzers, these emissions will have risen to half of the total. Calculations of future emissions, which have now been presented in a report from World Wildlife Fund UK, show how much of them are likely to come from cold starts.

The effects of new emission standards, both already decided upon and expected from the European Community by 2000, have also been analyzed in the report. The calculations show that as a result of the new regulations, the emissions of carbon monoxide (CO), volatile organic compounds (VOCs), and nitrogen oxides (NO_x) from cars will be greatest in 1992, and thereafter decline during the next twenty years. In 2003, after ten years with catalyzers, the emissions of CO, VOCs, and NO_x are expected to have declined by 43, 60 and 64 per cent respectively, as compared with 1990, but will rise again after 2010 as a result of the expected increase in traffic.

In the late eighties it was assumed that the advent of petrol-driven cars with catalyzers would mean a reduction of emissions by 80 to 95 per cent. According to the WWF report, however, these assumptions were far too optimistic. Now, as a result of a large number of measurements, the foreseen reduction will be "over 75 per cent." The main uncertain factors are a) the volume of emissions from cold starts, and b) the failure and degradation of catalysts. In the study these factors have however, on the basis of the best available information, been taken into account.



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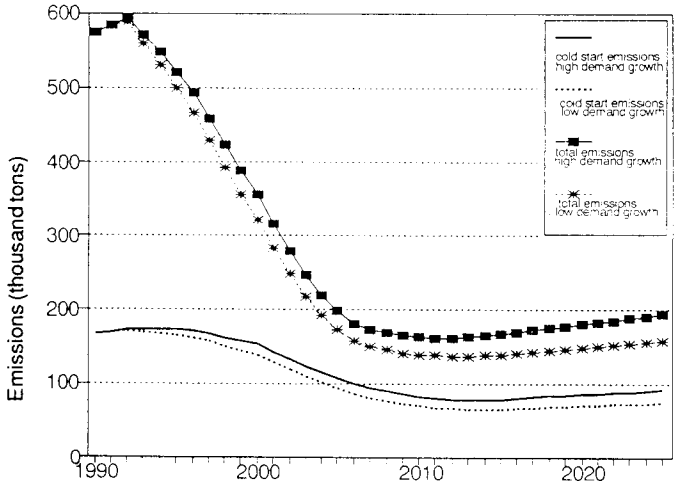
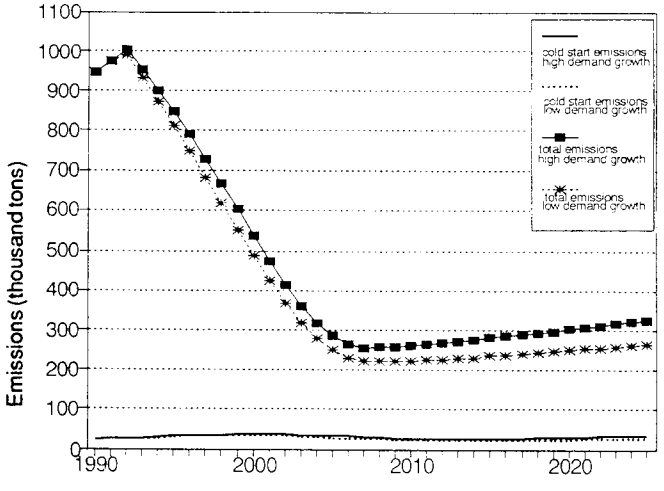
The exhaust emissions, especially of CO and VOCs, are greatest (in grams per kilometre) when the engine is cold – that is, just after starting off. The emissions of NO_x, on the other hand, are not especially great at the start. They are greatest at high speeds and in sudden accelerations. The emissions from cold starts are large, partly because combustion is incomplete and so the consumption of fuel is high before the engine gets warmed up, and partly because it takes a few minutes before the catalyzer has become sufficiently warmed up to function properly. In other words, during the minutes after starting, when the emissions from the engine are highest, the catalyst does not work.

The catalyzer only functions effectively after it has reached its working temperature of at least 300 de-

Total emissions from UK passenger cars 1990-2025: VOC (left) and NOx (right).





grees centigrade. Even on a warm day in an urban environment that would be after about ten kilometres of driving, and on a cold day still longer.

Cold starts are a prominent part of the picture because 70-80 per cent of the emissions of CO and VOCs from a catalyzer-equipped car during a 10-kilometre drive occur in the course of the first few kilometres. Traffic statistics, too, show this to be a big and growing problem. Most of the trips by car in Britain are short – the distance for about 60 per cent of them being less than eight kilometres.

For diesel-driven cars the cold-start penalty is generally less than that for a petrol vehicle equipped with a three-way catalyzer. On short journeys the emissions of CO from a petrol-driven car are much higher. On the other hand the NO_x emissions from the latter will typically be about half. Of late the sales of diesel-driven cars have been on the increase in Britain, amounting in 1992 to about 15 per cent of the total for new cars. It is assumed too, in the WWF study, that the proportion will continue to increase.

Lowering speeds on motorways and other non-urban roads, say, by fitting cars with speed governors, could be an effective way of reducing the emissions of nitrogen oxides. As in most European countries, the average vehicle speeds have been increasing on all types of road in Britain, outside of urban areas. Earth Resources Research has calculated that if no cars exceeded the speed limits in Britain, the emissions of NO_x (from cars) would be reduced by 4 per cent. A strictly enforced speed limit of 50 mph (80kph) would reduce them by 12 per cent.

Cold-start emissions can be reduced to some extent through technical measures to bring down the light-up time for the catalyst, as for instance by pre-warming the catalyzer. A still better way might be to avoid the shortest trips altogether. Since more than a quarter of the car journeys in Britain are for distances of less than three kilometres, there should be some possibility in such cases of persuading motorists to walk or cycle instead.

CHRISTER ÅGREN

Future emissions from cars 1990-2025: The importance of the cold start emissions penalty, by C. Holman, J. Wade and M. Ferguson, Earth Resources Research. Obtainable from WWF UK, Panda House, Weyside Park, Godalming, Surrey, England GU7 1XR.

Effects of high speeds and accelerating

IT IS A KNOWN FACT that catalyzers are ineffective for some time after a car has been started from cold. Now comes the Italian auto magazine Quattroroute with a study showing the cleaning action to be distinctly worse also during bouts of acceleration and when the car is being driven at a high speed.

There must be a well-balanced mix of air and fuel for a catalyzer to function properly. The air-fuel mix to the engine is regulated by a sensor, which however becomes inoperative in certain situations. This happens especially at high speeds, when there might be a risk of the catalyzer becoming overheated. In the case of some of the magazine's test cars, it took place as soon as the speed began to exceed 135 kilometres per hour.

The sensor also becomes disengaged when the driver presses hard on the accelerator to get more engine output. In many makes of car this will occur when accelerating from as low a speed as 40kph. From the Quattroroute study it appears that accelerating gives rise to a three or fourfold increase above normal in the emissions of volatile organic compounds and carbon monoxide. There is a decrease on the other hand in nitrogen oxides.

Sources: **Quattroroute,** November 1992, reported in Sveriges Tekniska Attacheer's newsletter, *Trafik och miljö*, February 1993.

Recent publications

The economic costs of reducing CO_2 emissions (1993)
Special issue of OECD Economic Studies (No. 19) presenting work on the economic costs of reducing carbon-dioxide emissions, as seen from different aspects, as well as a review of carbon taxes and current energy policies in OECD countries.

£15.00. 208 pp. Available from OECD, 2 rue André Pascal, F-75775 Paris Cedex 16, France.

Cost-effective strategies for reducing nitrogen deposition in Europe (1993)
By Markus Amann and Ger Klaassen. Study exploring the potential cost savings which would result from a combined control of emissions of nitrogen oxides and ammonia, aimed at reducing nitrogen deposition in Europe in a cost-effective way.

38 pp. Published by IIASA, A-2361 Laxenburg, Austria.

Scandinavian plants with NOx control installations (1992)
By Anna-Karin Hjalmarsson. An overview of plants equipped with NO_x control technology in Sweden, Denmark, and Finland. Lists over 110 units with a total installed capacity of 30,000 MW fuel input.

40 pp. Report 4152. Can be ordered from the Environmental Protection Agency, Information Dept., S-171 85 Solna, Sweden.

Fifteen European organizations – a guide for environmental activists (1993)
A handbook extensively presenting organizations and conventions that are of significance for the environment in Europe.

20 guilders (incl. postage). 110 pp. Published by Youth and Environment Europe, Oude Gracht 42, NL-3511 AR Utrecht, The Netherlands.

Climate change – our national programme for CO_2 emissions (1993)
Response from Friends of the Earth UK on a discussion document from the Department of Environment.

£6.00. 47 pp. Obtainable from Friends of the Earth, 26-28 Underwood Street, London, England N1 7JQ.

ROAD FREIGHT

Growth and emissions

A CONSIDERABLE PART of the air pollution in the European Community comes from the carrying of freight by road. That kind of road transport is answerable for 23 per cent of the total emissions of nitrogen oxides and around 5 per cent of those of carbon dioxide. According to a recent study* it is also expected that despite the cleaner vehicles that are gradually being introduced, the increase in the demand for transport will soon offset any short-term improvements.

The weight of goods being transported within the Community has remained largely constant over the last decade, but the distances the goods are being carried have increased significantly. Light-goods traffic has been growing even more rapidly than carrying by heavy-duty trucks. This trend, which is expected to continue, reflects the growth in activities such as delivery and servicing, and changed practices in distribution such as just-in-time systems.

Over the last thirty years too, the road infrastructure in Europe has grown considerably both in extent and quality, while that for rail and water has suffered from neglect or closure. Between 1978 and 1988, for example, the EC road network grew in length by nearly 5 per cent, while the rail network shrank by 3.6 per cent.

As regards future growth, the forecasts are in general agreement that there will be large increases in freight volume over the next twenty years. The EC's forecast, for example, envisages an overall increase of 26-39 per cent in total ton-kilometres between 1990 and 2010.

The technical options available for reducing the emissions from freight vehicles are more limited than they are for cars. Often they also involve complex trade-offs between the different pollutants. The penetration of any new technology-based measures is controlled, too, by the rate of turnover of the stock. In some of the southern European states, that rate is very low, with many trucks remaining in the fleet for as much as thirty years. The emissions from older vehicles can be alarmingly high when compared with those from modern, regulated ones.

Two types of engine are used in freight vehicles. Petrol engines are typical for the smaller kind of vehicle, and are used in roughly 60 per cent of the Community's light-duty trucks, although the percentage varies between member states. The diesel engines that are used in freight carriers are larger, more powerful, and more efficient than petrol engines, and are thus more suited to the larger goods vehicles.

The common legislative approach to reducing emissions is through regulation of the emission rates for new vehicles. The emission stan-

dards for heavy-duty trucks (HDTs) are now set in grams per kilowatt-hour (i.e. per unit of power output), and although the standards have been tightened, the trend towards more powerful HDTs has meant lower reductions in the rates of emission. Moreover the increase in power enables HDTs to accelerate faster and maintain higher average speeds, which tends to result in a higher consumption of fuel and greater emissions of pollutants. Since the emission standards for light-duty trucks are being set in grams per kilometre (i.e. per unit of distance travelled by the vehicle), the problem does not arise in their case.

Legislation produced by the EC Commission will now make it compulsory to fit speed-limiters to new HDTs greater than 12 tons, to be set approximately to 90 kph. This will take effect for new vehicles in January 1994. For vehicles registered after January 1, 1988, retrofitting will be required by January 1995 if the trucks are used in international trade, and by January 1996 if they are only employed in domestic traffic.

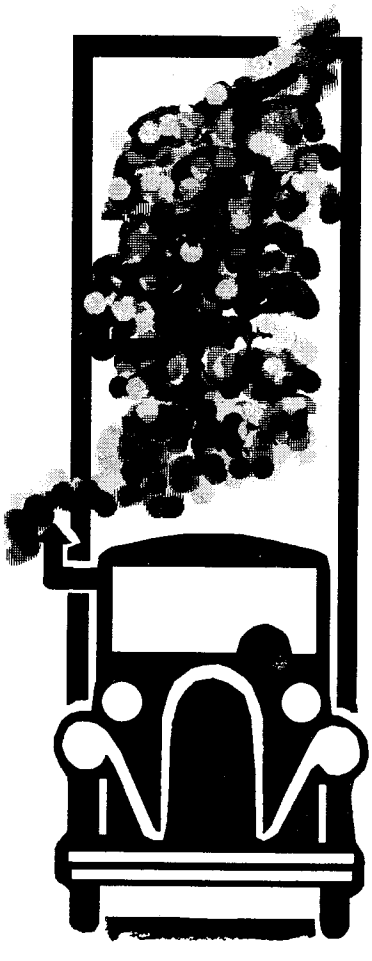
The Commission is also attempting to harmonize fuel taxes throughout the Community, with the aim of making tax levels converge to the average of current taxes in the member states. This would result in an increase in fuel prices in some countries, while in others they would fall. Thus, although the aim is to reduce CO2 emissions, contrary signals will be given to the market in those countries where prices fall. Such a situation could be avoided by harmonizing to the highest level of taxation now current in the Community.

Through use of the Transport-Emissions Model, developed by Earth Resources Research, projections have been made of the CO_2 and NO_x emissions up to the year 2010. Two different scenarios were taken. Scenario A is based on a steady but unspectacular economic growth with increasing road freight. It is essentially a "business as usual" scenario, with rather conservative projections of demand. Almost all the growth in freight carrying is assumed to be by road. The other, Scenario B, envisages much higher economic growth combined with a more energy-efficient economy, achieved through technological innovation and improved traffic management. Rail traffic is also expected to assume an increasing share of the market after the year 2000.

The CO_2 emissions rise considerably above the 1990 levels in both scenarios and remain so. The increases are most marked in southern Europe. Although the emissions are currently relatively low there, rapid growth is expected. This makes stabilization of Community CO_2 emissions very difficult to achieve, no matter how the burden is shared between the member states. Stabilization of the road-haulage contribution will require more drastic change than is envisaged in either of the scenarios.

Freight demand will have to be reduced or restructured

In Scenario A, emissions show a steep upward trend. By 2010 they are 70 per cent higher than in 1985, and show no sign of stabilizing. The long-term outlook for emissions is more promising in Scenario B, although here too there is a marked increase between 1985 and 2000. After that year emissions start declining, as much of the freight becomes transferred away from the roads.



Model results in both cases show NO_x emissions peaking over the next few years, since the emission regulations that are coming into force can be expected to substantially reduce the emissions of NO_x from heavy-duty trucks in the 1990s. Under Scenario A, NO_x emissions will fall below the 1985 level in the early 2000s, but will start to rise again around 2005. This indicates the fundamental problem: Unless further technical improvements can be made, increases in freight demand will more than offset the achievements of the technical approach in dealing with pollutants.

Scenario B also shows total emissions peaking in the 1990s, but a stronger and more sustained decline thereafter than in Scenario A. This is a result of tighter emission standards accompanied by a falling share for road transport in total freight carrying.

Any further reductions in NOx emissions, for example by using after-treatment devices, will be technically difficult. Furthermore, the resulting fuel penalties of such systems will add to the problem of CO2 emissions. At that point, both NOx and CO2 emissions can only be tackled by examining the broader issue of demand for freight transport.

If structural changes are to be brought about without resort to direct regulation, correct signals will have to be given to the market. Road pricing for freight would be one way to achieve this. A more representative distribution of the costs within and between freight modes would improve efficiency, increase competion between the modes, and make transport pricing more realistic. Taxation based on the distance travelled and vehicle load-capacity would be the simplest form of road-freight pricing.

Ultimately, if lasting reductions in CO_2 and NO_x emissions are to achieved, freight demand will have to be cut down or restructured.

CHRISTER ÅGREN

***Atmospheric Emissions from Road Freight in the EC.** By D. Taylor and M. Ferguson, Earth Resources Research, London. Published by WWF International, CH-1196 Gland, Switzerland.

Further publications

External costs of air pollution – the case of European transport (1992)
By Per Kågeson, for the European Federation for Transport and Environment (T&E). A report within a project entitled "Internalizing social costs of transport." It seeks to define the full costs of transportation and to propose ways of internalizing them through market instruments.

80 pp. Available from T&E Secretariat, Rue de la Victorie 26, B-1060 Brussels, Belgium.

Marginal and average costs of reducing nitrogen oxides and sulphur dioxide emissions in Europe (1992)
By Ger Klaassen, IIASA. For internalizing the environmental costs of transportation, estimates are needed of the cost of environmental damage. Based on the cost-of-avoiding-environmental-damage method, this study estimates the marginal and average costs of reducing SO_2 and NO_x emissions in the EC-EFTA region.

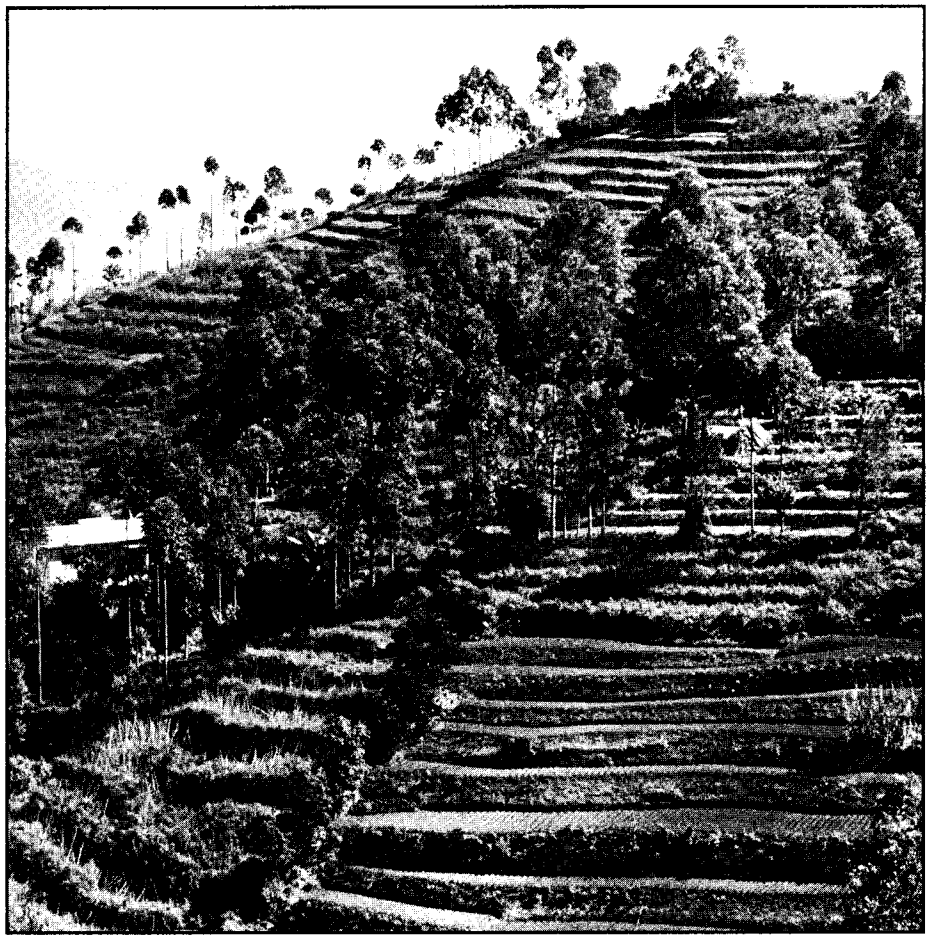
Background paper to the above report. 28 pp. Also published by T&E.

Damage costs of air pollution – a survey of existing estimates (1992)
By Ecoplan, a Swiss research institute. An assemblage of present estimates of the economic damage due to emissions of air pollutants from transportation. Although there may be some underestimation of the actual costs – not all the effects are known – this report still shows the external costs of transportation to be considerable.

24 pp. Published by T&E, address as above.

Moving toward integrated transport planning: energy, environment, and mobility in four Asian cities (1993)
Study by the International Institute for Energy Conservation exploring a new approach to improve vital urban transport systems. A lot of money could be saved if transportation systems were developed in a more integrated, people-friendly manner. That money could be invested in many other needed urban services such as health, education, and sanitation, the authors say. Other benefits are avoidance of air pollutant emissions and a massive reduction in lost hours of productivity by avoiding grid-locked traffic.

126 pp. Obtainable from IIEC, 750 First Street, N.E., Suite 940, Washington D.C., 20002 USA.



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Halting acidification in Asia

ACIDIFICATION is already a distinct problem in many parts of Asia, and there is a clear risk that in the near future the area will be open to marked increases in the local emissions of acidifying air pollutants. Population increases and rapid growth, as well as energy systems relying largely on the area's coal reserves, will combine to produce such an effect. There are estimates indicating that by 2010 the annual emissions of sulphur dioxide alone will have amounted to 76 million tons – more than is projected for the whole of Europe and North America.

In international negotiations for reducing the emissions of acidifying air pollutants in Europe, an integrated assessment model known as RAINS has been used. Through this computer model the negotiators have been able to obtain a fairly clear picture of the effects that various measures will have on natural and man-made systems.

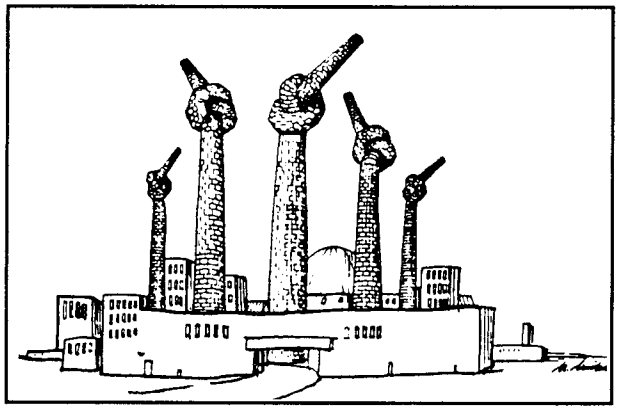
Now an international network of researchers is at work on adapting the RAINS model to Asiatic conditions. It is hoped that as a result of being able to see the projected effects of border-crossing air pollutants, Asian governments will be moved to cooperate in taking the necessary counter-measures. Although the main focus will be on acidification, associated problems such as those arising from the emissions of greenhouse gases will also be treated and included in a comprehensive strategy under the Global Environment Facility for the region.

It is intended that the project, financed by the World Bank and the Asian Development Bank, shall have been completed by the end of the present year.

Further information can be obtained from Professor Leen Hordijk, Center for Environment Studies, Agricultural University, P.O. Box 9101, NL-6700 HB Wageningen, The Netherlands.

Aid to East inventoried

THE COMMISSION of the European Communities has recently published an inventory* of the assistance given to the countries of Central and Eastern Europe, for environmental improvement, by the G-24 countries, the European Community, and international financial institutions (IFIs) during the period from the beginning of 1990 to the end of 1992. Although not purporting to represent an official attitude, the report notes the extent to which the listed programs have covered priority areas of the G-24 Environmental Sector Strategy and contributed to an improvement or solution of the most urgent problems. It also identifies constraints on their implementation.



The environment has been one of the priority sectors for G-24 assistance, and according to official G-24 statistics, between 1990 and 1992 the G-24 governments had committed more than Ecu500 million towards environmental purposes, mostly in the form of grants. Considerable sums had also been committed by the IFIs, but mainly as loans.

Many hundreds of projects have, according to the report, been undertaken during the last three years. Many have helped to build institutional capability, and some have achieved real improvements in the environment.

There is however no evaluation of results, only a general round-up of projects set going by the various G-24 countries. Instead there are a number of conclusions and recommendations, based on interviews with administrators of the programs and an analysis of the G-24 data base in Brussels.

Some of the conclusions coincide with observations already made by environmentalist NGOs, such as:

☐ There is a widely held and legitimate view, in the countries of Central and Eastern Europe, that there have been too many feasibility studies and reports. In too many cases the studies have failed to produce the institutional and financial information that is necessary for making investment decisions.

☐ By far the largest share of assistance had gone to Poland, Hungary, and Czechoslovakia.

☐ In some countries a relatively small proportion of the assistance was used for dealing with air pollution, and especially that coming from sources such as vehicles and low smokestacks.

☐ There should be a much greater focus on technical studies which are supported by appropriate policy, institutional, and legislative frameworks, and have a clearly defined route to implementation.

☐ Some donors have not made enough use of local expertise. When that expertise can be used, recipient governments should be consulted in the selection of appropriate resources.

☐ Program management should eventually be undertaken by the recipient countries themselves. This will become even more important as responsibilities are devolved and institutions decentralized. Where management capability does not already exist, support must be given to building it up.

Levels of funding, January 1990 to December 1992, millions of Ecu (approximate figures).

Austria	35
Belgium	3.7
Canada	2.7
Denmark	48
Finland	20
France	3
Germany (1992)	5.6
Italy	?
Japan	3.4
Luxembourg	0.12
Netherlands (1992)	6.5
New Zealand	?
Norway	12.5
Sweden	19
Switzerland	2.8
United Kingdom	1
USA	49
European Commission	252
European Bank for Reconstruction and Development	10,000
European Investment Bank	750
Nordic Environment Finance Cooperation	40
World Bank	?

What the banks are doing

The European Bank for Reconstruction and Development is providing loans for energy and environmental projects in all the countries of Central and Eastern Europe. It began operations in 1991 with a capital of Ecu10 billion, and is owned by the major western economies, the European Community, the European Investment Bank, and the countries in which it operates, including the central and eastern European ones, the Baltic States, Albania, and the new independent states of the former Soviet Union.

Unlike the European Investment Bank, the EBRD is not constrained to lending against government guarantees, and it has responded to the increasing problem of securing guarantees for environmental projects from recipient governments by developing hybrid or limited-resource loans.

The European Investment Bank has been mandated to invest up to Ecu1 billion in Hungary and Poland, and up to 0.7 billion in Bulgaria, Romania, and the Czech and Slovak Republics.

The Nordic Investment Bank is analogous to the EIB and is providing limited funds for Hungary and the Czech Republic. It also operates the Baltic Investment Loan Scheme, which is aimed at small and medium enterprises in the Baltic countries.

Like the EIB, it normally requires government guarantees.

The Nordic Environment Finance Cooperation is a multilateral risk-capital institution, owned by the five Scandinavian countries. It funds environmental projects in Poland, Hungary, the Czech and Slovak Republics, and the Baltic States. It is concentrating on projects that have a good payback potential, investing in the first place in enterprises that sell goods or services to a number of customers. It is for instance investing in local concerns that provide desulphurization equipment.

The World Bank has been active in setting up strategies for the environment and energy sectors in eastern and central Europe, and starting projects with a component for environmental improvement – either by providing loans or supporting projects for technical cooperation, such as studies of environmental and energy strategies for individual countries.

Supporting projects in the Czech and Slovak Republics

AUSTRIA. Monitoring of the emissions of air pollutants around the cities of Most and Chomutov. Flue-gas desulphurization at Nowak power station.

DENMARK. Ten projects, including one for reducing air pollution in Decin, another for planning district heating systems in northern Bohemia, as well as for energy saving in Slovakia.

FRANCE. Study of measures for the control of air pollution in major industrial centres.

NETHERLANDS. The province of South Holland is cooperating with North Bohemia in preparing a plan for a general environment policy in the North Bohemian coal district, as well as a course in air-pollution management for Czech civil servants. Also supporting projects for energy saving in housing and developing equipment for measuring solar radiation.

NORWAY. Supporting the reduction of SO_2 emissions through the use of the Elsorb process, and the monitoring of VOCs and heavy metals in the atmosphere.

US ENVIRONMENTAL PROTECTION AGENCY. Two major regional projects focusing on air-quality management in northern Bohemia and Upper Silesia, and the development of an integrated plan for environmental management in the Ostrava-Katowice region.

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Supporting projects in Poland

DENMARK. Seven projects, including one for the reduction of pollution from coal-fired heating systems in Gdansk, others for the transfer of wind power technology to Poland and the development of renewable energy.

FINLAND. Joint venture for manufacturing heating pipes in Warsaw.

GERMANY. Environmental studies, concerning for instance environmentally compatible methods for hard-coal mining and processing in Upper Silesia.

NORWAY AND SWEDEN JOINTLY. Support for the setting up of three new stations for monitoring transboundary air pollution and the biomonitoring of individuals exposed to a high level of environmental pollutants.

SWEDEN. Improvement of district heating in Torun, assessment of forest damage, energy saving in the Bangoow district heating system.

GREAT BRITAIN. Financing a study of economic instruments for the reduction of air pollution.

UNITED STATES. Supporting the Environmental Initiative: power plant retrofit for the demonstration of an advanced desulphurization system at the Skawina power plant in Cracow. An emergency energy program has demonstrated the potential for low-cost improvements in energy efficiency at factories and refineries. The US has also supported energy-pricing analyses and training in international oil procurement.

Further projects in Poland include one for regional energy efficiency, which provides technical as-

sistance and training through energy-industry contacts. There is also the Cracow Clean Fossil Fuels and Energy Efficiency Program to promote the commercialization of cost-effective approaches to the reduction of environmental pollution in the historic parts of the city – by means of demonstrations and testing and cost-sharing in commercial joint ventures. An air-monitoring network is also receiving support.

WORLD BANK and PHARE programs. Projects for restructuring the power and coal sectors and the gasification of coal.

No indication is given of the size of these various projects, nor of how far they have been implemented. In general it may be said that the concrete help from Western countries during the past three years for improving the air-pollution situation in central and eastern Europe, and especially in the so-called Black Triangle region, has been very marginal. Some start has been made by American agencies in South Poland, but according to Polish environmentalist groups, the implementation of the promised projects is proceeding very slowly.

According to the survey, the European Commission has provided, through the PHARE program, by far the greatest part of the funding for the environmental sector in central and eastern Europe during the last three years, having thus supported ninety-four projects. From a review of the G-24 database, it appears that the projects in Poland and Hungary have covered most of the sub-sectors, including air pollution, water pollution, waste management, policy elaboration, research, information, and education.

Most of the funding provided through the PHARE program

In the Czech and Slovak Republics the funding has been directed mainly towards water pollution, waste management, and institution building. Regional projects have included pre-feasibility studies for the Elbe and Oder river basins, contributions to the Danube river-basin program, and the Baltic and Black Sea programs. Support has also been given to the Regional Environment Centre and the preparation of the report on the State of the Environment in Europe.

REINHOLD PAPE

*** Assessment of G-24 Assistance to the Countries of Central and Eastern Europe in the Environmental Sector.** Commission of the European Communities, Directorate General, External Relations, G-24 Coordination Unit, Rue de la Loi 200, B-1049 Brussels, Belgium.

Following the initiative in 1989 of the Group of 7 (USA, Japan, Germany, Italy, Great Britain, France, and Canada) to arrange multilateral aid to Poland and Hungary, the OECD countries formed the Group of 24, G-24, to coordinate assistance to eastern Europe as a whole. Its PHARE program (originally Poland/Hungary Aid for Restructuring Economies) which dates from 1990, is precisely for that purpose. Retaining the name, it is now in the hands of the European Commission. See also Acid News 3/91, p. 10.

Principal aims of the donor countries in the G-24 group

AUSTRIA. Projects must have a positive influence on air and water pollution entering Austria from outside.

BELGIUM. Has, since 1990, been supporting projects concerning the monitoring of air pollution, industrial waste management, and nuclear plants.

CANADA. Focus on training, institution building, and feasibility studies of monitoring, sulphur handling, and the reclaiming of mined lands.

DENMARK. The country's CEE Environmental Programme, which started in April 1991, places particular emphasis on the reduction of air pollution, on waste, waste-water effluents, and the strengthening of institutions. Aspects concerning energy, such as efficiency, come under the Ministry of Energy.

FINLAND. Provides funds for projects that are aimed at reducing airborne and water-borne pollution in the Baltic Sea region.

FRANCE. Priorities are mainly institution building, training, and environmental audits.

GERMANY. Supports training and institution building by organizing seminars, expert advice, and visits to study environmental policy, law, administration and management, and nature protection.

ITALY. Mutual agreement for cooperation with Slovenia in regard to transboundary water-borne pollution.

JAPAN. Projects supported are mainly in the areas of municipal waste management, flue-gas desulphurization, training in environmental protection.

LUXEMBOURG. Has provided special software for the automated monitoring of air pollution at the Czech and Slovak hydrometeorological institutes.

NETHERLANDS. Gives assistance for the strengthening of the environmental management activities of the environmental ministries and other authorities, and for the development of integrated environment control, particularly with regard to planning, legislation, and other instruments (such as environmental impact assessment). Support for private environmental groups is channelled through an association of Dutch environmentalist NGOs. Aids in emergency situations where public health is threatened.

NORWAY. Assistance includes the financing of feasibility studies of air and water pollution, environmental management, monitoring, and training.

SWEDEN. Focus is particularly on waste water management, although funds are also provided for projects in many other fields.

SWITZERLAND. Hazardous waste management and forest management.

UNITED KINGDOM. Support for training and the transfer of expertise through the Environmental Know-How Fund.

UNITED STATES. Provides finance for joint policy analyses, direct technical assistance, and training to strengthen institutions, as well as for direct technical assistance and equipment for demonstration projects, and also regional projects.

Possible early warners

OVER THE PAST TWENTY YEARS or so, European fungi specialists have documented the disappearance of many different types of fungi from our forests. Although changes in land use and forest management plus over-collecting have played a part in the observed decline, air pollution also appears to be an important factor, as a recent comparative study of forest fungi in Norway and Germany has shown.*

The study, undertaken by a large team of Norwegian and German scientists, evaluated the types, number, and biomass of the larger fungi (or macromycetes) present at three similar sites (in terms of their climate and dominant types of soil and vegetation) from northern Norway (no or little pollution), through southern Norway (moderate pollution loading) to South Germany (the Black Forest – heavily polluted). This was done through a score of visits over a three-year period and then calculating the relationship between the variation in fungal distribution and production between the sites and parameters such as climate, changes in soil conditions due to acidification, forest history and management, and the geographical position of the sites.

Their findings indeed confirmed the view that, as pollution increased southwards and the soils became more acidified, both the number of species and the total number of fruiting bodies (the above-ground mushrooms) decreased. More interestingly, it also became clear that certain species were more suited to the pollution conditions at the different sites. For example, when the team examined historical records for mushrooms collected in the Black Forest in the 1930s, 1950s and late 1970s, it was clear that a number of species had become locally extinct in recent times, but still were found at the unpolluted site in North Norway. Among them was the gastronomically-valued chanterelle mushroom *(Cantherellus cibarius)*, whose decline in the Netherlands has also been linked to air pollution.

Similarly in the Black Forest, a number of species have increased in extent and commoness since the 1930s, suggesting that they may have some form of tolerance to more acidified, disturbed conditions. The authors of the study, in common with previous researchers, suggest that the dominance of such a suite of species may act as an "early-warning" signal for more widespread forest decline.

This is a message that could be heeded much more in the current scientific evaluation of critical loads for forest ecosystems. Certain species of fungi (known as mycorrhizal fungi) have special, intimate links between themselves and forest trees, providing the trees with nutrients and other essential benefits. This recent study indicates that mycorrhizal fungi in particular were disadvantaged by increasing pollution. Thus if threshold criteria for forest vitality are to be defined, we may in future have to think more about the quality of the underground fungal component as well as the more traditional forest-production concepts.

ANDREW TICKLE

* Gulden et al. (1992) **Macromycetes and air pollution. Mycocoenological studies in three oligotrophic spruce forests in Europe**. Bibliotheca Mycologia, Band 144. J. Cramer, Berlin.

Dr Tickle is plant ecologist specializing in air-pollution effects and policy. He works in association with the London-based environmental research group, Earth Resources Research.

NEW PUBLICATIONS SERIES

A NEW SERIES on air pollution and climate has started with two publications, the one entitled The Eastern Atmosphere detailing the pollution resulting from the coal-based economies of the countries of Central and Eastern Europe, the other giving proposals for abating the emissions of air pollutants from the so-called Black Triangle.

The first is a digest of relevant parts of a book entitled The Eastern Environment (in Swedish *Österuropas miljö*) by a social scientist who has made a special study of the problems of East-Central Europe. In the second a Swedish consultant proposes ways of using energy more efficiently, particularly in the field of domestic heating. A professor of the University of Mining and Metallurgy, Cracow, in turn presents a detailed scheme for a more efficient heating system for that city.

The publications will not be distributed like the Factsheets with the magazine, but can be ordered specially, and free of charge, from the Swedish NGO Secretariat on Acid Rain.

THE EASTERN ATMOSPHERE: J. SALAY

THE "BLACK" TRIANGLE: A GENERAL READER