A CROSS-NATIONAL COMPARISON OF AIR POLLUTION MANAGEMENT: FRANCE, THE GERMAN DEMOCRATIC REPUBLIC, AND THE UNITED STATES

Loretta Hervey
Robin Dennis

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Preface

This report is one of a series describing a multidisciplinary multinational IIASA research study on the Management of Energy/Environment Systems. The primary objective of the research is the development of quantitative tools for regional energy and environment policy design and analysis--or, in a broader sense, the development of a coherent, realistic approach to energy/environment management. Particular attention is being devoted to the design and use of these tools at the regional level. The outputs of this research program include concepts, applied methodologies, and case studies. During 1975, case studies were emphasized; they focused on three greatly differing regions, namely, the German Democratic Republic, the Rhone-Alpes region in southern France, and the state of Wisconsin in the U.S.A. The IIASA research was conducted within a network of collaborating institutions composed of the Institut fuer Energetik, Leipzig; the Institut Economique et Juridique de l'Energie, Grenoble; and the University of Wisconsin-Madison.

W.K. Foell
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(i) INTRODUCTION

Air pollution is currently causing discomfort and disease in every industrialized nation, East and West. A case study of regional energy and environmental policy in the Rhone-Alpes region of France, the German Democratic Republic, and the state of Wisconsin in the United States was undertaken to examine how three countries with highly diverse governmental and economic institutions have approached a common problem. At one end of the political/economic spectrum is the U.S., with decentralization of power a diffuse decision-making structure, and a philosophy of private enterprise. At the other extreme is the GDR, with centralized decision-making, nationalized industry, and a tradition of comprehensive planning. France may be typified by a mixture of these elements - a long history of centralized government and nationalization of some energy enterprises.*

The close ties of the IIASA Ecology Project with research institutions in France, the GDR, and Wisconsin permitted the collection of parallel legal documents dealing with environmental protection in the three regions. The IIASA team also obtained empirical values of pollution concentrations in the cities of each study area. This material provided a basis for a cross-national comparison of such factors as government roles in supervising industry, the chain of authority in the implementation of pollution legislation, pollution standards, and sanctions against polluters. Also, a preliminary attempt was made to assess each country's progress in executing its legislation, through examination of current concentrations of pollutants in the ambient air.

* The general institutional structure of each region was described in more detail in an earlier IIASA research memorandum: S. Born, P. Hedrich, J.M. Martin et al., "Energy/Environment Models and their Relationship to Planning in Wisconsin, the German Democratic Republic and Rhone-Alpes." (RM 76-21, April 1976). The essays presented here were written by policy makers or experts in the energy field in each study area. For further information on the GDR, see also K. Hanf's report, "Policy and Planning in the German Democratic Republic - an Interorganizational Perspective," Internationales Institut fuer Management und Verwaltung, Berlin, 1975.

In the first section of this report, the evolution of pollution legislation is traced in France, the U.S., and the GDR, with special attention given to emerging patterns of federal-regional responsibility in the environmental sphere. In the following section, the current structure of governmental bureaucracies which have been set up to implement environmental legislation are examined in each study area. Next, attention is focused upon the limits now in effect for pollutant concentrations in the ambient air* and for emissions** in France, the GDR, and the U.S.; here conceptual and definitional problems in comparisons of pollution 'standards' are emphasized. Strategies for obtaining compliance to legislation, such as financial penalties, are summarized in the fourth section. Finally, environmental legislation is considered in the light of existing levels of pollution in the cities of each region.

It must be stressed that this paper is based for the most part upon information provided in legal texts; it was not possible to gather evidence on the extent to which the laws are in fact enforced. Thus one may not assume that rigorous-sounding legislation necessarily implies equally rigorous implementation.

* 'Ambient air pollution concentrations' are defined as quantities (mass/unit volume or parts per million by volume) in the ambient air.

** 'Emissions' are defined as quantities (weight or volume) of given pollutants discharged at their source, i.e. plant chimneys.

(1) HISTORICAL DIFFERENCES IN POLLUTION CONTROL EFFORTS

FRANCE

Stationary Sources. Of the three countries under scrutiny, France has had most experience with direct government supervision of polluting industries. As early as 1810 Napoleon decreed that plants which emit offensive odors could not be built without permission. Under the 1917 'Law of Classed Establishments' the requirement for authorization was extended to dangerous, as well as offensive plants.[1] The final group of emittors to be brought under government control were combustion installations: in 1948 these units were ordered to conform to construction, installation, and output norms, and further to submit to periodic control visits. In 1964 they were included for the first time in the list of 'Classed Establishments.'[2]

The 1960's were marked by legal efforts to standardize pollution control measures and to extend government prerogatives. A general 1961 law ordered competent officials to determine permissible levels of particulate, toxic, maloderous, and radioactive emissions. In 1963 uniform monetary fines were imposed on plants which failed to conform to emission restrictions, and Departmental Prefects were authorized to take emergency action against polluters in case of danger to public health. During this decade Prefects also acquired the power to create "zones of special protection" with stringent emission standards in heavily polluted metropolitan areas.[3]

Recent pollution legislation in France has been mainly directed toward specific industries. For instance, in 1966 emission norms and other technical instructions were issued for the operation of thermal power plants. The following year formulas were published for calculating minimum chimney heights in new combustion installations; subsequently, emission limits for cement factories, iron-ore agglomerations, urban incinerators, cast-iron foundries, and steel works have appeared.[4]

French authorities have also attempted to decrease emissions more directly by limiting the sulfur content of fuels. A 1967 decree specified that the sulfur content of heavy fuel oil No.1

and light fuel oil could not exceed 2%, while that of heavy fuel oil No.2 was limited to 4%. In 1968 the sulfur content of domestic fuel oil was restricted to .7%, with progressive decreases to .3% forseen for the 1970's.[5]

Motor Vehicles. Legislation aimed at cutting down emissions from motor vehicles first appeared in the early 1960's in France. In 1963 a test of the opacity of smoke emissions was ordered for all new motor vehicles. The following year it was determined that the total quantity of unburned hydrocarbons could not exceed 15% of the fuel consumed during vehicle operation. Finally, a 1970 decree aligned French legislation with Regulation 15 of the Geneva Accord of 1958, as well as with the 1970 Directives of the Council of Ministers of the European Community.[6]

Ambient Air. The concept of 'ambient air quality standards' has not been developed in French legislation.[7] The government has preferred to control pollution directly at the level of the emitting plant, rather than by setting general air quality standards and then giving plants or local authorities responsibility for ensuring that they are met. This seems to accord with France's traditionally highly centralized government and its history of government initiative in policing industrial emissions.

UNITED STATES

The history of environmental legislation in the U.S. attests to the federal government's very gradual assumption of responsibility for pollution control. In the 1955 'Air Pollution Control Act' a federal role was seen only in the funding of local anti-pollution programs and research. The 1963 'Clean Air Act' gave the Secretary of Health, Education, and Welfare (HEW) the authority to involve dangerous polluters in a conference - public hearing - court suit procedure; but this process proved so time-consuming that it only underscored the inability of the federal government to take action against emittors.[8] Only after the passage of the 1967 'Air Quality Act' was the Secretary of HEW empowered to go directly to court to force a stop to dangerously high levels of pollution.

Ambient Air. The 'Air Quality Act' also marked the federal government's first attempt to set nation-wide air quality norms.

The provisions of the Act reveal the indirect tactics which legislators found it necessary to employ at this early stage: HEW was required to publish 'air quality criteria' for dangerous pollutants; the states were then to develop 'air quality standards' designed to meet the federal 'criteria,' to produce plans for implementing and enforcing the standards, and, finally, to gain federal approval for these measures. If a state proved lax, HEW was permitted to intervene. However, not one state implementation plan was approved between 1967 and 1970, and HEW could not force compliance to non-existant plans.[9]

The failure of the 1967 Act led U.S. legislators to restate its provisions in a much more detailed and stringent manner in the 1970 'Clean Air Act Amendments.' The pollution 'criteria' of the earlier law (which had functioned simply as guidelines for the States' own standards) were replaced by national 'air quality standards,' which the states were required to adopt without modification. The pattern of federal-state interaction which had characterized the 1967 Act was carried over into the new law, for the states were ordered to develop plans for attaining and maintaining the national standards, and to submit them to the new Environmental Protection Agency (EPA) for approval. However, the Amendments specified more exactly the content of the states' plans: they were to include land-use and transportation schemes, emergency plans for high pollution episodes, and outlines for state-wide pollution surveillance systems. The states were to secure federal approval for their plans by the target date of May 31, 1975, but extensions have since been granted.[10]

Stationary Sources. The U.S. federal government has taken the prerogative in controlling pollution from stationary sources much more slowly than its French counterpart. Until recently, U.S. legislators have preferred the more indirect approach of focusing their attention on ambient air quality and leaving point-source emission control to local authorities. This policy seems to reflect the country's overarching institutional structure: separation of federal and local power and government reluctance to interfere with private industry.

However, U.S. lawmakers did call for several federal emission standards for stationary sources in the 1970 Amendments. Here the

EPA was instructed to publish standards for rare, but dangerous, pollutants not likely to be covered by state implementation plans. In addition, the EPA was given the task of developing performance standards, including emission standards, for certain industrial plants. In the early 1970's standards were issued for such plants as new or reconstructed steam generators, sulfuric and nitric acid plants, cement plants, and iron and steel mills.[11]

Motor Vehicles. Perhaps because the issue of federal vs. state jurisdiction is not as salient for mobile sources of pollution, the federal government has taken a direct approach toward curbing motor vehicle exhaust. When the need to regulate automobiles was recognized in the early 1960's, lawmakers skipped the stage of drafting guidelines ('criteria'); instead, in a 1965 Act they directed the Secretary of HEW to set national emission standards for new foreign and domestic vehicles. By 1970, CO emissions from new cars were to be 71% lower than those from 1963 models, and hydrocarbon exhaust was similarly to be reduced by 82%. In the 1970 Clean Air Act Amendments, legislators took the radical step of calling for a nearly emission-free car engine within six years (later extended to eight).[12]

GERMAN DEMOCRATIC REPUBLIC

Ambient Air. Because the GDR was founded in 1949, its legislators have had less time and many more basic organizational problems to resolve before addressing environmental issues, than have their French and American counterparts. The first attemt to regulate air pollution in the GDR was recorded in a 1968 regulation, in which "threshold values" - levels of pollution above which damage to human health is believed to occur - were defined for ambient concentrations of 48 substances. Public officials were directed to consider these values when issuing siting permits, planning new investments, and reconstructing existing plants.[13]

The philosophy underlying the GDR's approach to environmental protection was first clearly expressed in the 1970.

'Landeskulturgesetz.' Here environmental problems were incorporated into the planning process which characterizes GDR policy-making in general. As the law states, "the requirements of a socialist society are to develop productivity in a planned manner, so as to lead to an increase in the utility and productivity of natural resources and guarantee the maintenance and beautification of the natural environment."[14] The conviction that economic and conservationist goals can be coordinated through planning is the earmark of GDR environmental legislation.

Stationary Sources. Underlying the GDR's plans is the assumption that industry and government can work together to control pollution. At the level of the national government, both ambient air quality and emission norms have been developed; 1973 legal directives set threshold values for ambient air concentrations of 113 pollutants, and provided as well formulas based on ambient air pollution levels and chimney heights for calculating permissible emissions. It is forseen that industry officials will use these prescriptions to assure that emissions from plants do not cause ambient air quality norms to be violated.[15]

Despite this delegation of responsibility, the central government bodies retain ultimate leverage over emitting plants. For instance, the Chairman of the National Council of Ministers (Vorsitzende des Ministerrates) has the power to restrict industrial operations, or to order a change in fuels during dangerous episodes of pollution. Punitive measures have also been spelled out for disciplining plants with chronically excessive emission levels.[16]

Motor Vehicles. The GDR's emphasis on cooperation between government and industry is also found in measures to control emissions from motor vehicles. A 1974 directive gave the federal Department of Exhaust Gas Inspection (Abgaspruefstelle der DDR) the task of setting emission threshold values for internal combustion engines and developing techniques for testing motor vehicles. At the same time the directive called for the creation of 'Exhaust Gas Deputies' (Abgasbeauftragte) in all plants connected with the importing, producing, or repairing of motor vehicles. Their task is to assure self-policing in plants by checking whether motor vehicles meet threshold emission values.

By 1974 norms had also been set for permissible idling time in moving traffic, CO emissions (by weight of vehicle), and lead content of fuels.[17]

This overview of the evolution of environmental legislation in France, the U.S., and the GDR has revealed contrasting styles of problem-solving. Governmental philosophy about reconciling economic and ecologic goals seems to be most clearly articulated in the legislation of the GDR. There the emphasis is on the planning of investments so as to avoid unhealthy concentrations of pollutants. The centralized decision-making system of the GDR has permitted the parallel development of both emission and ambient air quality norms at the national level, and the maintenance of these norms is assumed to be a cooperative venture between government and industry.

In France the highly centralized government has laid most emphasis on the direct policing or industry by means of emission restrictions, rather than on the intermediate step of supervising ambient air quality.

In the U.S., in contrast, the responsibility of the federal government has been confined to the setting of air quality standards (and emission standards for several types of stationary sources), while state authorities are charged with working out implementation plans for meeting the standards and policing industry. The division of power between national, state, and local authorities, as well as the restriction of government interference in private industry, has thus produced a more complex and diffuse approach toward pollution control than is found in the GDR and France.

(11) CURRENT BUREAUCRATIC ORGANIZATION

Just as the approaches toward the setting of pollution norms in France, the GDR, and the U.S. seem to reflect the general institutional structure of each country, the chain of authority set up to implement environmental legislation follows a similar pattern.

For instance, the centralized management and planning characteristic of the GDR government as a whole is reproduced in agencies for environmental protection. At the national level, the Council of Ministers (Ministerrat) has responsibility for policy-making, planning, and central management of pollution control activities. The federal Ministry of Health (Ministerium fuer Gesundheitswesen) has been given the task of setting ambient air threshold values and developing a nation-wide pollution monitoring system. Concomitantly, the Ministries of Machine and Vehicle Construction and Transportation (Ministerium fuer Allgemeinen Maschinen-, Landmaschinen-, und Fahrzeugbau und Ministerium fuer Verkehrswesen) must set emission threshold values for internal combustion engines. Finally, the Ministry for Environmental Protection and Water Management (Ministerium fuer Umweltschutz und Wasserwirtschaft) is responsible for assuring the coordination of all pollution-abatement measures.

At the local level in the GDR, the distribution of tasks between District Councils (Raete der Bezirke) and polluters accords with the national policy of cooperation between government and industry. Thus, emission threshold values for individual plants are set by the Councils with the help of the plants themselves. If a plant finds it impossible to meet these limits, it must work with its local Council to develop plans for lowering emissions. Representatives of government and industry also collaborate in planning 'accommodation' measures to decrease the harmful effects of unavoidable pollution, and 'compensation' measures in case of injuries to workers or damage to their living conditions.[18]

As in the GDR, the strong central government of France has stressed the central coordination of pollution control activities. Since 1973, the Directorate for the Prevention of Pollution and Nuisances (la Direction de la Prevention des Pollutions et des

Nuisances), within the Ministry for the Protection of Nature and the Environment (Ministere de la Protection de la Nature et de l'Environment), has been responsible for preparing a national program for combatting pollution. The Minister of the Environment (Ministre de l'Environment) is in charge of a corps of Environmental Inspectors and Regional Environmental Delegates (Inspecteurs generaux de l'Environnement et Delegues regionaux a l'Environnement); he has as well ultimate responsibility for all environmental legislation, and must take action during episodes of exceptionally high pollution. Several other Ministers at the national level are concerned with pollution problems, including the Minister for Industrial and Scientific Development (Ministre du Developpement Industriel et Scientifique), the Minister of Public Health (Ministre de la Sante Publique et de la Securite Sociale), and the Minister of the Interior (Ministre de l'Interieur).[19]

As far as actual regulation of noisome industries is concerned, the French government uses the following clearly articulated procedures. Before a potentially dangerous plant may begin operations, it must receive authorization from the Inspectorate of Classed Establishments (Conseil Superieur des Etablissements classes), a service under the jurisdiction of both the Mines Inspectorate (Service des Mines) and the Departmental Prefect. If the plant is permitted to open, it must conform to precise technical prerequisites set forth as conditions of authorization. These include specification of fuels to be used, permissible emission rates, and monitoring procedures. The instructions result either from application of legal directives, which have been worked out by representatives of the industrial branches and the government, or (if no such directives exist for a particular type of plant) from the deliberations of the Inspectorate of Classed Establishments. After granting an authorization, the Inspectorate has the further responsibility of making periodic control visits, to assure that the technical prescriptions are being followed.[20]

In the U.S. the chain of authority in environmental affairs is based upon the traditional division of power between the national and state governments. This has led to complicated federal-state interactions, in which states must win federal

approval for their pollution-control programs. On the federal level the Environmental Protection Agency is responsible for funding and coordinating research on environmental problems, for trying to introduce conformity into pollution-abatement schemes across the country, for giving financial support to local programs, and for establishing ambient air quality standards and some emission standards. The Administrator of the EPA also has recently acquired the authority to bring willful violators of pollution laws to court, and to order investigations of plants suspected of having illegally high emissions.[21]

Wisconsin may be used to illustrate the role of state governments in pollution control in the U.S. In response to the requirements of the 1967 Air Quality Act, the Wisconsin Department of Natural Resources (DNR) was given the task of establishing a comprehensive air pollution abatement program for the state. In 1970 it assumed responsibility for developing the 'air quality implementation plan' called for by the Clean Air Act Amendments. This plan had to provide for industrial emission standards strict enough to assure compliance with federal ambient air standards, as well as emergency plans for pollution crises, a statewide pollution surveillance system, and inspection of emitting plants. When the federal EPA Administration rejected all state implementation plans in 1973,* the South East Wisconsin Regional Planning Commission (SEWRPC) stepped in to work with the DNR. The two agencies are currently cooperating in developing a Regional Air Quality Maintenance Plan, which is based on an evaluation of SEWRPC's 1985 Land Use Plan and transportation projections. The Wisconsin Public Service Commission is yet another state agency involved in pollution control; it polices electric utilities by requiring them to submit every two years a ten year plan for new construction. Before building is commenced, the Commission must also carry out an environmental impact analysis.[22] Thus in the U.S., responsibility is not only distributed between federal and state government - it is further spread among a multitude of state agencies.

* The rejections resulted from the states' failure to consider the problem of maintaining clean air standards, as population and motor vehicles increase.

(111) AMBIENT AIR QUALITY STANDARDS

Before making cross-national comparisons, it is important to consider that the concept of a standard may not be exactly equivalent in France, the GDR, and the U.S. In fact, the word 'standard' is only found in U.S. legislation; here a 'primary ambient air standard' is defined as the 'maximum level of a pollutant which should be permitted to occur in order to protect human life,' and a 'secondary ambient air standard' is 'the maximum level of the pollutant which should be permitted to occur in order to protect animal and plant life and property from damage, and thereby protect the public welfare from any known or anticipated adverse effects of an air pollutant.'[23] In the GDR, the term ambient air 'threshold value' is used in place of 'standard.' This term is defined as 'the maximum concentration of a pollutant, which according to medical knowledge does not have a harmful effect on the human organism'.[24] Its denotation is thus quite similar to that of the U.S. primary ambient air standard.
The term 'reference value' is used in French legislation to indicate desirable limits for pollution concentrations in the ambient air. The sphere of applicability of such 'reference values' is narrower than that of U.S. standards and GDR threshold values, for they are used mainly in calculating permissible chimney heights.[25]

International differences may also be seen in the time-periods for which a norm or standard applies. For instance, the U.S. air quality standard for CO is given in the form of an 8-hour average, while the corresponding GDR threshold value is a 24-hour average. Though these may be converted to a common time-unit, the original units might reflect different theories about the duration of pollution which is critical for health effects.

The current limits for concentrations of selected pollutants in the ambient air of the U.S., GDR, and France are presented in Table 1. The figures given for the U.S. are primary ambient air standards; secondary standards are either the same or more restrictive than the primary standards.

Table 1. Highest Concentrations of Pollutants Currently Permitted in the Ambient Air of France, the U.S., and the GDR.[26]

Pollutant	France	U.S.A.	G.D.R.
CO	--	10,000$\mu g/m^3$ 8hr av.*	1000$\mu g/m^3$ 24hr av.
SO_2		80$\mu g/m^3$ ann.av.	
	250$\mu g/m^3$ 24 hr.av.	365$\mu g/m^3$ 24hr.av.*	150$\mu g/m^3$ 24hr.av.
NO_2	--	100$\mu g/m^3$ ann.av.	40$\mu g/m^3$ 24hr.av.
HC	--	160$\mu g/m^3$ 3hr.av.*	--
P.M.	150$\mu g/m^3$ 24hr.av.	260$\mu g/m^3$ 24hr.av.*	--
Dust	--	--	150$\mu g/m^3$ 24hr.av.
Soot	--	--	50$\mu g/m^3$ 24hr.av.

* Concentration not to be exceeded more than once per year.

When considering these figures, it is tempting to ask which country has the strictest norms for air quality. It would appear that the GDR 'threshold value' for SO_2, 150$\mu g/m^3$, the French reference value of 250$\mu g/m^3$, and the U.S. 'standard' of 365$\mu g/m^3$. (All are 24 hour average). However, it is difficult to judge whether one country's limits are uniformly more rigorous than those of another, because comparable norms would not be found for each of the pollutants under study.

(1V) EMISSION STANDARDS AND NORMS

France, the GDR, and the U.S. also show differences in their approaches toward limiting emissions from stationary sources. Here a fundamental question is whether emission standards are set at the national level for all plants of a given type, or whether permissible emission levels are determined for each plant individually, on the basis of such factors as the existing level of pollution.

In the U.S., the national emission standards which have recently been issued for new stationary power plants, certain types of chemical factories, and incinerators are applied uniformly to plants of a given type.* In the GDR, in contrast, permissible emission levels are set on an individual basis. For this purpose, formulas have been issued for calculating permissible emissions at given stack heights and pollution conditions.** In France, emission regulations are similarly tailored to plants individually. Technical instructions, including emission limits, are worked out by the Inspectorate of Classed Establishments for each new plant which receives authorization to begin operations. For some facilities, such as thermal power plants, cement works, iron and steel mills, and incinerators, maximum admissible pollution concentrations have been standardized in legal directives; but as Benarie has explained, "they are matched by the Inspectors to each individual plant (e.g. by way of dispersion and stack height calculations)."[27] Specific formulas for calculating required stack heights under given meteorological conditions and existing pollution levels have also been issued by French lawmakers.**

These different approaches suggest an underlying divergence in the concept of emission limits. In the GDR and France, the relationship between emissions and immissions has been worked out precisely: permissible levels of emissions vary with existing ambient air concentrations. If changes in the ambient air quality

* An example of emission standards currently in effect in the U.S. may be found in Appendix I.

** The French and GDR techniques for calculating required stack heights. heights are summarized in Appendix II.

occur, for instance because of the introduction of new industry, then emission limits can be modified. In contrast, the emission 'standards' being developed in the U.S. are less flexible; it is just assumed that if industry complies with the standards, ambient air quality will be protected. Thus, while U.S. emission 'standards' seem to be considered fixed quantities, France's 'maximum admissible concentrations'and GDR emission 'threshold values' are more adaptable; they may be revised to accord with new environmental conditions or even economic goals.

A more uniform approach has been taken toward limiting emissions from motor vehicles in the three countries under study. French motor vehicle emission norms comply with the stipulations of the Geneva Agreement of March 20, 1958; the quantity of pollutants collected in a 13-minute standardized test may not exceed the values presented in the following table:

Table 2. French Motor Vehicle Emission Standards.[28]

Legal Weight of the Vehicle in kg.	CO in gr.	Hydrocarbons in gr.
Below 750	120	10.4
750-850	131	10.9
850-1020	140	11.3
1020-1250	161	12.2
1250-1470	182	13.1
1470-1700	203	14.0
1700-1930	223	14.8
1930-2150	244	15.7
Above 2150	264	16.6

Nearly the same emission limits for CO were to be used in production controls in the GDR in 1975. It was planned, however, that beginning in 1976 the norms for each weight of vehicle would become more stringent. [29]

In the U.S. emission norms for light weight passenger vehicles are expressed on a 'per vehicle mile' basis rather than as the cumulative result of a testing period. According to the 1970 Clean Air Act Amendments, CO emissions were to be limited to .41 gr. per

vehicle mile by 1975. NO_2 exhaust was to be cut to 3.0 gr. per vehicle mile by 1976. Automobile manufacturers have managed to obtain a number of deferments for meeting these standards, however - the latest being until 1978.[30]

(V) CONTROL STRATEGIES

The international differences noted in previous sections may also be seen in the area of enforcement. The types of sanctions applied to plants which disregard environmental legislation seem again to reflect the general institutional structures of the countries under study and the relations between government and industry which these engender.

For instance, the interest of the French government in controlling pollution at the plant level is expressed in the relatively high financial penalties currently in effect for exceeding emission limits and hampering control checks. If a plant operator refuses an inspection, he may according to law be imprisoned for up to three months and fined from 400-20,000 F ($80-$4000). Unsatisfactory findings during an initial inspection can lead to a fine of 400-2000 F ($80-$400), as well as an injunction to stop operations. An additional penalty of 100,000 F ($20,000) and 2-6 months in prison can be imposed on an operator who ignores such an order. The effectiveness of these control actions is suggested by the government claim that the percent of plants found not to comply with emission regulations dropped from 20% in 1963 to 7% in 1969.[31] However, harder data on the frequency with which the fines are applied would be needed, in order to evaluate the stringency of French control strategies.

In contrast, the small fines levied against recalcitrant polluters in the GDR indicate that financial penalties are not an important part of this country's air pollution control strategy. Plants which do not adher to pollution regulations during everyday operations or pollution emergencies could be required to pay 10-300 M ($40-$120). Numerous infractions in an attempt to gain unfair economic advantage can result in a fine of 1000 M ($400). "Dust and Exhaust Money" can also be exacted from an emitting plant, based upon the length of time that emission norms are exceeded and the pollutants involved. The imposition of this fine is meant to be more constructive than punitive, however, for it is thought to supply an economic stimulus for the installation of anti-pollution devices. GDR control strategies seem in general to focus more on planning future decreases in emissions, rather than on rigorously punishing current offenders.[32]

In the U.S. the complicated division of responsibility for pollution control between federal, state, and local government seems to have hindered the enforcement of environmental legislation in the past. The 1963 Clean Air Act empowered the Administrator of the EPA to initiate an 'abatement conference - court suit' procedure to stop health-endangering pollution, but this has proven inordinately time-consuming. (The procedure involves not only the EPA and the delinquent industry, but also state, regional, and local environmental agencies, a public hearings board, and judicial officials). The fact that the conference-hearing-court suit process was used only 10 times in 7 years attests to its impracticality.[33] Only since the 1970 Clean Air Act Amendments have federal and state environmental agencies had the authority to make investigations of emitting plants and to initiate criminal proceedings. Willful violations can be punished with a $25,000 fine per day and a year's imprisonment. While such sanctions have rarely been applied, state and federal authorities seem to have been eager to take advantage of their prerogative to investigate emitting plants. In the last six months of 1974, for instance, the EPA carried out 2,517 investigations with 234 enforcement procedures, and states made 81,160 investigations with 7,205 enforcement actions.[34]

(V1) EMPIRICAL FINDINGS

France, the GDR, and the U.S. are currently in the process of extending their networks of monitoring stations, in order to collect more reliable and representative measurements of pollution concentrations.

In 1972 the French government developed a 5-year plan for expanding its network of monitoring devices to include all densely populated or highly industrialized areas, as well as for standardizing measurement procedures. The plan includes tying authorization of Classed Establishments to participation in monitoring activities. At the present time, available data is restricted to measurements of SO_2 and P.M. concentrations in 18 French cities.[35]

In the GDR environmental officials are also in the midst of developing and publishing standardized measurement procedures. In addition, plans have been drawn up for establishing ambient air concentration 'registers' in populated areas, so that statistical data on background concentrations can be recorded. Currently, Dust and SO_2 concentrations are being measured in 19 cities and towns of the GDR.[36]

Until the late 1960's monitoring equipment was in operation in only 6 cities in Wisconsin, a typical midwestern state in the U.S. When the Department of Natural Resources obtained authority to develop a statewide pollution control program in 1967, it immediately began to extend monitoring activities. There are currently stations in 29 cities, including 10 continuous monitoring sites. P.M. and SO_2 are the pollutants most often measured, but a small number of stations also monitor oxidants, hydrocarbons, COH, and CO. A centralized laboratory was opened in 1973, in order to facilitate quality control of analysis procedures.[37]

International comparisons of pollution concentrations must be undertaken very warily, even if cities of similar size are considered; first, the mix of industries may differ between cities, and second, measurement techniques have not been standardized. Because of such uncontrolled factors, only tentative conclusions can be made from the following graphs:

Figure 1. French Cities: Particulate Matter Concentrations (Annual Average) vs. City Population Size - 1967-1973.

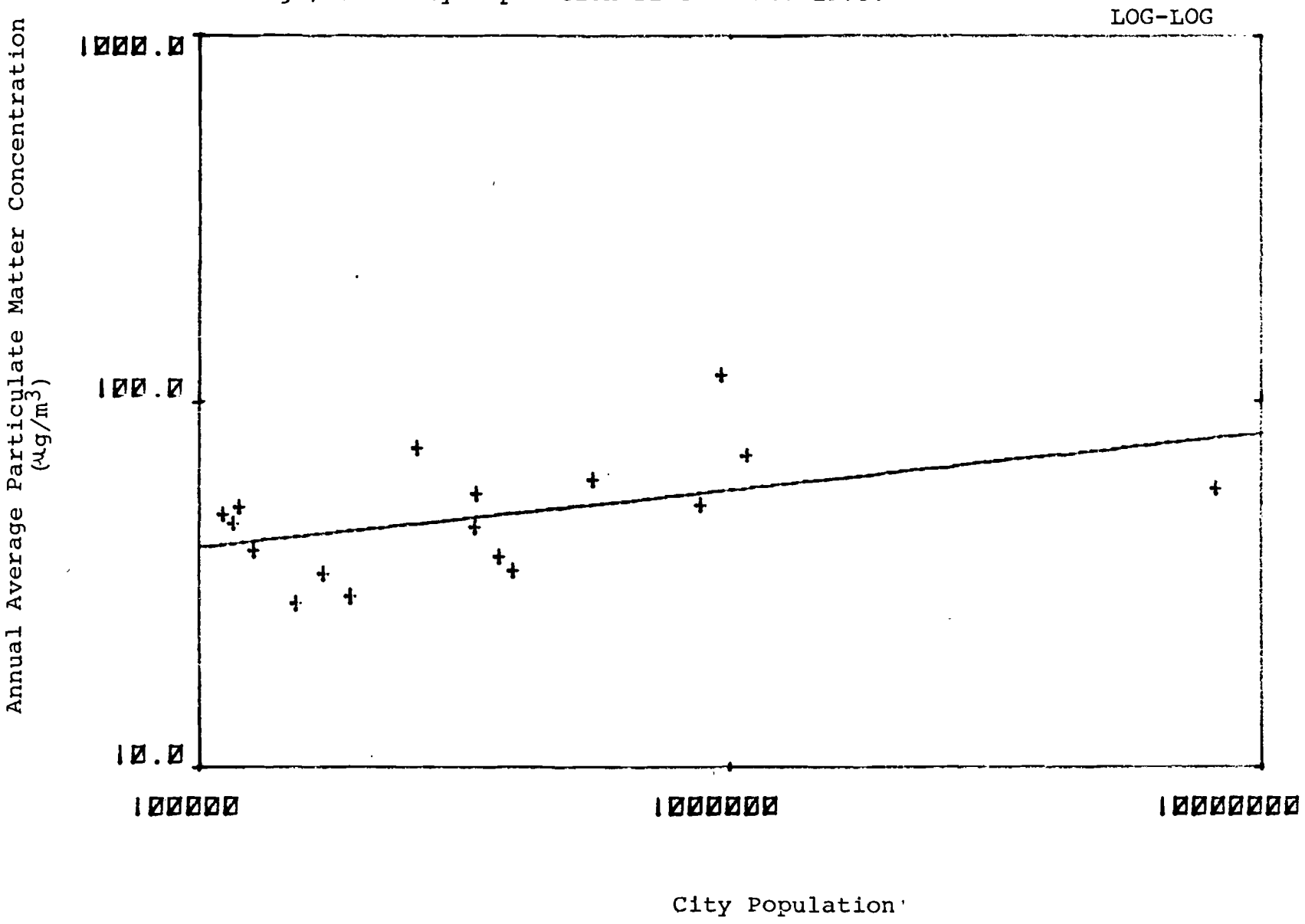


Figure 2. GDR Cities: Particulate Matter Concentrations (Annual Average) vs. City Population Size, 1965-1969.

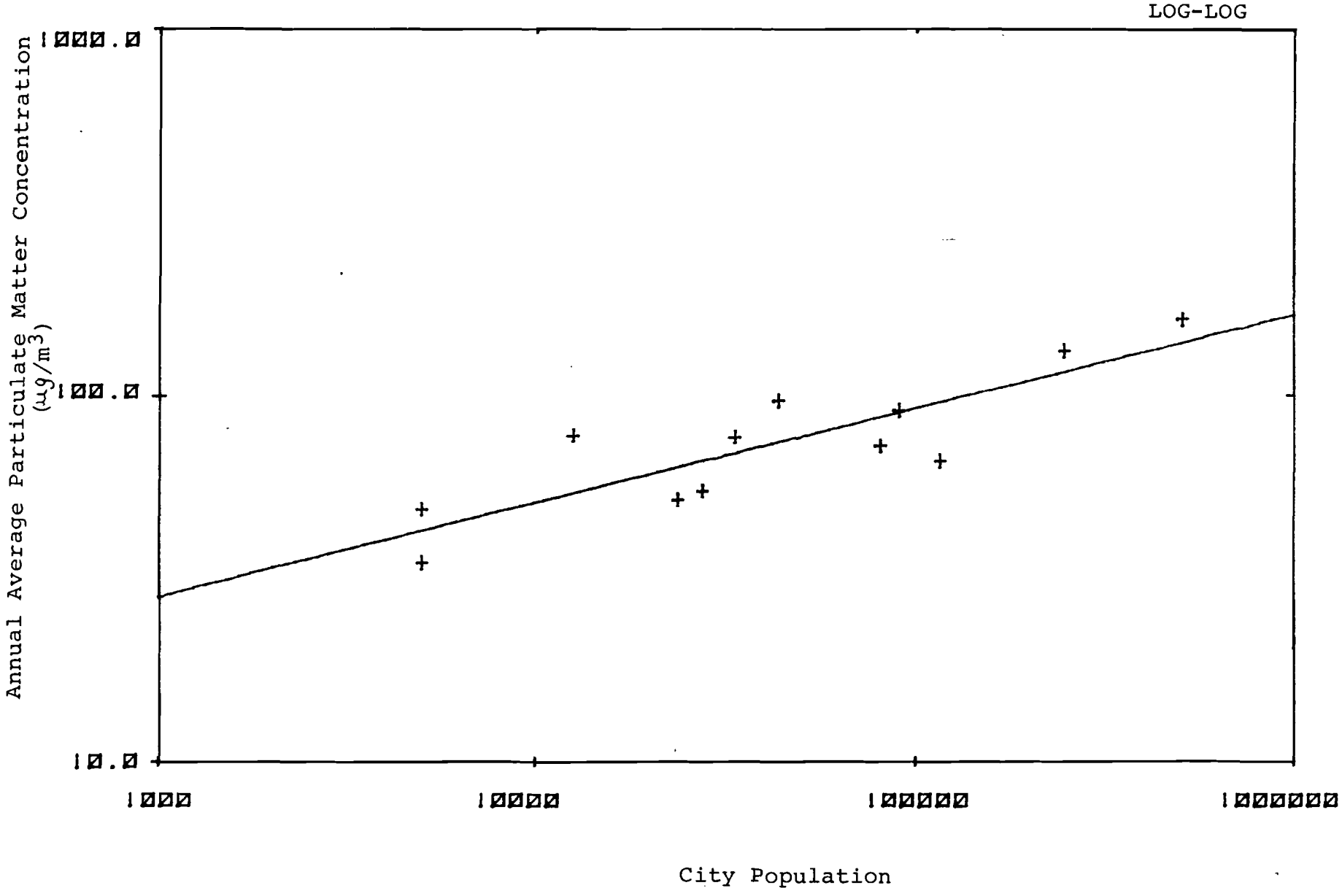
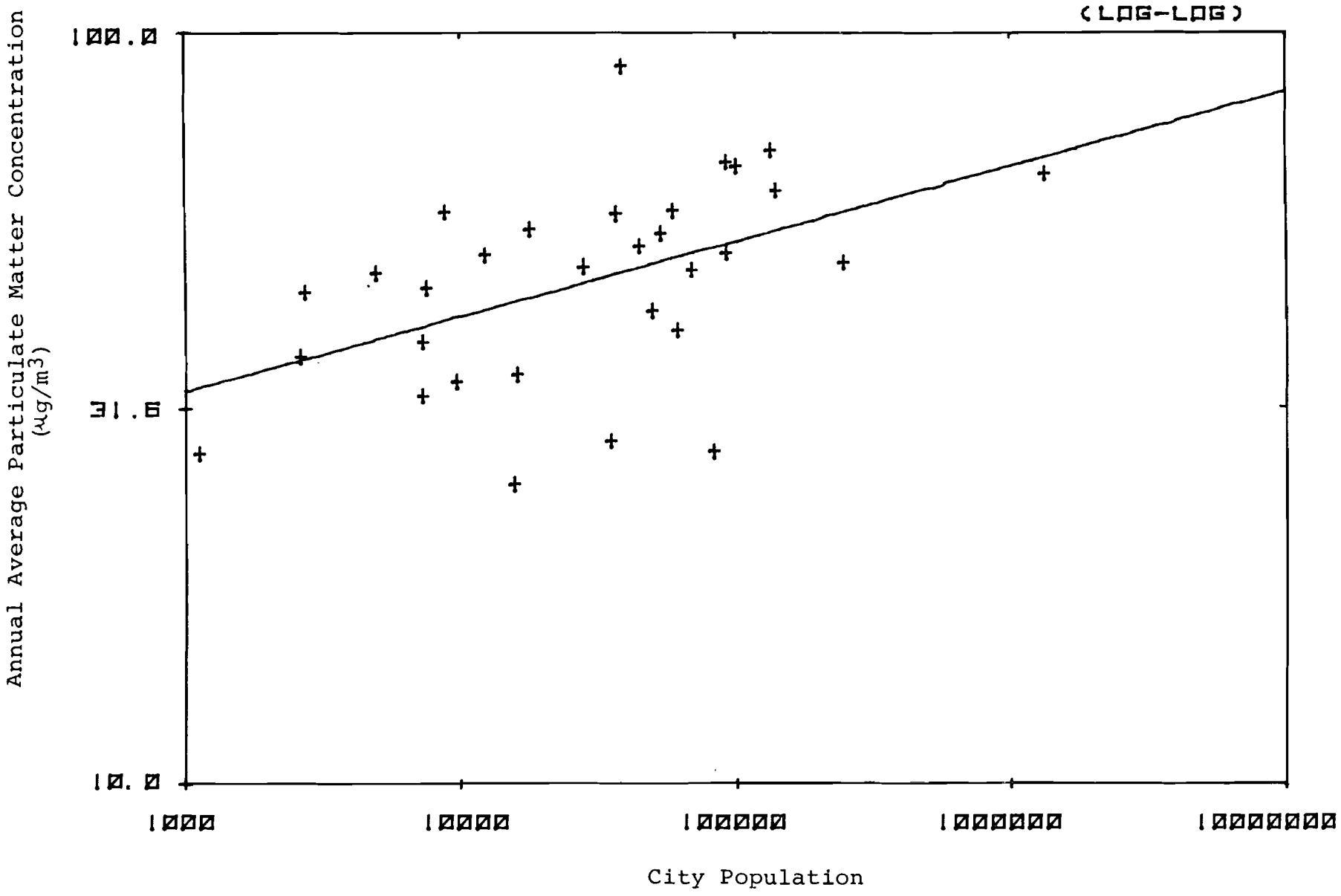


Figure 3. Wisconsin Cities: Particulate Matter Concentrations (Annual Average) vs. City Population Size - 1973.



It must first be noted that there is a marked positive relationship between annual average P.M. concentrations and city size in each of the three countries under study. If particular points are taken from the graphs and compared, it appears that the GDR has the highest P.M. concentration for a given city size, followed by France and the U.S. For instance, the city of Plauen in the GDR (population = 80,871) recorded an annual average P.M. concentration of 70 $\mu g/m^3$ in 1970, while St. Etienne in France (metropolitan population = 110,897) registered an annual average P.M. concentration of 61 $\mu g/m^3$ in 1972, and Beloit, Wisconsin (metropolitan concentration = 81,880) reported an annual average P.M. concentration of 28 $\mu g/m^3$ in 1973. The findings may have been distorted, however, by the need to compare readings from different years and from cities with different types of industry.

It may be fairer to assess the success of air pollution control efforts by looking at changes over time in each country individually. Of the 17 French cities for which pollution concentrations could be obtained, 9 showed a consistant decrease in P.M., and 8 in SO_2, during the past decade. Readings in the remaining cities either stayed constant or showed wide fluctuations over time. A French observer has attributed the general improvement in France to a decrease in the sulfur content of fuel, to new regulations requiring taller stacks in emitting plants, and to the creation of zones of special protection.[38]

In GDR cities, pollution control efforts during the latter part of the 1960's seem to have been successful in holding pollution concentrations steady. None of the cities for which readings were available showed a decrease in pollution by 1970, and unfortunately, measurement results could not be obtained for subsequent years.

A survey of ambient air P.M. concentrations in Wisconsin revealed a consistent decrease at each measurement station between 1971 and 1973. A 1975 EPA publication reported the same trend in the U.S. as a whole, with a 25% decrease in SO_2 ambient air concentrations between 1970 and 1974; still, pollution levels were found to be increasing in about 12 big cities.[39]

(V11) CONCLUSION

The question of how three countries with very different political structures have approached the same functional problem of controlling pollution is complex. This comparative analysis of environmental legislation has suggested that the institutional stucture of each country has exerted an idiosyncratic influence on each component of strategies for combatting pollution. In France, a highly centralized government can be detected in a long history of government initiative in policing industry, the centralized administration of pollution control activities, and the seemingly severe penalties for exceeding emission norms. The diffusion of power in the U.S. perhaps underlies the gradual involvement of the federal government in the area of pollution control, the delegation of responsibility for setting air quality standards to the federal government and for controlling emissions to state and local governments, the complicated procedure whereby federal approval must be gained for state pollution programs, and finally, the difficulty in implementing effective enforcement measures. The centralized decision-making and emphsis on cooperation characteristic of the GDR may be seen in its comprehensive planning of measures for decreasing pollution, the collaboration between government and industry representatives in setting emission norms, the self-policing of plants, and the lack of emphasis on punitive measures.

Whether the strategies of one country are more effective than those of another in combatting pollution cannot be determined at the present time. Final evaluation of pollution legislation will have to await the full implementation of all the laws currently "on the books." Most of the legislation in the three studies areas is so new that target dates for compliance have not yet been reached, or have been subject to deferments. For instance, technical instructions for combustion installations issued in 1975 in France called for

the installation of pollution monitoring devices by 1978. The managers of plants built before 1976 were also given until 1978 to comply with emission norms.[40] In the GDR 1976 was given as a deadline for meeting emission threshold values published in 1973.[41] In the U.S. 16 states have won deferments until 1977 for the enactment of federally-approved abatement programs, and many power plants and steel mills are seeking deferments until the late 1980's for meeting emission standards.[42]

APPENDIX I

Emission Performance Standards for Fossil Fuel Fired Steam Generation Units with Heat Input of More than 250 million BTU per hour: U.S.

Pollutant	Fuel	Maximum Emission per 10^6 BTU Heat Input (kg per 2 hour ave.)
SO_2	Liquid	.36
	Solid	.54
Particulates	All	.04
NO_2	Gaseous	.09
	Liquid	.13
	Solid	.31

Source: J.T. Dunham et al. "High Sulfur Coal for Generating Electricity," Science, Vol. 184, No. 4134, April 1974, p. 47.

APPENDIX II

The following formula is one of the standard formulas used in France for calculating necessary stack heights for a given level of emissions from new combustion facilities:

$$h = \sqrt{\frac{Aq}{Cm}\sqrt[3]{\frac{1}{R\Delta T}}}$$

Here
- h = stack height in meters
- A = 340 for SO_2, 680 for P.M.
- q = pollutant emission rate in kg/hr
- ΔT = temperature difference between the emitted gas and the ambient air (annual average of area) in °C
- R = gas rejection rate in m^3/hr
- C_m = air quality reference values [.25 mg/m^3 for SO_2, .15 mg/m^3 for P.M.] minus the annual average SO_2 or P.M. concentration

Source: M. Benarie, "Air Pollution Legislation and Governmental Controls of Air Quality in France," Institut National de Recherche Chimique Appliquee, Vert-le-Petit, 1975, p. 3.

APPENDIX II (con't)

A 1973 GDR legal text provides a table of values for 'effective' increases in stack heights, discriminated according to the amount of gas emitted, the speed with which the gas is discharged, and its temperature. A second table indicates permissible emissions of SO_2, on the basis of 'effective' chimney heights and the existing level of pollution. These values have been generated from a dispersion model.

In the GDR emission limits for other pollutants are calculated according to the equation

$$e_z = S \cdot MIK_k$$

where

e_z = the permissible emission of a given gaseous pollutant in kg/hr

S = the 'multiplication factor' for other gaseous pollutants

MIK_k = short-time interval ambient air concentration threshold value of a particular pollutant

The 'multiplication factor' is based upon the emission limits for SO_2 (which in turn depends upon the general level of pollution existing in a given area, as well as 'effective' chimney heights).

Source: Gesetzblatt der DDR. Teil I, No. 18, 24 April 1973, "Erste Durchfuehrungsbestimmung zur Fuenften Durchfuehrungsverordnung zum Landeskulturgesetz - Reinhaltung der Luft - Begrenzung und Ueberwachung der Immissionen und Emissionen." pp. 166-171.

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2. Ibid. pp. 7, 25-30.

3. Ibid. pp. 2-28.

4. Ibid. pp. 12-20.

5. Ibid. p. 32. Here the percentages of sulfur refer to the weight of the fuels, not the volume.

6. M. Benarie, "Air Pollution Legislation and Governmental Controls of Air Quality in France." Institut National de Recherche Chimique Applique, Vert-le-Petit. 1975, Table 3.

7. The first step taken in this direction occurred in the early 1970's when ambient air "reference values" for SO_2 and P.M. were promulgated for use in calculating required chimney heights.

8. William D. Hurley, Environmental Legislation. Charles C. Thomas Press, Springfield, Illinois, 1971, pp. 34-41.

9. Ibid. pp. 43-50.

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15. Gesetzblatt der DDR, Teil I, Nr. 18, 24 April, 1973, "Fuenfte Durchfuehrungsbestimmung zum Landeskulturgesetz - Reinhaltung der Luft." pp. 157-162.

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19. P. Jarrault, op.cit. pp. 45-46.

20. Ibid. pp. 9-20. See also M. Benarie, "Air Pollution Legislation and Governmental Controls of Air Quality in France." P.2.

21. Hurley, op.cit. pp. 34-50.

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23. Southeastern Wisconsin Regional Planning Commission, op.cit. p. 11.

24. Gesetzblatt der DDR. "Fuenfte Durchfuehrungsverordnung zum Landeskulturgesetz - Reinhaltung der Luft," op.cit. P. 157.

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27. Benarie, "Air Pollution Legislation and Governmental Controls of Air Quality in France." op.cit. p. 2.

28. Ibid. Table 3.

29. Gesetzblatt der DDR. "Zweite Durchfuehrungsbestimmung zur Fuenften Durchfuehrungsverordnung zum Landeskulturgesetz," op.cit. p. 355.

30. U.S. Environmental Protection Agency, "Progress in the Prevention and Control of Air Pollution in 1974." op.cit. pp. 5-25, 53-59.

31. P. Jarrault, op.cit., p. 23, 28.

32. Gesetzblatt der DDR. "Fuenfte Durchfuhrungsverordnung zum Landeskulturgesetz - Reinhaltung der Luft," op.cit. pp. 161-162.

33. Hurley, op.cit., p. 34-50, 58-59.

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35. P. Jarrault, op.cit. p. 33.; J. Syrota, "Les Donnees du Problem de la Pollution Atmospherique," Pollution Atmospherique, No. Special, Juillet, 1972. pp. 43-44; Etude C.I.T.E.P.A. (Centre Interprofessionel Technique d'Etudes de la Pollution Atmospherique), "Statistiques francaises de la Pollution due a la Combustion." Etude Documentaire, No. 40.; Benarie, M., "Etudes de la Pollution Atmospherique de Mulhouse, Strasbourg, Rouen, et Vaudreine," Institut National de Recherche Chimique Appliquee, Vert-le-Petit, 1967-1973.

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