

Weidner, Helmut

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# WZB

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A SURVEY OF CLEAN AIR POLICY IN EUROPE

HELMUT WEIDNER

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## **A SURVEY OF CLEAN AIR POLICY IN EUROPE**

### **Summary**

The paper presents a brief overview on the most important developments in European clean air policy. Special consideration is given to the activities in the European Community using, among other things, the results of an international conference on clean air policies in large European cities. In conclusion, some suggestions for improving clean air policy are made. A comprehensive annex of tables provides the reader with current key data on the most relevant aspects of clean air policy in the 12 EC member countries.

## **LUFTREINHALTEPOLITIK IN EUROPA - EIN ÜBERBLICK**

### **Zusammenfassung**

Es wird ein kurzer Überblick zu den wichtigsten Entwicklungen in der europäischen Luftreinhaltepolitik gegeben. Der Schwerpunkt liegt dabei auf den Maßnahmen in der Europäischen Gemeinschaft; hierbei wird unter anderem auf Ergebnisse einer internationalen Konferenz zur Luftreinhaltepolitik in europäischen Großstädten zurückgegriffen. Abschließend werden einige Vorschläge zur Verbesserung der Luftreinhaltepolitik gemacht. Ein umfassender Tabellenanhang gibt aktuelle Informationen zu relevanten Bereichen der Luftreinhaltepolitik in den zwölf EG-Mitgliedsländern.

## **I. Introduction**

Contrary to the USA and Japan, for example, European clean air policies had remained immobile far too long. One consequence of this attitude was the serious damage to forests in many countries. West Germany was, and is, particularly seriously affected although, since the early 1970s, the Federal Government claimed to have the best air pollution control system in Europe. Unfortunately, nature could not be convinced by these claims. However, to be fair, in those times not only governments and industries did not care much about negative effects of emissions from mobile and stationary sources to nature. With some few exceptions, natural and social scientists as well as grass-roots movements and environmental organisations did not pay much attention to this issue either. Widely unacknowledged was the fact that high smoke stacks do not solve any problems but merely shift them to somewhere else. Public awareness of air pollution problems was generally low. From the late 1970s on, however, environmental consciousness increased much faster among the general public than in parliaments. In some countries citizens' action groups and environmental organisations soon began to play a decisive role in promoting the issue. Today, in all European countries, they are far ahead of their governments when it comes to recognizing problems and demanding countermeasures.

## **II. Clean Air Policy: Development and Basic Features**

### **1. Basic Literature**

The following survey of clean air policy in Europe mainly focusses on those regulations and policy instruments which have decisively contributed to pollution abatement. A more comprehensive overview on regulatory instruments and emission trends for central air pollutants is provided by the UN Economic Commission for Europe (National Strategies and Policies for Air Pollution Abatement, Geneva 1987) and the OECD (Environmental Data Compendium 1987, Paris 1987). This survey is based on these two studies and on results of research projects carried out at the former Research Unit Environmental Policy/Science Center Berlin (especially, P. Knoepfel & H. Weidner, International Comparison of Air Pollution Control Policies for

Stationary Sources, 6 volumes, Berlin 1985--available only in German; H. Weidner, Air Pollution Control Strategies and Policies in the F.R. of Germany, Berlin 1986; H. Weidner, Clean Air Policy in Great Britain. Problem Shifting as Best Practicable Means, Berlin 1988). The general remarks and recommendations in the final chapter are based also on several studies on Japanese environmental policy conducted by the author since 1975.

## 2. International Developments

Since the early 1980s, a great deal of motion has become noticeable in Europe's air pollution control policy. This was, not in the least, started by earlier initiatives of international or supranational organisations and a few pace-setting countries in western Europe. Especially, the activities of Swedish scientists, the OECD and the United Nations's Economic Commission for Europe (ECE) brought about the wide recognition of 'Acid Rain' as an international environmental problem.

Nevertheless, it still took quite a while until coordinated efforts bore effect. For example, the Geneva Convention on Long-Range Transboundary Air Pollution was subscribed by 34 countries in November 1979. However, it could not enter into force before March 1983, when a sufficient number of countries had ratified its provisions.

In July 1985, the ECE Executive Body at its meeting in Helsinki adopted a protocol on the reduction of SO<sub>2</sub> emissions by at least 30 % by 1993 at the latest (using 1980 emissions as the baseline). It entered into force on September 2, 1987. Up to now, 21 countries are member to this so-called 30 Per Cent Club (i.e., 21 countries have signed the "SO<sub>2</sub> Protocol," 18 of which also have ratified its provisions). Some of these countries have committed themselves to reduce sulphur dioxide emissions by even more than 30 %. Yet, some of the world's greatest SO<sub>2</sub> emitters--USA, UK, Spain and Poland-- still have not joined the "30 Per Cent Club."

In September 1987, an ECE working group tried to adopt a corresponding draft protocol on a 30 % reduction in nitrogen oxides emissions by 1995. Unfortunately, no agreement was reached. Of the 22 countries attending the

NO<sub>x</sub> group meeting Austria, FRG, the Netherlands, Sweden, and Switzerland backed the proposal for a 30 % reduction by 1995. Denmark, Norway, Spain and the United Kingdom only agreed to freeze current NO<sub>x</sub> emission levels. The remaining countries were either indifferent or generally disapproving. Later on, a compromise was reached to the effect that NO<sub>x</sub> levels of 1987 were to be maintained. The United States, however, claimed a credit for their earlier cutbacks in NO<sub>x</sub> emissions.

The European Communities (EC) have passed several directives concerning air pollution. Among these, the directive on automobile exhausts is particularly weak compared to the strict emission standards that are in force in the USA and Japan. In June 1988, after a long period of intensive deliberations, the Ministers of the Environment in the EC finally agreed to stricter standards for small cars (i.e., vehicles with an engine capacity below 1.4 litres) and for diesel-engined cars. The agreement on stricter exhaust standards for small cars was crucial because this type of car is most widely used in the EC. It is prognosed that by the early 1990s they will account for 60 % of all motor vehicles. These standards, too, were the result of a compromise and did not reach the level of the Japanese and US American standards favoured by Denmark, FRG, Greece, and the Netherlands. Even so, France still was dissatisfied and upon her intervention the compromise was disaffirmed. Yielding to the pressure from the leading French car manufacturers, Peugeot and Citroen, in July 1988 the French government demanded that the compromise solution be postponed for five years.

In June 1988, after more than five years of debate, the EC Ministers of the Environment agreed on a directive on emission limits for SO<sub>2</sub>, NO<sub>x</sub> and dust for large combustion plants. It is the aim of the directive to cut back total SO<sub>2</sub> emissions from stationary sources with a production capacity of more than 50 MW until the level of 1980 is reached. 25 % of this cutback shall be achieved until 1993, 43 % until 1998 and 60 % until 2003. This implies that the various member countries will have to introduce different levels of cutbacks depending on their SO<sub>2</sub> emissions in 1980. Three countries--Greece, Ireland and Portugal--will be allowed to increase their emission levels compared to 1980. With regard to NO<sub>x</sub> emissions from existing stationary sources, cutbacks will be implemented in two phases (1993 and 1998) with a total reduction of 36 % throughout the EC. Again, Greece,

Ireland and Portugal will be allowed to increase NO<sub>x</sub> emissions compared to the 1980 emission levels in these countries. With regard to new plants commissioned after July 1987, the agreed emission standards will reduce SO<sub>2</sub> and NO<sub>x</sub> emissions by 80 % and 50 %, respectively, compared to current emissions from unmodified plants. However, plants in Spain burning high-sulphur fuels are exempted from this regulation until the end of 1999. All in all, this compromise directive on emission limits for large combustion plants is quite lenient compared to what would be technically possible, economically feasible and ecologically necessary.

### 3. Laws and Regulations

By now, all European countries have enacted air pollution control laws and regulations. These are primarily concerned with sulphur dioxide, nitrogen oxides, dust, suspended particulate matter (SPM), and, partly, volatile organic compounds (VOC), lead, ozone, and a few other substances. The policy objectives underlying these regulations and corresponding policy programmes tend to be broad and vague. They usually postulate the protection of human health and the environment from damage, nuisance, etc.

Some West European countries have set **ambient air quality standards** (maximum permissible concentration levels for air pollutants in the ambient air), at least for the most prominent pollutants. In East Europe, a comparatively great number of countries has fixed very strict ambient air quality standards (AAQ standards) for numerous pollutants. It is, however, a well-known fact that AAQ standards can be almost insignificant because they can easily be misused for a merely symbolic policy. Their actual effectiveness depends on several variables, above all the established enforcement and monitoring systems. These restrictions in mind, East European AAQ standards have little influence on practical policy. The Netherlands and Switzerland may probably be considered as countries having very strict and enforcement-oriented AAQ standards for SO<sub>2</sub> and NO<sub>x</sub>.

From a practice-oriented point of view, **emission standards** are of greater relevance for air pollution control policy. This might be one of the reasons why various EC member states have been blocking an agreement on emission standards for stationary sources for so long. In general, most

countries have set emission standards for certain pollutants and for certain sources. Yet, only a few have set legally binding, uniform emission standards for stationary sources or, at least, for large combustion plants--independent of the location of the source and the general air quality in the area. Austria, Switzerland, the Netherlands and the Federal Republic of Germany are among those countries that have enacted emission standards which also reflect the international technological "state of the art".

Of similar importance are so-called **product-related standards** limiting, for example, the amount of lead contained in petrol or the amount of sulphur contained in fuels. Studies have shown that such standards are easily to implement and highly effective regarding air quality improvements.

There are only very rare cases of **clear-cut goals** to reduce certain pollutants within a fixed timeframe encompassing the commitments of the "30 % Club." One case is Switzerland where  $\text{SO}_2$  emissions have to be reduced to the level of 1950 until 1990. With regard to  $\text{SO}_2$  but less so for  $\text{NO}_x$ , such definite policy goals can only be found in the Netherlands, the FRG, France, Austria, Luxemburg, and the Scandinavian countries. Policy studies indicate that the more determined governments are to actually reduce emissions, the more clear-cut and concrete are officially announced policy goals.

The opposite applies, of course, when governments are not so determined. Presumably the most striking example for this thesis is the FRG. For many years, the comprehensive and very detailed laws and regulations in West Germany, although very strict in wording, have had only minor influence on reducing emissions from old and new combustion plants. The Ordinance on Large Combustion Plants, enacted 1983, laid down clear-cut goals and a strict timetable for their implementation. In less than four years, the Ordinance has effected more abatement measures than had been taken in double the time prior to its enactment. In fact, with this Ordinance West Germany became the pacemaker in Europe with regard to  $\text{SO}_2$  and  $\text{NO}_2$  abatement measures at stationary emission sources. Furthermore, the center of



gravity in West Germany's clean air policy has shifted from its previous (and largely ineffective) orientation towards immission (ambient air quality) to an orientation towards emissions.

As a result of this new direction in West German environmental policy, from 1983 to mid-1988 165 flue gas desulphurisation units have been installed in 72 power plants desulphurising 35,500 MW of power plant capacity. This brought about a reduction in SO<sub>2</sub> emissions from power plants by two thirds (from 2 million tonnes to 0.7 million tonnes). Calculations indicate a further reduction by 10 % within the next four years. From 1982 to 1987 NO<sub>x</sub> emissions from power plants fell by 22 %. Due to denitrification measures emissions will be decreased by 70 % until the early 1990s. The first denitrification units started operation in 1985. In mid-1988 almost 6,000 MW of power plant capacity were equipped with such units, for the end of 1988 12,500 MW are envisaged. The Federal Environment Agency estimates that by 1995 total NO<sub>x</sub> emissions in Germany will be reduced by 43 % compared to 1982 (i.e., from 3 million tonnes to 1.7 million tonnes). In 1988, still 2.55 million tonnes of NO<sub>x</sub> were emitted, yet more than half of it by mobile sources.

In conclusion, I would recommend that whoever is interested in actual progress in air pollution control policy should not pay too much attention to emphatic but vague policy objectives and promises but request for pragmatic and clear-cut goals. However, it is always easier to have politicians and decision-makers within the economic sector agree on a grand call for preventive environmental policy to reconcile society and nature than on pragmatic proposals to reduce pollution by a definite amount within a fixed period of time and with continuously monitored emission data made open to the public.

The principle of **preventive action** (instead of react & cure) as the guiding principle of air pollution control policy is emphasised, in any explicit way worth speaking of, only in Finland, the FRG, Italy, Norway, and Switzerland. In early 1988, the British government published a seven-point charter setting out their new strategy for environmental protection. The principles outlined in the charter demand, among other things, that a "preventive precautionary approach" must be adopted. Yet, as experience has shown, especially in the FRG where a so-called precautionary principle

was laid down as one fundamental principle of environmental policy as early as 1974, only policy implementation reveals whether this principle has actually guided environmental policy. Research results indicate that due to implementation and enforcement shortfalls the basic programmatic principle of precaution (prevention of emissions and damage instead of remedial action) has, until recently, not substantially influenced air pollution control activities. Whether the new measures that have been adopted in West Germany--flue gas desulphurisation and denitrification, catalytic converters for cars, etc.--are part of a preventive policy as the German government claims or whether they should be seen rather as **active restoration policies** applied in areas where problems have become all too obvious is a matter of further discussion.

According to the opinion of a majority of experts, the best long-term environmental policy is integrative and preventive in its orientation and accompanied by an ecology-oriented structural reformation of the economy. Nevertheless, current national and international environmental policy still is primarily reactive although in part much more effective than in previous years. The analysis of policy instruments applied in European countries reveals a general preference for conventional emission control policies and end-of-pipe technology. As it turned out, however, such policies are insufficient in the long run. They cannot prevent the emergence of hazardous substances as such, with the consequence that, as a rule, **problems** are **shifted** spatially and temporally or from one environmental medium to another. It should suffice here to mention only one example. Although, as yet, only a few flue gas desulphurisation and fluidised bed combustion units operate there already is good reason for the concern that the by-products and wastes they generate (e.g. gypsum and ashes with high concentrations of heavy metals) may lead to new environmental problems.

#### 4. The Polluter-Pays Principle

Although the advantages of so-called market-oriented instruments for the promotion of environmental policy have been emphasised repeatedly for quite some time, a survey of the European situation shows that only few countries actually apply flexible economic instruments in their environmental policies. Almost all countries have committed themselves to the

polluter-pays principle. Nevertheless, they use much more so-called positive incentives for polluters, such as direct and indirect subsidies, loans at favourable terms, or tax reductions, than negative incentives, such as charges and fees. Only in France, the Netherlands, Norway, and Sweden does the emission of  $\text{SO}_2$  or the use of fuels with a high sulphur content entail costs. Some East European countries also exact penal fees, but these are barely incentives for curbing emissions.

In a report issued by the Dutch government in December 1987 entitled "Interim Evaluation of Acidification", the idea was propagated to establish an "anti-acidification fund" in combination with so-called compensating levies. The suggestion is that all air polluters pay a special national environmental authority for using the natural resource air. In other words, they would have to buy their right to emit a certain amount of acidifying substances ( $\text{SO}_2$ ,  $\text{NO}_x$ , ammonia and volatile organic compounds) at a certain price. The proposal outlined in detail in the report "An Anti-acidification Fund" (July 1988) was met with the opposition by economic interest groups and currently is still under debate.

In general, there is a striking discrepancy between official commitments to the polluter-pays principle and the policy instruments actually applied. Most instruments are regulatory ones of the type "command and order", although charges on emissions by larger combustion plants, for example, could be easily implemented with regard to  $\text{SO}_2$ ,  $\text{NO}_2$ , and dust. Therefore, it can be assumed that the reasons behind this situation are "political" and not technical or administrative. As it seems, the more effectively an instrument could reduce pollution, the fewer its chances to be implemented, at least, when the addressees are well-organised and powerful groups of emitters.

## 5. Monitoring

In all European countries air quality is monitored in one way or the other.  $\text{SO}_2$ , dust, and carbon monoxide usually are monitored most comprehensively, whereas  $\text{NO}_x$ , lead, VOC, and ozone are measured at just a few monitoring stations. Furthermore, there is a great variety with regard to density of monitoring networks, number of pollutants monitored continu-

ously and quality of the technical equipment. It is, therefore, almost impossible to compare monitoring results from different countries, which also explains why it is so difficult to enforce an EC clean air policy based on mutual AAQ standards. It is assumed, for example, that the NO<sub>x</sub> monitoring network in London is not adequate to meet the requirements of the EC directive on NO<sub>x</sub> concentrations in the ambient air, because the monitoring results seem all too positive. There are similar problems in other EC or non-EC countries. For example, it is almost an open secret that even in West Germany, where one of the most modern monitoring systems was established, NO<sub>x</sub> concentrations in large cities, especially along roads, are inadequately monitored. It is suspected that a more problem-oriented monitoring system (with more stations located at road sides) would reveal excessions of the maximum allowable NO<sub>x</sub> concentrations as prescribed by the EC directive.

**Emissions** from large stationary sources are very rarely monitored continuously although appropriate appliances have been available for many years. In Europe, continuous monitoring of SO<sub>2</sub> and NO<sub>x</sub> at large combustion plants is common practice only in Austria, Finland, France, Great Britain, the Netherlands, and West Germany. Considering that exact and up-to-date emission data are a prerequisite for a rational (effective and efficient) environmental policy, there are surprisingly few countries in which continuous monitoring of emissions is required.

Additionally, nowhere in Europe is the public informed continuously on the amount of emissions from single, large emitting sources. This restrictive information policy is usually justified with the necessity to protect trade secrets. Yet, what "secrets" would actually be disclosed if the public knew that a power plant is fuelled with coal and that its output is higher in the winter than in the summer? I find it hard to believe that disclosure of such "secrets" would give any competitor a great advantage...

Reliable and comprehensive data on emissions of single sources, at least of the larger ones, are not only a necessary tool for sound environmental planning, they are also a precondition for check-ups. And, last but not least, they are important means for residents in the vicinity of emission

sources as well as for the general public to evaluate achievements in air pollution control or to make use of what small possibilities for legal action against polluters they have.

All in all, the means to inform the public on hard facts are still in their infancy. Insufficient statistical bases and lack of transparency make it altogether difficult to establish baseline conditions which would represent an equally fair point of departure for those countries participating in international activities against air pollution. Moreover, they make it also difficult to assess the actual outcome of such international cooperation. Considering this, one cannot help thinking that the issue of monitoring is principally a matter of politics, so that environmental policy more or less comes down to an "information game," although a game with an asymmetric information basis for the players. Those affected by pollution have little access to relevant information while operators of large emission sources and responsible authorities have ample opportunity to manipulate or withhold information. In my opinion, environmental policy research as well as environmental organisations have, so far, not paid enough attention to this issue. Therefore, I very much hope that the British Freedom of Information Campaign will find many followers in other European countries.

At present, the **effects** of air pollution are monitored in all countries in one way or the other. In particular, damage to vegetation, forests, buildings, and monuments are monitored. Studies on health impairments, especially long-term epidemiological studies, on the other hand, are surprisingly rare. As yet, no European country has introduced a national accounting system assessing the effects of air pollution and clean air policy on a monetary basis. But, at least, more research on this subject has been carried out in recent years. One would assume that intensive studies on the negative effects of air pollution would initiate corresponding environmental policy measures. However, I have come across cases where just the opposite applies. In West Germany, for example, research on negative effects of air pollution initiated and financed by public authorities has increased **after** strict abatement requirements for polluting sources were enforced. The main motivation for this kind of ex post analysis could have been the need to legitimate and defend costly requirements for pollution control against the opposition of the business sector.

From common sense and scientific points of view alike, this kind of bureaucratic behaviour seems rather irrational. Still, this observation is almost completely in line with the general observation that political decision processes obey their very own rationale. Which priorities governments set in environmental policy seems to depend rather on considerations of how influential and well-organised interest groups might react than on the determination to define adequate policy goals and means for implementation. Thus, it would be naive to explain shortfalls in developing and implementing efficient preventive environmental policies merely with a lack of scientific information on the relationship between environmental pollution and its effects. Policy analyses have clearly demonstrated that governmental priorities in environmental policy are primarily the outcome of a decision making process in which business interests are over-represented and public interests underrepresented.

### III. Achievements and Remaining Problems

#### 1. General Overview

As outlined above, recent European air pollution control policy has shown considerable progress in the area of SO<sub>2</sub> emissions--although in some countries, particularly in East Europe, only to a limited extent. Meanwhile, a few countries have already achieved the goal of the "30% Club". On the other hand, however, one cannot disregard the fact that in some countries SO<sub>2</sub> pollution abatement has become quite a problem lately. The nuclear accident at Chernobyl in 1986, the recent disclosure of information that the area around the British nuclear power plant Windscale was highly radioactively contaminated in the 1950s, and the latest scandal in West Germany about nuclear waste transports have made it increasingly difficult to implement nuclear energy programmes as one means to reduce sulphur dioxide emissions. As a matter of fact, several countries achieved their reduction in SO<sub>2</sub> emissions primarily through the substitution of fossil fuels by nuclear energy and plan for further reductions in this manner (e.g., France, Belgium, UK, CSSR, USSR). In France and Belgium, already more than 60% of the total electricity is generated by nuclear power.

Pan-European measures, comparable to SO<sub>2</sub> abatement, against NO<sub>x</sub> pollution, hydrocarbons, and ozone are still not in sight. Only few countries, especially Sweden, the Netherlands, Austria, Switzerland, and West Germany, seem to be willing to promote concerted international measures against these pollutants. Yet it is most urgent to take such measures as the example of NO<sub>x</sub> emissions illustrates. For years, nearly all European countries have registered continuously rising NO<sub>x</sub> emissions with a particularly sharp increase in nitrogen oxides emitted by cars. Considering the ever growing number of vehicles in circulation and the increasing total mileage as well as the weak compromise on an EC standard for NO<sub>x</sub> emissions by cars, this trend is likely to persist. Except for very rare cases, most European countries neither have employed large-scale NO<sub>x</sub> abatement technologies (e.g. denitrification plants for flue gas or fluidised bed combustion systems) nor do they plan to do so in the foreseeable future. The East European countries, still struggling hard to tackle the SO<sub>2</sub> problem, in all likelihood will not be prepared to ratify any strict international agreement on NO<sub>x</sub> reductions--which also holds true for some West European countries. It would be most important, by all means, to adopt stricter car exhaust standards, such as the Scandinavian countries, Switzerland, Liechtenstein, and Austria demanded in a joint resolution in July 1985 and, meanwhile, have already started to implement. This policy measure is absolutely justified since--with just a few exceptions--over 50 % of all NO<sub>x</sub> emissions in Europe are related to automobile traffic.

The ECE report on national strategies and policies for air pollution abatement mentioned above draws the following conclusion.

" As regards actual emission trends, most of the Parties report reduced emission of sulphur dioxide. Of the 27 Parties for which data are available both for 1980 and a more recent year. . ., 23 have reduced sulphur dioxide emissions compared to 1980. Ten Parties have reduced their emissions by 30 per cent or more. . . . Signatories to the Protocol . . . estimate their 1995 emissions to be 30 per cent or more below the 1980 level. Eleven Parties forecast a reduction by about 50 per cent or more before 1995, four of them even more than 65 per cent. The emission data on nitrogen oxides submitted by 27 Parties generally show a nearly constant level or a slight reduction over the past three to five years. Future estimations are available from 15 Parties. The estimated trends from 1980 to 1995 vary considerably, from an increase by 50 per cent to a decrease by 50 per cent, however, eight Parties plan to reduce their NO<sub>x</sub> emissions between now and 1995."

" While acknowledging these positive developments . . . there are clear indications that further emission reductions are required."

These conclusions were confirmed by the results of a recent international conference on air pollution control policy.

## 2. Clean Air Policy in Major Cities of the European Community: Results of an International Conference

The findings of the international conference "Clean Air Policy in Major European Cities" held in West Berlin, September 30 - October 2, 1987, demonstrate that the significance of industrial culprits as far as air pollution in large cities within the European Community is concerned has declined since the mid-1970s, in some cases quite considerably. In the meantime, motor vehicle traffic has become the dominant source of nitrogen oxides, soot, lead, carbon monoxide and hydrocarbons which pollute the air of Europe's major towns and cities. Delegates from the following cities contributed to the conference: Athens, West Berlin, Brussels, Frankfurt-on-Main, Copenhagen, Lisbon, London, Madrid, Manchester, Milan, Munich, Paris, Rome, Rotterdam, and Strasbourg.

On the basis of the written and verbal statements made by the civic representatives, the following information was presented to the conference and then made available to the press:

- o In practically all of the towns and cities represented at the conference, air pollution presents a grave problem. This is particularly borne out by the results from air quality monitoring networks, by means of which especially sulphur dioxide and particulates, but also soot, lead levels in particulates, carbon monoxide, nitrogen oxides and increasingly ozone are measured in all of the cities involved, using more or less automated methods.
- o Although the monitoring networks have, in part, achieved a considerably high technical standard, improvements are still necessary. This is especially true with regard to the selection of representative



sites for placing the monitoring equipment and the unification of methods in order to make measurement results comparable across EC countries.

- o With the exception of ozone, the concentration of pollutants is higher in winter than in summer. In virtually all of the cities represented, the standards of air quality were to a large extent in line with the EC norms, although cases of increased air pollution were perceptible from time to time where the established norms were frequently considerably exceeded. Whereas pollution from sulphur dioxide, dust, and lead has, in part, receded drastically, in the case of nitrogen oxides the tendency has often been that of an upward trend.
- o As far as the sources of pollution are concerned, in the case of sulphur dioxide and particulates the principal cause remains the heating of buildings, be it oil or coal fired, whereas industrial sources situated within the major towns and cities, with certain exceptions, no longer bear a dominant responsibility for urban pollution in the case of classical air pollutants, such as, for instance,  $\text{NO}_x$ , soot, lead, and  $\text{SO}_2$ . It was pointed out that, in the meantime, motor vehicle traffic has become the principal cause of urban air pollution as far as  $\text{NO}_x$ , soot, lead, carbon monoxide, and hydrocarbons are concerned-- $\text{NO}_x$  and hydrocarbons contributing to the creation of photochemical oxidants in and around urban centres.
- o In certain cities (e.g. Rotterdam, Strasbourg, Copenhagen, and Berlin) extreme readings of concentrations of sulphur dioxide and particulates were largely caused by the "importing" of these pollutants. The "exporting" regions were stated to be principally the south of the G.D.R., Poland, Czechoslovakia, and the Ruhr region of West Germany. Furthermore, reports from the representatives of Rotterdam and Berlin pointed out that the long-distance transportation of air pollutants did not only lead to the short-term extremes, but also contributed considerably to the continuous air pollution load. In Rotterdam, 30 to 50 % of the average concentrations of  $\text{SO}_2$  are caused by outside sources, in West Berlin 25 to 50 %.

- o At the moment, unequivocal correspondences between the concentrations of pollutants measured and adverse effects on human health can no longer be demonstrated. It is increasingly more difficult to distinguish the effect of air pollution on human health from that of other health factors. It was generally emphasized that the populace ought to be promptly and properly informed of the levels of air pollution in order to avoid "smog hysteria." Each of the cities represented reported damage to buildings and cultural monuments whose repair resulted in considerable expense.

During the course of the conference, the subject group to be discussed at greatest length was that of the measures for improving air quality. As far as the four "classical" source groups--the heating of buildings, power stations, industry, and motor traffic--are concerned, the measures taken by those cities represented at the conference in the area of clean air policies will be surveyed in the following.

In general, the measures undertaken clearly demonstrate the influence of the respective national regulatory systems on the possibilities available to the cities themselves to carry through suitable clean air policies, both in a positive and in a negative direction. Thus, for example, clear directives with regard to important groups of pollutants and emission sources are still, at least in part, lacking (e.g. air quality standards, emission limits). Similarly, examples of national regulations were cited which were not sufficiently flexible to cope with the manifold problems with which the cities themselves had to deal. On the other hand, it was made apparent by many reports that national regulations have proved extremely helpful when carrying out measures at the municipal level. In this respect, it may be universally observed that, in the case of administrative procedures, clear guidelines--be they emission, product or air quality standards--specifically improve the possibility of reducing emission levels in cities if and when they are flexibly laid down, in the sense that the opportunity exists of their being tightened according to the needs of a given municipality.

The reports on the individual pollution source groups may be summarised as follows:

### 1) The Heating of Buildings

In all of the cities taking part in the conference, measures relating to energy policy were encouraged to a greater or lesser extent. Invariably, these relate to measures aimed at energy savings and the conversion from heavily polluting fuels (coal and oil) to fuels causing less pollution, in particular gas. At the same time, programmes for the replacement of energy-intensive, single-unit heating systems are available and have been positively evaluated. From Munich it was reported that a nostalgic trend of a dubious kind in respect of air quality control has expanded in recent years, namely, the installation and use of individual room fires, especially open fire-places and stoves. The pamphlets and information employed by the responsible authorities to counter this trend led, in their turn, to conflict with the commercial parties concerned--a graphic example of how difficult it is for urban authorities to pursue a systematic policy with regard to information concerning the environment even for "minor" areas without becoming embroiled in time-consuming arguments.

In the case of energy-related initiatives to reduce the level of emissions, a system of economic incentives is invariably established. These consist, among other things, of credits on favourable terms and grants for those persons who are willing to convert their existing heating systems. The country in Europe with the most experience in this area is actually the United Kingdom and the conference possessed a high degree of expertise in the representative of the English city of Manchester, the "home of smoke abatement policy," though London and Munich have also had many years of experience in this respect.

The switch to low-sulphur and low-smoke fuels, brought about especially as a result of directives aimed at limiting sulphur content, has had a particularly positive effect on the air quality in Europe's major cities. In the case of West Berlin (sulphur content limits for brown coal), London (sulphur content limits for oil in the City of London), and Athens and Milan (sulphur content limits on all fuels), the switch to low-sulphur fuels was implemented in accordance with national guidelines. However, it is not apparent from the reports made to the conference by the various representatives why such measures, which have proved effective and implementable without an enormous effort on the part of municipal administrations, have not been extensively employed in other cities too. Even so,

examples were given which illustrated how such measures were implemented by the municipal authorities themselves in the course of their own management, for instance, the ordering and burning of only those fuels with a specially low sulphur content in public buildings. Nevertheless, this aspect of civic authorities using their control of "supply and demand" for environmental purposes was, on the whole, little commented upon at the conference.

As far as the heating of buildings is concerned, it may be generally observed that the modernisation of furnaces and heating systems; the conversion to low-smoke and low-sulphur fuels; and the extension of district heating are all particularly successful measures in terms of reducing air pollution.

## 2) Power Stations and Industry

As far as this group of pollution sources is concerned, the most effective countermeasures have shown themselves to be such as have led to the building of flue gas desulphurisation and denitrification plants, both into existing as well as new installations. National targets (such as emission limits and a clearly laid-down timetable for the retrofitting of old installations) were extremely helpful to urban initiatives in this context. Even so, there have been examples whereby local authorities have been able to carry through stiffer measures, over and above those envisaged by national regulations, either by the subtle exercise of pressure on power companies, or through cooperation agreements. By the same token, it is evident that in a large number of towns and cities no flue gas desulphurisation units have been fitted to conventional power stations or large industrial furnaces, let alone denitrification plants. This state of affairs is reflected in the general national situation. In fact, this is an area where the issuing of EC guidelines for emission thresholds for large-scale furnaces would be helpful in respect of urban measures to combat pollution.

In summing up the situation with regard to power stations and the industrial sector, it became clear that measures aimed at reducing emissions through technical means; a preference for low-sulphur fuels as well as the

general use of fuels that cause a lower level of pollution have shown themselves to be particularly effective in improving air quality in major towns and cities.

### 3) Motor Vehicle Traffic

Each of the cities participating in the conference had resorted to traffic planning. The measures adopted ranged from an improvement of traffic-flow systems, prohibited zones and other restrictions (even quite rigorous ones, such as a differentiated ban on motor traffic in Athens), to an extension of local transport networks and bicycle paths. Similarly, periodic--or at least ad-hoc--controls of road vehicles and their exhausts are carried out.

However, it became clear that all these measures are not themselves sufficient to come to grips with the problem of air pollution caused by road traffic. In every one of the towns and cities, the problem of air pollution from motor vehicle traffic is a considerable one, and it was more or less generally apparent that present norms for motor vehicle exhausts are not adequate so as to achieve the necessary reductions before long. In fact, the problem is, in part, on the increase. This is not only true of private cars, especially diesel-powered vehicles, but also of commercial vehicles. A glance at the national situations in each of the 12 member states of the EC shows a general increase in emissions of nitrogen oxides by motor vehicles. In the period from 1970 to 1985, the number of vehicles had increased between 25 and in excess of 300 %, according to member state. At the same time, the total mileage of all motor vehicles had also increased during the same period in the region of 20 to very nearly 200 %. As far as can be ascertained, these trends show no sign of abating. It is thus to be expected that the exhaust norms at present set by the EC will not be adequate in order to provide suitable and sufficient relief.

It is obvious that for the time being the regulation of exhaust emissions from motor vehicles will remain one of the greatest challenges as far as clean air policies are concerned, especially with respect to the major cities, but also as regards specific activities at a supranational level. As regards the, up till now, insufficient regulations at the EC level and the very restricted room for manoeuvre on the part of municipal administrations, it would be recommendable for environmental policy decision-

making at the EC level to be thought out afresh so that the environmental policy needs of the major cities be more forcefully taken into account than previously. Nevertheless, it is surprising that, in this respect, the large cities themselves have not been more active in, as it were, forming a united front or else in promoting their interests through both national and international lobbies. Of all those present at the Berlin conference only one representative expressly gave voice to the idea of a concerted action on the part of all Europe's major cities with regard to car exhaust policies, and although his suggestion did not meet with opposition from the other delegates, it cannot be said that it was exactly greeted with enthusiasm. (For all that, one could learn from the very positive experience in Japan where during the 1970s seven large cities joined in a mutual effort to enforce strict exhaust standards against the resistance of the car industry and their allies in the central government and finally succeeded.)

Despite the legal and other restrictions mentioned above, which hamper the towns and cities in pursuing effective policies aimed at limiting motor vehicle exhausts, some interesting strategies have been thought up which have either led to improvements in themselves or at least stimulated attitudes towards environmental policies. For example, in formulating their regulations in the event of smog, both Munich and Berlin offered positive stimulus for the purchase of vehicles fitted with catalytic converters. As far as city-owned motor vehicles are concerned, some authorities have pursued a deliberate policy of purchasing those automobiles with improved exhaust systems. At the same time, some of the cities have encouraged the spread of petrol stations offering unleaded fuels--the necessary prerequisite for the use of catalytic converters. Even so, according to statistics put forward by the German Automobile Club (ADAC), there are still some member states of the EC which have too few outlets for unleaded petrol.

In summing up, it became clear that the following measures aimed at reducing motor vehicle pollution have shown themselves to be particularly useful: (1) measures aimed at improving traffic flow, (2) the introduction of vehicles with environmentally improved exhaust systems, (3) the regular control of exhaust emissions, (4) a reduction in the lead content of motor vehicle fuels, (5) a reduction in the sulphur content of diesel fuels, (6)

measures aimed at reducing the volume of traffic as well as an extension of local public transport systems together with community initiatives to reduce the volume of individual vehicle users.

Besides the measures on the part of civic authorities to improve air quality listed above, which were related to specific source groups, the construction of **monitoring networks** for specific problems has also proved significant. In this way, civic authorities have in general been able to construct a rational basis, both for introducing effective controls and for future planning. It may be generally observed that, as far as civic policies for air quality control are concerned, the collection, evaluation, and publication of environmental data is gaining significance across the board.

In view of the variety of measures being undertaken by the major towns and cities to promote air pollution abatement, which were presented to the conference, as well as the wealth of ideas apparent in their development and application, it is clear that the authorities involved do not merely pursue these matters in a routine manner but that, to a great extent, they display a willingness to experiment, coupled with a rich store of ideas--in some cases even what may be described as a "visionary pragmatism." As far as an improvement in the air quality around Europe's major cities is concerned, the extension and systemisation of exchanges of information with regard to individual city's experiences in coping with the problems of air pollution can only be of positive effect. In my opinion, this would not only feasibly be brought about by further conferences of this nature but also through "environmental partnerships" between towns with similar sets of problems. In this respect there are as yet still very few examples indeed; it might prove a new and stimulating task for the responsible EC authorities and the European Parliament to promote and support such an initiative.

#### **IV. Future Needs: Fundamental Changes in Environmental Policy Decision-Making, Policy Instruments, and Scientific Approaches**

On September 8, 1986, 21 European environmental protection organisations, meeting in a conference on "Acid Rain" in Stockholm, demanded that in Europe the total amount of  $\text{SO}_2$  be reduced by at least 80 % by 1993 and that total  $\text{NO}_x$  emissions be reduced by at least 75 % by 1995 at the latest. These demands are hardly politically achievable at the present time, but from the perspective of active environmental protection they seem justified.

At the international, and especially at the national, level it has been, above all, environmental groups and organisations which, often earlier than the responsible governmental agencies, have called attention to emerging environmental problems and pressed for counter-measures. Moreover, in many countries the activities of these groups and organisations, including massive protest against environmentally detrimental projects, helped achieve stricter environmental regulations--often against the powerful resistance of economic interests. There is no doubt, without the commitment of environmental groups and organisations, the air pollution situation in Europe would be much worse than it is.

In my opinion, this demonstrably stimulating and ecologically responsible position of environmental organisations should be accorded stronger recognition at future international meetings on environmental protection. This could be achieved through better access for these groups to decision-making processes, for example through formalized rights for representation in international organisations and responsible EC institutions.

Such a substantial participation of environmental organisations in international deliberations on environmental protection would be an important step towards the dynamisation of the still rather sluggish political process. In addition, the introduction of new regulating instruments through international agreement--international environmental policy has thus far shown itself to be little inclined towards innovation--could facilitate progress in environmental policy.



As we know today from the results of several studies, it is not by accident that the responsible authorities and the scientific community responded to serious and increasingly urgent environmental problems only very belatedly and insufficiently. This kind of behaviour has, ultimately, its roots in the established structures of priority setting and decision making which systematically prevent or hamper an adequate perception of environmental problems and, consequently, anticipatory and preventive measures.

There is no country that I know of where the lessons of the past would have led to fundamental changes in the basic structures guiding the perception of and response to complex environmental problems. This does not only apply to the political, administrative and economic sectors but to sciences as well. Most of the changes in air pollution control policy since the late 1970s have been basically conventional, more or less adhering to existing structures. What actually has occurred are more or less merely concessions to the fact that problems can no longer be ignored, but there are no substantial rearrangements or rejections of structures and approaches which have turned out to be unsuited for the promotion of an anticipate-and-prevent strategy. To put it more bluntly: the approaches of the 1980s would have been sensible if they had been applied in the early 1970s. They do not reflect the current state of environmental awareness, knowledge and needs, and they remain principally reactive.

Thus, what we really need is not so much a further refinement of existing regulations in pollution control. What is needed would be a **quantum jump** in environmental policy and related areas, i.e. the creation of conditions allowing for shifts from the existing priority setting and decision making towards a more substantial influence of environment-oriented interests in economy, law, politics, and science. I am quite aware that such a demand is easily made but very hard to implement. I am also aware that basic concepts for such a fundamental revision of existing environmental decision-making systems are still in their infancy. However, the results of research projects at the Science Center Berlin as well as numerous studies on environmental policies in Europe, the USA and Japan suggest at least three basic elements ("building blocks") which have a strong potential for stimulating the preventive aspect in environmental policy.

- (1) A comprehensive, problem-centered environmental monitoring and reporting system to enhance comprehensibility of the issues and informations involved (**transparency**);
- (2) substantial grass-roots participation in decision-making processes pertaining to environmental policy (**substantial participation** and **decentralisation** of environmental decision-making);
- (3) equality before the law, or at least the creation of legal parity between those who suffer from environmental pollution and those who pollute the environment (**parity of legal weapons**).

At present, all European countries have legal systems that are strongly biased in favour of those polluting the environment. There are several means to improve this situation, such as effective international regulations on responsibility for environmental damage based on strict liability; proof of damage on the basis of statistical plausibility instead of strict causality; and the reversal of the burden of proof in cases of demonstrable environmental damage and plausibility that a certain polluter (or a group of polluters) is responsible for the damage. The latter meaning that--given the state of knowledge on the consequences of air pollution--large emitters and/or governmental authorities would be required to demonstrate that present levels of SO<sub>2</sub>, NO<sub>x</sub>, VOC, etc. emissions and the corresponding levels envisaged for the future are **not** hazardous for our health and the environment; and they should be obliged to demonstrate this on the basis of similarly rigid scientific criteria as they usually request from those demanding a reduction of emission levels.

I think the three "building blocks" mentioned above must also be regarded as a fundamental dictum of democracy. Ultimately, they mean nothing else but the introduction of the principle of fairness to environmental policy.

A N N E X

Set of Core Information  
on Air Pollution in the  
European Community

**Sources:** EUN/ECE, National Strategies and Policies for Air Pollution Abatement, Geneva 1987; idem, European Forest Damages Intolerably High, Press Release ECE/ENV/9, July 2, 1987; OECD, Environmental Data Compendium 1987, Paris 1987; as well as statistical data collected and computed by the author.

**Attention:** When interpreting these tables, caution should be exercised because definitions and classifications may vary from country to country.



	Motor Vehicles in Use Unit: 1000		Change 1970 - 1985 in %	Road Traffic Volumes of all Vehicles in billion veh.-km		Change 1970 - 1985 in %	Total HC/VOC Emission <sup>*)</sup>		Total CO Emission	
	1970	1985		1970	1985		Year	1000 Metric Tonnes	Year	1000 Metric Tonnes
	BELGIUM	2 327		3 662	57		33.3	47.3	42	
DENMARK	1 329	1 767	33	23.0	29.7	29	1980	106 <sup>x</sup>	1980	602 only mobile sources
FRANCE	14 395	24 366	69	208.0	328.0	58	1984	2 000 - 2 300	1980	5 200 <sup>x</sup> excl. ind. processes
GERMANY, F.R.	15 107	27 416	82	234.2	358.9	53	1986	2 400	1986	9 300
GREECE	345	1 885	446	9.2	28.6	211	1978	82 <sup>x</sup> excl. industr. processes	1978	695 excl. ind. processes
IRELAND	446	808	81	10.7	18.8	76	1984	62	1985	456
ITALY	11 134	24 300	118	146.4	257.8	76	1978	496 <sup>x</sup> excl. industr. processes	1978	4 036 excl. ind. processes
LUXEMBOURG	105	165	57	1.5	2.5	67				
NETHERLANDS	2 777	5 200	87	48.3	77.7	61	1985	456	1984	1 112
PORTUGAL	668	2 210	231	9.4	29.1	210	1983	376	1980	533
SPAIN	3 119	10 884	249	34.2	75.1	120	1980	739 <sup>x</sup>	1980	3 780
UNITED KINGDOM	13 571	19 660	45	178.9	277.2	55	1985	2 020	1985	5 394

\*) HC/VOC data marked x from OECD, Environmental Data 1987.



4

	NUCLEAR POWER PLANTS OPERATED			TOTAL ENERGY REQUIREMENTS in MTOE		
	Number of units 1987	Gross Capacity in MW	Percentage of Total Electricity Supply	1980	1983	1985
		1987	1987			
BELGIUM	7	5 784	66.1	45.61	39.75	42.83
DENMARK	—	—	—	19.37	16.59	19.46
FRANCE	53	51 924	69.8	194.20	186.25	197.16
GERMANY, F.R.	21	19 961	36.6	274.53	252.69	268.50
GREECE	—	—	—	16.24	16.81	18.38
IRELAND	—	—	—	8.69	8.66	9.16
ITALY	2	1 132	0.1	142.78	135.50	140.21
LUXEMBOURG	—	—	—	3.71	2.94	3.27
NETHERLANDS	2	540	6.0	65.96	57.80	62.15
PORTUGAL	—	—	—	11.42	12.48	12.76
SPAIN	9	6 797	32.0	71.77	71.93	74.31
UNITED KINGDOM	39	13 611	18.4	201.32	193.02	202.80

## 5

	TOTAL SO <sub>2</sub> EMISSION in 1000 Metric Tonnes					Reduction Rate			Reduction Rate from 1980	
	Year	Amount	1980	Year	Amount	from	to	%	to	%
	BELGIUM	1970	1 033	799	1984	467	1970	1984	55	1984
DENMARK	1970	523	438	1985	326	1970	1985	38	1985	26
FRANCE <sup>1)</sup>	1971	2 966	3 558	1985	1 845	1971	1985	38	1985	48
GERMANY, F.R. <sup>2)</sup>	1970	3 600	3 200	1985	2 400	1970	1985	33	1985	25
GREECE			800*	1983	720*				1983	10
IRELAND	1972	186	219	1985	138	1972	1985	26	1985	37
ITALY	1972	3 200	3 800	1985	2 503	1972	1985	22	1985	34
LUXEMBOURG	1970	35	23	1985	13	1970	1985	63	1985	44
NETHERLANDS <sup>3)</sup>	1970	685	487	1985	275	1970	1985	60	1985	44
PORTUGAL	1970	116	266	1983	305	1970	1983	+163	1983	+15
SPAIN	1975	3 004	3 250	1983	3 250	1975	1983	+ 8	1983	0
UNITED KINGDOM <sup>4)</sup>	1970	6 120	4 670	1985	3 580	1970	1985	42	1985	23

1) Total Emission in 1987 (preliminary figures): 1,520 000 t/a

2) " " " " " " : 2,000 000 t/a

3) " " " " " " : 282 000 t/a

4) " " " " " " : 3,680 000 t/a

\* According to ECE from 1988, the total SO<sub>2</sub> Emission amounts to 400 kt in 1980 and to 360 kt in 1983. If these figures are correct Greece would have a better position in the ranking list.



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	TOTAL NO <sub>x</sub> EMISSION in 1000 Metric Tonnes					Change Rate			Change Rate from 1980	
	Year	Amount	1980	Year	Amount	from	to	%	to	%
	BELGIUM			442	1984	385				1984
DENMARK	1970	192	251	1985	238	1970	1985	+ 19	1985	- 5
FRANCE <sup>1)</sup>	1973	1 699	1 867	1985	1 600 <sup>a)</sup>	1973	1985	- 0.4	1985	- 9
GERMANY, F.R. <sup>2)</sup>	1970	2 400	3 100	1985	2 900	1970	1985	+ 17	1985	- 7
GREECE			127	1983	150				1983	+ 15
IRELAND	1972	55	67	1985	68	1972	1985	+ 19	1985	+ 1.5
ITALY			1 480 <sup>b)</sup>	1985	1 595				1985	+ 7.2
LUXEMBOURG			23	1985	22				1985	- 4
NETHERLANDS	1970	398	535	1985	537	1970	1985	+ 26	1985	0
PORTUGAL	1970	72	166	1983	192	1970	1983	+ 63	1983	+ 14
SPAIN	1975	624	ca. 950	1985	950 <sup>c)</sup>	1975	1985	+ 34	1985	0
UNITED KINGDOM	1970	2 033	1 916	1985	1 837	1970	1985	- 10	1985	- 4

1) Total NO<sub>x</sub> emission 1987a (preliminary figures): 2,350 000 t/a

2) " " " 1986 " " : 3,000 000 t/a

3) " " " 1987 " " : 1,990 000 t/a

a) Excluding emissions by agricultural activities estimated to be about 700 kt/a.

b) Arithmetic mean; basic data: 1 410 - 1 550 000 Metric Tonnes

c) Arithmetic mean; basic data: 779 - 1 122 000 Metric Tonnes

7

TOTAL SO<sub>2</sub> EMISSION PER :

	Most Recent Year	Area in tonnes/sq.km		Inhabitants in kg/cap.		Unit of Gross Domestic Product in kg/1000 US \$		Unit of Energy Requirements in kg/TOE	
		most rec. year	1980	most recent year	1980	1980	1985	most recent year	1980
		BELGIUM	1984	15.07	25.77	47.17	81.14	6.78	3.90
DENMARK	1985	7.58	10.19	63.92	85.46	6.60	4.40	16.75	22.61
FRANCE	1985	3.39	6.54	33.42	65.15	5.43	2.66	9.36	18.32
GERMANY, F.R.	1985	9.64	12.85	39.34	51.98	3.93	2.77	8.94	11.66
GREECE	1983	5.46	6.06	72.73	80.81	19.93	17.95	42.83	49.26
IRELAND	1985	1.97	3.13	38.30	64.39	11.39	6.57	15.07	25.20
ITALY	1985	8.32	12.63	43.84	67.36	9.61	6.04	17.85	26.61
LUXEMBOURG	1985	4.33	7.67	32.50	63.01	5.07	2.54	3.98	6.20
NETHERLANDS	1985	6.71	11.88	18.97	32.72	2.88	1.57	4.43	7.38
PORTUGAL	1983	3.32	2.89	29.90	27.09	10.60	11.76	24.44	23.29
SPAIN	1983	6.44	6.44	84.40	86.93	15.32	14.90	45.18	45.28
UNITED KINGDOM	1985	14.67	19.14	62.90	82.93	8.75	6.11	17.65	23.20

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TOTAL NO<sub>x</sub> EMISSION PER :

	Most Recent Year	Area in tonnes/sq.km		Inhabitants in kg/cap.		Unit of Gross Domestic Product in kg/1000 US \$		Unit of Energy Requirements in kg/TOE	
		most rec. year	1980	most recent year	1980	1980	1985	most recent year	1980
BELGIUM	1984	12.42	14.26	38.89	44.65	3.75	3.21	9.28	9.69
DENMARK	1985	5.54	5.84	46.67	49.22	3.79	3.21	12.23	12.96
FRANCE	1985	3.11	3.43	28.98	34.38	2.85	3.46	8.59	9.61
GERMANY, F.R.	1985	11.65	12.45	47.54	50.49	3.81	3.34	10.80	11.29
GREECE	1983	1.14	0.96	15.00	12.83	3.16	3.74	8.92	7.82
IRELAND	1985	0.97	0.96	18.89	19.14	3.48	3.24	7.42	7.71
ITALY	1985	5.30	4.92	27.93	26.10	3.74	3.85	11.38	10.37
LUXEMBOURG	1985	7.33	7.67	55.00	57.50	5.07	4.30	6.73	6.20
NETHERLANDS	1985	13.10	13.05	37.04	37.41	3.16	3.07	8.64	8.11
PORTUGAL	1983	2.09	1.80	18.82	16.44	6.62	7.40	15.39	14.54
SPAIN	1985	1.88	1.88	24.61	24.74	4.48	4.18	12.78	13.24
UNITED KINGDOM	1985	7.53	7.85	32.51	33.97	3.59	3.14	9.06	9.52





NO<sub>x</sub> EMISSIONS :

BY SOURCE IN 1000 METRIC TONNES AND PERCENTAGE CONTRIBUTION

	Year	Stationary Combustion Sources	%	Industrial Non-combustion sources	%	Non-industrial and domestic sources incl. resid. heating	%	Mobile Sources	%
BELGIUM	1984	87	23	20	5	26	7	252	65
DENMARK	1985	144	60	1	0.4	8	3.6	85	36
FRANCE *	1985	370	22	53	3	140	8	1 130	67
GERMANY, F.R.	1985	1 090	37	20	1	130	5	1 670	57
GREECE	1980	Power Plants	17	Industry	9	Small Sources	2		72
IRELAND	1983	Power Plants	33	Industry, incl. commercial sect.	7	Small Sources	7		34
ITALY	?	Power Plants	24	Industry	14	Small Sources	16	ECE-Data for 1983: 51-46%	46
LUXEMBOURG	1985	2.5	11	3.6	17	1.6	7	14	65
NETHERLANDS	1983	138	27	23	4	38	7	323	62
PORTUGAL	1983	44	23	28	15			120	62
SPAIN	1985	350-357 a)	37	110-204 b)	16			339-561 c)	47
UNITED KINGDOM	1984	830	49	100	6			750	45

\* not including 700 t from agricultural activities

a) Arithmetic mean: 354

b) Arithmetic mean: 157

c) Arithmetic mean: 450

INDEX : TOTAL SO<sub>2</sub> AND NO<sub>x</sub> EMISSIONS IN 1980 AND 1985 PER

	AREA in tonnes/sq.km				INHABITANTS in kg/cap.				GROSS DOMESTIC PRODUCT in kg/1000 US \$				ENERGY CONSUMPTION in kg/TOE			
	SO <sub>2</sub>		NO <sub>x</sub>		SO <sub>2</sub>		NO <sub>x</sub>		SO <sub>2</sub>		NO <sub>x</sub>		SO <sub>2</sub>		NO <sub>x</sub>	
	1980	1985	1980	1985	1980	1985	1980	1985	1980	1985	1980	1985	1980	1985	1980	1985
BELGIUM	100	100	100	95	94	56	78	71	34	22	57	43	36	25	67	60
DENMARK	40	50	41	42	100	76	86	85	33	25	57	43	46	37	89	79
FRANCE	25	23	24	24	76	40	60	53	27	15	43	47	37	21	66	56
GERMANY, F.R.	50	64	87	89	61	47	88	86	20	15	58	45	24	20	78	70
GREECE	24	36	7	9	94	86	22	27	100	100	48	51	100	95	54	60
IRELAND	12	13	7	7	73	46	33	34	57	37	53	44	51	33	53	48
ITALY	49	55	35	41	78	52	45	51	48	34	57	52	54	40	71	74
LUXEMBOURG	30	29	54	56	67	39	100	100	25	14	77	58	13	9	43	44
NETHERLANDS	46	45	92	100	40	23	65	67	15	9	48	42	15	10	56	56
PORTUGAL	11	22	13	16	31	36	29	34	53	66	100	100	47	54	100	100
SPAIN	25	43	13	14	99	100	43	45	77	83	68	57	92	100	91	83
UNITED KINGDOM	74	97	55	58	96	74	59	59	44	34	54	42	47	39	66	59
INDEX 100 =	25.77	15.07	14.26	13.10	85.88	84.20	57.50	55.00	19.93	14.90	6.62	7.40	49.26	45.18	14.54	15.39

\* In case of missing data for 1985, the figures from the most recent year were taken.



	DAMAGE TO FORESTS	AMBIENT AIR QUALITY STANDARDS (LONG-TERM AVERAGE)	
		SO <sub>2</sub>	NO <sub>2</sub>
BELGIUM	18 % of total forested area	80/779/EEC = 0.08/0.12 mg/m <sup>3</sup>	85/203/EEC (only short-term standard!) = 0.20 mg/m <sup>3</sup> 98 perc.
DENMARK	Western peninsula of Jylland	80/779/EEC	85/203/EEC (see Belgium)
FRANCE	38% of coniferous trees 1986 (1 Million hectares surveyed)	80/779/EEC	85/203/EEC (see Belgium)
GERMANY, F.R.	54 % of total forested area (1986)	0.14 mg/m <sup>3</sup> and 0.05 in areas with concentr. below 0.05 mg/m <sup>3</sup>	0.08 mg/m <sup>3</sup>
GREECE	no information	80/779/EEC	85/203/EEC (see Belgium)
IRELAND	no information	80/779/EEC	85/203/EEC (see Belgium)
ITALY	5 % of total forested area (1984)	80/779/EEC	85/203/EEC (see Belgium)
LUXEMBOURG	20 % of coniferous trees (1986)	80/779/EEC	85/203/EEC (see Belgium)
NETHERLANDS	59 % of coniferous trees (1986)	0.075 mg/m <sup>3</sup> 50 perc./24 h 0.250 mg/m <sup>3</sup> 98 perc./24 h	0.135 mg/m <sup>3</sup> limit value 0.080 mg/m <sup>3</sup> guide value
PORTUGAL	no information	0.08 mg/m <sup>3</sup> daily mean 0.25 mg/m <sup>3</sup> 98 perc. all d.m./y.	85/203/EEC (see Belgium)
SPAIN	39 % of coniferous trees 1986 (500 000 hectares surveyed)	80/779/EEC	85/203/EEC (see Belgium)
UNITED KINGDOM	67 % of coniferous trees 1986 (1 461 000 hectares surveyed).	80/779/EEC	85/203/EEC (see Belgium)



	Emission Charge System	Car Exhaust Standards: Support for stricter Standards as in the EEC Directive	Green Parties in National Parliament	Number of petrol stations with unleaded petrol *	
				1986	July 1988
BELGIUM	no		yes	100	103
DENMARK	no	yes	no	900	all stations
FRANCE	Since 1986 very small charge on SO <sub>2</sub> Emissions	no	no	89	721
GERMANY, F.R.	no	yes	yes	12 500	all stations
GREECE	no	yes	no	40	135
IRELAND	no	no	no	--	23
ITALY	no	no	yes	90	720
LUXEMBOURG	no	yes	yes	24	all stations
NETHERLANDS	Fuel levy	yes	no	8 000	all stations
PORTUGAL	no		yes	--	30
SPAIN	no	no	no	70	63
UNITED KINGDOM	no	no	no	174	1162

\* Figures for 1986 provided by the European Commission;  
 Figures for July 1988 provided by ADAC (German Automobilist Association)

Abatement Technology in Large Combustion Plants  
in operation or under construction

Sulphur Content Limit  
Value for Gasoil

General Speed Limit  
km/h

Flue Gas  
Desulphurization

Flue Gas  
Denitrification

Fluidized  
Bed Combustion

in weight-%

Motorways

Trunk Roads

	Flue Gas Desulphurization	Flue Gas Denitrification	Fluidized Bed Combustion	Sulphur Content Limit Value for Gasoil in weight-%	General Speed Limit km/h Motorways	Trunk Roads
BELGIUM	no	no	no	0.3	120	90
DENMARK	yes	no		0.3	100	80
FRANCE	no	no	yes	0.3	130	90
GERMANY, F.R.	yes	yes	yes	0.3 (0.2 1988)	no	100
GREECE	no	no	no	0.3	80	80
IRELAND	no	no	no	0.3-0.5	97	97
ITALY	yes	no	no	0.3	90/140	80/110
LUXEMBOURG	no	no	no	0.3-0.5	120	90
NETHERLANDS	yes	yes	yes	0.3	100	80
PORTUGAL	no	no	no	0.5	120	90
SPAIN	no	no	no	0.3-0.5	120	90
UNITED KINGDOM	under construction	no	yes	0.3-0.5	112	97

RANKING LIST  
SO<sub>2</sub> EMISSION (INDEX)  
1980

COUNTRY	INDEX
GREECE	80
SPAIN	73
BELGIUM	66
UNITED KINGDOM	65
ITALY	57
DENMARK	55
IRELAND	48
FRANCE	41
F.R. GERMANY	39
PORTUGAL	36
LUXEMBOURG	34
NETHERLANDS	29
SWITZERLAND	13

**Note:** Mean values of indices for area, inhabitants, GDP, and energy requirement.  
The higher the number, the more unfavourable the emission situation.

RANKING LIST  
NO<sub>x</sub> EMISSION (INDEX)

1980

COUNTRY	INDEX
F.R. GERMANY	78
BELGIUM	76
LUXEMBOURG	69
DENMARK	68
NETHERLANDS	65
PORTUGAL	61
UNITED KINGDOM	59
SPAIN	54
ITALY	52
FRANCE	48
SWITZERLAND	42
IRELAND	37
GREECE	33

**Note:** Mean values of indices for area, inhabitants, GDP, and energy requirement.  
The higher the number, the more unfavourable the emission situation.

RANKING LIST  
SO<sub>2</sub> EMISSION (INDEX)  
1985

COUNTRY	INDEX
SPAIN	82
GREECE	79
UNITED KINGDOM	61
BELGIUM	51
DENMARK	47
ITALY	45
PORTUGAL	45
F.R. GERMANY	37
IRELAND	32
FRANCE	25
LUXEMBOURG	23
NETHERLANDS	22

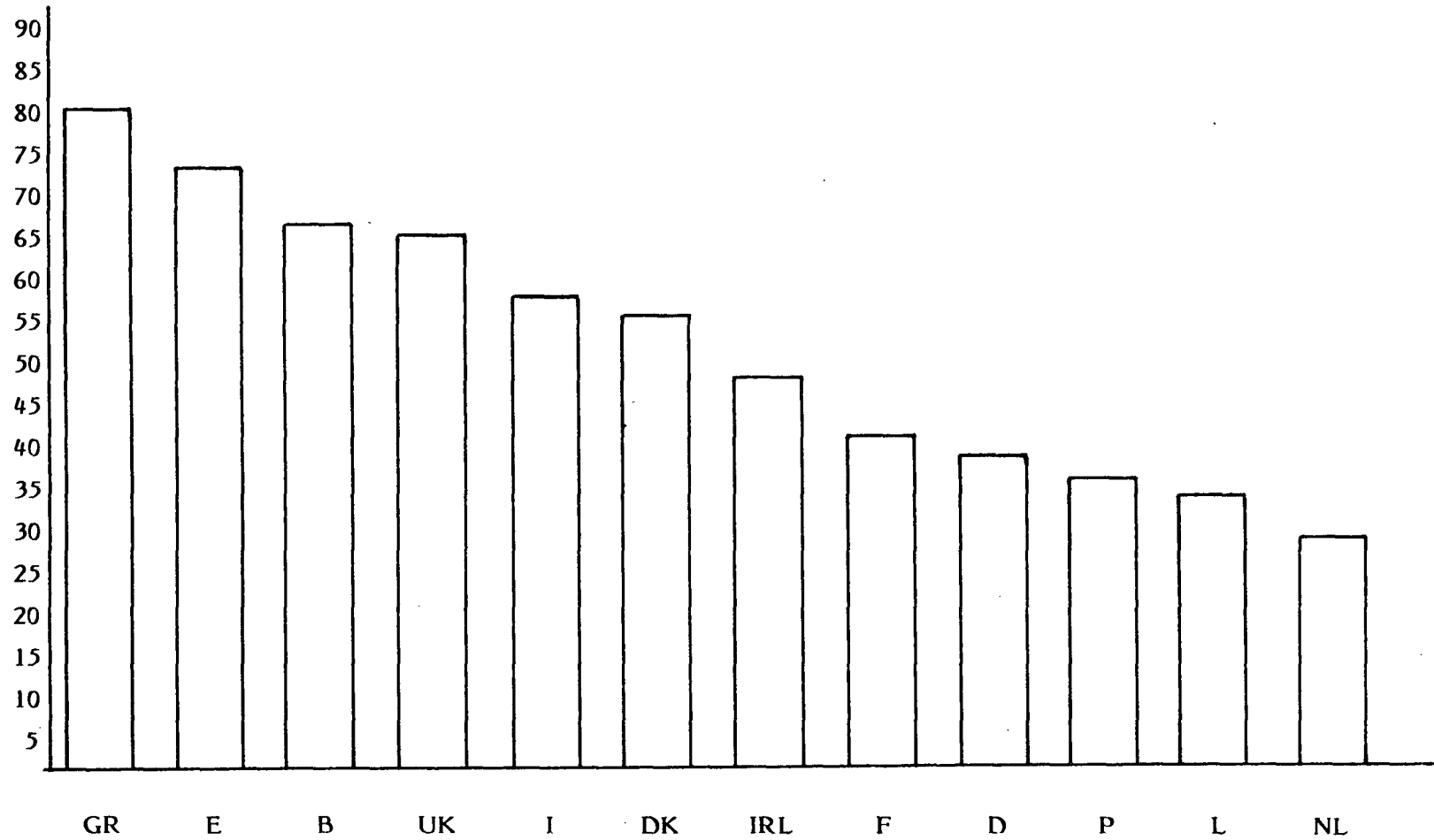
**Note:** Mean values of indices for area, inhabitants, GDP, and energy requirement. The higher the number, the more unfavourable the emission situation. In case of equal indices, the ranking was determined by the highest absolute value.

RANKING LIST  
 NO<sub>x</sub> EMISSION (INDEX)  
 1985

COUNTRY	INDEX
F.R. GERMANY	73
BELGIUM	68
NETHERLANDS	66
LUXEMBOURG	65
DENMARK	63
PORTUGAL	63
UNITED KINGDOM	55
ITALY	55
SPAIN	50
FRANCE	45
GREECE	37
IRELAND	34

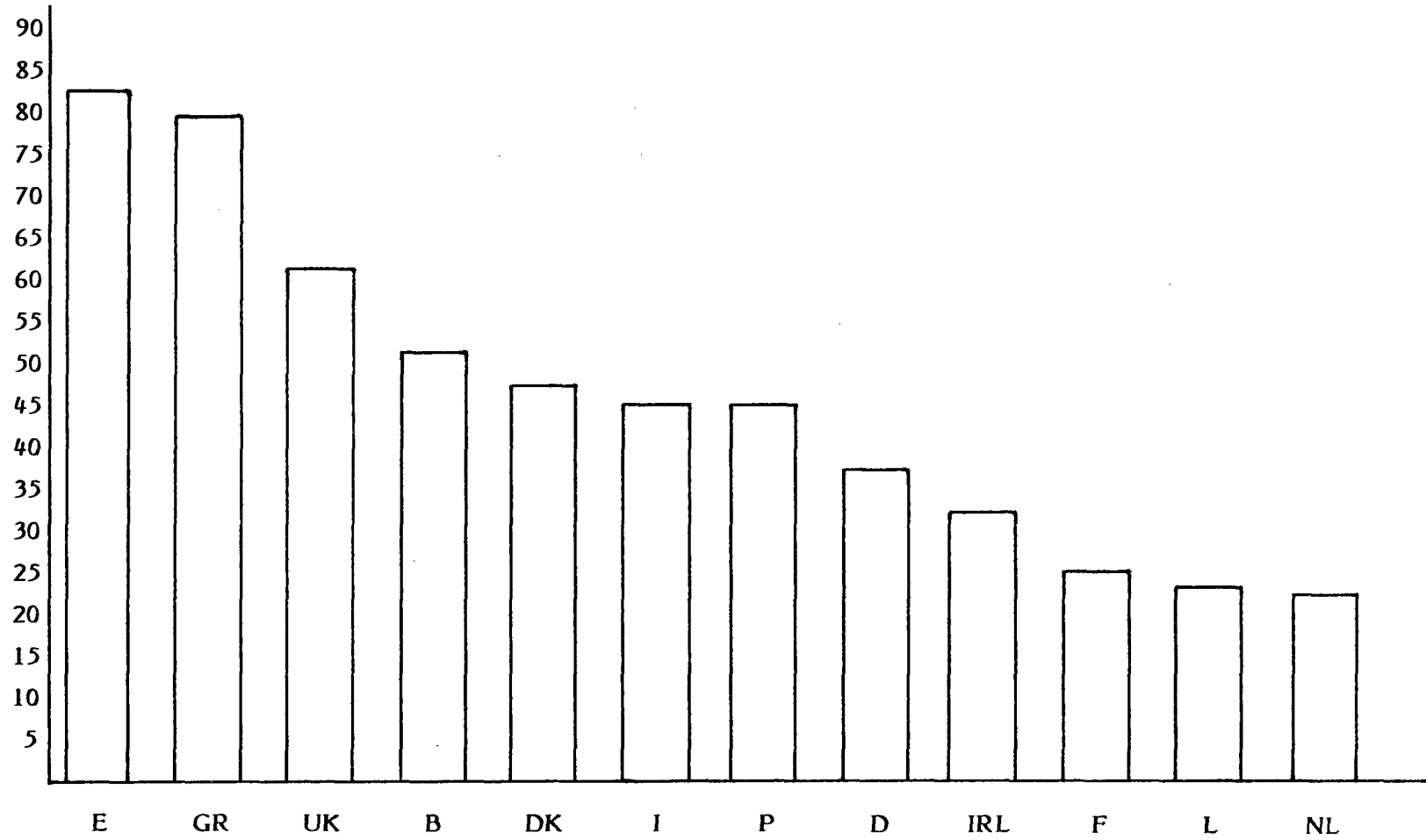
**Note:** Mean values of indices for area, inhabitants, GDP, and energy requirement. The higher the number, the more unfavourable the emission situation. In case of equal indices, the ranking was determined by the highest absolute value.

SO<sub>2</sub> EMISSIONS (INDEX) 1980



Note: Mean values of indices for area, inhabitants, GDP and energy requirement.

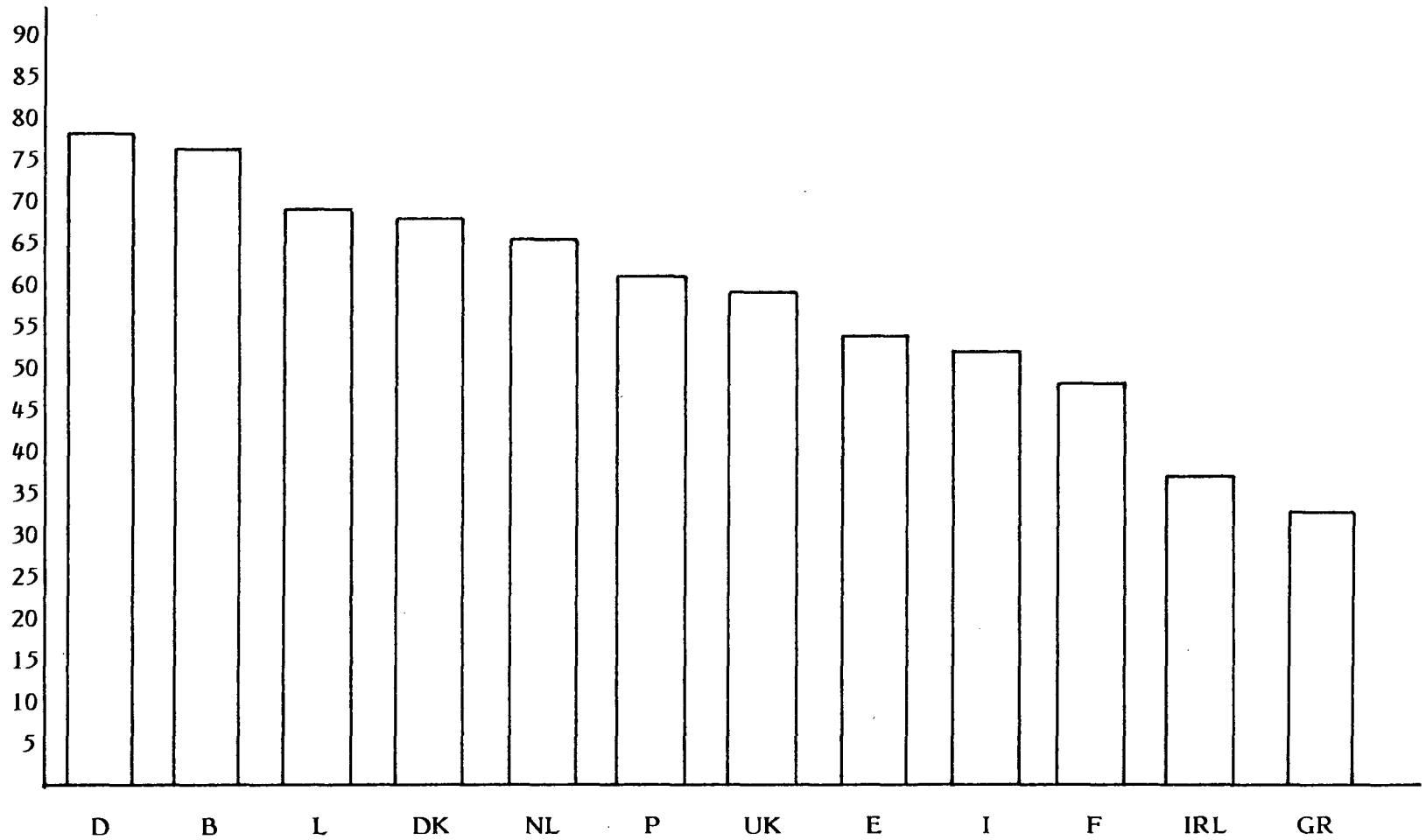
### SO<sub>2</sub> EMISSIONS (INDEX) 1985



Note: Mean values of indices for area, inhabitants, GDP and energy requirement.

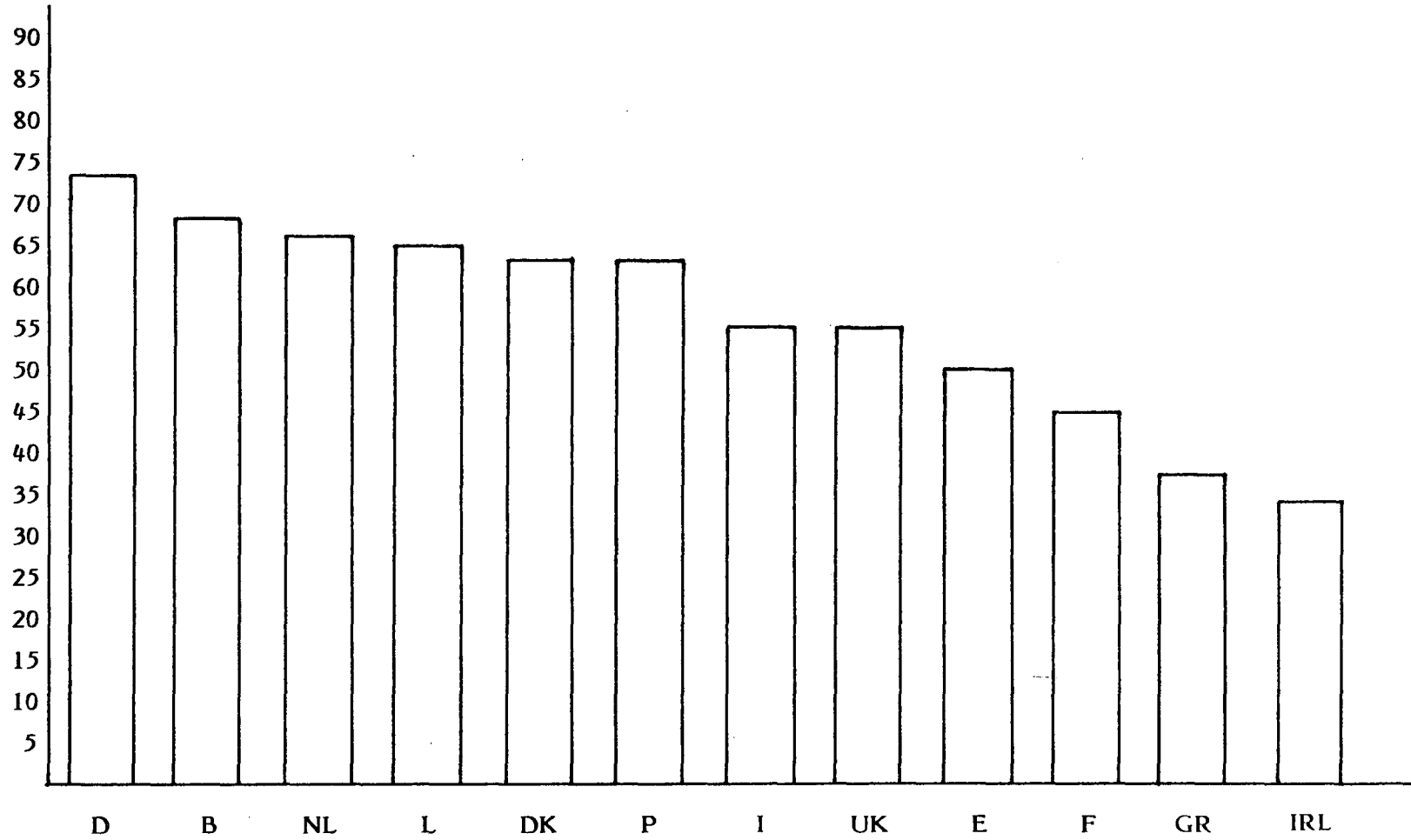


NO<sub>x</sub> EMISSIONS (INDEX) 1980



Note: Mean values of indices for area, inhabitants, GDP and energy requirement.

NO<sub>x</sub> EMISSIONS (INDEX) 1985



Note: Mean values of indices for area, inhabitants, GDP and energy requirement.